

# Pore decisions



**Choosing the right filters for your beverage plant is critical explains Lisa M. Madsen, technical manager, Pall Corporation**

**W**hen you're talking about beverages, water isn't just an ingredient – it's the ingredient. It is the very basis of any alcoholic beverage or soft drink produced, and put quite simply, if you have no water, you have no beverage. Taking it a step further, if you don't have high-quality water, you won't have a high-quality beverage. Regardless of the beverage you're producing, water is a critical raw material in producing what every marketer strives for: a unique product signature.

## Water quality?

Apart from the obvious health concerns, water quality is critical to the taste and appearance of any beverage. Product integrity is dependent on high water quality, a must regardless of the beverage you're producing.

In the beverage universe, a truly unique product signature is the painstaking result of a precise combination of liquid ingredients including flavours, additives, sweeteners, enhancers and water. As the basis of any beverage, the quality of the water has a direct impact on product taste.

Apart from maintaining precise control of individual ingredient fluids, their mixing and separation, the most variable ingredient from place to place is water. Fluctuations in water quality and content affect taste, appearance, and even safety. It can also affect the efficient operation of any bottling or production facility. Feed water content and quality can vary according to raw water source and pretreatment.

Achieving measurable and repeatable water

quality is essential to protecting brand integrity anywhere in the world. Precise treatment of raw water helps provide the foundation for creating and protecting the brand. Since incoming water frequently comes from sources including municipal water supplies, ground water, surface water and springs, it presents a plethora of challenges.

Waterborne cysts, oocysts, bacteria and viruses can contaminate source water, bringing with them serious health implications; undesirable metals and salts can affect the taste, colour, and uniformity of the product. The challenge, of course, is to remove all variability regardless of the source, as well as provide low-SDI feed water for downstream processes. By ensuring the integrity of their processes and ingredients, manufacturers will realize the repeatable consistency required of successful products. Ultimately, the goal is not just to make water safe, but to do so while simultaneously and efficiently achieving taste and economic targets.

## Cost vs quality

Many filtration processes of varying removal capabilities go into the production of a beverage, and for different reasons. The rule of thumb is that fine filtration is used to control quality; coarse filtration is used to control economics. As you would expect, the finer the filter, the more it costs. In the same line, fine filters can cost twice as much as coarse filters.

And while water is the most important resource in beverage production, not all the water used in a plant goes into the product. In fact, up to 75 per cent of plant water may go into running utilities

or other plant processes. So while you may want your product to be of the highest quality, you probably won't want to invest in fine filters for plant processes that can be suitably served by more cost-effective coarse filters.

Coarse filters are also commonly used as pre-filters, which extends the life of the finer filters housed downstream.

Fine filtration is accomplished by different filtration technologies: fine depth filters and membrane filters. Fine depth filters have particle removal ratings less than 10 microns and the ratings are established by slightly different methods than for coarse filters. This class of fine filters does not always retain microbial pathogens like *cryptosporidium* or *E. coli* efficiently. Membrane filters, however, are designed to provide a validated removal of microbes and often have a correlated integrity test that can be performed to confirm the quality of the filter effluent. In most cases, when there are downstream quality problems, they are related either to system breaches downstream of this type of filter or to a failure of the filter itself.

Quality control of water during production of beverages is critical. However, if controls are applied to incoming plant water these additional in process filtration steps will have longer on stream life providing an improvement in overall production plant economics.

**Membrane water treatment**

Benefits of crossflow membrane filtration include product consistency, process and plant efficiency, and maximising throughput per square foot of footprint. With a minimal use of plant footprint, plant efficiency can be increased significantly and the product consistency that is the result of increased process control is achieved.

Advancements in membrane process technology have led to its increasing acceptance for the removal of bacteria, particles, dissolved salts and natural organic material which, if allowed to pass through, can impart undesirable colours, tastes, and odours to the water.

Thanks to favourable maintenance requirements and less reliance on chemistry, membrane water purification systems are increasingly being chosen by treatment professionals.

In the long run, when compared to conventional chemical treatment, membrane filtration will deliver lower overall production costs, fewer processing steps, higher yield, a higher degree of selectivity, and greater flexibility in handling feed liquids with different specifications and in which viscosity fluctuates. A membrane filtration system, due to its modular design, is easy to expand step-by-step, so that capacity always fits actual needs.

Membrane systems also feature a modular design which allows for treatment expansions that closely match production demands, offering an unparalleled degree of precision and flexibility.

There are four pressure-driven membrane processes: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO).

**Membrane Filtration Processes:**

- Cartridge Microfiltration (MF) routinely removes particles and microbes larger than 0.1 microns to around 1 micron in size
- Crossflow Microfiltration (MF) has a molecular weight cut-off (MWCO) between 300,000 and 1,000,000. This process separates particles with a size less than 0.2 µm
- Ultrafiltration (UF) uses a membrane with a MWCO between 500 and 300,000. This process separates compounds in the range of 0.0001 to 0.1 µm
- Nanofiltration (NF) offers separation qualities between ultrafiltration and reverse osmosis. They require a lower working pressure and give higher flux than RO membranes, but have a lower salt separation capability
- Reverse osmosis (RO) uses the most impermeable membrane. These membranes have a MWCO of less than 500 and require high pressure

Filtration processes		
Filtration Type	Separation/Removal capabilities	Separation/Removal capabilities
	Particulate	Microbial
Coarse	>10 microns	
Fine	1-10 microns	1 micron may provide TR of <i>Giardia</i> and <i>Cryptosporidium</i>
Cartridge Microfiltration (MF)	>0.1-1 microns	<0.45 micron removal of <i>E. coli</i> , <0.2 micron removal of <i>Pseudomonas</i>
Crossflow Microfiltration (MF)	>0.1 microns	<0.45 micron removal of <i>E. coli</i> , <0.2 micron removal of <i>Pseudomonas</i>
Ultrafiltration (UF)	0.005 -0.09 microns	<50 nm removal of viruses
Nanofiltration (NF)	5-10 angstroms	
Reverse Osmosis (RO)	<5 angstroms	

**Conclusion**

Ideally, every beverage experience should be a unique combination of aroma, flavour, sweetness, and tartness. Water quality can change the beverage signature in any of these areas. More than just equipment, manufacturers need to make educated decisions to meet their filtration and separations needs throughout the production process.

Expertise of this type integrates solutions to allow companies to reduce total cost of ownership, enable new processes or products, and meet regulatory requirements.

The separation technologies applied must provide verifiable effluent and the services rendered must provide demonstrable value. If this is accomplished, manufacturers will have increased control over their product – which is really the ultimate goal of any manufacturer. ■

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