Operator Quiz Corner

Membrane Filtration

Dan Laprade, Training Coordinator
(*dlaprade@masswaterworks.org* *413-883-7030)*

Membrane filtration technologies are becoming more popular in municipal water treatment for the removal of an increasingly wide range of contaminants. Whether it's nanofiltration, microfiltration, ultrafiltration or reverse osmosis they all operate by forcing water through a semipermeable membrane.

The permeability of the membrane is dictated by its pore size which will determine what size particle it is capable of removing. Reverse osmosis membranes have the smallest pore size and are therefor capable of removing nearly all contaminants while microfiltration has a larger pore size better suited for removing suspended particles as well as most pathogens.

TYPE OF MEMBRANE	PORE OPENING	CONTAMINANT REMOVAL
Microfiltration (MF)	1 micron	Bacteria, Algae, Clay, Suspended solids, iron, manganese, humic acids, viruses, cysts
Ultrafiltration (UF)	0.01 micron	
Nanofiltration (NF)	0.002 0.005 microns	Salts, metal ions. Natural organic matter
Reverse Osmosis (RO)	< 0.005 microns	

The most common membrane filter arrangement is to have thousands of hollow strands tightly packed together in a tubular cartridge. The walls of each hollow strand has a selected membrane pore opening and the raw water is either forced from the outside of the hollow strand to the inside or from the inside of the hollow strand to the outside. "Flux" is the term used to describe the amount of water that passes through the membrane and is expressed in gallons per membrane surface area (ft^2) per day. The treated water from the membrane process is called the permeate. The pore openings will eventually become clogged and must be cleaned by backwashing individual cartridges. If backwashing alone does not clean the membrane, then they must be rinsed with a chemical solution. To minimize fouling there is often a pre-membrane treatment process to remove larger particles.

While the cost of membranes has come down over the years it is still considered to be an expensive filtration technology when compared to conventional media filtration. Membrane equipment has the advantage of a smaller building footprint but will usually have a higher operational cost due to the pumping requirements needed to push the water through the membrane.

Click here to see how membrane filtration is changing municipal water treatment in many parts of the world: https://www.youtube.com/watch?v=bfr82RB72U8

1) Which of the following types of membrane filters is likely to foul the quickest?
   a) Microfiltration
   b) Ultrafiltration
   c) Nanofiltration
   d) Reverse Osmosis

2) As the water temperature increases the flux through the filter membrane is likely to _____
   a) Increase

b) Decrease
c) Stay the same
d) Depends on the type of membrane

3) In order to extend the run time of an RO membrane which of the following constituents should be removed through a pretreatment process?
   a) Turbidity
   b) Iron & Manganese
   c) Hardness
   d) All of the above

4) True or false? Membrane filters will generate more residuals than conventional gravity fed media filters.
   a) True
   b) False

5) Which of the following is a disadvantage of using membrane filtration instead of conventional gravity fed media filters?
   a) Poor contaminant removal
   b) High energy cost required to pump water through the membrane at high pressures
   c) Inability to backwash
   d) Large building footprint