

Retention Efficiency of Ultrafiltration Membranes

Most filters are efficiency rated based on often standardized tests using defined hard particles of either random shapes and sizes (ISO Test Dusts) or defined shapes and sizes Latex Beads or Bacteria. Ultrafiltration membranes are efficiency rated based on the molecular weight of a challenge material that can vary greatly in shape, size, and consistency. That is why they are often defined as Nominal Molecular Weight Cut Off (NMWCO) and is expressed in Daltons.

NMWCO is determined by challenging a membrane in a test cell with a known molecular weight material that can consist of biological molecules (Albumin) to organic polymers (Dextran). The percent rejection is determined by measuring the amount of the test molecule in the permeate (filtrate) versus the amount in the challenge using the formula $1 - \frac{\text{permeate concentration}}{\text{feed concentration}}$.

While this seems like an appropriate method of determining the efficiency of a membrane designed to remove organic molecules, it can be highly variable in its results depending on the size and shape of the test cell, the operating parameters (flow rate, pressures, temperature, etc.) and challenge material (challenge molecule, pH, TDS, etc.). In addition, what percentage of rejection is used to establish the rating is also variable from manufacturer to manufacturer.

Therefore it is nearly impossible to predict the performance of one manufacturer to another based on their NMWCO rating. Some typical NMCO curves are represented below:

To compensate for the variables associated with this methodology for membrane ratings, the membrane are typically selected that have NMWCO ratings significantly smaller than the size of the molecule that is desired to be retained. An example of this is the use of 20K NMWCO rated membranes to retain Albumin which has a molecular weight of 68K. While this selection method assures a high efficiency in the retention of Albumin, it also can have an undesirable affect on the retention of smaller molecular weight species that may not be desired in the final product and will have to be removed by other means such as chromatography.

The method used to determine a membrane NMWCO not only affects its ability to have a high retention efficiency of larger molecules but also its overall molecular permeability of both other molecules as well as the carrying fluid. This is mostly affected by the molecular permeability distribution a subject that will be covered in an additional One Minute Filtration article.

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To discover more about Microfiltration Membranes and Ultrafiltration Membranes register for these short courses. They are each 4 hours long, with Microfiltration offered in the morning and Ultrafiltration offered in the afternoon. Lunch is included.

Keywords



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