Supor® Polyethersulfone Membrane

Performance Data in Syringe and Capsule Filter Formats

Introduction

For researchers working with protein containing solutions and media, being able to achieve the highest throughput with minimal protein loss is of the utmost importance. As an improvement over the HT Tuffryn® Polysulfone membrane and urethane capsules, Pall has commercialized Supor polyethersulfone membrane into a full line of products spanning Acrodisc® syringe filters to large volume AcroPak™ capsules. As compared to HT Tuffryn membrane, the products containing Supor membrane showed up to five times less protein binding with nearly twice the total throughput.

Background

Researchers working in biotech, the pharmaceutical industry, and academic laboratories face the need to sterile filter media, additives, and final product at various points throughout their workflow. Whether it is filtering media or additives prior to cell culture, or sterile filtering their final product, protein loss through non-specific binding to the filter membrane is critically important to laboratory personnel. This concern can be compounded when dealing with expensive components or by the need to change filters multiple times during a single batch filtration.

In addition, to facilitate wetting by aqueous-based solutions and decrease binding, many membranes have an external surface treatment using a surfactant. This treatment is necessary for a lot of inherently hydrophobic polymers. However, because it is applied externally to the membrane, this treatment can wash off during normal usage and could have the potential to interfere with sensitive cellular growth or detections systems used to analyze protein expression.

Using Supor polyethersulfone membrane can help to alleviate many of these concerns. The inherently hydrophilic nature of Supor membrane means there is no need for an external treatment, ensuring consistent performance of the filter with no extractables due to surfactant. In addition, Supor membrane's porosity and internal pore structure was designed with high throughput in mind, allowing for maximum throughput during each batch filtration. These combined advantages make Supor polyethersulfone membrane the preferred option over HT Tuffryn polysulfone for filtrations where protein binding, surfactant extractables, and filter longevity are a concern.

Methods and Materials

Table 1

Devices Analyzed for Protein Binding and Total Throughput

Acrodisc		Capsules	
4612 (Supor)	4192 (HT Tuffryn)	AcroPak 500 12995 (Supor)	Culture Capsule 12170 (HT Tuffryn)
12463420	12481980	FA0891	FZ2345
12605831	12607236	FA1717	FZ2706
12612251	12607922	FS7821	

To characterize the differences between the two families of products, the protocols were conducted on two different scale devices. Small devices, 25 mm Acrodiscs (part numbers 4192 and 4612) were compared; while on a larger scale the Culture Capsule and Acropak 500 (PN 12170 and 12995) were compared. The amount of protein that binds to the membrane and the amount of total throughput that could be achieved with each device was then determined.

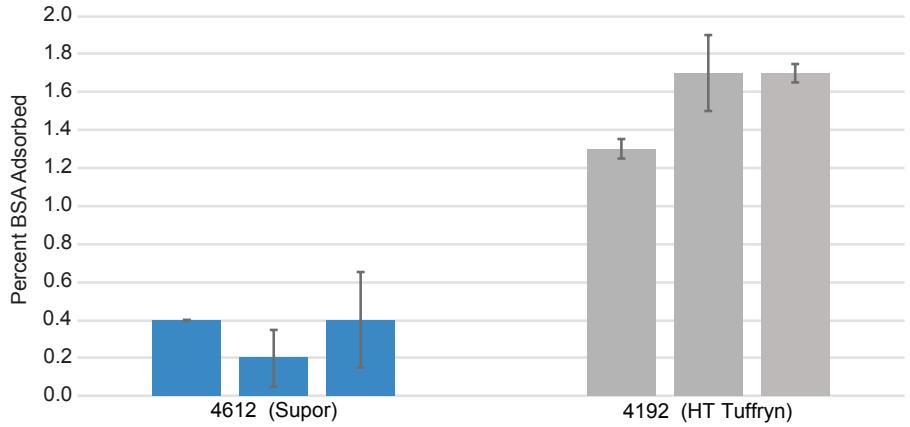
Protein binding was measured by an ELISA assay. This method was chosen because its high sensitivity and specificity allows for the recreation of real world usage scenarios without the concern of interfering substances potentially coming from the devices. The challenge fluid was a 0.1 mg/mL BSA solution. This was then passed through the filter, followed by a PBS flush to recover any fluid trapped within the membrane structure and the housing itself. This prevents the holdup volume of the different devices from artificially biasing the results. These two separate aliquots were analyzed so an accurate representation of the total amount of BSA recovered from the devices could be determined. The difference between the total amount recovered and the amount in the challenge solution was the amount lost to binding with the membrane. This procedure was conducted on both small volumes devices, the Acrodisc syringe filters, as well as larger volume capsule devices, demonstrating the difference in binding propensity can be attributed to the membrane as a major contributing factor. When comparing both small and large devices, the Supor membrane consistently outperformed the HT Tuffryn membrane with respect to low protein binding.

Total throughput, in tandem with protein binding, is a key determinant for the researcher in deciding which device to select for their applications. To demonstrate throughput performance, four different devices, two syringe filters and two capsule filters, were challenged with a 10% BSA/RPMI solution. The test solution was passed through the device at an upstream pressure of 5 psi. The initial flow rate was recorded and monitored until the flow rate had decayed by 75% of the initial value. At this point, the total volume passed through the filter was recorded and the filter is considered to have exhausted its usable life.

Results

Protein Binding was performed using two different 0.2 µm, 25 mm syringe filters which were compared for small volume testing. Part numbers, 4192, with HT Tuffryn membrane and part number 4612, with Supor membrane were analyzed for total protein binding. The Acrodisc syringe filter with HT Tuffryn membrane showed on average over four times higher binding than the Acrodisc with Supor membrane (Figure 1).

Figure 1

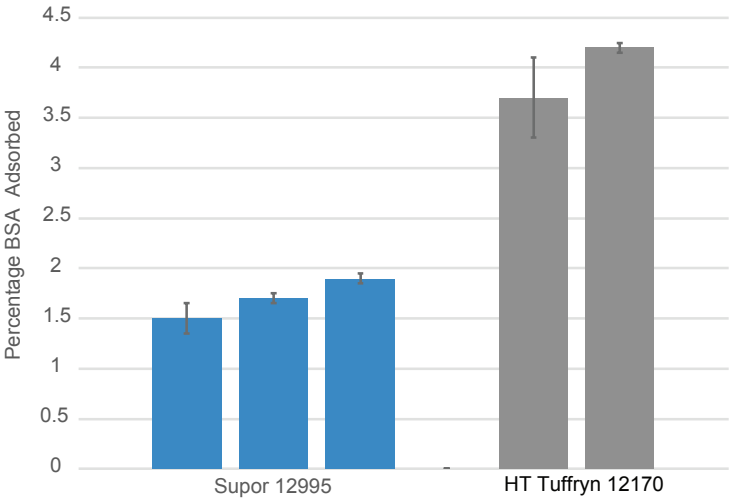


The Pall Acrodiscs, part numbers 4612 and 4192 were both challenged with a 0.1 mg/mL solution at a flow rate of 3 mL/min. After the filters had been exposed to the solution they were flushed with 25 mL of PBS buffer to remove any BSA lost in the hold up volume of the membrane. The amount of BSA present in both fractions was determined using an ELISA assay. The total BSA lost to adsorption on the membrane was determined using the formula:

Weight of BSA adsorbed	=	(Weight of BSA Challenged	-	(Weight of BSA in flow through	+	Weight of BSA) in PBS wash

This was not only observed in the smaller devices, however. This same increased binding propensity was also demonstrated by comparing the Culture Capsule, with two layers of 0.2 µm HT Tuffryn to the Acropak 500, which has two layers of 0.2 µm Supor membrane. When the two capsules were challenged with the 0.1 mg/mL BSA test solution, the HT Tuffryn Culture Capsule showed over twice the protein binding of the Acropak 500 filter capsule (Figure 2).

Figure 2



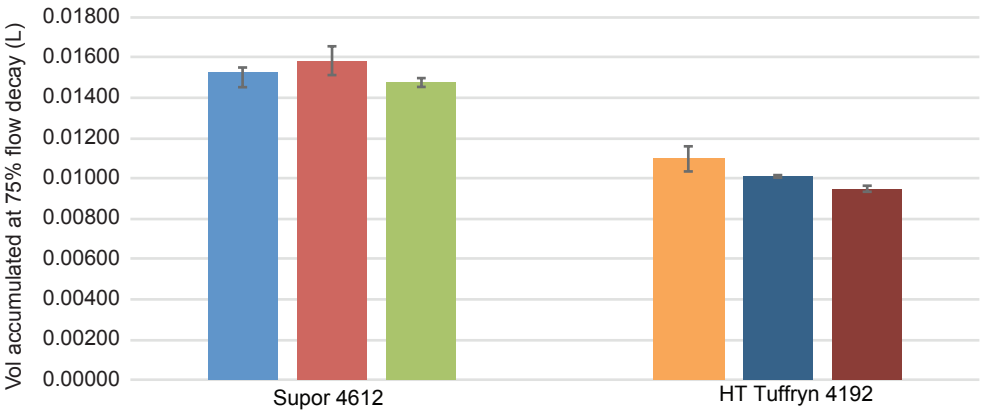
The Pall Acropak and Culture Capsule, part numbers 12995 and 12170 were both challenged with a 0.1 mg/mL solution at a flow rate of 200 mL/min. After the filters had been exposed to the solution they were flushed with 2.5 L of PBS buffer to remove any BSA lost in the hold up volume of the membrane. BSA present in both fractions was determined using an ELISA assay. The total BSA lost to adsorption on the membrane was determined using the formula:

Weight of BSA adsorbed	=	(Weight of BSA Challenged	-	(Weight of BSA in flow through	+	Weight of BSA) in PBS wash

In throughput performance, the devices using the Supor membrane consistently outperformed the HT Tuffryn devices. Both large scale and small scale devices showed higher throughput across several filtrations over multiple days.

Acrodisc syringe filters, part numbers 4192 and 4612, were compared on two subsequent days. On both days the Supor Acrodisc syringe filter, 4612, outperformed the HT Tuffryn devices. When comparing the total throughput, the Acrodisc with Supor membrane was able to filter over 1.5 times the volume of the BSA/RPMI solution than part number 4192 (Figure 3).

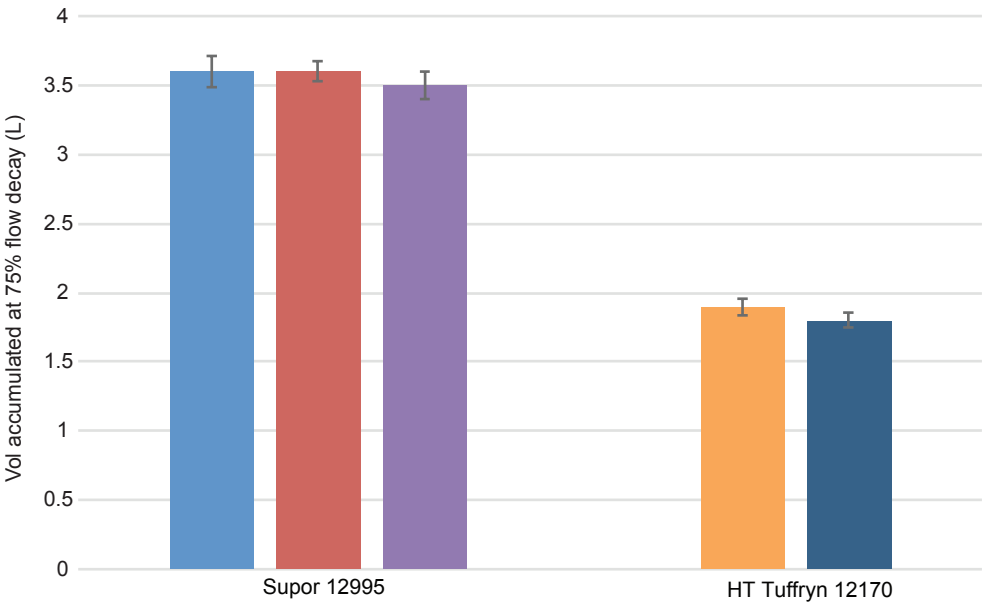
Figure 3



Acrodisc filters were challenged using a 10% BSA/RPMI solution at an upstream pressure of 5 psi. The volume of fluid able to be filtered through each device was determined gravimetrically and the filter was determined to have reached the end of its service life when the flow had decayed by 75% from the initial flow.

For large volume filtration applications, this increase in throughput was more pronounced when comparing the Culture Capsule, product number 12170, to the Acropak 500, product number 12995. When both devices were challenged with the same solution, the Acropak 500 had nearly two times the total throughput of the Culture capsule, while utilizing the same effective filtration area (Figure 4).

Figure 4



Filter Capsules were challenged using a 10% BSA/RPMI solution at an upstream pressure of 5 psi. The volume of fluid able to be filtered through each device was determined gravimetrically and the filter was determined to have reached the end of its service life when the flow had decayed by 75% from the initial flow.

Discussion

For researchers working with protein containing solutions and media, selecting the right filtration product with the best membrane for the application is a critical decision. Supor polyethersulfone membrane was developed to replace HT Tuffryn polysulfone membrane and simplify product selection. Pall has commercialized the Supor polyethersulfone membrane into a range of products from sterile and non-sterile syringe filters for small volumes to capsule size filters for up to 150 L filtration.

Supor membrane has three key advantages that make it the superior choice over HT Tuffryn membrane:

Surfactant Free – Supor membrane is surfactant free and inherently hydrophilic meaning it does not require an external wetting agent in order to effectively filter aqueous based solutions. To a researcher, it means less worries that an extractable will affect cell growth or interfere with sensitive protein quantification or detection methods.

Low Protein Biding – Supor polythersulfone membrane was formulated specifically with low binding in mind to minimize concerns that trace quantities of necessary or expensive proteins are lost to non-specific binding with the membrane. To a researcher, it is added assurance that supplements are in the final media preparation to support proper cellular growth or that trace amounts of proteins are in the final filtrate for detection and quantification.

High Throughput – Supor membrane was designed to improve throughput using a higher porosity per square centimeter and conical pore structure which combine to provide faster flow rates and higher throughputs of solution. This results in time and cost savings by being eliminating unnecessary changes in devices to filter the same total volume.

Researchers filtering <100 mL volumes will be pleased with the variety of Acrodisc syringe filters with Supor membrane ranging in pore size from 0.1 µm to 5 µm and 13 mm to 32 mm formats. The inherently hydrophilic nature and low binding qualities of the devices eliminate the need for a preflush prior to use to ensure no surfactant extractables or loss of protein to binding. The side by side comparison of Acrodisc syringe filters with Supor membrane and HT Tuffryn membrane provides confidence in superior performance. In addition to the high throughput as comparing 0.2 µm Supor membrane to 0.2 µm HT Tuffryn membrane, you can further enhance your throughput using Acrodisc PF syringe filters with Supor membrane 0.8/0.2 µm membrane layering. The built-in prefilter layer is ideal for hard to filter solutions.

Researchers filtering larger volumes have their needs covered with AcroPak capsule filters that can handle batches up to 150 L. The low protein binding data give a level of confidence that the final filtration will have the right concentration of protein with no additional extractables from external wetting agents. The high throughput performance demonstrated by comparison of 0.2/0.2 µm AcroPak capsule to a comparable urethane capsules with 0.2/0.2 µm membrane layering can be further improved by using an AcroPak capsule with 0.8/0.2 µm membrane layering. An additional considerations for capsule users is that the AcroPak capsules have two materials of construction while the old design urethane capsules have 5 different materials of construction that may come in contact with the fluid being filtered. This is of particular consideration in capsules due to the longer contact time during filtration.

The combined benefits of Supor membrane along with protein binding and throughput data support Supor polyether sulfone membrane is superior in performance to HT Tuffryn polysulfone membrane. For aqueous based, protein containing solutions or media, Supor membrane is the filtration media of choice for sensitive applications where protein loss and throughput are of critical importance.

For Further information about Pall Laboratory products, please contact LabCustomerSupport@pall.com

Full Line of Products containing Supor Membrane:

Acrodisc Syringe Filters with Supor Membrane

Part Number	Description	Pkg
4602	0.2 µm, 13 mm	75/pkg
4604	0.45 µm, 13 mm	75/pkg
4608	0.8 µm, 13 mm	75/pkg
4611	0.1 µm, 25 mm	50/pkg
4612	0.2 µm, 25 mm	50/pkg
4614	0.45 µm, 25 mm	50/pkg
4618	0.8 µm, 25 mm	50/pkg
4651	0.1 µm, 32 mm	50/pkg
4652	0.2 µm, 32 mm	50/pkg
4654	0.45 µm, 32 mm	50/pkg
4656	1.2 µm, 32 mm	50/pkg
4650	5 µm, 32 mm	50/pkg

Acrodisc PF Syringe Filters with Supor Membrane, Sterile

4187	0.8/0.2 µm, 25 mm	50/pkg
4658	0.8/0.2 µm, 32 mm	50/pkg

Serum Acrodisc Syringe Filter with Supor Membrane, Sterile

4525	GF/0.2 µm, 37 mm	20/pkg

Acrodisc Syringe Filters with Supor Membrane, Non-Sterile Bulk Packaging

4692	0.2 µm, 13 mm	1000/pkg
4668	0.1 µm, 25 mm	1000/pkg
4506	0.2 µm, 25 mm	1000/pkg
4504	0.8/0.2 µm, 25 mm	1000/pkg
4508	0.45 µm, 25 mm	1000/pkg
4509	0.8 µm, 25 mm	1000/pkg
4655	0.2 µm, 32 mm	1000/pkg
4659	0.8/0.2 µm, 32 mm	1000/pkg
4653	0.45 µm, 32 mm	1000/pkg
4661	1.2/0.45 µm, 32 mm	1000/pkg
4660	1.2 µm, 32 mm	1000/pkg
4662	5 µm, 32 mm	1000/pkg

AcroPak 20 Filters with Supor Membrane

12202	0.8/0.2 µm, non-sterile, with filling bell	3/pkg
12203	0.8/0.2 µm, gamma-irradiated, with filling bell	3/pkg

AcroPak 200 Capsules with Supor Membrane

12941	0.8/0.2 µm, gamma-irradiated, with filling bell	3/pkg
12093	0.8/0.2 µm, gamma-irradiated, with filling bell (1/4 in. MNPT inlet, 1/4 - 1/2 in. stepped barb outlet)	3/pkg

AcroPak 500 Capsules with Supor Membrane

Part Number	Description	Pkg
12997	0.1/0.1 µm, gamma-irradiated	1/pkg
12995	0.2/0.2 µm, gamma-irradiated	1/pkg
12991	0.8/0.2 µm, gamma-irradiated	1/pkg
12993	0.8/0.45 µm, gamma-irradiated	1/pkg

AcroPak 1000 Capsules with Supor Membrane

12999	0.1/0.1 µm, gamma-irradiated	1/pkg
12996	0.2/0.2 µm, gamma-irradiated	1/pkg
12992	0.8/0.2 µm, gamma-irradiated	1/pkg
12994	0.8/0.45 µm, gamma-irradiated	1/pkg

AcroPak 1500 Capsules with Supor Membrane

12686	0.2/0.2 µm, gamma-irradiated	1/pkg
12675	0.8/0.2 µm, gamma-irradiated	1/pkg

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6/16, PDF, GN16.0405