



Application Note

Choosing the Proper Laboratory Supracap™ Depth Filter Capsules

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Introduction

The Pall Supracap depth filter capsule is a device that comes in various sizes designed for depth filtration and sample preparation for downstream processing of 1-100 liters of solution. These solutions, typically coming from cell cultures, fermentation broths, and cell lysates, often contain large particulate loads of variable sizes that can be difficult to filter using standard membrane filters. Membrane filters are thin, typically with a narrow pore size distribution that prevent particles larger than the rated pore size from passing through the membrane filter. During filtration, particulate matter larger than the pore size builds up on the membrane surface, eventually clogging all the pores until no more solution can be filtered. This is especially true for samples that contain high amounts of debris or particulate matter. This debris can quickly cover the surface of the membrane, thereby dramatically decreasing filtering capacity. For these solutions, depth filtration is more efficient because a third dimension, thickness, is added to the filter to trap particulate matter both at the surface and throughout the inside of the entire filter media. In addition, different media substrates can be layered to more effectively capture debris and particulate matter. This gives depth filtration devices a much higher hold capacity for debris capture than is possible with a membrane, allowing for more solution to be filtered using depth filtration devices.

Pall Supracap filter capsules contain the same media materials as Pall's larger volume, production sized devices capable of filtering hundreds of liters of solution at a time. This gives users assurance that scalability will never be a problem. With two different types of filter media in three different configurations (Table 1), Supracap filters cover a wide range of particle size removal, allowing the user to selectively target a variety of size ranges for efficient clarification of media. The Pall Supracap 50 filter capsule is the smallest volume Supracap device, typically used for 1-3 liters of solution. The larger Supracap 100 filter capsules come in different sizes that can be used to filter up to 100 liters.

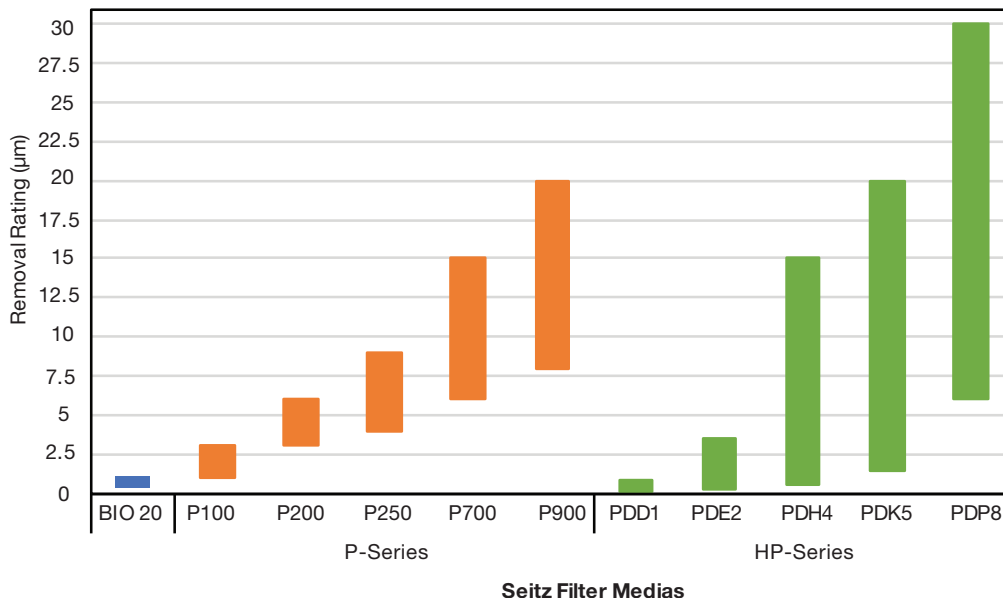
By choosing the correct Pall Supracap filter capsule, throughput can be maximized, saving time and money. The correct choice of filter type allows for removal of cells of differing sizes (e.g. bacteria, yeast, and mammalian cells), clarification of cell debris, cell lysates, or purification of blood/serum. Pall Supracap filters also have the ability to be stacked, greatly increasing throughput by allowing filters with different removal ratings to work in tandem to maximize the removal of debris and particulate matter from a solution.

Filter Media

Pall's Supracap devices contain one or two different types of media for filtration in a total of three different configurations. The first type of depth filtration media is Seitz® BIO 20, which consists of highly purified natural and modified cellulose fibers that are free from inorganic materials. It has the tightest removal rating of Pall Laboratory Supracap filters at 0.4 to 1 µm. The second media type found in Pall Supracap filters is the Seitz P-Series (P100 - P900), which is a more layered and complex media that is comprised of cellulose fibers, filter aids such as diatomaceous earth and perlite, and other resins that offer broader removal ranges than the BIO 20 media. The last media type is Seitz HP-Series (PDD1 – PDP8). This media contains two layers of Seitz P-Series depth filter sheets arranged so a more permeable layer is followed by a less permeable layer to increase flow rate and flow through of high particulate solutions. Figure 1 shows the three different media configurations along with their respective removal ratings.

Figure 1

Depth filtration ranges for Supracap depth filter capsule media.



Choosing the Correct Media

Pall's Seitz BIO 20 media is manufactured to have reduced levels of ash and heavy metal extractables. These filters are typically used when downstream applications are sensitive to metal ions. The 0.4 µm final cutoff makes it useful for final filtration steps and can be paired with other Supracap filters or used as a clarifying filtration step of supernatants after centrifugation. With a maximum removal rating of 1 µm, solutions with larger particulate sizes, like cell cultures or fermenter broths containing cellular debris, will need pre-clarification before being filtered through the BIO 20 Supracap filters to maximize flow through. The BIO 20 media can also protect chromatography columns or prevent rapid fouling of downstream sterile filtration membranes. The filtrate is suitable for further processing via tangential flow filtration (TFF) or can be used for the filtration of biopharmaceutical or therapeutic proteins.

Pall's Seitz P-series filters are manufactured to have low endotoxin levels and minimal release of extractables. These filters contain positively charged resins resulting in an electrokinetic adsorption potential that increases the retention of whole and crushed cells, cell lysate debris, endotoxins and other negatively charged host cell proteins, nucleic acids, and negatively charged viruses to better clarify biological solutions. The P100, P200, and P250 depth filters are for filtration of particulate matter in the 1 – 9 µm range and are typically used for filtration of cell-free fermenter broth, preparation of material for TFF, therapeutic proteins or vaccine purification, and blood/serum separation. Seitz P700 and P900 have a broader and higher range for more coarse filtration, with a range from 6 – 20 µm, and are useful for general cell removal from cell culture media (bacteria, yeast, or mammalian/insect cells).

Pall's Seitz HP-series filters are composed of 2 layers of Seitz P-series filter media. They share the same properties as the P-series material while having a high dirt/particle holding capacity. They are designed specifically to provide maximum throughput for particulate laden biological, bioprocess, and/or pharmaceutical samples. PDD1 depth filters have the tightest removal rating of the four HP-series filters with the smallest final pore size. While having a removal rating similar to BIO 20, the double layer nature of PDD1 makes it a better choice for general use as it captures a broader range of particles and due to its dual layer nature also has a higher capacity for debris capture. Like the BIO 20, PDD1 offers outstanding instrument and membrane protection. PDE2 depth filters are similar to the P100 and P200 media, but again with a broader removal rating. PDE2 also offers excellent membrane protection for downstream processes. PDD1 and PDE2 are most effective when used for secondary clarification after centrifugation or following initial filtration through higher rating depth filters. The final three filter medias, PDH4, PDK5, and PDP8, have high debris holding capacities and work well for cell and debris removal from fermentation feeds or cell culture media, with PDP8 being able to effectively clear cells at a 35 million cells per ml concentration while PDH4 and PDK5 should be used when the cell concentration is at or below 10 million cells per ml. They both excel in post fermentation applications, with the PDH4 media having a small enough final pore size to offer some membrane protection for other downstream applications like TFF.

Stacking Supracap Devices to Increase Capacity

Maximizing total output occasionally requires stacking different Supracap devices in series. For example, Pall has designed a system for clarifying cell culture media that is well suited for monoclonal antibody (mAb) production that places a PDP8 Supracap filter in series with a PDE2 Supracap filter. The Seitz PDP8 HP-series filter media has a 6 – 30 µm size range (Figure 1). This provides a more efficient removal of whole cells while allowing smaller debris to pass through the filter media. What flows through the PDP8 Supracap filter is then filtered by a PDE2 Supracap filter. This filter combination does its job by first clarifying mAb production media with high cell counts, up to 35 million cells per mL, then removing finer particulate matter to make the solution ready for downstream processing. The use of a PDP8 Supracap filter followed by a PDE2 Supracap filter is the same setup as Pall's Stax™ mAx Clarification Platform that can handle hundreds of liters of media at a time. This highlights the ease of scalability from small-scale runs using either Supracap 50 or 100 filter capsules to Pall's large-scale depth filtration platforms.

Table 1*Effective filtration area (EFA) of depth filter capsules.*

Device	Capsule Size	EFA (cm ²)	Connection Type	Seitz Media Type	Removal Rating (µm)	General Usage
Supracap 50	n/a	22	Luer fittings	Bio 20	0.4 µm – 1.0 µm	Final filtration, clarifying supernatant, protect columns, prefiltration to TFF
Supracap 100	NP5L	500	Sanitary flange or			
	NP6	1000	13 mm hose barb			
Supracap 50	n/a	22	Luer fittings	P Series	1.0 µm – 3.0 µm	Cell lysate, removal of endotoxin and negatively charged bio-molecules, therapeutic protein or vaccine purification, and blood/ serum separation
Supracap 100	NP5L	500	Sanitary flange or	(100, 200,	3.0 µm – 6.0 µm	
	NP6	1000	13 mm hose barb	250, 700, 900)	4.0 µm – 9.0 µm	
					6.0 µm – 15.0 µm	Retention of whole/crushed cells, general cell removal from cell culture media (bacteria, yeast, or mammalian/insect cells)
					8.0 µm – 20.0 µm	
Supracap 50	n/a	22	Luer fittings	HP Series (PDD1, PDE2,	0.1 µm – 0.85 µm	Final filtration, clarifying supernatant, protect columns, prefiltration to TFF
Supracap 100	NP5L	250	Sanitary flange or	PDH4, PDK5, PDP8)	0.2 µm – 3.5 µm	Cell lysate, removal of endotoxin and negatively charged bio-molecules, therapeutic protein or vaccine purification, and blood/serum separation
			13 mm hose barb		0.5 µm – 15.0 µm	
	NP6	500			1.5 µm – 20.0 µm	Retention of whole/crushed cells, general cell removal from cell culture media (bacteria, yeast, or mammalian/insect cells)
					6.0 µm – 30.0 µm	

Making the Final Decision

When choosing which Supracap device will be best for a solution, it is important to understand both the effective filtration area of the different medias and the particle size distribution of your solution. The Supracap 50 filter capsules have the same effective filtration area across all media types, but that is not the case for the Supracap 100 filter capsules. Due to the way the P-series and HP-series filter medias are constructed, the P-Series Supracap 100 devices have twice the effective filtration area of equivalent HP-series devices (see Table 1). This means that if you start your initial testing with the Supracap 50 filter capsules, the throughput of the HP-series device would need to be greater than twice that of the P-series device for it to be the best choice when scaling up to the Supracap 100 filter. There are also different sized Supracap 100 devices, meaning the same filter media can come in filter capsules with different effective filtration areas. Knowing the throughput of your solution when using a Supracap 50 device, along with the total volume you wish to process, the proper Supracap 100 device can be chosen to minimize the cost per liter of filtrate.

Choosing the correct removal rating for a Supracap device requires taking into account the particle size distribution of your solution. It may seem that having a broader removal rating would be the best option for all purposes, but that is not always the case. For instance, if the majority of a solution is cell free and only contains small particulate matter that are smaller than 5 µm in size, much of the depth filtration media in the broad range Supracap devices, like those with P250, PDH4, or PDK5 medias, would not be performing active filtration. The smaller particles would pass through the larger pore sizes, only getting trapped deep inside the filtration media. This decreases the effective filtration area of the filter, which reduces the total throughput and increases the cost per liter of filtrate.

The use of depth filtration devices is an effective way to quickly clarify large quantities of solution that contain high amounts of debris and particulate matter with minimal handling. Having a good understanding of the amount of particulate matter in your solution along with the size distribution of those particles is an important first step in choosing the best Supracap depth filter capsule for your application. By selecting the Supracap filter capsule with a removal rating that best matches the size distribution of your solution, you can maximize throughput and reduce costs. Having the same depth filtration medias in the Supracap 50 filter capsules, the Supracap 100 filter capsule, and Pall's depth filtration platforms enables the ability to easily and quickly scale up. The performance and wide variety of Pall Supracap depth filter capsules make them the clear solution for your depth filtration needs.



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