A wide range of applications for membrane filtration in the dairy industry

Polymeric membranes are used for separation, concentration and/or fractionation of a wide range of liquids. The membrane serves as a thin selective barrier for liquids and allows for the transport of various feed components when a driving force is applied.

Designed for crossflow filtration, the feed stream runs parallel to the membrane surface to create a shearing force along the surface which reduces fouling and buildup. In addition, the membranes feature an asymmetric pore structure, with large "finger pores" beneath the membrane to allow for rapid permeation to the permeate carrier, and smaller surface pores to tightly control the separation performance of the target molecules in the feed solution. Figure 1 shows the asymmetric pore structure of a PES ultrafiltration membrane.

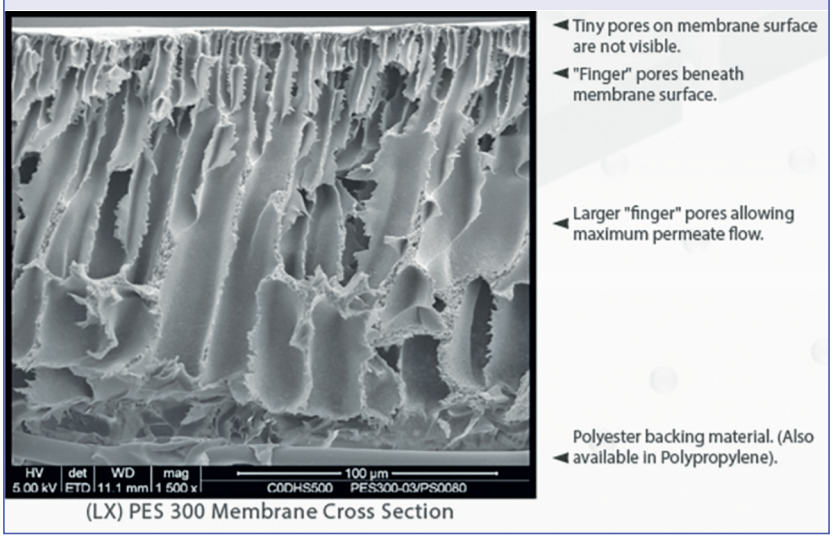
Dairy processing diagram

The diagram below shows how nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) membranes can be used throughout various stages of dairy processing. This includes the initial fat/microbial removal step, whey protein concentration, and even lactose concentration and demineralization.

Nanofiltration

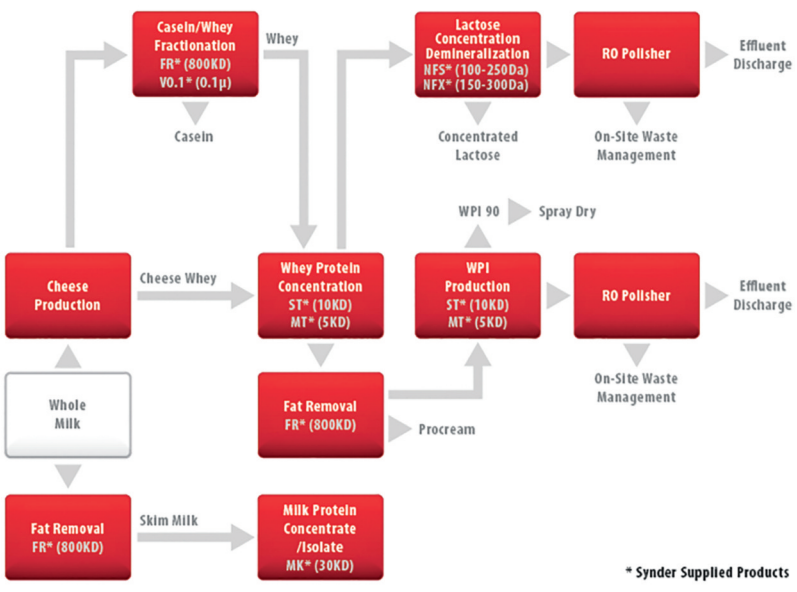
Lactose Concentration & Demineralization: In the later stages of dairy processing, nanofiltration is widely used for lactose concentration and demineralization prior to RO polishing and effluent discharge. NF membranes allow monovalent ions to pass through the membrane, while partially rejecting multivalent ions. This is beneficial for producing lactose-free milk and reducing the whey volume to obtain lower transportation costs. Moreover, the use of NF for mineral reduction helps to produce high purity lactose.

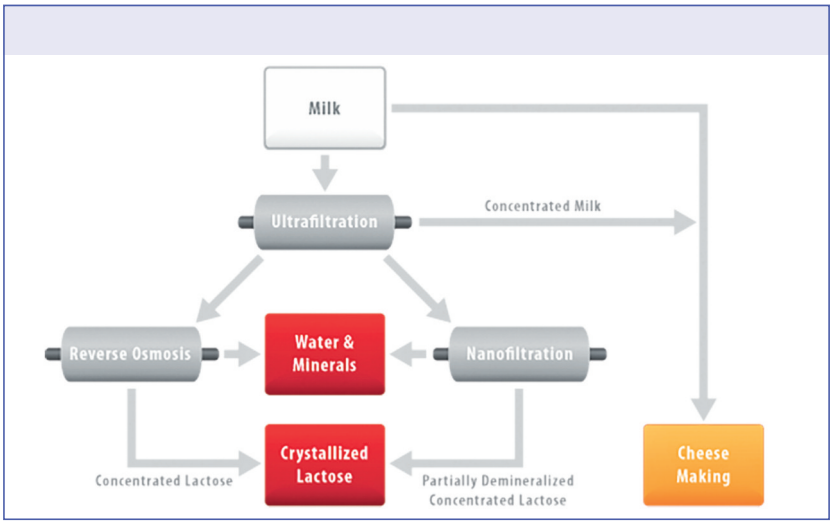
Figure 1



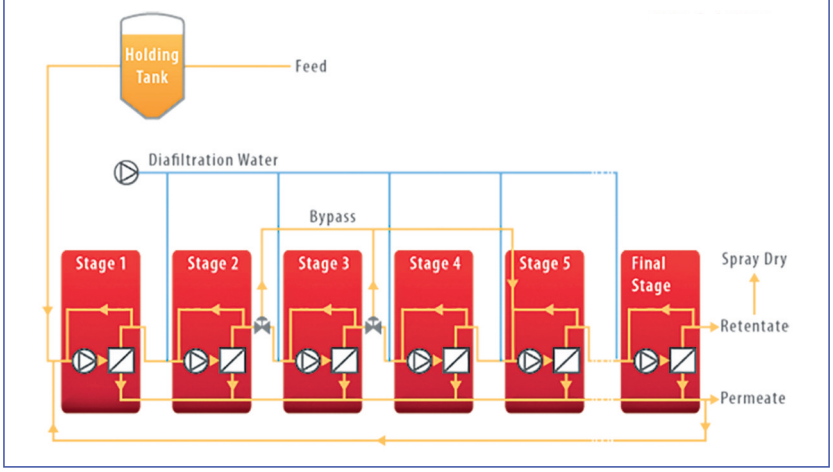
Asymmetric pore structure of PES ultrafiltration membrane — Photos: Synder

Dairy processing diagram

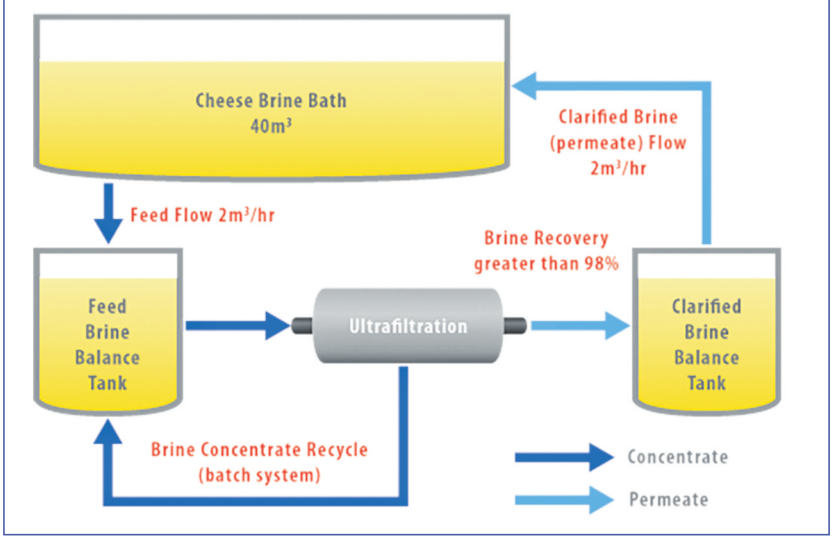




WPC/ WPI



Dairy – brine clariification



Ultrafiltration

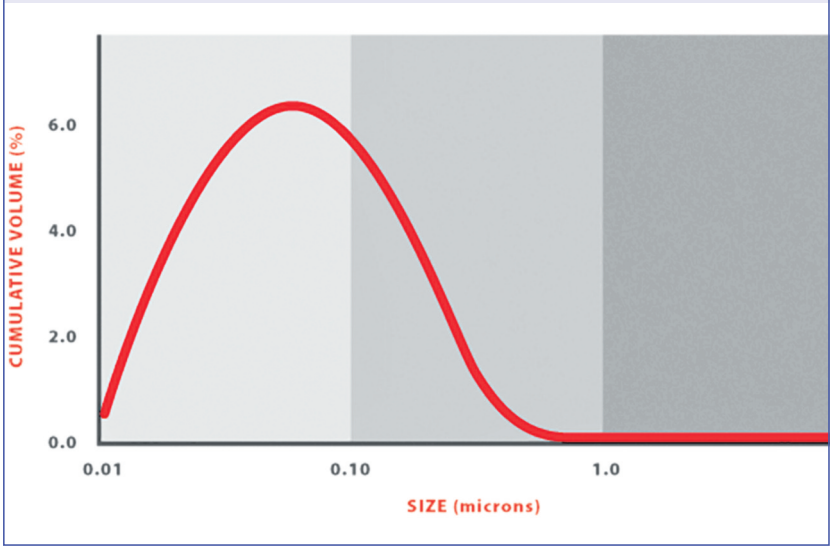
Whey Protein Concentrate/Isolate Production: Polymeric spiral-wound ultrafiltration elements are the industry standard for producing whey protein concentrate (WPC) and whey protein isolate (WPI) from cheese whey. Ultrafiltration PES-based membranes ranging in molecular weight cut-off of 3,000-10,000 Dalton are commonly used for this application, as they provide an optimal balance of flux, protein separation, and membrane durability.

In WPC, where continuous UF system are typically set up stage-by-stage, thicker feed spacers such as parallel-stranded or ribbed-type spacers are commonly used along with diafiltration towards the end in order to maximize total solid loading content and increase the efficiency of removing smaller non-protein species. In WPI, MF membranes are typically first used to lower the fat content in in the whey protein and are followed by UF and diafiltration to further concentrate the WPI. This creates a WPI that is high in protein and low in fat and lactose compared to WPC.

Brine Clarification: UF PVDF-based membranes with average molecular weight cut-offs of 50,000 Dalton are commonly used to clarify brine solutions generated while curing cheese. In cheese production, salt brining is used to add flavor to the cheese as well as prevent bacterial growth by drawing out moisture to form the rind. While this allows for the reuse of the solutions, it is also beneficial for providing an ionic balance which lets the cheese cure at an optimal rate.

Milk Protein Concentrate/Isolate Production: Ultrafiltration membranes with molecular weight cut-offs around 30,000 Dalton are often used for the concentration of milk proteins from skim milk. After whole milk is divided into skim milk and cream, the membrane can be used to fractionate and concentrate the milk protein. The whey and casein blend offers an abundance of nu-

Fat/ microbial removal



About Synder Filtration

Synder Filtration is a leading supplier of membrane filtration technology for the dairy industry, offering nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF) membranes for use in a wide variety of specialty process applications. Established in 1994, Synder has continued to grow as an independent U.S. membrane manufacturer, focusing on building long-term customer relationships through strong technical expertise, outstanding customer service, and unparalleled responsiveness. With over 30 types of membranes available, Synder offers an array of choices when it comes to molecular weight cut-offs and provides custom membrane development upon request. All sanitary products are compliant with US FDA CFR Title 21, EC Reg. No. 1935/2004, and EU Reg. No. 10/2011, and meet USDA, Halal, Kosher, and 3-A sanitary standards. Synder is a certified ISO 9001:2008 manufacturing company.

tritional properties and can improve the heat stability of the product it is added to. In addition, the bland flavor and light color make it ideal as an additive in products throughout the dairy industry.

Microfiltration

Protein Fractionation/Separation: Larger pore sizes in MF membranes allow for whey and casein to be easily separated before concentration in the UF step. PVDF membranes with cut-offs between 0.08 and 0.1µm are an economic choice for the separation of these proteins, and the protein standardization allows for better control over the quality of protein by-products and ratios.

Fat/Microbial Removal: PVDF membranes used for protein fractionation can also be used to remove the fat and produce high-quality WPC and WPI. The larger pore size of MF allows systems to operate at much lower pressures which allows for a reduction in energy consumption. MF membranes can also be used as a pretreatment step to pasteurization to ensure all bacteria and spores in the milk are completely eradicated.

In addition, membranes developed to withstand high temperatures and high pH conditions can be implemented to allow for sanitization without the use of chlorine, which can extend the membrane and equipment life.