# New Age Water Treatment

By Jeff Swanson

With all of the new technological advances in water treatment, the one that comes to mind for meeting the needs for new and improved EPA (Environmental Protection Agency) demands is Membrane Technology. Conventional and Direct Filtration Treatment Systems have long been the standard treatment processes. With the consistent changes with the Safe Drinking Water Act Standards, changes in how we think about water treatment should be considered. I often hear comments out in the field that 'WE' have to make our water 'TOO' clean! Some of the comments include, "How are our immune systems supposed to cope with such clean water?" "What if we travel to other countries? Will we get sick because our water is too CLEAN, and is our immune systems too used to super clean water? My comment to that is how clean should we make our water supplies? If someone gave me a choice as to how clean my water should be is: If you were to place a glass of clean water in front of me to drink and put'higher quality' water next to it; I would probably choose the one that is more highly refined. Why not? If I chose to mix it with juice concentrates, use in cooking recipes, make ice cubes, or expect optimum baking results, then, YES, super clean water usually yields the best results. Should I wish to water house plants, wash my car (without the mineral deposits on windows or exterior paint), or mix with household cleaning compounds, the results would more than likely be more beneficial than if I used a water source that contains minerals and other secondary non-regulated contaminants. One of the main concerns with using Membrane Technology is the ability to meet the new proposed Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR).

There are several classes of treatment processes that constitute membrane filtration for the purposes of LT2ESWTR compliance. These processes include: microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO). In addition, cartridge filtration devices, or membrane cartridge filtration (MCF) that meet the criteria for a membrane filtration process as defined under the rule would also be eligible for C*ryptosporidium* removal credit as membrane filtration (40 CFR 141.728). The most commonly used membrane technology in municipal or public water systems to date are the microfiltration (MF) method.

These technologies utilize a membrane barrier that allows the passage of water but removes contaminants. The membrane media is generally manufactured as flat sheets or as hollow fibers and then configured into membrane *modules*. The most common membrane module configurations are hollow-fiber (consisting of hollow-fiber membrane material), spiral-wound (consisting of flat sheet membrane material wrapped around a central collection tube), and cartridge (consisting of flat sheet membrane material that is often pleated to increase the surface area). If you are not familiar with these descriptions, in essence, these are all materials that offer such a small-pore size as to only allow water molecules through their surfaces and very little of the contaminants that are present in the water. The term "module" is defined as the smallest component of a membrane unit in which a specific membrane surface area is housed in a device with a filtrate outlet structure and is used to refer to all of the various membrane module configurations. This is more simply stated as very very fine filtration cartridge situated within a rigid housing with various configurations of inlets and outlets.

In addition to the various module configurations, there are a number of different types of membrane materials, hydraulic modes of operation, and operational driving forces (i.e., pressure or vacuum) that can vary among the different classes of membrane filtration (i.e., MF, UF, NF, RO, and MCF). Each of these characteristics of membrane filtration systems may be considered tools to meet the particular treatment applications.

For the purposes of the LT2ESWTR, a membrane filtration process is defined by two basic criteria (40 CFR 141.2):

1. The filtration system must be a pressure- or vacuum-driven process and remove particulate matter larger than 1 micron using a non-fibrous, engineered barrier, primarily via a size exclusion mechanism.

2. The process must have a measurable removal efficiency of a target organism

that can be verified through the application of a direct integrity test.

The ability of each of type of membrane filtration system to remove various drinking water pathogens of interest on the basis of size is as follows: In order of heirarchy - with MF on the lower end: Please keep in mind that a common human hair is approximately 100 microns, bacteria are approximately 0.2 microns – 12 microns, protozoa's (Cryptosporidium and Giardia) are between 2 and 11 microns, and viruses are usually between 0.01 and 0.1 microns.

1. MCF – 1 microns – 100 microns
2. MF – 0.1 microns – 100 microns
3. UF – 0.005 microns – 100 microns
4. NF – 0.001 microns – 100 microns
5. RO – 0.001 microns – 100 microns

MF and UF are the two processes that are most often associated with the term "membrane filtration." MF and UF are characterized by their ability to remove suspended or colloidal particles via a sieving mechanism based on the size of the membrane pores relative to that of the particulate matter. However, all membranes have a distribution of pore sizes, and this distribution will vary according to the membrane material and manufacturing process. When a pore size is stated, it can be presented as either nominal (i.e., the average pore size), or absolute (i.e., the maximum pore size) in terms of microns. MF membranes are generally considered to have a pore size range of 0.1 – 0.2 microns (nominally 0.1 microns), although there are exceptions, as MF membranes with pores sizes of up to 10 microns are available.

What does this mean to the public water treatment industry? The membrane technologies present many benefits to us in spite of conservative beliefs in favor of maintaining conventional technologies. Pretreatment chemicals are often not necessary when using membrane treatment. This can certainly offset budget line items often used to pay for thousands of dollars of chemicals used annually. A membrane treatment plant utilizes a much smaller 'footprint' when considering real estate and square footage of space needed when compared to the larger counterparts. When compared to 'slow sand' filtration plants that can virtually consume acres and acres of property, a membrane plant that supplies the same capacity may only fill the space of a small building. As far as quality, I have seen some our local existing membrane plants making water with as low as 0.007 – 0.009 Nephalometric Turbidity Units ( NTUs). The best I have seen a conventional or direct plant produce is around 0.02 or maybe 0.015 NTU's. Should such supposed 'overkill' be considered excessive? Or should such high quality water be the wave of the future? When considering membrane technology, it should be a matter of proper application, cost effectiveness, and ease of future maintenance.

When the consideration of membrane application may be an issue for your board or council, please remember to give us a call to aid in the review for RFP's and engineering review. This is a technology that I don't think is going to 'go away'. When new EPA and State Regulatory Standards need to be implemented into our public water systems, it will be necessary to apply the Best Available Technologies (BATs). I have met with some of our local systems that have already implemented this technology. They seem to be quite happy with; and willing to share their knowledge and experience with their water treatment plants. No, I am not a salesman for the industry. I am just looking towards the future and the demands that will have to be met. From talking with the existing plants, and having previous experience with membrane technology (primarily RO, NF, and UF), I think it is something to seriously consider. Although I have not worked directly with MF, I was excited to see how well it has already worked in the public water treatment industry. As the demand increases, perhaps the supply will offset the initial costs. But if you don't want your water to be TOO clean...Well…