

# Fujairah 2 Reverse Osmosis Desalination Plant



# The Fujairah 2 Reverse Osmosis Desalination Plant



Fujairah is one of 7 Emirates, located on the east coast of the United Arab Emirates on the Gulf of Oman. The country is experiencing high demographic growth resulting in the constant rise in electricity and drinking water demand.

The Fujairah 2 (F2) Reverse Osmosis Desalination Plant is part of the largest hybrid desalination plant in the world (linked to a 2,000 MW power plant and a 450,000 m<sup>3</sup>/day thermal desalination plant), with a total drinking water production capacity of 591,000 m<sup>3</sup>/day. 136,500 m<sup>3</sup>/day are produced through the Reverse Osmosis (RO) process and its associated Dissolved Air Flotation (DAF) pre-treatment system (see opposite page). ■



## The Gulf Desalination Platform

Taking advantage of the innovative aspects of the F2 RO desalination plant and the challenging location, Veolia Environnement Research and Innovation (VERI) decided to invest in and establish a state-of-the-art research facility on the F2 site. With a footprint of 3,000 m<sup>2</sup> the objective of the facility is to optimise the design of future seawater reverse osmosis desalination plants, optimise the operation of the F2 RO plant and to develop innovative solutions to mitigate the impacts of Harmful Algal Blooms (HAB). ■



## A constant commitment to the environment

Veolia Environnement (the world leader in environmental solutions) and all its subsidiaries are committed to sustainable development with the focus on all environmental issues. They are continuously striving to reduce the impact of their activities on the environment and on the natural resources. In line with this commitment the F2 RO plant has been designed with a sludge treatment system in order to avoid wastewater and sludge disposal into the sea environment. The wastewater is treated and the resulting sludge thickened for disposal in an engineered landfill facility. Effective energy recovery from the brine stream is achieved with the use of Pelton Turbines which has an efficiency of 87%. ■



# An innovative seawater pre-treatment process

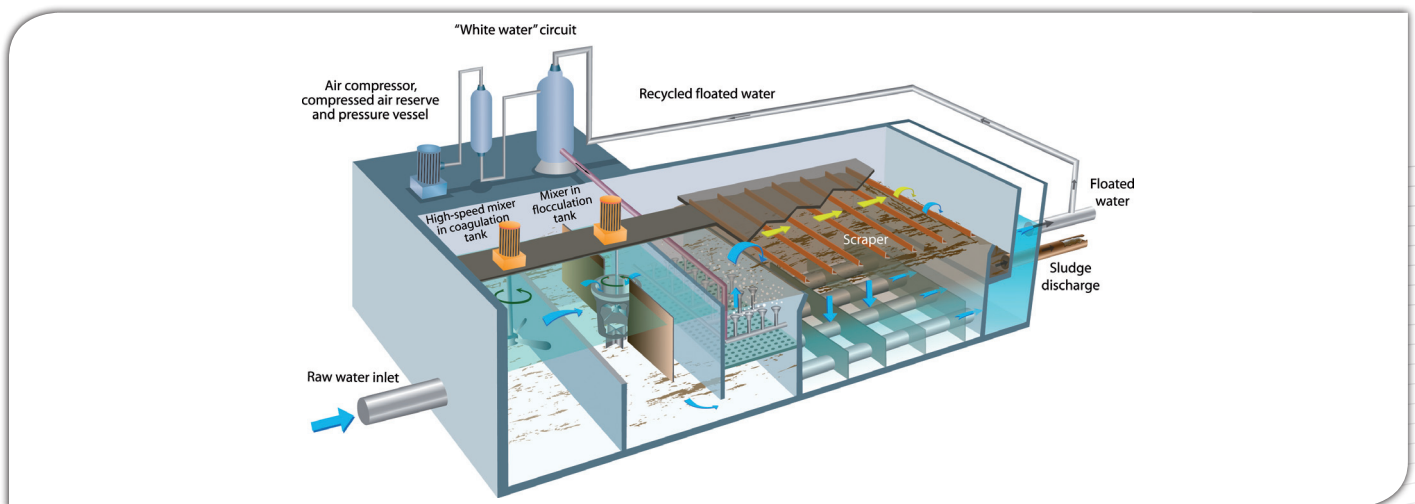
● ● ● The Dissolved Air Flotation process is generally accepted as the most appropriate treatment process for the effective removal of algae. Veolia's Spidflow™ Dissolved Air Flotation pre-treatment system has been incorporated to ensure a good and consistent sea water quality.

## The Spidflow™ process

Dissolved Air Flotation (DAF) is a well known and proven water treatment process. It is adapted for the removal of low density suspended particles such as algae in low turbidity waters. Spidflow™ is Veolia's high speed flotation solution for suitable but challenging raw waters including sea water. As illustrated in the graphic below, air is dissolved in water with a saturator and transformed to "white water" which contains microscopic bubbles after pressure release via specially designed nozzles. Flocculated sea water is uniformly mixed with the white water in co-current flow direction to allow the microscopic air bubbles to attach to and float the floc to the water surface. The proprietary Spidflow design ensures optimum hydraulic conditions to produce a constant high quality clarified water. Tank shapes and hydraulics were optimised with the use of sophisticated computer models which are based on years of research, experience and onsite process monitoring. Floated scum is removed with mechanical surface scrapers for dewatering and environmentally friendly disposal. ■

## The benefits of Spidflow™

Spidflow™ has proven its ability to treat harmful algae blooms as experienced frequently on the Gulf of Oman Coast. These blooms have caused several existing desalination plants in the region to reduce their production or terminate production because flotation was not part of their pre-treatment process. Indeed, despite several algae bloom events, the F2 RO plant has been able to produce continuously at the required capacity. Floated water quality and quantity were always maintained to normally operate the plant, even at full load and without reducing water production. The Dissolved Air Flotation process is fast becoming the norm in RO pre-treatment in the Gulf region due to its successful implementation and operation in the F2 RO plant, which was also the first. ■



# The F2 RO Desalination Plant Process



## 6 • Post Treatment

The RO permeate is blended with distillate from the adjacent Multistage Evaporation Distillation (MED) process after which the water is remineralised to render the final water potable as prescribed by the UAE National Drinking Water Regulations. Post treatment typically comprises water stabilization, pH adjustment and disinfection prior to final storage in four 100,000 m<sup>3</sup> storage tanks located adjacent to the F2 Water and Power Plant. ■



## 1 • Open Sea Water Intake

Sea water is piped by gravity flow, with 3 parallel pipelines (500 m off-shore) to a deep intake well. Following chlorination to discourage marine growth, the sea water is screened using static and rotating drum screens to prevent any marine life to enter the plant. The intake well is equipped with 4 vertical shaft turbine pumps to supply the required amount of seawater. ■





### 5 • Reverse Osmosis (RO)

RO aims at separating salts from sea water to produce fresh water with special purpose spiral wound membranes at high pressure (60 Bar) conditions. During operation, anti-scaling chemicals are purposely injected to prevent scale formation (precipitation due to super saturation) on the membrane surface which can cause performance deterioration.

The F2 RO plant has the following design features: partial 2 Pass, multi-port configuration, 10 first Pass racks with 12,960 high rejection membranes and 10 high pressure feed pumps each with Pelton Turbine as energy recovery device, 2 second Pass racks with 1,600 low rejection membranes and 2 booster pumps. ■



### 4 • Cartridge Filtration

This sea water polishing step comprises 16 cartridge filter vessels, each containing 224 cartridge filters. All suspended material above 5 micron in size is retained. Sodium bisulfite is added to the filtered water on demand for effective chlorine residual removal. Dirty filters are replaced and disposed of periodically, under strict disposal regulations. ■



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### 2 • Spidflow Dissolved Air Flotation (DAF)

The DAF comprises coagulation and flocculation (chemical addition and mixing to form small floc) followed by Dissolved Air Flotation. Acid, Ferric Chloride and Polymer can be used to achieve optimum floc formation which is important to ensure effective floc removal via dissolved air flotation. The floated and accumulated scum is continuously removed as waste and treated in the sludge treatment plant.

The 16 modular DAF units have been purposely added to remove algae and to improve the water quality in general. (see page 3 for process details). ■

### 3 • Dual Media Gravity Filtration (DMGF)

A dual layer of pumice (special volcanic material) and quartzite sand act as the filtration media inside the 12 filters. After 40 to 60 hours of operation, filters are backwashed in order to remove all accumulated floc and suspended material. Dirty backwash water is treated in the sludge treatment plant, while filtered sea water is pumped through the cartridge filters with 10 booster pumps. ■



## WATER CHARACTERISTICS

### Seawater Quality:

Nominal Flow rate	355,000 m <sup>3</sup> /d (78 MIGD)
Temperature	22 - 33°C
TDS	≤ 40,500 mg/l and TSS < 5 mg/l
Boron	≤ 5 mg/l
Total hydrocarbons	< 0.5 mg/l and < 0.1 before RO

**RO Recovery Ratio** 40% (average)

### Permeate Quality (Contract):

Temperature	22 - 35°C
TDS	≤ 317 mg/l
Boron	≤ 1.73 mg/l
pH	6.5 to 7.5

### Permeate Quality (Actual):

Temperature	22 - 33°C
TDS	200 - 300 mg/l
Boron	≤ 1.0 mg/l
pH	6.8 to 7.2

## KEY FIGURES / FACTS

- ● ● RO Desalination plant capacity:  
**136,500 m<sup>3</sup>/day**
- ● ● Population served:  
**550,000**
- ● ● Volume of dried sludge produced:  
**90 m<sup>3</sup>/month**  
(30% dried solids)
- ● ● Specific energy consumption:  
**3.7 kWh/m<sup>3</sup>**  
(post treatment and intake excluded)
- ● ● Number of employees:  
**30 (multinational)**



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