SUR
Desalination plant

الشرقية لتحلية المياه
Sharqiyah Desalination

An environmental and **competitive solution**

Challenge

Supplying water to a region facing water scarcity

The Sharqiyah region is situated on the eastern coast of the Sultanate of Oman. Although it is located next to the sea, it is suffering water stress all year round. Indeed, as a result of drought and over-exploitation of underground resources, groundwater has to be protected and spared as much as possible.
Nevertheless, the 350,000 inhabitants of the Sharqiyah region have to be daily supplied with drinking water. Therefore, PAEW (Public Authority for Electricity and Water) has awarded Sharqiyah Desalination Company with a contract to build, own and operate the reverse osmosis desalination plant of Sur in 2007.

Sharqiyah's solution

Delivering high quality drinking water while limiting the impact on the environment

The contract awarded to Sharqiyah Desalination Company covers the construction and operation of a 29 million m³ per year (80,000 m³/day) desalination plant and the construction of a reservoir with a capacity of 160,000 m³.

The Sur desalination plant complies with the more stringent environmental criteria in order to protect water resources as well as the environment as a whole.

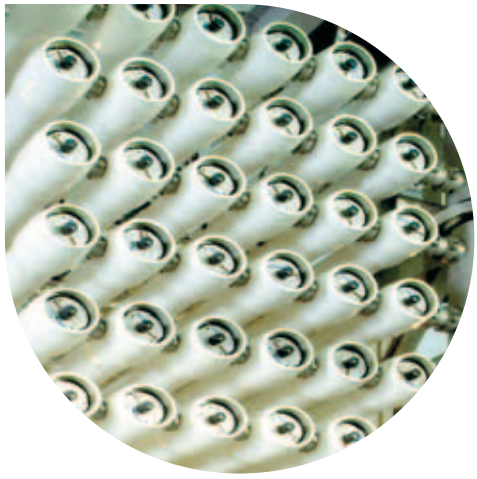
Sharqiyah implements the membrane desalination process also called reverse osmosis process. It consists in forcing water under high pressure through a semi permeable membrane that allows the water through but holds back the salt, bacteria, particles, etc.

Therefore, desalinated water is very pure and of high quality. The treated water total dissolved salt level is only 123 mg/L compared to 40,000 mg/L in the raw water pumped from the beachwells (the maximum salt concentration for human consumption is 400 mg/L).

The construction was undertaken by a consortium OTV (a Veolia Water subsidiary) - BEC (Bahwan Engineering Company). After a 3 year design and construction period, Sharqiyah started up the operation of the Sur desalination plant in October 2009.

Desalination, an alternative resource available in large quantities

In some countries, such as the Sultanate of Oman, saving water and turning to alternative resources is a necessity. By transforming seawater into drinking water, desalination is a high potential alternative solution to face water stress. It is an effective answer to meet the challenges of rapid population and economic growth, to face water shortages and to prevent over-extraction and pollution of coastal fresh groundwater. Improvements in technologies, especially in terms of energy requirements make desalination more and more economically and ecologically efficient.



A commitment to environment protection

As well as its construction and operation activities Sharqiyah Desalination Company is keen on actively strengthening its efforts to reduce the environmental impact of the desalination process. The Sur desalination plant is particularly efficient in this field.

As an example, energy recuperation (see page opposite, step 3) has been maximised at every stage of the process enabling the Sur desalination plant to use its energy not only once but many times, reducing the global quantity of energy required to operate the plant. Managing energy consumption is a key issue: one the one hand, it enables to reduce operating expenses and on the other hand it limits the impact of our operation on the environment.

Another example is the process used for the water intake, which is very innovative since it is entirely based on beachwells. These are wells dug into the beach to withdraw the seawater from the sand instead of taking it directly from the sea. This process (see page opposite, step 1) allows a lighter pre-treatment (thanks to sand natural filtration) and ensures a better quality of the water.

Sur Process in 6 steps

1

Beachwells catchment

The 9,000 m³/h raw seawater flow necessary
Osomosis process is extracted from the groun
Beachwells, making Sur Desalination Plant th
ter beachwells catchment facilities in the wor
type of catchment is giving:
- Very low colloidal clogging or bio-fouling in
Index SDI15<2)
- Very stable quality of seawater with consta
temperature amplitude and low pH.
With 33 individual beachwell units dispatched
raw water pumping design ensures a highly fle

Beachwells:

- 33 beachwells
- 80 meters deep
- Raw water capacity: 9,000 m³/h

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exible operation.

2

Pre-treatment

Reverse osmosis membranes require specific water quality to avoid the risk of clogging or bio-fouling. Therefore, the extracted seawater must be treated before passing through the membranes with a two step filtration system:
- In the first step, the raw water is treated by 14 pressure media filters. Each filter is filled with sand for large particles sizes and bio-cell removal.
- In the second step, finer filtration is achieved by micronic cartdrige filters to "polish" the seawater.

Pre-Treatment:

- 14 pressure media filters
- 11 micronic cartdridge filters (5 microns)

3

High Pressure Pumps and Energy Recovery Device (ERD)

The salt water, cleared of all impurities, is then pushed by high pressure pumps, through the reverse osmosis membranes. The required pressure level (60 bar) for the reverse osmosis process is energy consuming. To optimize and reduce the final product price, Energy Recovery Devices (ERD) have been implemented. This device allows a high recovery grade (97%) of the mechanical energy contained in the high pressure discharged brine, resulting in an energy reduction per produced cubic meter as high as 40% in comparison with a conventional plant.

Pumps and ERD:

- Number of ERD: 24
- Number of high pressure pumps: 8
- High pressure system: 60 bar
- ERD: 97% efficiency

4

Reverse Osmosis Treatment

In the membrane building, the separation of salt from water is achieved in a two passes reverse osmosis and boron removal process. The achievement of a high boron ion removal is an important consideration in the design of Sur plant to comply with Omani Health standards. The eight independent 1st pass train configuration allows a high plant modularity and flexibility to adapt to the water demand.

Reverse Osmosis:

- First pass: 8 independent trains and 114 pressure vessel (PV)/train
- Second pass: 4 trains and 80 PV/train
- Each PV contains 8 membranes
- Total reverse osmosis capacity: 80,000 cubic meters/day

5

Post-Treatment

The demineralized water coming out of the membranes is not potable. Adjustment of its chemical characteristics, based on a remineralization with CO2 and lime addition is needed. Caustic soda for pH adjustment can also be added.

Post-treatment:

- Limestone storage filters: 4
- Limestone reactor size: 4 x 72 square meters

6

Drinking Water Storage Tank

Before storage, the potable water is disinfected and preserved with Chlorine injection. The massive concrete reservoirs have been designed to store two days of potable water production in two separate tanks of 80,000 cubic meters each.

Potable Water Storage Tank:

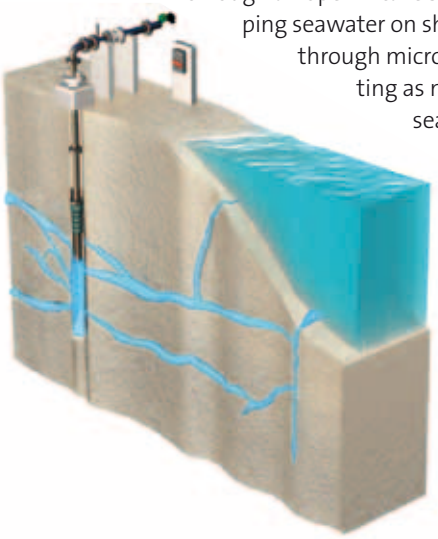
Number of Reservoirs: 2
Total storage capacity: 160,000 cubic meters
Number of concrete columns: 1,400

Desalination Plant Characteristics

Beachwells

With 216,000 m³/day (9,000 m³/h) installed seawater beachwells capacity, Sur Desalination Plant is the largest beachwell catchment facilities in the world.

A standard seawater catchment facility is taking the raw water directly from the sea through an open intake structure. Sur Desalination Plant is pumping seawater on shore from in the ground (80 meters deep) through micro-karstic cracks. Those cracks are operating as natural filtration units making Sur raw seawater with the best quality achievable in desalination process:



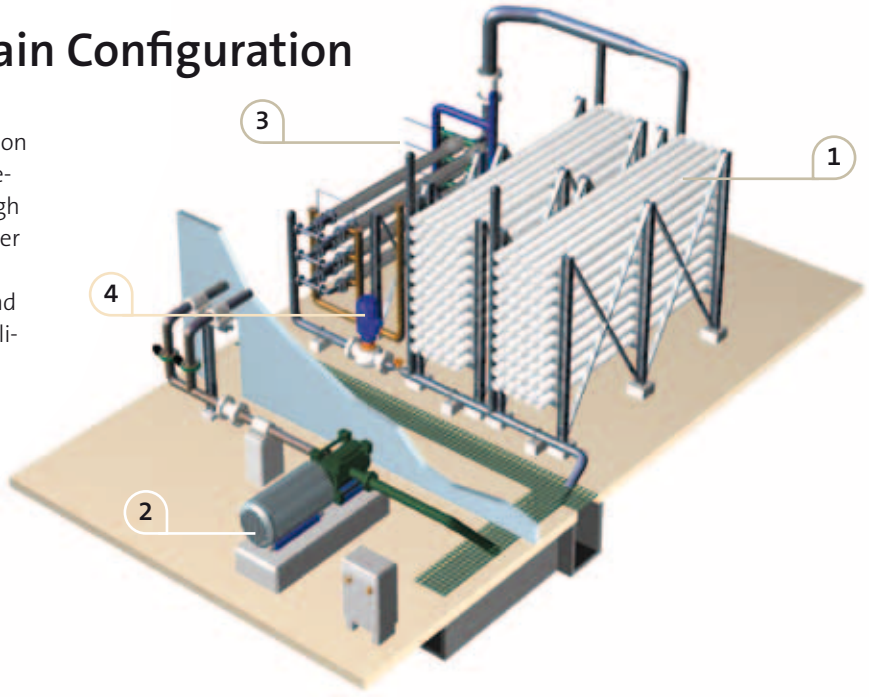
- Low turbidity (< 0.1 NTU),
- Low Silt Density Index SDI (SDI15 < 2),
- Low pH compared to standard seawater (pH~7.5),
- Stable overall ionic balance all along the year,
- Low temperature amplitude between day and night,
- No impact of seawater quality changes (red sea, bloom algae, oil spillage...).

Individual 1st pass RO Train Configuration

The Reverse Osmosis treatment is based on 8 independent and individual first pass train's configuration to adapt at anytime the production to the water demand. This configuration is giving to the plant a high flexibility while guaranteeing a stable drinking water quality production.

Each train has been designed to work by its own and to produce 12,500 m³/day (520 m³/h) of de-mineralized (permeate) water. It is composed of:

- one set of 912 reverse osmosis membranes with associated pressure vessels (1),
- one high pressure pump (2),
- one Energy Recovery Device (3),
- one recirculation pump (4).



	Seawater Characteristics	Treated Water Characteristics (Actual Product Water Qualities after post-treatment)
TDS	39,700 mg/l	123 mg/l
Calcium Hardness	108 mg/l	101 mg/l
Chloride (Cl)	21,447 mg/l	20 mg/l
Sodium (Na)	13,912 mg/l	2 mg/l
Magnesium (Mg)	1776 mg/l	3 mg/l
Potassium (K)	531 mg/l	2 mg/l
Boron	4.5 mg/l	0.35 mg/l
Conductivity	56.1 mS/cm	207 µs/cm
pH	7.5	7.6

Treated Water Characteristics

Population covered: 350,000
Treatment Capacity: 29 million cubic meters/year (80,000 cubic meters/day)
Price tag for the plant's construction: $148 million
Total people employed at the site: 33

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