

Desalination

Operations begin at Adelaide facility

The Adelaide Desalination Plant at Port Stanvac has commenced operation. The plant is scheduled to achieve 100GL/a capacity by the end of 2012.

The \$1.83 billion facility has begun producing water and the volume entering the city's water supply network will progressively increase in the near future.

In the post-treatment stage lime, fluoride and chlorine are added to the permeate. "Following post-treatment, SA Water will begin a rigorous testing regime to ensure the desalinated water quality is suitable for blending with treated water from the Happy Valley Reservoir and once they are satisfied, the desalinated water can be delivered to customer taps," SA water minister Paul Caica said.

The AdelaideAqua consortium – comprising McConnell Dowell, Abigroup, Acciona Agua and Trility (formerly United Utilities Australia) – holds the contract to design, build, operate and maintain the facility for 20 years. A joint venture of SMEC and Hatch is the design consultant to AdelaideAqua.

"The plant's pre-treatment process and efficient reverse osmosis design provides high levels of reliability, significant energy savings and a smaller plant footprint," Acciona Agua development director for Australia Jose Maria Ortega said. "Innovative technology will diffuse the saline concentrate back into the sea, meeting strict environmental performance criteria."

In August, the federal government has finalised the agreement to provide \$228 million towards the expansion of the plant to 100GL as part of its total commitment of \$328 million.

Federal parliamentary secretary for sustainability and urban

water Senator Don Farrell said the funding will provide a substantial benefit for South Australia's security of domestic supply while also supplying environmental benefits.



SA water minister Paul Caica samples the permeate produced by the Adelaide Desalination Plant.

"The agreement ensures a 6GL environmental water entitlement for the River Murray every year, and will also provide 12GL-24GL as an environmental allocation during favourable years, capped at 120GL over a 10 year rolling period," Farrell said.

Environmental water delivery and use will be confirmed by the Murray Darling Basin Authority. ●



A view of reverse osmosis racks at the Adelaide Desalination Plant. The plant has 35,520 membranes in total.

With the commissioning of new plants in Adelaide and Perth, Australia is one of the largest users of desalination. Also included in this section are reports from an international desalination conference in Perth.



Perth's second desalination facility, the Southern Seawater Desalination Plant, has started operating and is planned to reach capacity of 100GL/a.

Southern Seawater Desalination Plant opened three months early

The first stage of the Southern Seawater Desalination Plant was opened by the WA water minister Bill Marmion in September.

The facility, being built near Binningup approximately 150km south of Perth, began operations three months ahead of schedule and within the \$955million budget.

The state government said that by the summer of 2012/13 the plant's capacity will be expanded from 50GL/a to 100GL/a.

The plant is being built by the Southern Seawater Joint Venture, which comprises Técnicas Reunidas, Valoriza Agua, Water Corporation, WorleyParsons and AJ Lucas.

"Construction of the SSDP and its associated integration works has been the largest and most complex infrastructure project the Water Corporation has ever delivered," Marmion said. "This breaks a long tradition of reliance on our dams and groundwater supplies, which have been suffering due to lower than average rainfall.

"It is a great testament to everyone involved that the project ran so smoothly and the plant itself could be built in as little as 18 months. It is proof that major construction projects can be delivered on time and on budget in this state, even with the unprecedented levels of activity under way in the resources sector."

Marmion said a lot of work has been put into protecting the

environment. "A vegetated corridor has been built to allow possums to move across the fenced site and considerable attention was also paid to the protection of whales and dolphins," he said.

The plant was also named Project of the Year by the WA Chapter of the Australian Institute of Project Management in September. ●



Perth's Southern Seawater Desalination Plant was opened by federal parliamentary secretary for urban water Senator Don Farrell (left), Water Corporation chief executive Sue Murphy and WA water minister Bill Marmion.

Conference showcases Australian and overseas achievements

Desalination is not a “silver bullet” for water shortages, but a “useful tool” as part of diversified water supplies, Water Corporation chief executive Sue Murphy said at the International Desalination Association World Congress on Desalination and Water Reuse 2011 held in Perth in September.

She said the view commonly expressed in the media that utilities have overinvested in desalination is “unfair”. She said that desalination plants provide “insurance” for water supplies “whether it rains or not”.

Murphy predicted there will be desalination plants supplying the south coast of Western Australia in the next ten years. However, she envisaged that more immediate applications of desalination will be found in mining towns and resources projects.

In her keynote presentation at the conference she said the Australian experience of desalination is a story of resilience to a changing climate. In particular, Western Australia has been suffering declining reservoir runoff since the 1970s. The decision to build the Perth Seawater Desalination Plant, commissioned in 2006, was a “fantastic leap”, she said. It was the first to supply a capital city in Australia and has consistently operated above nameplate capacity.

WA water minister Bill Marmion told the conference said the Perth plant has set benchmarks in environmental performance, energy efficiency and impact on marine environment.

Managing director of desalination company Osmoflo Marc Fabig told the conference that long before the large urban plants, Australia had a history of making smaller desalination facilities for industrial or rural applications. For example, a reverse osmosis plant was built at the Bayswater powerstation in NSW in 1987.

International Desalination Association president Imad Makhzoumi said that Australian desalination plants are models of sustainability and environmental stewardship. He said that the

desalination industry continues to develop technologies to reduce its environmental impact.

Singapore's experience

The use of membranes for water recycling and desalination has been the key change of the last decade, Singapore's water minister Dr Vivian Balakrishnan told the conference.

He said that by 2061, the city-state plans to produce 50% of its water through recycling and 30% through desalination.

Singapore aims to become self-sufficient before its water supply agreements with Malaysia terminate. Already, two-thirds of its area acts as a catchment as the estuaries have been dammed to create reservoirs, Balakrishna said.

The city's first desalination plant opened in 2005 and the sec-



Water Corporation chief executive Sue Murphy said that desalination can be viewed as insurance for water supplies.

PHOTO: KIRILL REZTSOV

Approaching theoretical limit for reverse osmosis

Future research to improve the energy efficiency of sweeter reverse osmosis desalination plants should focus on pretreatment and post-treatment stages, according to an article published in the 5 August 2011 issue of *Science*.

The article was written by Menachem Elimelech from Yale University and William A. Phillip from the University of Notre Dame, US.

The article found that the energy demand of the reverse osmosis process is “only 25% higher than the practical minimum energy for desalination for an ideal reverse osmosis stage.” However, extensive pre- and post-treatment processes drive up a desalination plant's overall energy needs.

“Eliminating the pretreatment stage or reducing the pretreatment demands would substantially reduce the energy consumption, capital cost, and environmental impact of desalination plants, but this requires the development of fouling-resistant

membranes with tailored surface properties, as well as membrane modules with improved hydrodynamic mixing,” the article said. “Alternatively, developing new, energy-efficient desalination technologies that are inherently less susceptible to fouling compared to high-pressure, membrane-based desalination methods could also reduce or eliminate pretreatment.”

Improved membrane technology can also reduce the need for post-treatment, the article said.

According to the article, demand for fresh water will increase in the coming years due to population growth, industrialisation and urban development. “Seawater desalination offers the potential for an abundant and steady source of fresh water purified from the vast oceans, and although it must be considered after all other options have been implemented, it should be viewed as a crucial component in the portfolio of water supply options.” ●

ond is due for completion in 2013. In addition, five plants use membrane technology to produce high-quality recycled water for industry, supplying 30% of the city's needs. Branded as NEWater, some of it is blended with raw water in a reservoir for potable use.

Business opportunities

Entrepreneur Sir Richard Branson was another keynote speaker, addressing the conference via telephone and recorded video. He noted there was a constant need for new products and better services in the water sector.

Water is too important an industry to be neglected by entrepreneurs, he said. Prizes – such as the Ansari X prize for spacecraft or the Longitude Prize set up by the British Parliament in the 18th century – are a good way to encourage people to develop their ideas, Branson said.

A major challenge for humanity is to thrive within natural limits, Branson said.

He also discussed the plans of one of his companies, Virgin Oceanic, to explore deep trenches on the seafloor to find new species and learn more about the oceans.

Global context

The capacity of the world's desalination plants has increased by 8.8% compared to 2010, according to the 24th DesalData IDA Worldwide Desalting Plant Inventory launched at the conference. There are 15,988 plants with a total capacity of 66.5GL/d, which

includes any removal of dissolved solids from water,

Around 60% of the installed capacity is used to treat seawater for potable use.

A majority of the plants use reverse osmosis technology, although there has been an increase in hybrid plants that combine membrane and thermal systems, as well as new technologies such as forward osmosis and electrodeionisation.

Advances in technology have reduced the energy requirements of desalination, with seawater reverse osmosis energy consumption reaching as low as 3kWh/kL with energy recovery systems in place. However, capital costs have been increasing possibly as a result of larger plants being built in environmentally sensitive areas.

The Middle East is the biggest market for desalination, with large-scale programs in Spain, US and Algeria. Australia is the 7th largest market with the Wonthaggi plant under construction in Victoria the 12th largest in the world.

According to Water Desalination Report editor Tom Pankratz, China is forecast to become one of the biggest desalination markets. The mining industry in South America is another potentially large market, he said. There were growth prospects for using reverse osmosis to treat coal seam gas water.

Desalination could also be used to enhance oil recovery by desalinating seawater that would then be pumped underground, International Desalination Association past president Lisa Henthorne said. ●

Research centre unveiled in Perth

Australia's first dedicated desalination research facility was officially opened in Perth in September.

The Desal Discovery Centre and Desal Research Facility were opened by the WA water minister Bill Marmion. They are part of the National Centre of Excellence in Desalination Australia (NCEDA).

The facility at Murdoch University's Rockingham campus will be used by researchers from 13 universities and the CSIRO working with industry to improve desalination technologies.

"The new state-of-the-art Rockingham Desalination Research Facility will enable scale-up from bench to pilot processes, with potential for full scale commercial solutions," NCEDA chief executive Neil Palmer said.

"Our unique new Desal Discovery Centre will teach schoolchildren about water science, and how desalination works."

Speaking at the International Desalination Association World Congress 2011 in Perth, NCEDA chief science officer David Furukawa said the centre will focus on five "areas of need":

- pretreatment
- reverse osmosis
- novel desalting technologies
- concentrate management
- social, environmental and economic issues.

He said that the overriding issue of how to dispose of concentrate was particularly important for inland and remote communities.

Furukawa said that industry support has leveraged the initial \$9.6 million in federal and state government funding to \$31.8 million. The centre so far has provided funding for 33 research projects. ●



NCEDA chief executive Neil Palmer (second from left) with (l-r) board members John Pluske, Graeme Rowley, Alan Law, chief science officer David Furukawa, Keith Cadee, Vicki Chen and Adam Lovell.



A view of a completed tunnel.

Intake and outfall tunnels win prize

Construction of the intake and outfall tunnels for the Southern Seawater Desalination Plant in Perth received an Earth Award from Civil Contractors Federation Western Australia.

The awards recognise best environmental and management practices in the construction industry.

Züblin Australia was contracted to build the tunnels by the Southern Seawater Joint Venture, which comprises Técnicas Reunidas, Valoriza Agua, Water Corporation, WorleyParsons and AJ Lucas.

The intake tunnels measure 2.4m in diameter and 860m in length. The brine discharge tunnel is 2m wide and 965m long.

The three tunnels were constructed using pipejacking technology through trenchless tunnelling techniques. Pipes were designed and manufactured at the Züblin factory in Thailand and exceeded Australian Quality Standards. They were finished with a HDPE lining.

Unlike open-cut tunnelling, underground pipejacking has reduced the impact on the environment both along the shore and along the seabed.

Trenchless tunnels of this length and with such a complex three-dimensional spiral alignment had never been attempted before in Western Australia. Due to the length of the tunnels, the TBMs had to be powered by high-voltage electricity. Specialist high-

voltage electricians and a supervisor had to be on site at all times.

The TBMs bored through changing geophysical conditions. Areas of soft sand changed to hard rock and then back to soft sand. Occasionally there were large voids in the alignment path. The machines could switch between working in slurry mode and the earth pressure balance mode to cope with variations in the ground conditions.

Once the tunnels were bored, the TBM was recovered from its underwater location. This has not been attempted before in WA. A recovery can and bulkhead enabled safe recovery from beneath the seabed, leaving the tunnel dry and allowing works to continue inside the tunnel.

Modifications were made to the launching seals after it was found that the length of the tunnel caused wear and enabled groundwater to seep into the shaft.

Waste products were treated and reused. A desanding machine separated water from the sand and soil excavated during the tunnelling operations. The sand was used as clean landfill. The water was pumped back into the TBM. A settlement pond enabled excess slurry to be separated and recycled. ●

This article is based on Züblin Australia's CCF WA Earth Awards submission.



Recovering a TBM from the seabed.

Projects deferred in regional areas

The proposed \$370 million West Pilbara Desalination Project will be deferred, after the WA government reached an agreement with Rio Tinto to secure water supplies for Karratha, Roebourne, Dampier and Wickham. The state government also released a study that recommended against large-scale desalination of groundwater in the Wheatbelt.

WA regional development minister Brendon Grylls and water minister Bill Marmion said under the new agreement Rio Tinto would surrender its annual entitlement to water from the Millstream aquifer.

Rio Tinto will develop its own alternative water supply from the Bungaroo Valley at an estimated cost to the company of US\$310million. The company said it will build, own and operate a 10GL/a borefield and pipeline system in the lower Bungaroo Valley, 35 kilometres southeast of Pannawonica.

“Heavy rains in the Pilbara following the 2010/11 cyclone season replenished major drinking water sources and secured short-term water supply. The rain, combined with this agreement, has allowed the government to defer the desalination project,” Marmion said. “The government was separately engaged in discussions with Rio on the possibility of reducing their use of scheme water for industrial purposes.”

Grylls said that in return for surrendering its allocation from the Millstream water supply scheme it built 40 years ago, some of Rio Tinto’s obligations to carry out secondary iron ore processing in the state would be amended. The company and the state government will jointly develop a proposal to upgrade the

existing water supply infrastructure and increase its capacity.

The WA government also released the results of a study which recommended against desalinating saline or brackish groundwater reserves in the Wheatbelt.

The study carried out by URS Australia concluded that large-scale desalination of groundwater was not currently feasible, but there may be opportunities for small schemes with improved technology in the future.

“This study has found that there are logistical and technological challenges to the treatment and use of major saline water resources in the dryland agricultural areas. It is unlikely that the major ‘seawater equivalent’ resources can be exploited economically for use within the agricultural areas, and it is even less likely that exporting this water out of the region will be economically viable,” the report said.

“The overarching recommendation is that further research and investigation of the feasibility of treating saline water resources in the dryland agricultural areas should focus on matching local supply and demand scenarios within the region, where the technical issues and costs of treatment can be met by the economic value of supplementing or replacing imported water resources.”

In releasing the report, Marmion said improvements in pretreatment technology along with improved understanding of water quality are likely to reduce the cost of desalination in the future.

The report is available at:

www.water.wa.gov.au/PublicationStore/first/100114.pdf ●