

NAMIBIA'S TREKKOPJE



Keyplan

– A desal plant built tough

Southern Africa's largest seawater desalination plant, the 55 000 m³/d Trekkopje plant in Namibia, is now operational. Lani van Vuuren reports.

First announced in 2007, the Trekkopje desalination plant, situated near Wlotzkasbaken, about 30 km north of Swakopmund, was constructed to mainly serve Areva Resources Namibia's new Trekkopje Uranium Mine. Namibia is the world's fifth-largest producer of uranium, while also boasting abundant resources of diamonds, copper, silver, tungsten and lead.

However, Namibia has one of the driest climates in the world, and water – or the lack of it – has been a significant inhibitor to development in the country to date. When Areva Resources sought to open its new opencast uranium mine in Namibia's Erongo region, it explored

several water supply options, including groundwater and surface water. However, these sources proved insufficient to meet the mine's initial 20 million m³/year requirement, and a decision was taken to develop a desalination plant instead.

"The availability and advances in desalination technology, such as high efficiency membranes and energy recovery devices, have made seawater desalination a viable solution for water supply in mining applications where a high assurance of supply is required, reports Martin Pryor, Process Manager at Keyplan, which designed and constructed the Trekkopje desalination plant.

The Trekkopje desalination plant has become of great strategic importance for the Erongo region and for Namibia. Studies undertaken for the provision of water revealed that there are insufficient water resources to provide for existing development levels in the region much beyond

Above: The seawater reverse osmosis high-pressure pumps and energy recovery. The plant only consumes 4,1 to 4,5 kW of energy for every cubic metre of water produced, comparable to the best in the world.

2010. Thus, at the inception of the project, the desalination plant was designed not only to accommodate the mine's requirements, but also for possible future water supply to other users in Erongo.

ENVIRONMENTAL CONSIDERATIONS

As the area of development is highly regarded for its wide open vistas and expansive desert views, the siting of the desalination plant had to be carefully selected. An already disturbed site (an abandoned borrow pit) was therefore chosen for construction of the plant. Any further disturbance to the area was minimised by, for example, prohibiting off-road

driving outside the designated construction area. The permanent water pipeline and power line traverse inland along an existing quarry road to the Trekkopje mine.

Even the plant itself has been built in such a way as to blend in with its natural surroundings. “The relatively flat nature of the area meant that the skyline would be easily broken by development. We therefore appointed an architect to design the building in such a way that it would blend in with the natural slopes of land as much as possible, used neutral colours and avoided the use of, for example, face brick,” Pryor tells *the Water Wheel*.

Furthermore, a 185 km² lichen field is located to the north-east of the site. This field is considered one of the best expressions of these lichens along the coast. The whole area was demarcated and access strictly prohibited. In fact, the pipeline now acts as an additional barrier to the lichen fields.

TECHNICAL DETAILS

Construction a high-tech plant in such a corrosive environment was no mean feat. Among others, the engineers had to overcome a relatively unprotected coastline, where the water temperature and salinity levels vary; changes in water quality and delivery of the required quantity of fresh water over a distance of about 50 km to an altitude in excess of 500 m above mean sea level. “This is one of the toughest environments in the world to work in,” notes Pryor.

The overall project infrastructure consists of:

- Two 1 200 m seawater in-take pipelines and a 600 m brine disposal pipeline;
- A seawater transfer pump station;
- A desalination process plant;
- Three treated water transfer pump stations and pipeline to the mine;
- A 54 000 m³ terminal water storage reservoir at Trekkopje mine; and

Key features of the Trekkopje desalination plant

Desalination plant design capacity	20 Million m ³ /y (54 794 m ³ /d)
Desalination plant installed power	12 724 kW
Intake system designed supply	45 million m ³ /year
Eleven parallel UF trains	17 760 m ³ /d each
Nine parallel SWRO trains	7 008 m ³ /d each (operating at 63 bar pressure)
Power consumption (desalination plant)	4,1–4,5 kW per m ³ of water produced
Power consumption (SWRO system)	2,58 kWh per m ³

Source: Keyplan

- A 132 kV power line from the Kahn sub-station to the desalination plant (Only the seawater transfer pumpstation and desalination process plant was installed by Keyplan).

The seawater intake system is designed to draw in a volume of 15 076 m³/hour, which caters for a future potential water demand at 45 million m³/year. The carbon steel intake pipes each received a concrete weight coating on the outside and suitable corrosion protection on the inside. With its total

capacity of 55 000 m³/year the plant is the largest ever to be constructed in southern Africa.

A seawater intake structure was installed with 40 mm-inlet screens which can be removed for cleaning or replacement. The intake and brine pipelines were placed in a 1,5 m-deep trench in the sea bed rock, through the surf zone for which a 400 mm-long temporary jetty was erected. In order to minimise the potential marine ecology impact of the brine disposal, discharge via a pipeline into deep water



Top left: The low-pressure feed pump gallery for the seawater reverse osmosis plant.

Bottom left: The ultrafiltration feed pump gallery.



Keyplan

was specified. The marine intake works and brine discharge was constructed by M & R Marine.

PRE-TREATMENT

Since the water quality of seawater along the Namibian coast is nutrient rich, has high plankton levels and contains kelp forests, pre-treatment of the seawater is required. In addition, macro-fouling from mussels, crabs, oysters, sea anemones and barnacles, combined with micro-fouling from bacteria, slime and algae, greatly restrict the flow of water along pipelines and in process equipment.

“Swakopmund is subject to an infrequent phenomenon ‘red tides’ and upwelling of low oxygenated water together with hydrogen sulphide from decaying organic material which raises seabed sediments,” notes Pryor. “When these events occur, the desalination plant is managed accordingly to ensure that effective water treatment can be achieved.”

Three pre-treatment technologies were selected. Firstly, irregular shock dosing of chlorine is applied to control biofilm and macro-fouling. The treatment of sulphides and upwellings will also be treated by chlorination. Secondly, chemical coagulation using ferric chloride is used to assist in plankton and colloidal particle removal. Lastly, seawater entering the

desalination plant will pass through a set of screens less than 100 micron to capture the fine sediment and organic debris.

MEMBRANE PROCESSES

The desalination plant uses ultrafiltration (UF) followed by reverse osmosis (RO) to clean the water. Both the UF and RO membranes, as well as much of the other specialised equipment, were sourced from abroad.

The UF membranes remove turbidity, plankton and bacteria in the system. Eleven parallel UF trains were installed each capable of producing up to 740 m³/hour of filtered seawater. Scale and fouling is controlled by anti-scalant dosing, and a specially developed anti-scalant, with good biodegradable properties, was selected for this application.

The seawater (SW) RO process uses spiral wound, thin-film composite polyamide membrane elements. Nine independent parallel SWRO trains were installed. Following the UF, a lower pressure supply pump conveys water through a single pipe to the high pressure pump and energy recovery devices. Each SWRO train has a design production capacity of 7 008 m³/day.

An overall recovery rate of 38% to 40% is achieved, meaning that

The ultrafiltration plant and backwash piping. Eleven parallel UF trains were installed each capable of producing up to 740 m³/hour of filtered seawater.

40% of the seawater is converted into treated water, while the remaining 60% is returned to the sea. The plant was constructed in a modular fashion to allow for future expansion to meet future commercial and industrial needs.

POST TREATMENT AND WATER TRANSFER

The permeate from the SWRO is marginally corrosive due to low calcium and alkalinity. A limestone remineralisation filter containing marble chips, followed by a small dose of soda ash is used to ensure water of optimum quality.

The stabilised water then flows into a 2 000 m³ small on-site pump station surge tank before being pumped overland to the mine 50 km away. The water is transported via two booster pump stations to a 54 000 m³ terminal reservoir at the mine at an elevation of 520 m above mean sea level.

The plant started delivery in March in preparation for mine activities to begin, and Keyplan has been awarded a ten-year operations and maintenance contract to run the desalination plant. This project is set to pave the way for similar future developments in the southern African region where water scarcity is a barrier to development. □