American Membrane Technology Association

America's Authority in Membrane Treatment

Future of Desalination in the United States

As the nation's population grows and industrial development expands, our domestic need for reliable water supplies continues to become increasingly critical. As municipal, industrial, and agricultural demand for fresh water increases, the quality and availability of traditional water sources continues to decline, while the cost of developing new supplies continues to rise.

San Diego Water Authority Claude "Bud" Lewis Carlsbad Desalination Plant, Carlsbad, CA

Seawater desalination facilities in California are employing beach wells to reduce pretreatment requirements and improve plant efficiency.

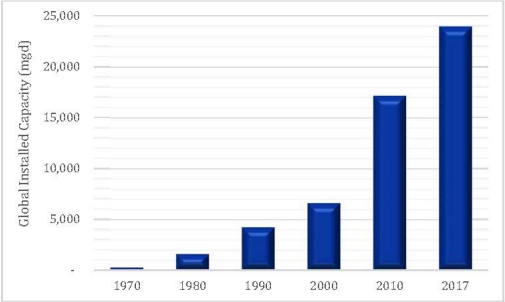
The United Nations World Water Development Report has projected that 75 percent of the world's population could face a water scarcity crisis by 2050, including many parts of the United States. Traditional surface water development sites, such as dams, reservoirs and aqueducts, are being exhausted and many proposed projects are no longer feasible due to significant environmental concerns or the high capital investments required. While conservation has been effective at reducing demands in many areas, there are limitations in the amount of water that can be conserved, and sources of new water supplies will continue to be needed in the foreseeable future.

Desalination technologies provide an opportunity to tap what would otherwise be unsuitable water supplies, such as ocean water, brackish groundwater, and wastewater effluent, to augment diminishing freshwater supplies and provide a sustainable water source to meet water needs. Ocean water desalination offers a vast water source in seemingly unlimited quantities in the United States. Over three-quarters of the earth's surface is covered by water that is too salty to sustain human life or farming. Many water stressed areas also have access to moderately salty, brackish water or wastewater supplies with elevated levels of dissolved solids. Membrane desalting, or desalination, creates new freshwater supplies by separating water from salt and other dissolved minerals in sea water, brackish water or wastewater. Other contaminants, such as dissolved metals, pathogens, organic matter (including trace organic compounds), dissolved inorganics (such as arsenic, nitrate, selenium), and radionuclides, are also removed by membrane desalination methods.

The United States currently has over 1,400 installed desalination plants with the majority being used to desalt brackish groundwater. In the future, membrane desalting will continue expanding, utilizing alternative water supplies to meet growing freshwater needs.

Desalination Across the Globe

In 2017, desalting plants worldwide had the capacity to produce over 24 billion gallons of freshwater per day, with 59 percent of these plants using seawater or ocean water as their feedwater source. In many arid areas of the world, desalted water provides the only reliable source of fresh water. Improvements in membrane technology over the last several decades have resulted in membrane technologies surpassing thermal processes in worldwide desalting capacity. This trend will continue as membrane efficiencies further improve and as desalination membranes are applied in an increasing array of water supply and treatment applications.



The use of Desalination has grown dramatically since the 1970 invention of the thin film composite RO Membrane.

Past Research Funding and Technological Advances

The desalination process dates back to the 4th century BC when Greek sailors developed an evaporative process to desalinate readily available seawater into safe drinking water. Desalting increased dramatically in the last half of the 20th century, enabling regions with limited or no freshwater supplies to grow and flourish.

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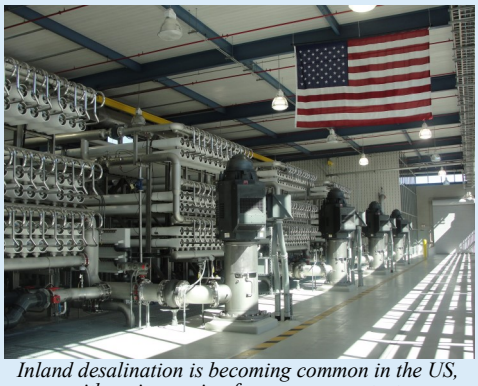
Innovations in membrane design, such as this 16-inch configuration at a potable reuse facility, are creating more efficient designs and lower treatment costs.

Many of the advances in desalination technologies in the past several decades were made possible by generous US government research funding. One of the most concentrated efforts was the creation of the Office of Saline Water (OSW) in the early 1950's and its successor organizations like the Office of Water Research and Technology (OWRT). From its inception in the early 1950's through its termination in 1982, when most federal desalting research was discontinued, the US government actively funded research, |development, and demonstration projects, allocating about $900 million (in 1985 dollars) in the process.

This funding supported much of the fundamental investigation and research of a variety of innovative technologies for desalting seawater and brackish water. Most importantly, these programs were primarily responsible for the development of reverse osmosis by US researchers, resulting in a groundbreaking technological advancement that was exported around the world and revolutionized saline water treatment on a global scale. Many advances in distillation technologies were developed, as well.

Future Prospects for Desalting in the US

- Membrane technology will be increasingly employed in ocean water, brackish groundwater, and recycled wastewater treatment facilities as membrane technologies continue to improve and water supply needs become increasingly critical.
- Nanofiltration membranes will be increasingly used to remove taste, odor, and dissolved organic material in drinking water and for water softening.
- Industries will increase the use of membrane technology to remove impurities in the water used in their operations, to remove potentially toxic contaminants in their effluent, and for production of ultrapure water. Novel desalination technologies, such as forward osmosis and membrane distillation, will expand their role in addressing industrial desalination needs.
- Large scale potable reuse facilities will move forward over the next 10-20 years, employing desalination technologies to produce safe drinking water from wastewater supplies. Currently only 7% of wastewater in the United States is reused and only a small portion of this is for potable uses.
- Desalination will be increasingly employed at inland locations with advancements in high recovery RO and zero liquid discharge allowing improved concentrate management alternatives.
- The number of seawater desalination facilities will expand in the United States as improvements in energy efficiency, energy recovery, and renewable energy supplies continue.



Inland desalination is becoming common in the US, with an increasing focus on concentrate management and disposal alternatives.

Implementation Challenges

While membrane desalination technologies are in use across the nation, key implementation challenges remain. As plant capacities increase, concentrate management is becoming increasingly important, particularly for inland locations where cost-effective concentrate reduction and disposal alternatives are needed. Regulations and permitting strategies for potable reuse are under development in numerous states, and these will ultimately enable the validation of significant pathogen removal with integrity testing techniques applied to desalination membranes. As planning and permitting continues for new seawater desalination facilities in California, Texas, and Florida, intake and discharge strategies are being explored to minimize the plant's impact on the marine environment.

Need for Additional Research

Continued advancements in membrane technology will help ensure that desalination reaches its full potential in helping the nation meet its growing water needs in the face of increasing water scarcity. To meet these challenges, there is a need to continue direct federal support of desalination and other membrane research, development, and demonstration projects. Federal funding in support of research and development will not only benefit all users of desalting technology in the US, but will also improve the competitiveness of US firms overseas. While membrane-based desalination originated in the US, and major advancements continue to be made by US companies, a continued national focus is critical to maintaining our leadership within this growing and essential industry.

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.

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