Membrane Filtration for small systems—

A PRIMER

Part 1 of 2

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Summary: *This is the first in a two-part series on the basics of membrane filtration for small municipal systems—those serving less than 10,000 people. Small systems are where dealers can have an impact since some water treatment methods they promote have been approved by the SDWA amendments of 1996 as "best available technology" to meet federal drinking water regulations in such applications. This first article will offer a brief overview of membrane filtration and focus on microfiltration and ultrafiltration. The next article will focus on nanofiltration and reverse osmosis.*

A membrane or, more properly, a semi-permeable membrane, is a thin layer of material capable of separating substances when a driving force is applied across the membrane. The pressure-driven membrane processes discussed in this article are microfiltration (MF), ultrafiltration (UF), nanofiltration (NF) and reverse osmosis (RO).

These processes are designed for either crossflow or dead-end operating modes. In the crossflow mode, the feed stream flows across and tangential to the membrane surface and permeate (or filtrate) passes through the membrane. Crossflow operation results in a continuously flowing waste and permeate stream. Some systems treating relatively low turbidity waters—while designed for crossflow— may operate in a dead-end flow pattern where the waste "concentrate" stream is produced by intermittent opening of the concentrate valve.

Once considered a viable technology only for desalination, membrane processes are increasingly employed for removal of bacteria and other microorganisms, particulate material and natural organic material that can impart colors, tastes and odors to the water and react with disinfectants to form disinfection by-products (DBPs) considered a health hazard to varying degrees. As advancements are made in membrane production and module design, capital and operating costs continue to decline.

Conventionat alternatives

Membrane filtration systems' capital costs, on a basis of dollars per volume of installed treatment capacity, don't escalate rapidly as plant size decreases. This factor makes membranes quite attractive for small systems. In addition, for groundwater sources that don't need pretreatment, membrane technologies are relatively simple to install. And the systems require little more than a feed pump, membrane modules and some holding tanks. According to a 1997 report by the National Research Council, most experts foresee that membrane filtration will be used with greater frequency in small systems as the complexity of conventional treatment processes for small systems increases.

New regs favor membranes

Membrane processes have be- come more attractive for potable water production in recent years due to increased stringency of drinking water regulations. Membrane processes have excellent separation capabilities and show promise for meeting many existing and anticipated drink- ping water standards. The Surface Water Treatment Rule (SWTR) and the anticipated Ground Water Disinfection Rule have led to investigation of UF and MF for turbidity and microbial removal. The new Disinfectants/ Disinfection By-Product (D/DBP) Rule has increased interest in NF and UF membranes for DBP precursor removal. Potable water treatment has traditionally focused on processes for liquid-solid separation rather than on processes for removing dissolved contaminants from water. Thus, the effect of the 1996 Safe Drinking Water Act (SDWA) amendments has been to encourage small system water treatment professionals to consider more unconventional treatment processes, such as membrane technologies— alone, or in conjunction with other liquid-solid separation technologies—to meet current regulations.