

Molecular weight cut-off determination for polysulfone membranes

Application Note Pharmaceutical Analysis

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Introduction

Polysulfone allows easy manufacturing of membranes, with reproducible properties and controllable pore sizes. These membranes are used for applications like haemodialysis, but also for waste water recovery or food and beverage processing. Cartridges made from polysulfone membranes offer extremely high flow rates at very low differential pressures.

Polysulfone membranes are characterized by several characteristics:

- Average pore size and pore size distribution
- Molecular weight cut-off (MWCO)
- Size selectivity
- Filtration behavior
- Sieve curve and retention efficiency
- Binding or non-binding efficiency
- Pore accessibility
- Chemical, physical and biological stability
- Hydrophobic properties
- Fouling

With the exception of the last two, all of the listed properties can be determined easily with just one single filtration experiment followed by GPC/SEC characterization saving time and minimizing cost.¹ GPC/SEC is a robust and fast method that can be easily established also in regulated laboratories needing to comply with GxP or FDA 21CFR11.

System Requirements

	Conditions
Pump	PSS SECcurity GPC1260 isocratic pump <ul style="list-style-type: none"> • flow rate [mL/min]: 1 • mobile phase: 0.1M NaCl
Injection system	PSS SECcurity GPC1260 Autosampler <ul style="list-style-type: none"> • injection volume 100µL
Columns	<ul style="list-style-type: none"> • PSS SUPREMA precolumn (8*50mm) • PSS SUPREMA 10µ 30Å (8*300mm) • PSS SUPREMA 10µ 1 000Å (8*300mm) • PSS SUPREMA 10µ 1 000Å (8*300mm)
Detectors	Refractive index PSS SECcurity 1260 RI
Filtration sample and Calibration	<ul style="list-style-type: none"> • Stock solution: Dextran, broad molar mass distribution • Calibration: Dextran molar mass standard kit PSS-dxtkitd
Software	PSS WinGPC UniChrom with ChromPilot, sieve curve option and Compliance Pack (optional)



Procedure, Results & Discussion

• Filtration experiment

The membrane is characterized by filtration of a stock solution covering the complete pore size range of the membrane.² Dextran samples with a broad molecular weight distribution are employed.

• GPC/SEC experiment

A conventional GPC/SEC system with RI detection is used to measure the stock solution, the filtrate and (optional) the retentate.

GPC/SEC conditions are shown in the System Requirements above. For accurate results a pump with a high precision, columns with high resolution, and internal standard correction are recommended.

• Data Evaluation

The GPC/SEC traces of the filtrate(s) and the stock solution are overlaid. Fig. 1a shows the overlay of the RI signals for the stock solution and the filtrates of two polysulfone membranes, A and B. Fig 1b shows the overlay of the filtrate of membrane C with the stock solution.

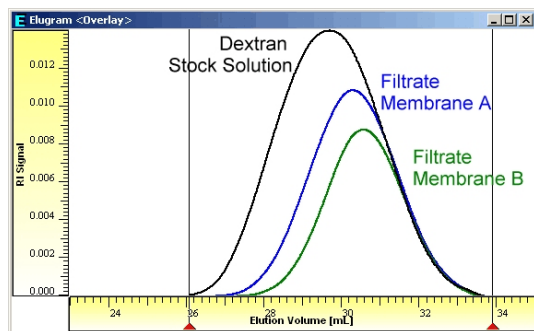


Fig. 1a: Overlay RI signals membranes A and B

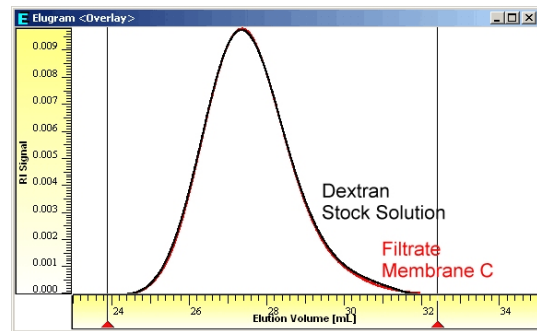


Fig. 1b: Overlay RI signal defective membrane C

These pictures show that membrane A and B are different with respect to their filtration behavior. As expected, the higher molar masses/larger molecules (eluting at low elution volumes) are not able to pass the membrane and are missing in both filtrates.

Membrane C, however, must be defective, since the measured RI signals for the stock solution and the filtrate do not differ in shape and area. This means that all molar masses passed completely through the membrane.

The sieve curves were determined using the equation:
$$SieveCurve = 1 - \left(\frac{Filtrate}{StockSolution} \right)$$

Figure 2 shows the resulting sieve curves for membranes A and B, as well as the corresponding molar masses. The molar masses were obtained using the Dextran calibration curve. In addition the molecular weight cut-off values (MWCO) for 5 different % limits are displayed. Other results that can be obtained are e.g. the average pore size and the membrane selectivity.

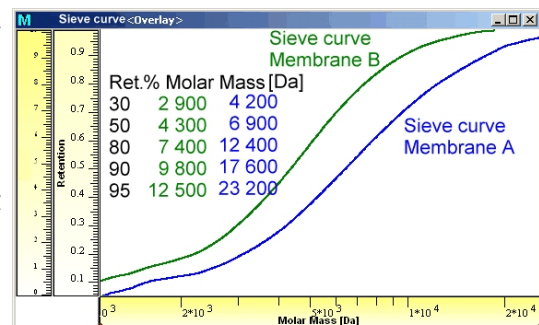


Fig.2: Sieve curves and MWCO for membranes A and B

Literature

¹ P. Kilz, M. Viktorin, LC/GC Europe 20 (4), page 224 (2007)

² P. Kilz, Polym. Sci. Mat. Eng.77, page 56 (1997)