SEA WATER DESALINATION PLANT FOR PORT GHALIB RESORT

A Case Study

Port Ghalib is a new world class Resort located along the southern Red Sea coast at Marsa Alam in Egypt. This integrated development spans 18 km of pristine beachfront, with access to the Red Sea turquoise blue waters and world famous Coral. The Resort is complemented by a backdrop of rugged desert mountains providing magnificent panoramic views, and is recognized as a model for environmental conservation, cultural preservation, design creativity, beauty and diversity of entertainment and leisure experiences.

The resort includes an International Marina that has 1050 fully serviced berths, and a tree-lined corniche with a vibrant and cosmopolitan promenade that bustles with residential, commercial and entertainment complexes. In addition to the marina, port Ghalib fetures some of the most exiting and thematically planned resort hotels. The hotels are complemented by a conference centre that caters for 1500 delegates, offering state of the art equipment and facilities. An Entertaiment island located at the tip of the corniche harbors a museum, children's area and night clubs. For the enthusiastic diver, the Coral Beach Diving Resort offers the ultimate experience in diving by providing access to explore the world famous coral formations and marine life of the South Red Sea.

A VIEW OF A REVERSE OSMOSIS STREAM

Due to Port Ghalib's location, it was necessary to create an infrastructure to supply water, power and waste treatment needs for the area. Consequently, one of the major plant utility design and construction contracts for Port Ghalib was awarded to The Metito Group for the water desalination plant, owned and operated by EMAK for Utilities and Services, a subsidiary of M. A. Kharafi Group. The water desalination plant is scheduled to be completed in phases as the development of the area progresses. Once the resort is fully developed, the plant will be able to produce 18,000 m3/day.

Metito was entrusted to execute the water desalination plant through a multi- million US Dollar contract, which was awarded against fierce international competition. Metito accomplished the challenging task whilst meeting the stringent requirements laid down by EMAK and the project manager, BECHTEL.

Scope of Work:

This included the complete design, engineering, manufacture, inspection, testing and supply, installation, commissioning, start-up, performance test and reliability test.

Technical Characteristics:

1. Design Basis

The sea water reverse osmosis desalination plant has a design capacity of 3,000 m3/day (4 duty trains, 2x1000 m3/day & 2 x500 m3/day) for the first phase. The total dissolved solids in the feed source (sea water) are 45,000 mg/l, and the Reverse Osmosis Plant was required to reduce the dissolved solids content to 300 mg/l or less.

2. Design Data for the Reverse Osmosis Units

Description	Unit	Phase I	Phase II
No. of streams		2x500 m^3/d 2x1000 m^3/d	4x1000 m^3/d
Total feed water requirements	m^3/h	417	556
Feed water design temperature	$^{\circ}C$	25-30	25-30
Feed water quality (TDS)	ppm	45000	45000
Reverse osmosis recovery	%	30	30
Feed water pressure	Bar	70	70
Operation Period	h/day	24	24
Reverse osmosis output hourly flow	m^3/h	124.8	166.7
Brine hourly flow	m^3/h	292.2	389.3
Product water pH		7	7
Electric power recovery	%	36	36
Total output daily flow	m^3/d	3000	7000

3. Process Description

Feed water is extracted from six beach wells which naturally filter raw water prior to lifting it to the raw water tank through an under ground piping network. Disinfection is then effected by dosing Calcium Hypochlorite solution, which prevents biological contamination that otherwise can lead to biofouling of the membranes.

Feed water is then injected with a coagulant agent, polyelectrolyte, which agglomerates small particles to form larger ones that are easily retained in the media filters. The injection of polyelectrolyte prevents colloidal fouling at the membranes surface.

The chemically pretreated sea water then passes through pressure type dual media filters containing graded sand/gravel/anthracite for the removal of particulate organic and colloidal matters. The upper layer of anthracite removes large suspended particles which may clog the bottom layer of sand, while the sand media

AN OVERVIEW OF THE SEAWATER REVERSE OSMOSIS PLANT ROOM

removes the smaller suspended matter. When the control timer reaches the preset time for cleaning, or the differential pressure across the filters reaches the preset values, an automatic backwash and cleaning sequence begins. The exhausted filter is air scoured to abrade off any solid material adhering on to the media particles, then the backwash pump boosts filtered water to the filter bed for fluidisation of the media and washing out the accumulated suspended solids. Part of the filtered water is stored in a backwash water storage tank for backwashing purposes, whilst the balance of the filtered water passes to the cartridge filters.

Prior to the cartridge filtration system, feed water is dechlorinated by the addition of Sodium Metabisulphite, thus preventing chlorine attack on the membranes, a problem that would cause irreversible damage . A REDOX potential monitor located downstream of the cartridge filtration system protects the membranes by shutting down the units at a preset level of oxidation potential.

Acid is dosed to aid in pH control and to ensure that calcium carbonate does not precipitate in the reject brine stream of the membranes. Acid converts carbonates to carbon dioxide gas, thereby reducing the carbonate concentration and eliminating the possibility of subsequent precipitation of calcium carbonate in the reject stream.

Antiscalant is then injected to inhibit residual carbonate and non carbonate scaling on the permeators. Since scaling control is prevented by acid injection,

LOCATION OF MARSA ALAM

dosing of the antiscalant is performed intermittently, depending on the safe operation of the acid dosing system and the preset pH value.

After chemical treatment, water passes through an inline static mixer to ensure proper mixing of the dosed chemicals. The chemically conditioned water then passes through cartridge filters, where suspended solids above 5-micron size are removed. Following this, water is boosted to approximately 70 bar (g) by high pressure pumps and is divided inside the RO permeators into permeate and reject streams. 30% of the feed sea water and a small quantity of total dissolved solids are transported across the membranes to the permeate stream. The remaining 70% water flows out through the brine outfall line to a Pelton Wheel turbine, which is provided to recover the pressure energy.

The energy recovery turbine takes advantage of the high pressure remaining in the brine stream. Brine is fed through an adjustable nozzle to the Pelton Wheel producing rotating output power, which is used to assist the main electric motor in driving the high pressure pump. The permeate is monitored in terms of conductivity by special purpose instrumentation.

During normal operation, deposits of mineral scale, biological matter, silt and insoluble organic constituents may build up on the membrane surface at a very slow rate. A specially designed and installed cleaning system minimises the use of operating chemicals and maximises the long term efficiency of the membranes.

The plant is designed to produce a continuous, steady stream of desalinated water. If the units are operated intermittently, the permeate is automatically flushed back through the high pressure pump, ERT, high pressure pipework and membranes during shutdown to replace the high salinity raw water with low total dissolved solids product water. This prevents corrosion of

THE MULTI-MEDIA FILTRATION SYSTEM

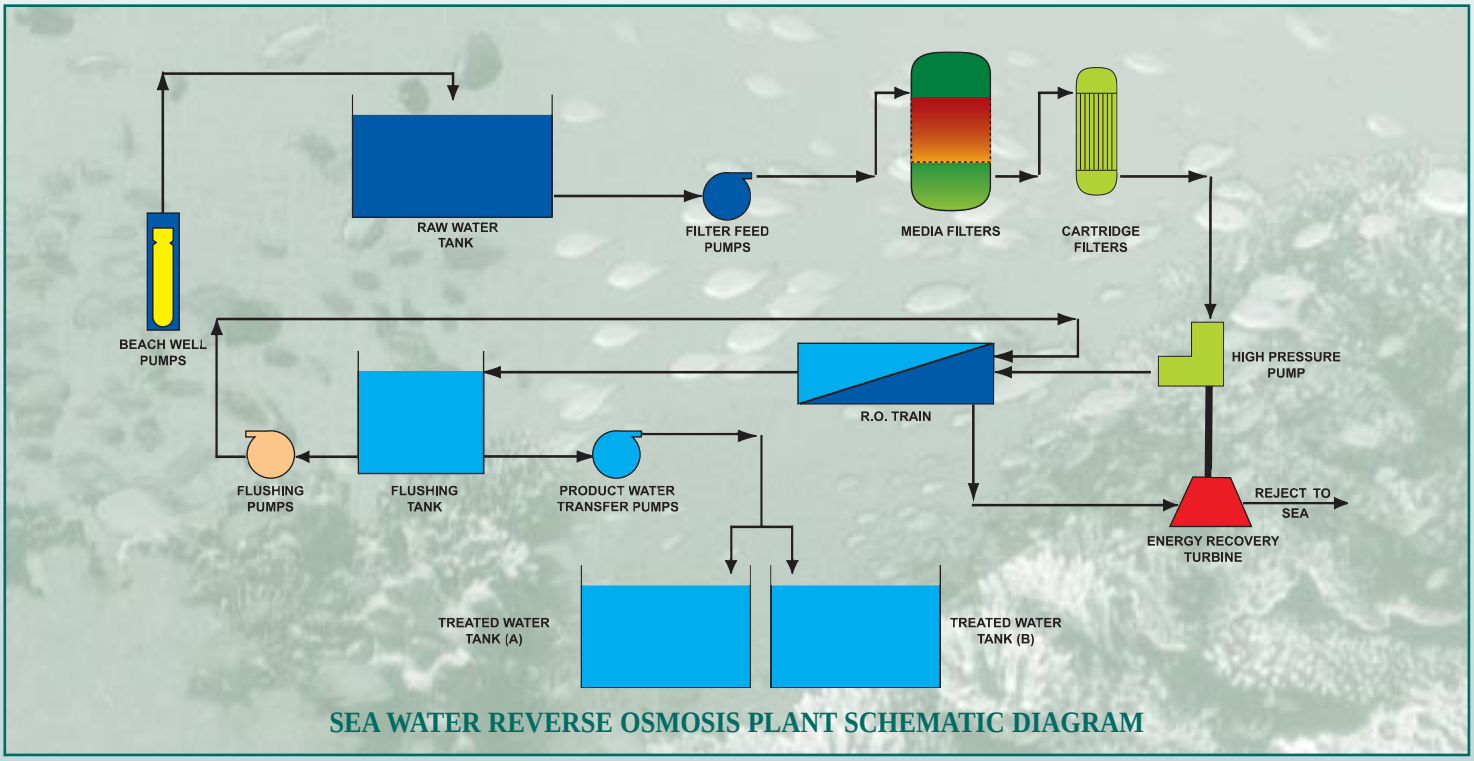
THE MARINA : NUCLEUS OF PORT GHALIB'S RESORT COMMUNITY

pumps and pipework, and minimizes the precipitation of sparingly soluble salts inside the membranes. Flushing is achieved using product water from the flushing tank boosted by flushing pumps. Lime is dosed into reverse osmosis permeate to raise the pH to approximately 7-7.2 to render it suitable for potable applications, whilst chlorine is dosed for disinfection purposes.

The permeate, duly pH corrected and post chlorinated, is stored in product water tanks, from where it is distributed on the site to satisfy the various needs.

Water produced by the Metito desalination plants has contributed to the success of the project, the well being of the residents and the preservation of an environment that is considered to be amongst the most captivating in the world.

POWER TRANSFORMERS



SEA WATER REVERSE OSMOSIS PLANT SCHEMATIC DIAGRAM