STERLITECH Corporation

HP4750 Stirred Cell

Assembly and Operation Manual

Contents

1. Introduction

The HP4750 Stirred Cell is a high-pressure, chemically resistant stirred cell that performs a wide variety of membrane separations. With a maximum pressure rating of 1000 psig (69 bar), the HP4750 is ideally suited to simulate the flow dynamics of reverse osmosis (RO) filtration, nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) systems. Stainless steel (316L) construction and chemically resistant components make it an ideal choice to filter aqueous and non-aqueous solutions.

Any 47-50 mm diameter membrane disk can be used with the stirred cell, which provides excellent versatility. This instruction manual describes the functions, features, configuration, start-up, and operation of the HP4750 Stirred Cell. Before operation, please review the features and the technical specifications in Table 1.

Table 1: HP4750 Stirred Cell Features and Technical Specifications

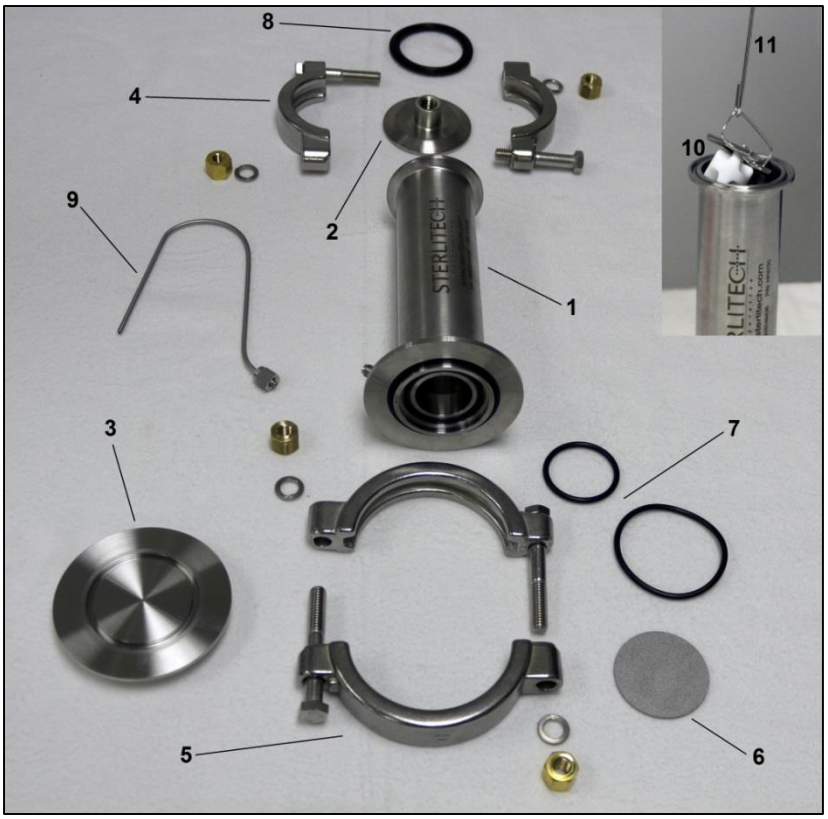
Parameter	Description
Membrane Size:	47-49 mm diameter (1.93 inches)
Active Membrane Area:	14.6 cm^2 (2.26 in^2)
Processing Volume:	300 mL
Hold-Up Volume:	1 mL
Maximum Pressure:	69 bar (1000 psig)
Maximum Temperature:	121 °C (250 °F) at 55 bar (800 psig)
PH Range:	Membrane dependent
Connections:	
Permeate Outlet:	1/8-inch diameter 316L SS tubing
Pressure Inlet:	¼ inch FNPT
Wetted Materials of Construction	
Cell Body:	316L Stainless Steel
O-rings:	Buna-N, others available as options
Gaskets:	Buna-N, others available as options
Stir Bar:	PTFE-coated magnet
Dimensions:	
Cell Body Diameter:	5.1 cm (2.0 inches)
Cell Top Width (assembled w/clamp)	10.2 cm (4.0 inches)
Cell Bottom Width (assembled w/clamp)	13.3 cm (5.25 inches)
Cell Height:	22.1 cm (9.5 inches)
Assembled Weight	(6 lb.)
Autoclavable	Yes

2. HP4750 Components

Verify that the stirred cell was shipped complete, intact, and undamaged. The complete set of stirred cell parts is found in Figure 1 below.

1. Stainless steel cell body
2. Cell top
3. Cell bottom
4. Cell top coupling
5. Cell bottom coupling
6. Porous stainless steel membrane support disk
7. 2 O-rings
8. Top Gasket
9. Permeate Tube
10. Stir bar assembly
11. Stir bar retriever

Figure 1: HP4750 Components



3. Stirred Cell Assembly

After verifying that all of the necessary components were shipped and present, you can begin the assembly of the stirred cell.

1. Wet the O-rings with a small amount of water or the fluid to be processed.

   Note: *HP4750 Stirred Cells are shipped with Buna-N O-rings and gaskets by default; other materials such as Viton and PTFE are available as options. Table 2 on page 10 outlines O-ring and gasket material compatibility.*

Photo 2.1: Outer Ring Insertion

2. Insert the O-rings in the bottom of the cell body. (Photo 2.1 & 2) Check to be certain that the O-rings fit properly in the grooves.

Photo 2.2: Inner Ring Insertion

3. Place a piece of precut membrane over the center O-ring. The membrane should be installed with the active side toward the cell reservoir. In general, membranes coated on substrate have a shiny, active side and a dull, substrate side. (Photo 2.3)

Photo 2.3: Membrane Filter Insertion

4. Place the stainless steel porous membrane support disk on top of the membrane to hold the membrane in place. (Photo 2.4)

   Note: *If you cut your own membranes, the stainless steel porous disk can be used as a template. See Appendix 1 on page 14 for more details.*

Photo 2.4: Membrane Support Disk Insertion

5. Fit the cell bottom onto the cell body, aligning the circular groove with the circular ridge on the bottom of the cell body. (Photo 2.5)

Photo 2.5: Cell Bottom Assembly

6. Use the 3-inch high pressure coupling to clamp the cell bottom to the cell body. Tighten the high pressure coupling with 16 foot pounds of torque for 1000 psig (69 bar) operation. (Photo 2.6)

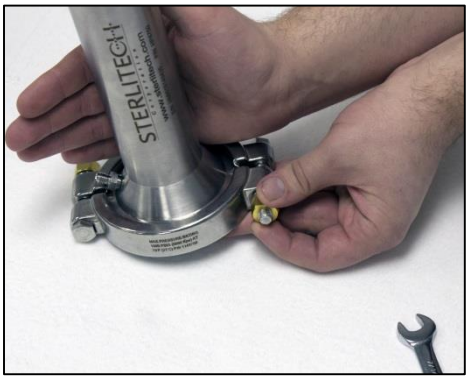


Photo 2.6: Bottom Clamp Assembly

7. Insert Permeate Tube into side of cell body, tighten using a wrench. (Photo 2.7)

   ***Note**: The HP4750 uses Swagelok connection fittings. More detailed instructions, information and images of the fittings can be found in Appendix 1 on page 13.*

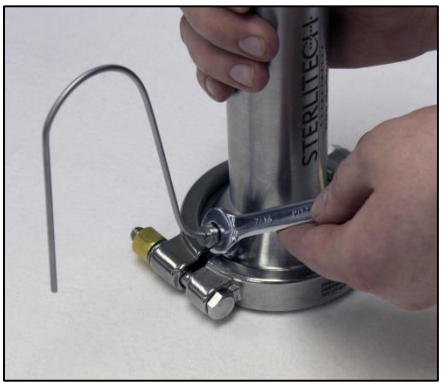


Photo 2.7: Permeate Tube Installation

8. Insert the Stir bar assembly by dropping it into the Cell Body through the 2-inch-diameter opening at the top (Photo 2.8a). Alternatively, the stir bar assembly can be lowered into the cell with the stir bar retriever (Photo 2.8b). Figure 2.8c shows the correct position of the Stir Bar Assembly. After the assembly is in place, pour the solution to be filtered into the Cell Body.

Photo 2.8a: Stir Bar Insertion

Figure 2.8c: Proper Stir Bar Position

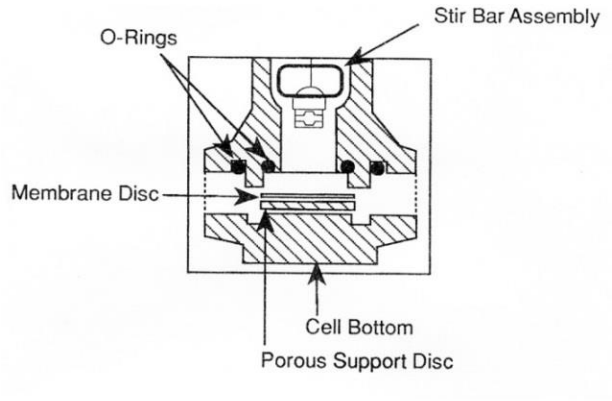


Photo 2.8b: Stir bar Insertion with stir bar retriever

9. Insert the gasket on the top of the Cell Body, making sure it fits properly in the grooves. (Photo 2.9)

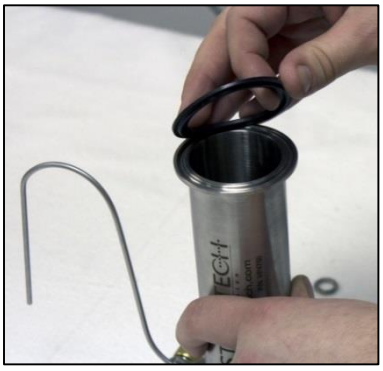


Photo 2.9: Gasket Installation

10. Use the 2-inch high pressure coupling to clamp the cell top to the cell body. Tighten the high pressure coupling with 16 foot pounds of torque for 1000 psig (69 bar) operation. (Photo 2.11) After both clamps are properly attached, the HP4750 Stirred Cell should be centered on top of a magnetic stirrer.

Photo 2.10: Cell Top Attachment

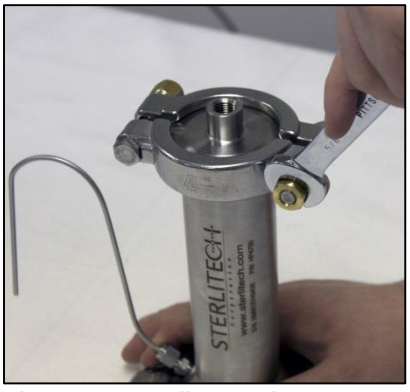


Photo 2.11: Cell Top Clamp

4. Operation of the HP4750 Stirred Cell

1. Attach a high pressure hose (sold separately, Sterlitech Part Number: 1151427) to the fitting on the Cell Top. (Photo 2.12)

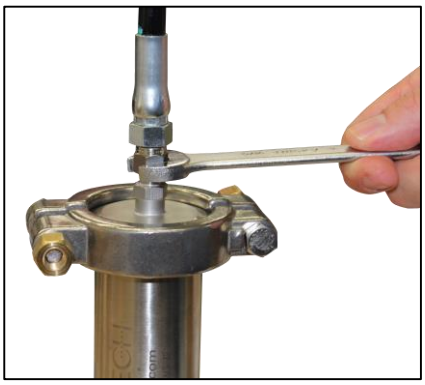


Photo 2.12: High Pressure Hose Attachment

2. Connect the other end of the hose to the pressure regulator assembly on the inert gas supply or the compressed air supply. The compressed air or inert gas source selected will determine pressure regulator (sold separately, Sterlitech Part Number: 1144026) style and pressure requirements. (Photo 2.13)

Photo 2.13: Pressure Regulator Connection

3. Place a Permeate Collection Vessel (user-supplied) under the Permeate Tube. (Photo 2.14)

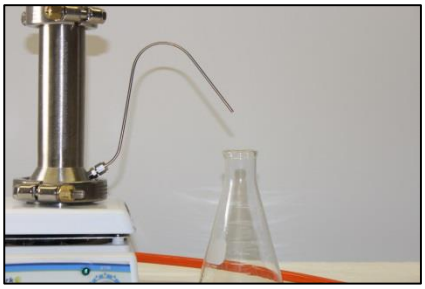


Photo 2.14: Permeate Collection Vessel

4. Turn on the magnetic stirrer (sold separately, Sterlitech Part Number 1144030 or 1144031) to start the motion of the Stir Bar Assembly. (Photo 2.15)

Photo 2.15: Magnetic Stirrer

5. Begin filtration by gradually pressurizing the HP4750 Stirred Cell, checking for leaks. Foreign material on the surface of the seals and insufficient tightening of the clamps are most common causes for leakage.

Note: Preconditioning the membranes before use will ensure consistent performance. *See Appendix 2 on page 14 for more details.*

6. Upon completion of filtration, turn off the pressure source and depressurize the unit by the pressure relief valve (sold separately, Sterlitech Part Number: 1155893). (Photo 2.16)

   Caution: Do not depressurize the HP4750 Stirred Cell by loosening the couplings.

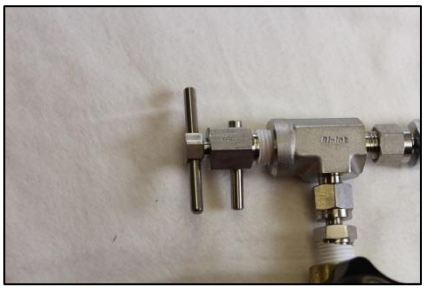


Photo 2.16: Pressure Relief Valve

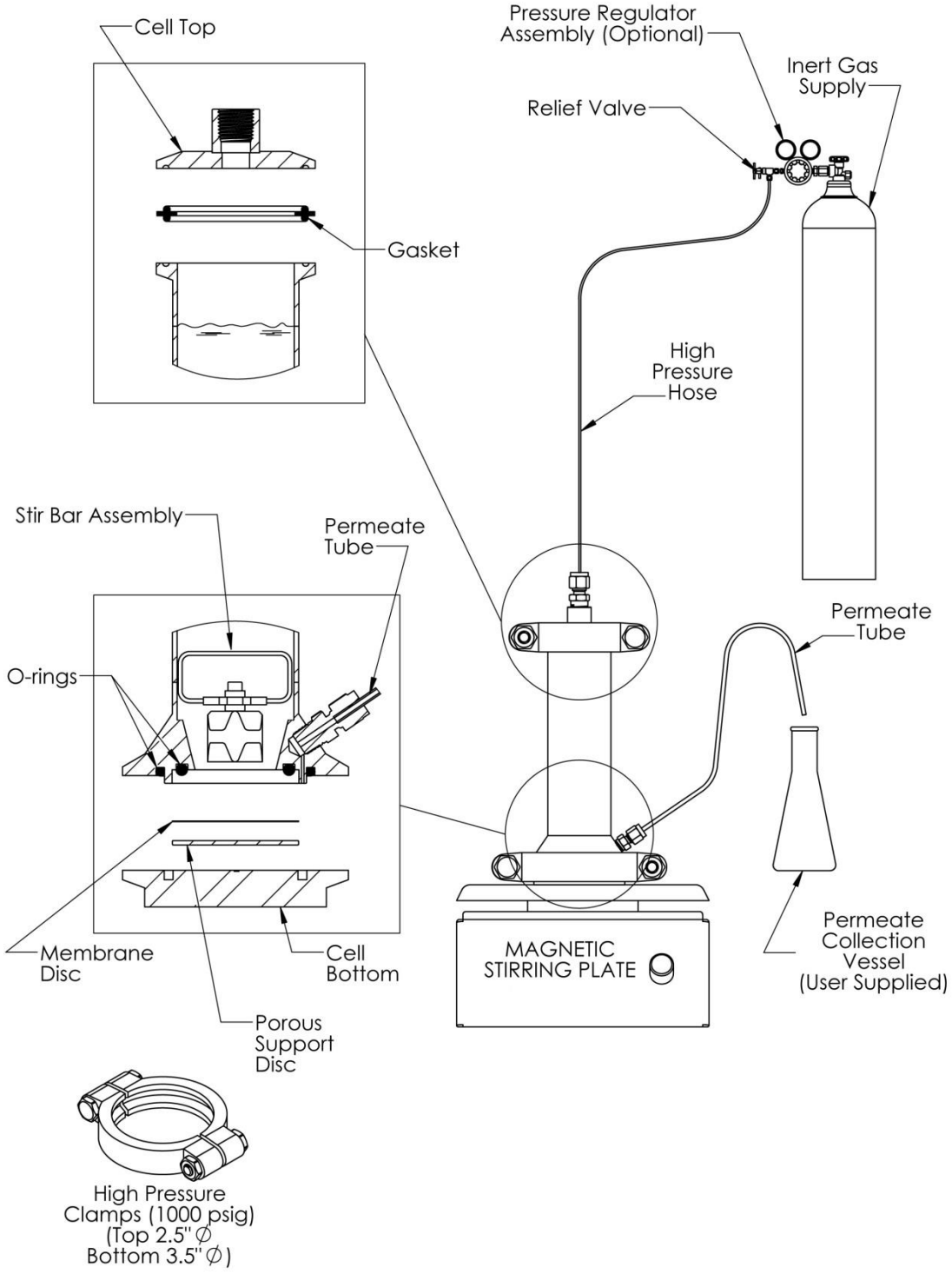
7. Once it is depressurized and empty, the HP4750 Stirred Cell can be cleaned with a variety of cleaners, including detergents, solvents, caustic, acid, enzyme cleaners, etc.

Note: Choice of the appropriate cleaning regime should also consider the compatibility of the gasket and O-ring material. A section of O-ring chemical compatibilities is presented on page 11.

5. HP4750 Example System Configuration

Figure 3 illustrates the typical configuration of a standard HP4750 Stirred Cell System. The drawing shows the three major components of the system: the Cell Body with removable top and bottom, Stir Bar Assembly, and Standard Coupling.

Figure 3: HP4750 Stirred Cell System Schematic



6. Accessory and Spare Part Ordering Information

Accessories and spare parts for the HP4750 can be ordered by calling Sterlitech Corporation at 1-877-544-4420 or by visiting www.sterlitech.com.

Table 2: Accessory and Spare Part Ordering Information

Product	Shipping Weight kg (lb)	Ordering Number
HP4750 Stirred Cell, for operation to 69 bar (1000 psig)	3.8 (8)	HP4750
Accessories		
Pressure Regulator Assembly, 6.9-69 bar (100-1000 psig)	2.3 (5)	1144026
Pressure Relief Valve, 69 bar (1000 psig)	0.1 (0.25)	1155893
High Pressure Hose, 183 cm (72 inch)	0.7 (1.5)	1151427
PTFE O-ring/Gasket Kit	0.5 (0.1)	1144028
Viton O-ring/Gasket Kit	0.5 (0.1)	1144029
PTFE Encapsulated Viton O-ring/Gasket Kit	0.5 (0.1)	1144027
Buna O-ring/Gasket Kit	0.5 (0.1)	1144034
EPDM O-ring Gasket Kit	0.5 (0.1)	1144036
Magnetic Stirring Plate		
115 VAC 60 Hz	2.3 (5)	1144030
230 VAC 50 Hz	2.3 (5)	1144031
Spare Parts		
Cell Top	0.1 (0.25)	1143891
Cell Body	1.4 (3)	1149782
Cell Bottom	1.4 (3)	1143073
Porous Support Disk	0.1 (0.25)	1114910
Stir Bar Assembly	0.1 (0.25)	1143109
Membrane Packs		
Visit www.sterlitech.com for membrane ordering information.		

7. O-ring Chemical Compatibility

The following O-ring and gasket compatibility chart (Table 4) is provided as an aid in selecting a specific synthetic rubber compound for a particular application situation. Operating conditions and environment must also be considered in determining the media suitability.

For recommendations regarding fluids not listed, consult Sterlitech. The recommendations represent compatibility of materials only and do not necessarily constitute a recommendation for use in a specific application.

Table 3: O-ring Chemical Compatibility Chart

Code	Compound	Temperature Range
BN	Buna-N	-40 to 120 °C (-40 to 250 °F)
EP	Ethylene-Propylene	-50 to 150 °C (-65 to 300 °F)
V	Viton	-30 to 205 °C (-20 to 400 °F)
P	PTFE	-156 to 232 °C (-250 to 450 °F)

Media (Liquid or Gas)	Code	Media (Liquid or Gas)	Code
Acetic Acid, Glacial	EP	Glycols	EP
Acetone	EP	Grease and Oils	BN
Aluminum Salts	BN	Hydrazine	EP
Ammonium Hydroxide	EP	Hydrochloric Acid	EP
Ammonium Salts	BN	Hydrofluoric Acid	EP
Amyl Alcohol	EP	Hydrogen Peroxide	V
Aniline Dyes	EP	Kerosene	BN
Aromatic Fuel – 50%	V	Linseed Oil	BN
Benzene	V	Methyl Ethyl Ketone	EP
Bleach Liquor	EP	Mineral Oils	BN
Butanol (Butyl Alcohol)	BN	Naphthas	V
Butyl Cellosolve	EP	N-Hexane	BN
Carbon Disulfide	V	Octyl Alcohol	EP
Carbon Tetrachloride	V	Organic Ester	EP
Cellosolve	EP	Peanut Oil	BN
Chlorinated Solvents	V	Phenol	V
Crude Oil	V	Pyridine Oil	EP
Cutting Oil	V	Sewage	BN
Decane	BN	Sodium Acetate	EP
Denatured Alcohol	BN	Sodium Chloride	BN
Detergent, Water Solution	BN	Stoddard Solvent	BN
Diesel Oil	BN	Sulfuric Acid	V
Diethylene Glycol	EP	Tannic Acid	BN
Dry Cleaning Fluids	V	Tertiary Butyl Alcohol	V
Ethyl Alcohol	BN	Titanium Tetrachloride	V
Ethyl Hexanol	BN	Transmission Fluid	BN
Ethylene Glycol	EP	Trioctyle Phosphate	EP
Fatty Acids	V	Varnish	V
Fatty Oil	BN	Water (Demineralized)	BN

8. Return Material Order Procedure

If materials are to be returned to Sterlitech for repair, evaluation, or warranty consideration, a Return Material Authorization (RMA) number must be obtained from Sterlitech prior to the return. Contact Sterlitech's Customer Service Department for these forms.

Be sure to include a complete, detailed written reason for the return. Also, include serial numbers, installation and removal dates, and any other pertinent information that is available. HP4750 Stirred Cells have a serial number imprinted on the cell body.

Indicate the proposed disposition of the material, and reference the RMA number on all packages or cartons. All material must be shipped to Sterlitech with freight prepared by the customer.

9. Warranty

The following is made in lieu of all other warranties expressed or implied. Sterlitech Corporation guarantees equipment to be free from defects in material and workmanship when operated in accordance with written instructions for a period of one year from receipt. Parts not manufactured by Sterlitech are covered by their manufacturer's warranties, which are normally for one year.

Manufacturers and Seller's only obligation shall be to issue credit against the purchase or replacement of equipment proved to be defective in material or workmanship. Neither manufacturer nor seller shall be liable for any injury, loss or damage, direct or indirect, special or consequential, arising out of the use of, misuse, or the inability to use such product.

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Technical Assistance:

Please contact us if you have any questions or technical inquires about our products.

Appendix 1: HP4750 Bibliography

The following studies utilized the HP4750 Stirred Cell in their method and are listed here to illustrate the potential applications for the HP4750. These studies are good references for understanding the operation of the HP4750 Stirred Cell.

Title	Abstract	Full Citation
Modeling of the retention of atrazine and dimethoate with nanofiltration	The HP4750 stirred cell was used to test which nanofiltration membrane (NF90, NF200, NF270, and DK) worked best at removing pesticides from water.	A.L. Ahmad, L.S. Tan, S.R. Abd. Shukor. Modeling of the retention of atrazine and dimethoate with nanofiltration. Chemical Engineering Journal, Volume 147, Issues 2–3, 15 April 2009, Pages 280–286. http://dx.doi.org/10.1016/j.cej.2008.07.015
Effects of palm oil-based fatty acids on fouling of ultrafiltration membranes during the clarification of glycerin-rich solution	In this study, the HP4750 cell was used to examine the membrane-binding properties fatty acids with polyethersulfone (PES) and polyvinylidenefluoride (PVDF) ultrafiltration membranes.	Indok Nurul Hasyimah Mohd Amin, Abdul Wahab Mohammad, Mastura Markom, Leo Choe Peng. Effects of palm oil-based fatty acids on fouling of ultrafiltration membranes during the clarification of glycerin-rich solution. Journal of Food Engineering, Volume 101, Issue 3, December 2010, Pages 264–272. http://dx.doi.org/10.1016/j.jfoodeng.2010.07.006
Preparation and characterization of a neutrally charged antifouling nanofiltration membrane by coating a layer of sulfonated poly(ether ether ketone) on a positively charged nanofiltration membrane	The HP4750 stirred cell was used to test the antifouling and separation capability of a specially prepared, electrically neutral nanofiltration membrane.	Chaoyi Ba, James Economy. Preparation and characterization of a neutrally charged antifouling nanofiltration membrane by coating a layer of sulfonated poly (ether ether ketone) on a positively charged nanofiltration membrane. Journal of Membrane Science, Volume 362, Issues 1–2, 15 October 2010, Pages 192–201. http://dx.doi.org/10.1016/j.memsci.2010.06.032
Synthesis and characterization of a carbon nanotube/polymer nanocomposite membrane for water treatment	The HP4750 was used to characterize the separation properties of carbon composite membrane at 2.9, 3.9 and 4.9 MPa.	Hosam A. Shawky, So-Ryong Chae, Shihong Lin, Mark R. Wiesner. Synthesis and characterization of a carbon nanotube/polymer nanocomposite membrane for water treatment. Desalination, Volume 272, Issues 1–3, 3 May 2011, Pages 46–50. http://dx.doi.org/10.1016/j.desal.2010.12.051

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Founded in 2001 in Kent, WA, Sterlitech Corporation manufactures and markets filtration-focused laboratory products to a broad spectrum of scientific and industrial sectors. Its line of flat sheet membranes and tangential flow cells deliver industry-leading performance and reliable results. Configured for reverse osmosis, nanofiltration, ultrafiltration, and microfiltration applications, Sterlitech's bench scale test equipment provides the versatility required to innovate.

Sterlitech's comprehensive line of products is supported by the expertise of its technical specialists who can assist with application-specific product selection, and provide customized solutions where necessary. Unique problem-solving approaches, flexibility, and consistent quality have made Sterlitech Corporation a renowned global provider of filtration products and equipment.

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