February 2016

The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

TECHNICAL BRIEF

Water supply

Investigating the sustainability of desalination and water reuse

A newly-completed Water Research Commission (WRC) study grew South African knowledge about the cost and operation of desalination and water reuse plants as alternative water technologies.

Background

South Africa is generally a water scarce country and water could become the limiting factor in sustaining social and economic development in the region in the future.

During the last three decades tremendous development and improvements in the use of membrane technology, both internationally and locally, have taken place. This allows the technology to gain popularity in desalination and advanced water reclamation schemes as a means of providing an alternate water resources.

This project, among others, evaluated on various costs (capital and operating) of existing desalination and reuse plants as a function of the quantity of water produced, as well as the various technologies used.

Operational and maintenance challenges experienced are also reported on. Finally the study provided a number of Best Operating Practices to maximise production of desalinated and reclaimed water while at the same time ensuring the sustainability of the technology in terms of cost minimisation.

The desalination plants investigated in the study	
Plant	Type of plant
Mossel Bay (15 Ml/d SWRO plant)	Desalination
Sedgefield (1.5 Ml/d SWRO plant)	Desalination
Albany Coast (1.8 Ml/d SWRO plant)	Desalination
Beaufort West (2.1 Ml/d reclamation plant)	Reuse
Windhoek (21 Ml/d Goreangab reclamation plant)	Reuse
George (10 Ml/d UF plant)	Reuse
Mossel Bay (5 Ml/d UF/RO plant)	Reuse

This research project enhances the knowledge on the subject within the South African water community and provides information relevant to the South African situation and context.

The information will be of beneficial use to municipal engineers and the water community as a whole. This may be used for more effective future planning and comparison of different water-supply options.

The cost of desalination in South Africa

The desalination and water reuse plants selected for this study were based on their location and importance with respect to augmenting water supply in the associated regions.

The capital and operational costs associated with all these plants are greatly influenced by the actual unit processes, including pre-treatment, that are employed to achieve the desired results. In addition, the abstraction of raw water, and the conveyance of product water can have a significant impact on the plant's capital and operating cost.

In the cost data provided in the final report, only the normal element within, or close to, the plant boundary are included so that comparisons between the different plants can be made. In the case of zero or low production (as in the case of the Mossel Bay and Sedgefield plants), the unit cost of water is extremely high, and this decreases as the water production of a particular plant increases up to the full capacity.

Depending on the water demand and cost to meet the demand, operating rules and a strategy to optimise the cost

of producing water can be developed. It is recommended that the most efficient operational mode, relevant to the specific plant circumstances and water demand requirements, is selected to optimise energy use and thus cost efficiency of the selected plant.

Energy consumption is one of the major contributors in the process selection and operation of desalination plants. Seawater desalination reverse osmosis plants are relatively energy intensive typically consuming in the region of 3.5 to 4.5 kWh/m^3 of treated water. In comparison, conventional physico-chemical processes associated with reuse plants are far less energy intensive.

The energy consumption of desalination and water reuse plants has a major impact on the overall operation and maintenance cost of running/maintaining these plants. **In seawater desalination particularly, the electricity costs are typically in excess of 50% of the total operation and maintenance costs, while that for reuse plants is in the 10% to 25% of the total operation and maintenance costs.**

Best practice considerations

Running the plant at higher capacities during off-peak times where time of use tariffs are lower than during peak hours can lead to significant reduction in the power costs.

Plants that are maintained in a zero production mode may benefit from doing their regular maintenance procedures, such as clean-in-place, during cleaning and flushing of membranes and performance tests during off-peak tariff hours.

Ensuring ultrafiltration/reverse osmosis (UF/RO) membrane integrity is maintained in optimal condition for as long as possible as a vital factor in the lifecycle of reuse plants. Extending the period between membrane replacements (typically every four to five years) has significant impact on overall cost effectiveness, sustainability and lifespan of the plant.

The implementation of an effective monitoring programme is essential to ensure both the plant and UF/RO membranes are in optimal operating condition.

Membrane replacement has major financial implications in the operation and maintenance of these plants.

Regular monitoring, recording and interpretation of laboratory analyses and plant measurements is an essential part of day-to-day operations and troubleshooting. This is to ensure the plant operates optimally and that all physical (and chemical) barriers are maintained.

The focus of plant operation and maintenance should be to ensure that the integrity of the plant is protected and kept in excellent working condition at all times.

Further reading:
To obtain the report, *Investigation into the Cost and Operation of Southern African Desalination and Water Reuse Plants Volume 1 (Overview of desalination and water reuse)* (**WRC Report No. TT 636/15**), *Volume 2 (Current status of desalination and water reuse in southern Africa)* (**Report No. TT 637/15**); *and Volume 3 (Best practices and cost and operation of desalination and water reuse plants)* (**Report No. TT 638/15**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.