AsahiKASEI

BioOptimal™ MF-SL

Hollow Fiber Microfilter

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BioOptimal MF-SL is a hollow fiber microfilter that utilizes an efficient filtration mechanism based on size exclusion and tangential flow filtration. These two aspects allow the filter to smoothly and effectively separate the contents of a solution.
One prevalent application of this combination is the separation of the proteins and the cells of a cell culture solution. When used for this purpose, the filter recovers a high amount of proteins quickly due to its capacity to process large volumes extremely efficiently. Additionally, the filter produces a high quality filtrate in a single processing step due to its gentle treatment of cells which reduces the release of fouling cell debris.

BioOptimal MF-SL Features

- Processes large volumes quickly
- Achieves high protein recovery rates through tangential flow filtration
- Produces low turbidity filtrates with a single processing step
- Creates little damage to cells due to low transmembrane pressure (TMP)
- Possesses excellent scalability
- Enhances cost effectiveness due to its regeneration capability

Application Examples

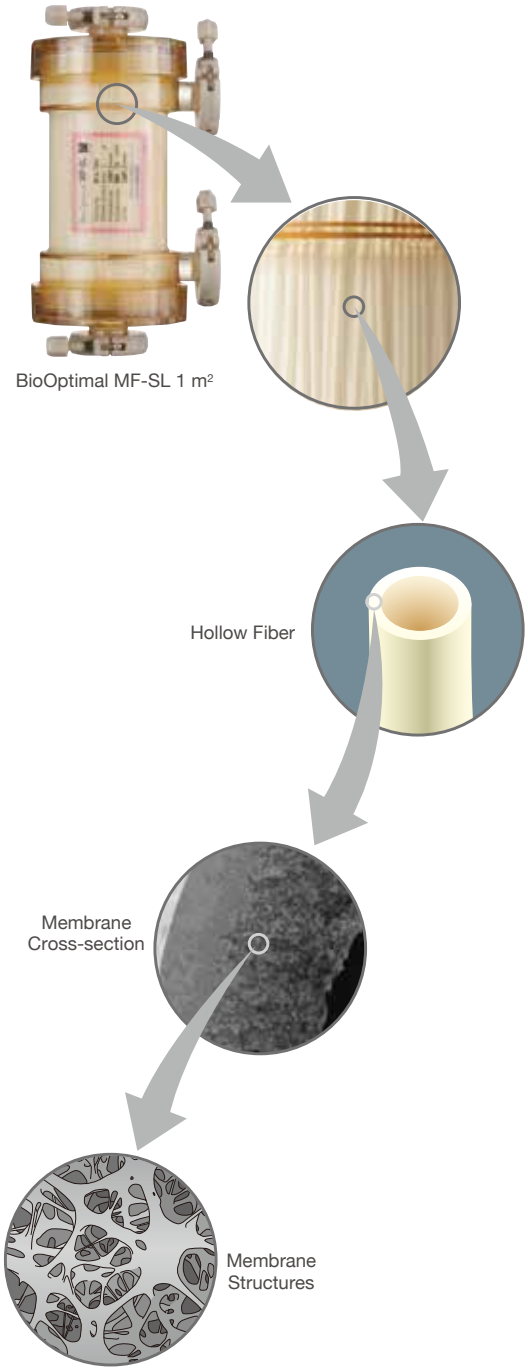
- Removal of animal, insect, or yeast cells from batch, fed-batch, or perfusion cultures
- Size-based exclusion removal of impurities before further processing

Filtration Mechanism

▶ Hollow Fiber Microfilter

BioOptimal MF-SL is a hollow fiber microfilter. The membrane structures of the hollow fibers have pores with nominal diameter of 0.4 µm. During filtration, these pores allow the filter to effectively separate the contents of a solution through a size exclusion mechanism.

Figure 1 BioOptimal MF-SL Structure



▶ Tangential Flow Filtration

The combination of the size exclusion mechanism and the tangential flow filtration mode allows the filter to separate the components of a solution while preserving their integrity. When separating cells and proteins, the tangential flow safely circulates the cells inside the hollow fibers and returns them to the feed solution reservoir as the TMP pushes the target proteins through the hollow fiber membranes. Due to this gentle treatment, the amounts of cell-derived impurities are reduced to a minimum.

Figure 2 Filtration Mechanism

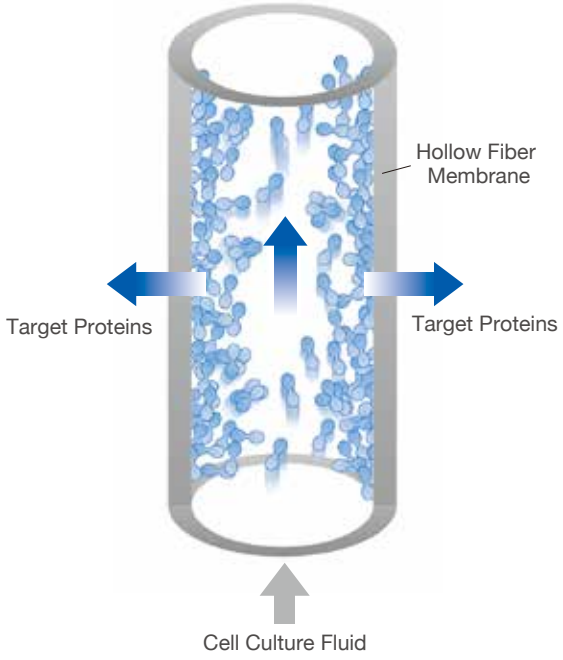
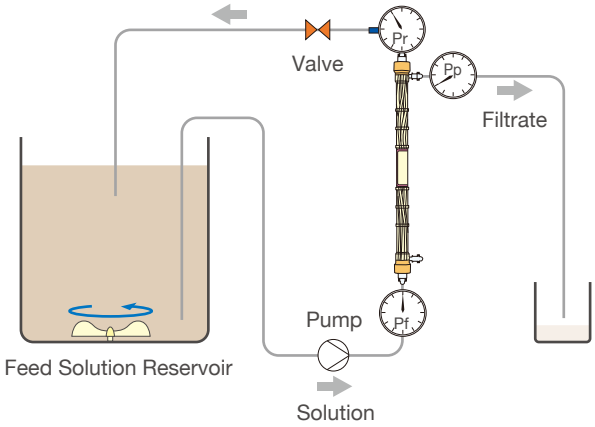


Figure 3 Basic Tangential Flow Filtration Operation

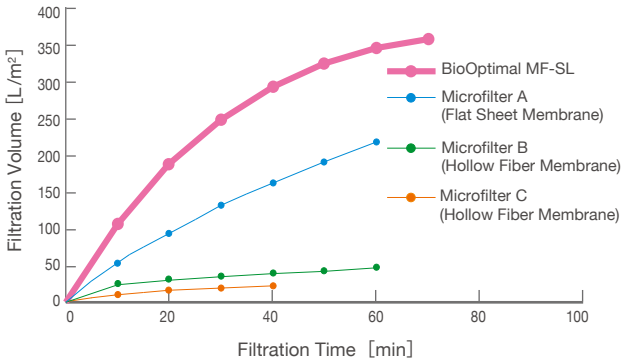


Efficient Processing

▶ Quick Large Volume Processing

A key feature of BioOptimal MF-SL is its ability to quickly process large volumes of feed solution.
As shown in Figure 4, compared to other existing microfilters, BioOptimal MF-SL can process the largest volume of solution in the shortest amount of time.

Figure 4 Filtration Volume vs. Filtration Time

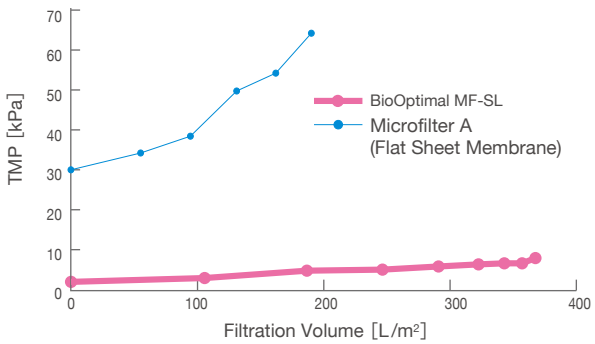


Experiment processed a suspension of CHO cells with Cell Density: 1.2x10⁷ cells/mL, Viability: 99.4%, Turbidity: 872 NTU

▶ Stable Filtration Performance

Unlike other microfilters, BioOptimal MF-SL's unique membrane structure and tangential flow filtration mode allow it to provide a consistently low TMP despite increases in filtration volume.
This low TMP results in a reliably high target protein recovery rate.

Figure 5 TMP vs. Filtration Volume

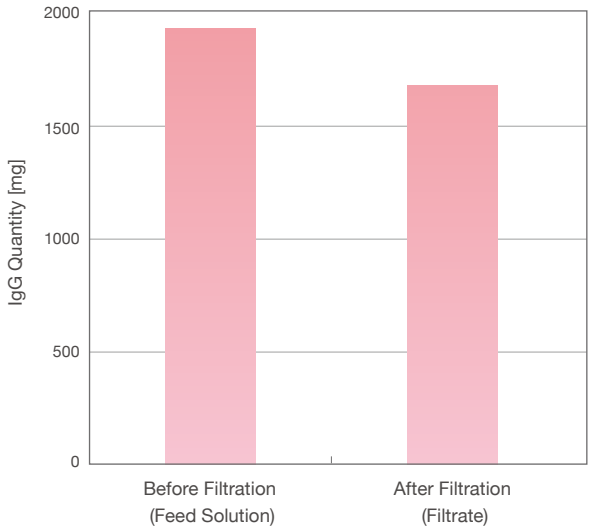


Experiment processed a suspension of CHO cells with Cell Density: 1.2x10⁷ cells/mL, Viability: 99.4%, Turbidity: 872 NTU

▶ High Protein Recovery Rate

BioOptimal MF-SL achieves high recovery rates of target proteins. Figure 6, which illustrates the before and after of a BioOptimal MF-SL filtration, shows a filtrate with a 92% recovery rate of the IgG originally spiked into the CHO cell feed solution.

Figure 6 IgG Quantity Before and After Filtration



High Quality Filtrates

▶ Less Bioburden on Downstream Processes

BioOptimal MF-SL can produce a high quality filtrate even from a feed solution with low cell viability and high turbidity. Figure 7 compares the turbidities of a filtrate produced by BioOptimal MF-SL and a filtrate produced by a competitor filter, both using feed solutions of CHO cells with cell densities of 1.48×10^7 cells/mL, viabilities of 78.6%, and turbidities of 1600 NTU. The BioOptimal MF-SL filtrate clearly shows a much higher degree of clarity.

The very low filtrate turbidity provided by BioOptimal MF-SL contributes to the improvement of the next purification steps in the downstream process. As Figure 8 shows, the filtration capacity of a 0.22 µm sterile filter is much less affected by the BioOptimal MF-SL filtrate than the Microfilter A (flat sheet membrane) filtrate.

Figure 7 Comparison of Filtrate Turbidities (Feed Solution Load: 1600 NTU)

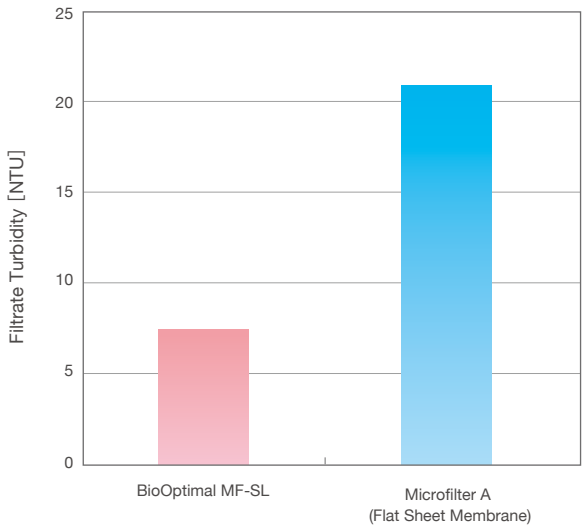
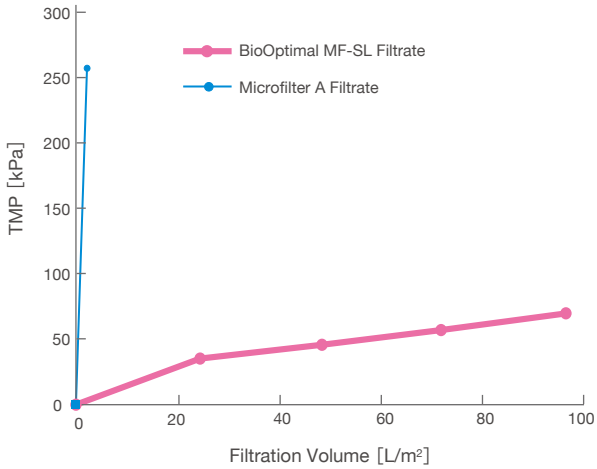


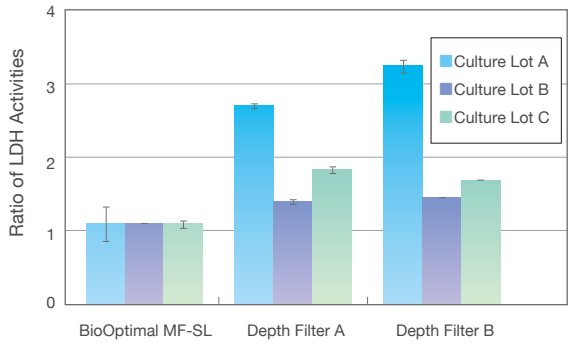
Figure 8 TMP vs. Filtration Volume of 0.22 µm Sterile Filter



▶ Limited Cell Damage

BioOptimal MF-SL's tangential flow filtration mode allows it to cause little cell damage and thus reduce the release of impurities caused by cell disruptions to a minimum. Figure 9 shows the amounts of lactate dehydrogenase (LDH), a cell disruption-derived impurity, in the filtrates produced by BioOptimal MF-SL and by two traditional depth filters. It is easy to see that BioOptimal MF-SL causes less cell damage.

Figure 9 Ratio of LDH Activities (After/Before Filtration)

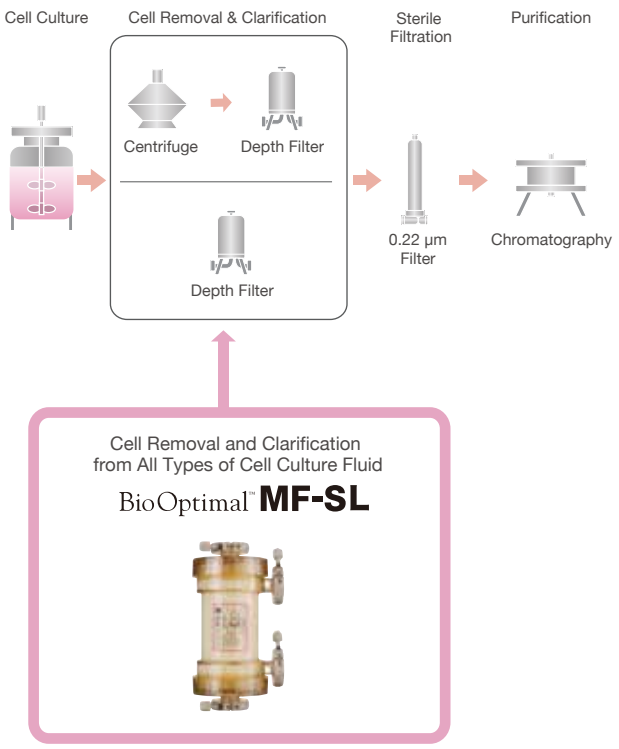


Easy Process Integration

▶ Process Simplification

BioOptimal MF-SL is able to clarify solutions quickly and completely in a single processing step. Therefore, it simplifies the cell culture clarification process and makes it more cost-effective by eliminating the needs for large investments like centrifuges and expensive disposable items like other depth filters.

Figure 10 Cell Removal and Clarification Process



▶ Linear Scalability

Because BioOptimal MF-SL is available in membrane surface areas of 0.005 m², 1 m², and 8 m², it can be easily scaled up and used for purposes ranging from lab-scale experiments to commercial production. As the filter's membrane area is determined by the number and length of its hollow fibers, changing the filter size only negligibly changes its processing volume per membrane area.

0.005 m² 0.19 m² 1 m² 8 m²

Product Specifications

■ Data Sheet

Nominal Pore Size	0.4 μm
Water Flux	≥ 21,000 L/m²/hr at 0.1 MPa (1 bar, 14.5 psi), 25 ˚C (77°F)
Maximum TMP and Maximum Feed Pressure	0.15 MPa (1.5 bar, 21.8 psi)
Chemical Compatibility	Acidic Solution: 20 mM acetic acid buffer solution (pH 4.0) for 15 hrs at 25 ˚C (77°F) Neutral Solution: 20 mM phosphoric acid buffer solution (pH 7.6) for 15 hrs at 25 ˚C (77°F) Basic Solution: 20 mM Tris buffer solution (pH 9.5) for 15 hrs at 25 ˚C (77°F) Caustic Solution: 0.5 N NaOH containing 3000 ppm NaClO for 24 hrs at 25 ˚C (77°F) Organic Solvent: 0.1% β-mercaptoethanol for 15 hrs at 25 ˚C (77°F)
Temperature Tolerance	Up to 123 °C (253 °F) for 10hr
Materials	Hollow Fiber Membrane: Polysulfone Housing: Polysulfone Sealant: Epoxy resin
Preservation Agent	20% Ethanol
Biological Safety	Conformance with the United States Pharmacopeia (USP) 31 Biological Safety Standards <87> and <88>

■ Ordering Information

Effective Membrane Surface Area	Scale	Number/Package	Catalog#
8 m²	Commercial Production	1	MFSL8000
1 m²	Development, Clinical Study	1	MFSL1000
0.19 m²	Development, Clinical Study	1	MFSL0190
0.005 m²	Research	1	MFSL0005

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