

## Desalination



# Innovations and training in desalination



Anthony Bennett provides a brief review of the increasing use of desalination technology. He then looks at the opportunities available for training and development in the industry provided by the International Desalination Association's Desalination Academy, following discussions with its Dean, Leon Awerbuch.

As of September 2013, the amount of new desalination capacity expected to come on line during 2013 was 50% more than previous year's total, according to data from the International Desalination Association (IDA) and Global Water Intelligence. Desalination plants with a total capacity of 6 million m<sup>3</sup>/d were expected to be operational during 2013, compared with 4 million m<sup>3</sup>/d in 2012. Data has yet to be confirmed for the last twelve months with the next global plant inventory due as we publish this article, but preliminary numbers suggest that the total capacity of plants that are online or under construction exceeds 82 million m<sup>3</sup>/d.

While the 2013 growth rate was somewhat lower than 2010, when 6.5 million m<sup>3</sup>/d of new capacity was completed, Awerbuch told us that the data shows the demand for desalination continues to grow and that an increasing proportion of that growth is coming from the industrial sector.

From 2010 - 2013, 45% of new desalination plants were ordered by industrial users such as power stations and refineries, while in the previous four

years, only 27% of new capacity was ordered by industrial water users.

Industrial applications for desalination grew to 7.6 million m<sup>3</sup>/d for 2010-2013 compared with 5.9 million m<sup>3</sup>/d for 2006-2009. Of the 7.6 million m<sup>3</sup>/d, the power industry accounted for 16%; oil and gas, 12% (up from 7% from 2006-2009); mining and metals, 11%; refining and chemicals, 11%; electronics, 5%; and food and beverage, 3%. Other numerous industrial applications accounted for the remaining 40%.

Seawater desalination continues to represent the largest percentage of online global capacity at 59%, followed by brackish water applications at 22%, river water projects at 9%, and wastewater recovery and pure water systems at 5% each.

## Projects

The largest operational desalination plant in the world had previously been the 880,000 m<sup>3</sup>/d Shaiba 3 thermal desalination plant in Kuwait. This was displaced in April 2014 when the Ras Al-Khair plant went on stream.

As the world's largest seawater desalination plant, for which Doosan won the

construction order in September 2010 from the Saline Water Conversion Corporation, the Ras Al-Khair plant produces 1,036,000 m<sup>3</sup>/d, sufficient to meet the daily water requirements of around 3.5 million people. The plant produced its first freshwater earlier this year, although the project was actually scheduled for completion in December 2015. As the world's largest hybrid plant, the project uses both membrane technology (reverse osmosis, RO at 309,360 m<sup>3</sup>/d) and thermal technology (multi-stage flash evaporation, MSF with a capacity of 727,130 m<sup>3</sup>/d). This plant also features the largest single MSF trains composed of 8 units with capacity of over 91,000 m<sup>3</sup>/d each. The RO plant has 17 trains.

The Ras Al-Khair plant is dual purpose with an export production capacity of 1.025 million m<sup>3</sup>/d desalinated water and an electricity production capacity of 2,400 MW, providing 1350 MW for the Maaden Aluminum Complex, 1050 MW to the Saudi Electricity Company, and about 200MW for internal consumption on site.

The combined cycle power plant is one of the more efficient power plants in the world. The total length of the double



RO desalination installation at Perth, Australia (Courtesy of IDA).

transmission lines from Ras Al-Khair plant to Riyadh and Hafr Al-Batin region will be 1,290 km.

The cost of Ras Al-Khair desalination and power plant project and the transmission lines from the plant has so far reached a massive 6.13 billion USD, according to the IDA.

The largest multiple effect distillation (MED) thermal desalination plant in the world is currently the Jubail Water and Power Plant, a Marafiq plant, built by SIDEM with an 800,000 m<sup>3</sup>/d production capacity from 27 MED units. The cost was 1 billion USD. This is also a dual purpose plant generating 2744 MW electricity in addition to desalinated water.

The largest hybrid MED-RO plant is the Fujairah II project constructed by SIDEM and Veolia as a green field development producing 2000 MW of power and 591,000 m<sup>3</sup>/d of water. The hybrid system includes five high-efficiency gas turbines operated in combined cycle mode. The Fujairah I project, owned by Emirates Sembcorp Water and Power Company and commissioned in 2004, comprises a hybrid MSF-RO system again combined with power production with a capacity of 893 MW and a seawater desalination capacity of 455,000 m<sup>3</sup>/d.

The largest seawater RO plant so far has been built by IDE Technologies: the

624,000m<sup>3</sup>/d Soreq SWRO plant near Tel Aviv, Israel. It came on line in October 2013. This plant has the unique feature of 16" membrane elements installed in vertical pressure vessels. This compares with the widely accepted, traditional design of 8" diameter membranes installed horizontally.

### IDA Desalination Academy

As evidenced above, the impressive growth in desalination continues, with its value for producing fresh water now firmly recognized around the world. Moreover, desalination technologies are used extensively in treating water and wastewater in industrial markets including oil and gas, mining, power production, food and beverage production, and heavy industries. Where once desalination was looked upon as a solution primarily for the Middle East, it is now seen as a critical aspect of water resource management around the world.

"This is, of course, driving the need for more highly trained professionals engaged in desalination and water reuse, with a parallel requirement for ongoing educational and professional development opportunities," said Awerbuch.

The IDA has responded to this need through setting up its Desalination Academy. We now look at how the Academy came about, its current work and plans for future development.

In September 2011, on an initiative of Dr. Corrado Sommariva, the then IDA President, the IDA decided to create a special training program as a part of the IDA Standing Technical Program Committee. Leon Awerbuch was appointed to develop a basic proposal outlining formation of what became the IDA Desalination Academy.

The document points out that, as the industry continues to expand and prosper, so does the need to provide high level, continuing education for all stakeholders. From plant operators to senior level executives and from those new to the industry to seasoned veterans, all stand to benefit from expanded knowledge.

The IDA, the global hub of information for the world's desalination community and a not-for-profit organization, is in a unique position to meet this need with members including the world's leaders in all aspects of the desalination industry. Recognized around the world for its leadership and the excellence of its technical programs and specialty conferences, the IDA has a sharp focus on education and sharing of knowledge.

Education is a critical part of the IDA's stated mission of "the development and promotion of the appropriate use of desalination and desalination technology worldwide in water supply, water reuse,

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