San Diego County Water Authority

Submerged Membrane Water Treatment

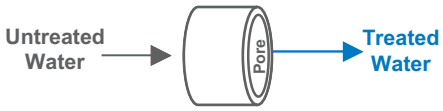
SEPT. 8, 2005

FACT SHEET

The Water Authority is a public agency serving the San Diego region as a wholesale supplier of water. The Water Authority works through its 23 member agencies to provide a safe, reliable water supply to support the region's $150 billion economy and the quality of life of more than 3 million residents.

How do membranes work?

Untreated water is forced through very fine **pores** in membrane fibers. The pores are just large enough for water molecules, or **permeate**, to pass through, but small enough to reject contaminants and particles, or **particulates**. These include dirt, dust, bacteria, cryptosporidium, giardia, and others.



What is conventional treatment?

Conventional treatment employs chemicals, or **coagulants**, that cause the contaminants to stick together. The water is then stirred so these clumps bump into each other to form larger clumps, or **floc**. The largest clumps are then allowed to settle out, and smaller clumps are removed by a sand filter.

What are the important differences?

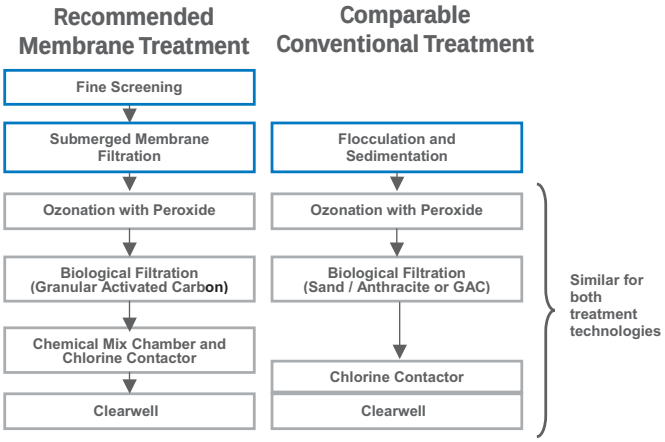
1) Because membrane filters remove all particles that cannot fit through the pores, they achieve a higher removal rate than conventional treatment. While conventional treatment is effective, it doesn't reach as high a degree of contaminant removal as membrane treatment.

2) Contaminant removal by membrane filters is more reliable. As long as water is forced through the membranes, the contaminants will be removed. In conventional treatment, success depends on proper management of chemicals. If the chemicals are not added in the right amount, treatment is less effective.

What treatment processes are used in the recommended plant?

The technology proposed in the recommended design is **submerged membrane treatment**. The membranes are immersed in a tank of untreated water where they filter out contaminants. No coagulation or sedimentation is required.

After membrane filtration, the process is very similar to conventional treatment. Ozonation and advanced oxidation provide **disinfection** and **taste and odor control**. The next step is deep-bed granular activated carbon filtration, which provides a **secondary particulate barrier**. The final step is **secondary disinfection,** by liquid chlorine generated on site, and chloramination. These provide additional taste and odor control. The treated water is stored briefly in a clearwell before distribution to users.



Does membrane treatment eliminate bacteria and viruses?

Yes. Smaller than all but the very smallest microbial contaminants, membrane pores screen out the vast majority of bacteria and viruses. Any microbial contaminants that do pass through the membranes are eliminated during primary or secondary disinfection.

Are membrane modules, cassettes, and trains all the same?

No. A membrane **module** holds a bundle of membrane fibers or strands. A membrane **cassette** contains multiple modules. A membrane **train** is a long assembly of cassettes submerged in a tank.

Is this different from seawater desalination membrane treatment?

Yes. In reverse osmosis seawater desalination, layers of membrane sheets are encased in a pressurized vessel. Water is pumped at very high pressure into the vessel and through the membranes. Submerged membranes are strands of membrane material immersed in a tank. A pump creates a vacuum that

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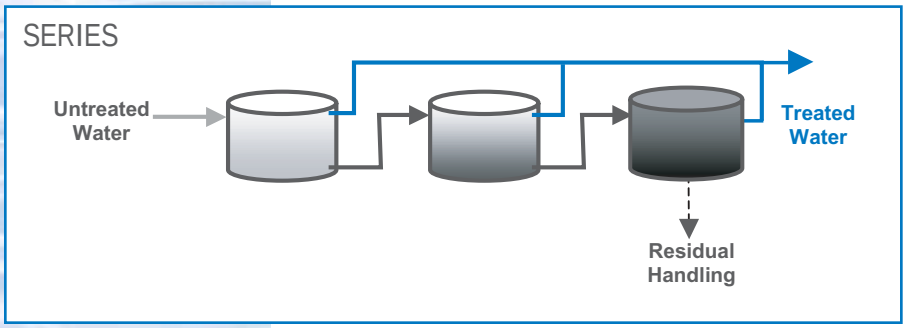
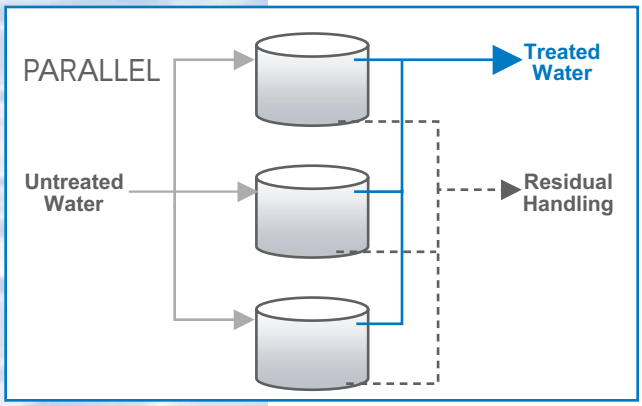
pulls water molecules into the hollow center of the membrane strands and out of the tank.

Are there different ways to design submerged membrane treatment?

Yes. The membranes can be configured in either a **series** (plug-flow reactor) or in **parallel** (batch reactor). In the series configuration, contaminants remaining in a membrane train are transferred to the next train to increase the amount of treated water produced. This increases the concentration of contaminants in each subsequent train. Any problems treating the higher contaminant level in the last membranes will affect the entire operation.



In the parallel configuration, untreated water makes a single pass through one membrane train. When membranes become blocked with contaminants, they are taken out of service for cleaning.



The recommended Twin Oaks Valley Water Treatment Plant is configured in parallel. A backup membrane train will keep the plant at full capacity while membranes are removed for cleaning.

How is the flow of water measured?

Flow through membranes is called the **flux**, and is measured in gallons per square foot of membrane surface per day, or **gfd**.

What is membrane fouling?

This occurs when too many contaminants adhere to the membrane surface, clogging the pores and limiting the flux, or flow rate. Regular **backwashing** and **clean-in-place cycles** help prevent this buildup.

Is there a concern about using a new technology?

No; this is not a new technology. Submerged membrane technology has been used to treat water for more than two decades. The key parameter in the Water Authority's membrane design specifications, the flux rate, was set at a very conservative level not to exceed that of any current membrane plant processing similar untreated water. The Service Contract includes a detailed **contingency plan** to address any membrane performance issues, should they arise during startup and commissioning.

Is a large submerged membrane plant as reliable as a smaller plant?

Yes. Although the recommended Twin Oaks Valley Water Treatment Plant would be the world's largest submerged membrane plant, it would essentially be **14 separate 7-mgd plants sitting side by side**. The Water Authority restricted membrane design proposals to the same flux rate, and to no more than a 20 percent increase in train size, as existing plants that have been in operation for more than two years. This requirement limited train size to 7 mgd and flux rate to 29-32 gfd.

Is there a 100-mgd membrane plant in operation today?

No. The largest submerged membrane water treatment plant to date, in Singapore, Malaysia, operates at 72 mgd. In 2006, the Regional Municipality of Peel in Toronto, Canada, will commission its 95-mgd Lakeview plant.

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