

OurwaterQuality

Ultrafiltration for clarity, critter removal

Membrane technology is a size-exclusion process that involves imposing water pressure against a semi-permeable, membranous surface. It is one of the fastest growing sectors in commercial, municipal and household water-purification — fueled primarily by the global demand to produce fresh water by desalinating sea water, but also increasing awareness of harmful disinfection byproducts from chlorination and the resistance of certain pathogenic organisms (especially spores such as *Cryptosporidium*) to chlorine disinfection.

Ultrafiltration systems operate at pressures from 30 to 100 psi, have a membrane pore size of from 0.002 to 0.1 micrometers (microns) and fall into the continuum of the four common membrane processes classified by (increasing) pore size: reverse osmosis, nanofiltration, ultrafiltration and microfiltration. To help put that range of pore sizes in perspective, one micron is one millionth of a meter and the finest sand grain is about 62.5 microns.

Water, dissolved solids, and smaller molecules will pass through the membrane, while particles larger than the pore size (including colloids, most microbiological contaminants, and large organic molecules) will be rejected and exit with the concentrate water. Ultrafiltration membranes require minimal pretreatment, with the exception of reducing high levels of iron and/or manganese.

Membrane technology is a highly effective separation process based on size rejection. Membranes are also rated by their approximate molecular weight cut-off (MWCO), which is the sum of the atomic weights of all the atoms in a molecule. MWCO is an indirect measurement of retention performance, and the membrane MWCO is determined as the solute size of which at least 90 percent is retained. The membrane acts as a barrier to molecules with a molecular weight exceeding the MWCO rating. This designation is widely used in other industries and in medical procedures such as dialysis.

For water-purification applications, membrane retention standards are



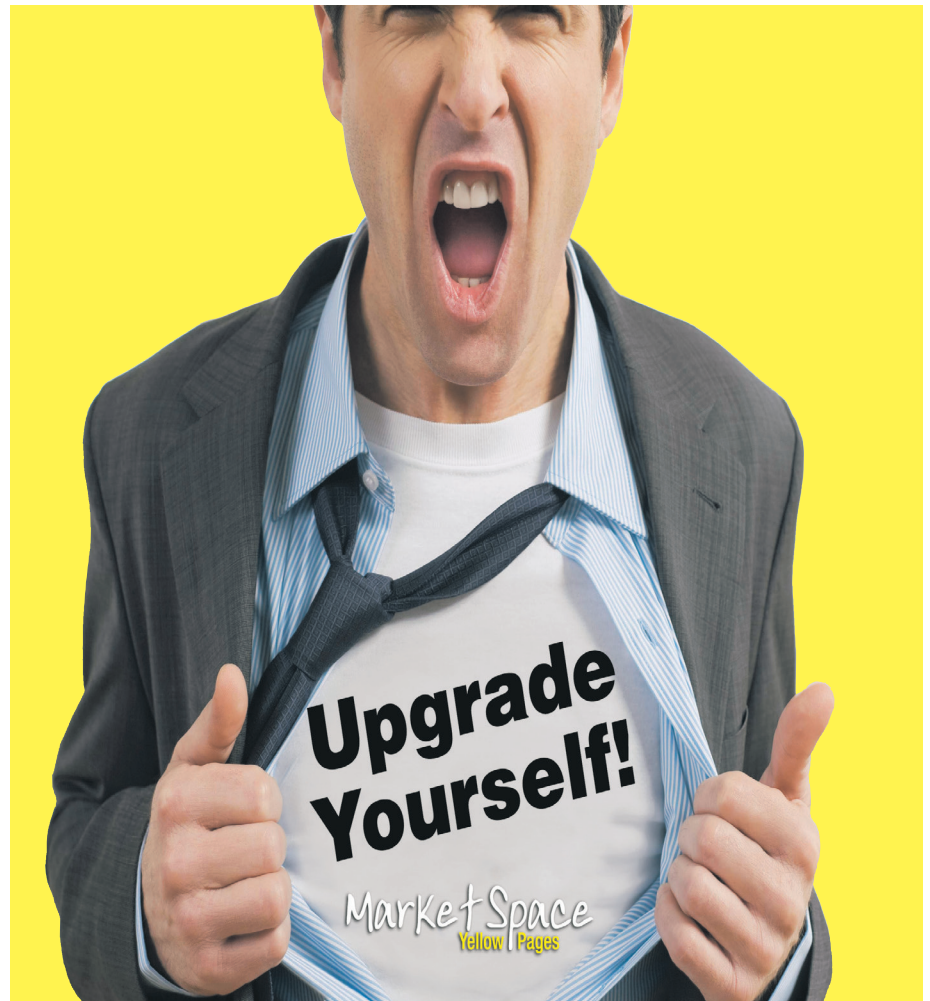
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determined by testing to NSF/ANSI standards. There is no direct correlation or conversion between two-dimensional pore sizes (measured in micrometers or nanometers, billionths of a meter) and three-dimensional MWCO measured in kD (kilo Daltons). One can easily find both ratings for a membrane. Ultrafiltration membranes are generally characterized as having a MWCO ranging from 10 to 100 kD. Other factors include the shape of the molecule, electrical charge and polarity.

Ultrafiltration is increasingly common in both well and household applications because of its ability to clarify turbulent water; remove large organisms, specifically *Cryptosporidium*, and some (but not all, viruses); and its high recovery efficiency. Ultrafiltration is by no means a substitute for reverse osmosis, but it is regarded as a “green” pre-treatment technique (not requiring chemicals, disinfection or pH adjustment) for removing suspended solids prior to reverse osmosis or other treatment processes. Ultrafiltration operates on water pressure, with electrical controls only for periodic flushing.

The most common ultrafiltration membranes in use are hollow-fiber tubes embedded in a cylindrical cartridge. The best way to determine if an ultrafiltration is suitable for the task is to connect a demonstration portable ultrafilter to a faucet or frost-free spigot and pass the challenge water through a very fine (0.45 micron) white filter paper to determine if discoloration or fine sediment are present.

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