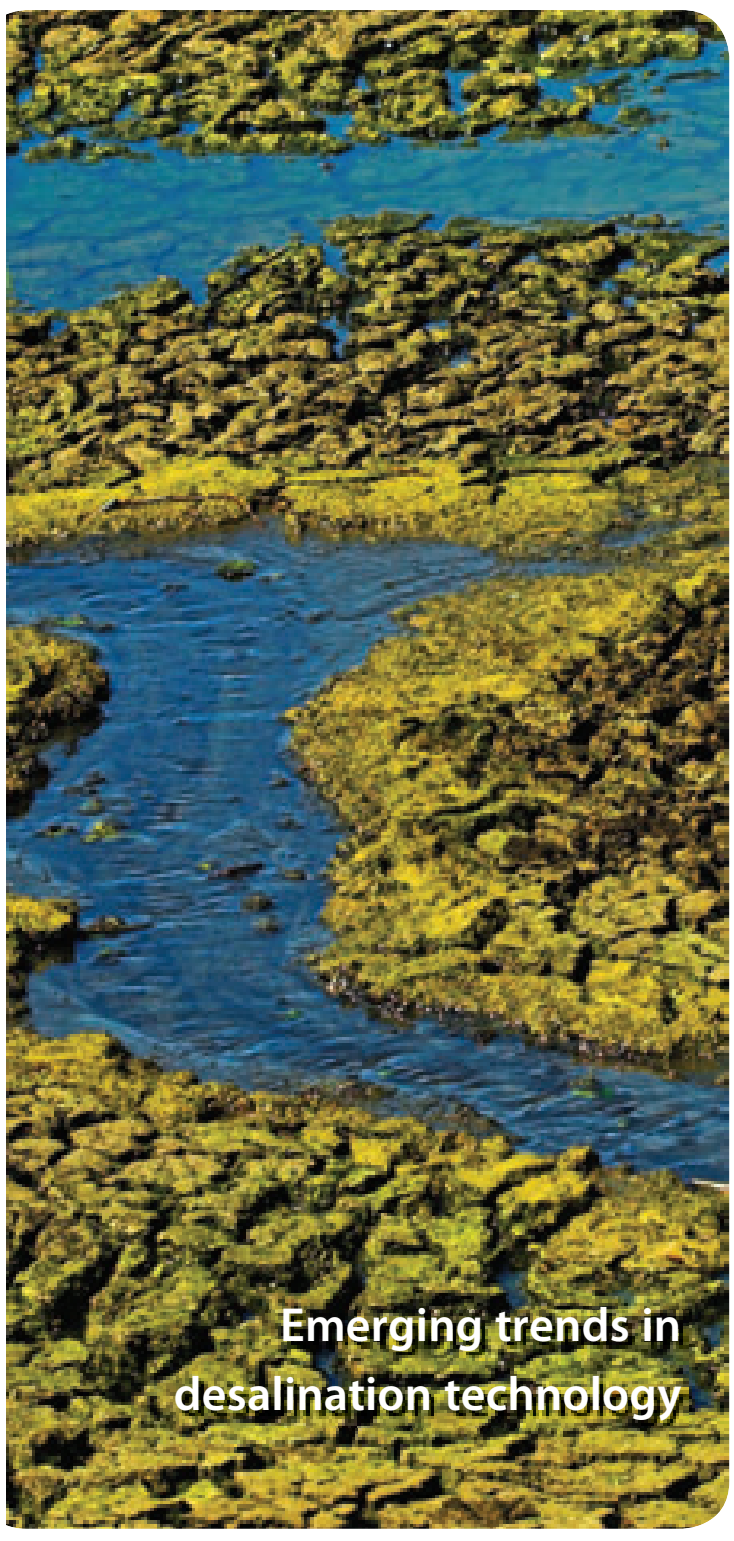
The Path to Desalination

Turning to the ocean as a source of drinking water is no longer a novel practice as the population continues to grow, especially in areas with insufficient freshwater supply. Continued advances in membrane technology, steady decline of operation and maintenance costs over the last 20 years and reduction of energy consumption have turned desalination of seawater into an important source of drinking water for many coastal cities and drought-stricken regions around the world. Today, there are operational desalination plants in almost every part of the world.

By Neda Simeonova



Water & Wastes Digest's editorial director, Neda Simeonova, asked Cedella E. Beazley, global marketing manager, FILMTEC Membranes for Dow Water Solutions, to comment on some of the global and U.S. desalination market trends and identify some of the key drivers that have contributed to the growth of desalination technology worldwide.

Neda Simeonova: Why has the use of desalination technology grown?

Cedella E. Beazley: There are a few main drivers moving the technology away from thermal desalination technology like multi-stage or multi-flash distillation, and moving it toward seawater reverse osmosis (RO). The RO technology has improved significantly since it was first applied commercially on seawater in the 1980s.

Over the last 20 years, the productivity of a single seawater RO element has tripled, and the water quality being produced by that same element has also improved. Today, you are not only getting more flow per unit, but you are also getting improved, pure water quality.

Even in the past couple of years, the nominal output flow of a single seawater RO element has increased by about 50%, whilst the quality of water being produced has been maintained or improved.

In the past, there was a trade-off between flow and pure water quality, but as of the last five years or so with the advancement of membrane chemistry, we have been able to improve both flow through the element and the pure water quality.

In addition, the capital cost and operation cost of seawater RO plants have dropped significantly to the point where in most cases, even in the Middle East where energy is still relatively cheap, a seawater RO plant is lower-cost to build and operate than competitive processes.

One of the other benefits of RO is that you are supplying energy to a pump and that pump will pressurize the water in order to push the purified water through the RO membrane itself; however, that energy can come from any source. It can come from a traditional fossil power plant, or in Australia for example, some of their new RO desalination plants are being powered by a combination of fossil and wind power. So an RO plant has the ability to use the cheapest local energy available.

Simeonova: What are some of the U.S. and global desalination market trends?

Beazley: There are definitely different drivers between the U.S. and the rest of the world. What is driving a significant growth of the desalination market outside of the U.S. is increased urbanization, which requires infrastructure development in developing countries like China and India. Some developed countries are experiencing severe and extended droughts in combination with some population growth, such as the coastal areas of Australia, the east coast of Spain and the Middle East, where you don't have a lot of naturally occurring freshwater.

The U.S. doesn't have the same kind of drivers. Generally, the U.S. has high level of freshwater available in many of the regions and as long as we continue to take care of that freshwater, we will not have the same kind of environmental drivers that other parts of the world are experiencing. We definitely do have some water-stressed areas, such as California, southwest U.S. and New Mexico, where you have population growth and/or dwindling freshwater supplies; they have looked to desalination as one of their options.

Simeonova: Up to what percent of the operation costs are represented by energy costs?

Beazley: Today's average cost of providing drinking water from seawater RO desalination is about $1 per m^3 (264 gal), which is significantly lower than the first desalination plants, which cost about $60 per m^3. The average seawater RO plant consumes about 3 kWh per m^3 down from 8 to 10 kWh in the 1980s, energy consumption being cut by a factor of three and now making up about one-third of total operating costs.

Simeonova: There have been some significant improvements in membrane fouling resistance. How have pretreatment methods improved membrane performance?

Beazley: One of the things that can make or break your seawater RO plant is to understand what sort of pretreatment is necessary. Dow and some of its original equipment manufacturer (OEM) partners have spent a considerable amount of time in the last five to 10 years to try to find ways to better characterize the seawater. It is important to know not just what the dissolved minerals in the water are but the biological activity, the suspended solids and the nature of those suspended solids so that you can properly design the pretreatment to eliminate or minimize as much as it is economically feasible the fouling of the RO membrane.

A well-designed RO pretreatment can take your membrane life from three to five years, up to seven to 10 years. It can easily double your membrane life and keep that membrane performing like new five years after it was installed. That's an area of development that we have stressed and working with our OEMs.

After Dow acquired Omex Environmental Engineering a couple of years ago, this has allowed us to gain access to good ultrafiltration (UF) technology, and we are seeing UF being used as RO pretreatment more often in seawater systems. One of the reasons why folks are moving to UF as it becomes more affordable is because UF can better handle swings in seawater quality. Getting the pretreatment right actually further reduces the operating cost of the systems and increases the lifetime of the RO element.

***Simeonova:** What are some of the desalination projects Dow has been involved in recently?*

Beazley: Here in the U.S., Tampa Bay, Fla., is a good example of where the RO technology has been used to desalinate seawater. Some other examples outside of the U.S. include one of the sister plants to the Ashkelon Desalination Plant in Israel. FILMTEC elements were used in the Ashkelon plant that started up about five years ago, which at the time was the largest plant of its size. Hedera is another plant in Israel of comparable size where 330,000 m^3 of freshwater per day is produced from seawater. We are also involved in projects in Australia and have been doing a lot of work in the east coast of Spain.

***Simeonova:** What kind of growth do you predict for the desalination market globally and in U.S.?*

Beazley: We are still seeing double-digit growth [globally], even with the downturn in the overall global economy. All of the large desalination plants are continuing right on track because they are addressing a need that is irrespective of what is going on with the economy. So all of the mega-projects that were planned for 2009 and 2010 and beyond are still on track, and desalination is one area where we expect to continue to see double-digit growth for the next few years.

Companies like Dow and other RO membrane manufacturers are adding production capacity and continuing to further improve the performance of their products. We are looking at improved designs for different components within the elements to further improve fouling resistance, and reduce pressure drop and operating pressure requirements for systems. We continue to do work on membrane chemistry to improve flows and rejections of pure water quality, while at the same time trying to find ways to improve fouling resistance of the elements.

Dow is focusing its research and development efforts on reducing the initial capital cost of the system by: reducing the footprint, looking at membrane developments both in the membrane chemistry and how the element is fabricated, looking at the components of fabrication materials of construction and researching how to improve and optimize to reduce day-to-day operating costs.

In the U.S., in addition to the fact that we have a lot of naturally occurring freshwater outside of the water-stressed areas, one of the biggest challenges facing desalination is the concept of membrane desalination in general. If we look to our colleagues in Australia, they have embraced membrane desalination as the most environmentally sound in terms of carbon footprint and being able to use alternative energy sources, etc. However, in the U.S. we will have to continue educating the general public around the pros and cons of membrane desalination and why it should really be the technology of choice. WWD

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