American Membrane Technology Association

America's Authority in Membrane Treatment

Membrane Desalination Water Quality

In the United States, we now regard safe drinking water as a Constitutional right. This was not always the case. Less than a century ago, our nation was periodically beset by epidemics caused by water-borne diseases, such as cholera and typhoid, which took thousands of lives.

Today, conventional as well as advanced water treatment technologies, combined with medical advances, have made these diseases virtually nonexistent in our country. Our drinking water supplies must comply with stringent federal, state and local drinking water standards. These standards are designed to keep contaminant concentrations below the levels, which might be considered a public health threat.

Only about 20 percent of the water withdrawn from surface and ground- water supplies is actually consumed. The remaining 80 percent is generally discharged into rivers, lakes and estuaries as wastewater or irrigation return flows, and can be subsequently reused at downstream locations. Each time water is reused the concentration of pollutants (including salt) in the discharge water increases.

Water desalting, or desalination, is a treatment process used to remove salt and other dissolved minerals from brackish water and seawater. Other contaminants such as heavy metals such as mercury, bacteria, viruses, and other pathogens, organic matter and known carcinogens may also be removed by some desalting methods.

Some compounds known to have adverse health effects, such as arsenic and boron, can also be removed by desalting processes. Pressure driven membrane-based desalting processes can also used to improve the quality of hard waters (high in concentrations of magnesium and calcium), waters contaminated with nitrates, radionuclides, herbicides and pesticides, natural and synthetic organics, and pathogens.

Water Quality Standards

The history of formal water quality standards goes back less than a century. In the 1890's, what was then known as the American Public Health Association began the first push for quality criteria as well as standard methods of analysis. It was not until 1914 that the United States government (strangely enough through the Treasury Department) issued even the most basic quality standards. By 1925, the US Public Health Service was given the lead role, which it retained until the Environmental Protection Agency (EPA) was formed in 1970.

The recent history of standards in the United States revolves largely around the Safe Drinking Water Acts of 1986 and its subsequent amendments. The standards are assigned and regulated at several levels:

- The Federal government, through the EPA, sets the standards, carries out appropriate studies and research, coordinates the work of other federal agencies and supports the states in enforcing the standards.
- The states, supported as necessary by EPA, develop their own standards, which must be at least as strict as federal standards. The states enforce the standards and develop their own certification and training programs.
- Local governments and utilities then work within the federal and state guidelines to build and operate facilities, implement land use plans and local regulations to protect water supplies, and carry out other relevant activities.
- Concerned individuals and groups propose additional standards through the initiative process. Such standards usually rely on public referenda, often at the state level, for adoption.

Uses of the Technology

In the United States, population growth and subsequent increases in demand for water in arid, semi-arid and coastal areas are contributing to a heightened interest in desalting membrane processes as a means to augment

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existing supplies by treating alternative sources of water previously ignored in favor of traditional freshwater supplies. In addition, many communities are turning to membrane technology and desalting as a cost-effective method of meeting increasingly stringent water quality regulations. Desalting technology can treat non-potable water supplies that are difficult to treat with traditional technology. Desalting technology has become a reliable method of producing high quality water to help meet the nation's growing freshwater needs, and is rapidly gaining credibility as a competitive treatment technology.

Over 1,300 desalting plants are in operation nationwide. Most of these plants, located on the eastern seaboard, the Gulf coast, the southwest, and California, are used to treat brackish, or moderately salty, groundwater for municipal drinking water supplies. The next most frequent use of desalting is to produce highly purified water for industrial use. Seawater desalting is now being considered for municipal water supply in Florida, Texas, California, and Massachusetts. Desalting processes also provide clean water for a variety of other uses:

- To meet more stringent federal drinking water regulations, water suppliers nationwide are turning to desalting to remove contaminants, such as heavy metals, dissolved organics, pathogens and known carcinogens, from both ground water and surface water supplies.
- Desalting is used for water softening and to treat taste, odor and color problems, and the precursors of disinfection byproducts.
- Desalting is used to convert seawater to drinking water. Many water-short areas of the world rely solely on desalted water for their drinking water supplies.
- Desalting is used to treat wastewater from municipal sewage plants for direct or indirect reuse. Such "reclaimed" or "recycled" water may be used for irrigation, fire protection, toilet flushing, industrial processing and cooling, wetlands enhancement and groundwater recharge, among other uses.
- Reverse osmosis is used in point-of-use, home water treatment systems, by individuals concerned about water quality.
- Desalting technologies are used to remove potentially toxic contaminants from industrial wastewater prior to discharge to the environment to meet ever more stringent water quality requirements of the Federal Clean Water Act.

Post-Treatment

The permeate from desalting processes, particularly that from seawater, is primarily a dilute solution of sodium chloride. To provide stability to the water, to prevent corrosion of piping systems and domestic plumbing, post-treatment to return some calcium hardness and bicarbonate alkalinity to the water is necessary. In many locations, post-treatment also includes the removal of carbon dioxide to raise the pH, Hydrogen Sulfide removal, and the addition of fluoride which is removed during the desalting process. Very often, corrosion inhibitors are added to further reduce the corrosion potential of the finished water. As in conventional treatment, disinfection is required, but the chlorine demand is greatly reduced by the desalting process, resulting in minimal formation of disinfection byproducts.

This material has been prepared as an educational tool by the American Membrane Technology Association (AMTA). It is designed for dissemination to the public to further the understanding of the contribution that membrane water treatment technologies can make toward improving the quality of water supplies in the US and throughout the world.

For more information, please contact:

American Membrane Technology Association (AMTA)
2409 SE Dixie Highway
Stuart, Florida 34996
Phone: (772) 463-0820
Fax: (772) 463-0860
Email: admin@amtaorg.com

or visit our website at:
www.amtaorg.com

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