desalination

the sustainable alternative

ready for the resource revolution

suez

desalination
by SUEZ

the stakes

3.9
billion people affected by water stress by 2030

97.5%
of the Earth's water reserves consist of seawater

60 %
of the world's biggest cities in coastal areas do not have access to freshwater

100
million m³/day
is the estimated installed desalination capacity to meet municipal and industrial requirements in 2015. This capacity will have doubled in the 10 years from 2005 to 2015

The gap between the available water resource and our municipal and industrial needs will reach 40% by 2030, and the number of people living in regions affected by severe hydric stress is expected to increase by a billion to 3.9 billion, out of a global population of 8.1 billion. The most severely affected countries and regions will be North Africa, the Middle East, Northern China, Southern India, Pakistan and certain parts of the United States and Mexico.

Since March 2015, all the Group brands (Degrémont, Ozonia, Aquasource, Ondeo IS, Ameriwater, Infilco, Poseidon...) became SUEZ. Meanwhile, from now own, the technologies and know-how of our Treatment Solutions offer will be distinguished with the label degremont®.

a mastered solution for local authorities and industry

Nearly 50 years of experience
Recognised as a pioneer in the technology of desalination by reverse osmosis since its first degremont® plant was established on the island of Houat in France in 1969, SUEZ has successfully developed and integrated complementary technologies to make this a sustainable solution.

SUEZ's desalination offer consists on four complementary areas of activity:

- **Customised design & build** to meet specific requirements with seawater or brackish water desalination plants – small or large, modular or standardised – designed and built according to site requirements and water types.
- **Operation and services solutions** for daily management, optimisation of desalination plants (pre-treatment, energy consumption, washing of membranes, etc.), and "à la carte" solutions such as the supply of spare parts, rehabilitation, employee training, etc.
- **"Packaged" equipment and technologies** to increase or diversify pre-treatment or reverse osmosis performances, or for an easy-to-operate modular and compact design.
- **Financing through BOT contracts (Build, Operate, Transfer)** for a long-term partnership in which SUEZ is fully involved from the design through to the plant transfer.

Outstanding advantages
Numerous municipal and industrial projects have enabled SUEZ to consolidate its world-leading position in the field, in particular thanks to:

- mastery of pre-treatment, reverse osmosis and remineralisation processes;
- expertise as builder and operator, enabling to offer local authorities and industry competitive solutions that are adapted to their particular operating requirements;
- comprehensive range of modular and standardised products to optimise delivery and commissioning times;
- operating support tools to safeguard freshwater production and continuously optimise operating costs;
- introduction of effective energy recovery systems to reduce energy consumption;
- solutions to preserve the Earth's flora and fauna in general and marine life in particular, both at water intake and on dispersion of brines.

Active in R&D
To adapt to future needs and optimise existing systems, SUEZ is engaged in research on the following subjects:

- direct osmosis;
- membrane distillation;
- new membranes;
- new membrane engineering;
- alternative energy sources;
- alternative processes for treating boron;
- reducing water loss in pretreatment;
- etc.

A prize-winner at the Global Water Awards 2013 for its technical prowess and environmental integration, the Victorian Desalination Plant designed and built by SUEZ is one of the biggest reference for the desalination industry worldwide.

1.5
million cubic meters of desalinated water produced by a plant operated by SUEZ

3.5
million cubic metres of desalinated water produced per day by a degremont® plant

10
million people supplied

an offer dedicated to

desalination

innovative technologies to optimise processes, reduce operating costs and lessen environmental impact

broad range of degremont® products, services and tools to provide relevant technical and economic solutions for the needs and challenges of local authorities and industry

SWRO Pilot desalination plant fully powered by renewable energy in Masdar, UAE

To contribute to Masdar city sustainable growth, SUEZ has designed, built and now operates and evaluates an advanced energy-efficient desalination pilot plant (104 m^3/d) which will be more energy-efficient than the current state-of-the-art desalination systems; and potentially powered by renewable energy sources.
The main aim of the project is to demonstrate that a Membrane-based Advanced Seawater Desalination Plant (Industrial Scale) is able to achieve less than 3.6 kWh/m^3 of electrical Specific Energy Consumption (SEC), a value below current benchmarks.
To do so, 3 different energy optimization solutions are tested:

- Optimizing operating conditions of current technologies;
- Implementation of a new SWRO brine treatment;
- Assessing impact of solar energy usage on the SWRO process and defining suitable operating conditions of the plant.

Seadaf ™

This compact solution for clarification by rapid dissolved air flotation (DAF) of saline water replaces the first filtration stage. It is useful for water that may present occasional peaks in suspension matter and algal bloom.

Seaclean™

This dual media (anthracite + sand) filtration technology is ideal for desalination plants of all sizes. It improves the performance of reverse osmosis membranes, increases their lifespan, reduces washing equipment and cuts water loss.

Ultramarine™ Smartrack™

This metallic chassis can accommodate different types of ultrafiltration membrane modules. The system is standardised and industrialised, reducing the time taken for implementation and allowing to master the cost of membranes renewal.

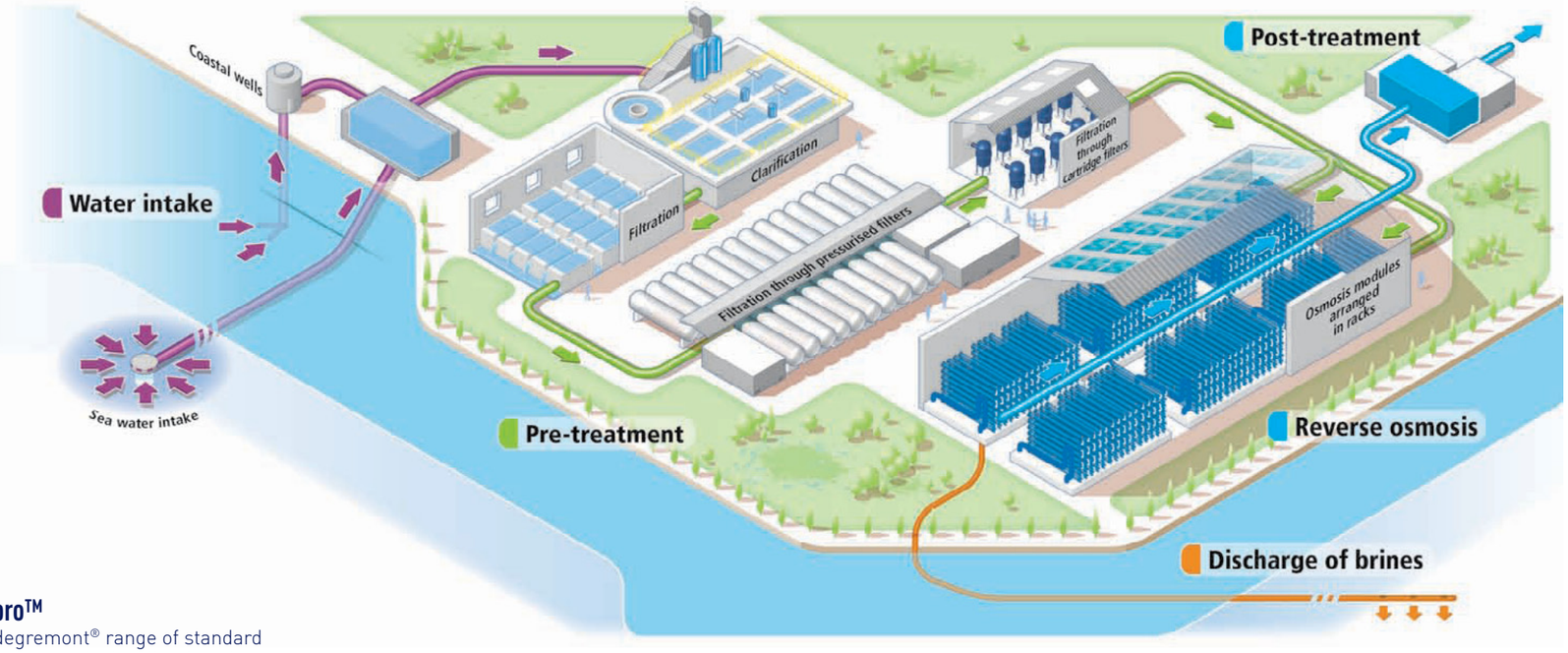
Seapro™

The degremont® range of standard reverse osmosis desalination plant elements has been developed based on feedback from its realisations.
Its main advantages are: reduced construction time, minimisation of technical and construction risks, and general optimisation of costs (civil engineering, construction, equipment, assembly, etc.). The most recent plant of this type is the Seapro™ 50K, which produces 50,000 m^3/day, comprising:

- water intake;
- pre-treatment by Seadaf™ rapid flotation, and ultrafiltration;
- a reverse osmosis pass;
- a remineralisation phase.

This plant is flexible in its design according to local conditions and client's specific requirements.

a reverse osmosis membrane
Only allows water to pass through and retains all the solutes, except for a few organic molecules very similar to water.



Offshore oil & gas

With its expertise in desalination and engineering know-how specific to offshore oil exploration and production, SUEZ designs and supplies units for desalination and sulphate removal to equip FPSO (Floating, Production, Storing and Offloading) vessels.

OMOBILE / MobilePro

These mobile (truck-mounted) desalination units guarantee the quality and quantity of water required without capital outlay, anywhere in the world and for all types of industry. The trucks are rented and are equipped with reverse osmosis or ion exchange units to produce industrial water. They guarantee the continuity of industrial water production in emergencies as well as anticipating purified water requirements during planned procedures.

Desalination robustness *

This modelling tool, developed jointly with ENGIE (Laborelec), offers three advantages:

- identification, by geographic region worldwide, of six typical seawater compositions and their annual profile;
- determination, according to profile, of the optimal dosages of chemicals to most effectively foresee the quality of the pre-treated water, thereby optimising the robustness of a desalination plant and its operating costs;
- the choice of the best line of pre-treatment to optimise investment and operating costs.

The tool is based on a statistical method using a database containing over 10 years of data (from pilot trials and plants).

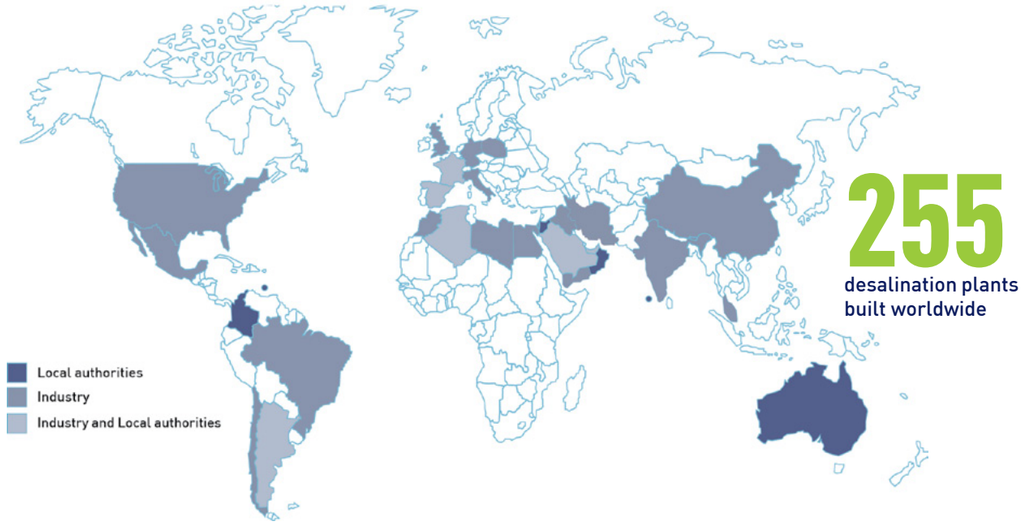
ControlBuild

This tool simulates the operation of a virtual desalination plant, enabling automated systems to be tested and parameterised upstream before being validated at the plant. It facilitates operational start-up on delivery of the plant and reduces the time needed for the commissioning phase (two month reduction at the 450,000 m^3/day Victorian desalination plant, Melbourne-Australia). The tool can also be used during the operational phase to simulate optimisation methods and thus continually improve performance.

* The robustness of reverse osmosis plants is defined as the capacity to provide an appropriate flow and quality of drinking water, in accordance with the capacities of the plant and the guarantees of the membrane supplier.

flagship realisations
for local authorities

a pioneer in desalination by reverse osmosis,
SUEZ has built 255 degremont® plants in all four corners of the world



255
desalination plants built worldwide

AL DUR, Barheïn

Complete and secure pre-treatment
With a capacity of 218,000 m^3 of drinking water per day, Al Dur has the biggest desalination plant in the Persian Gulf, which is part of a broader BOO (Build Own Operate) project.
In order to maintain a low clogging index and preserve the reverse osmosis membranes, the pre-treatment process has been designed to manage the high concentration of organic matter and significant build-up of algae in the waters of the Persian Gulf. The key of the plant's reliability is its complete and secure pre-treatment process, comprised of two treatment stages:
- flotation by Seadaf™ (14 x 66 m^2 units);
- dual media filtration under pressure (by 44 x 52 m^2 metallic filters).

For greater flexibility and to enhance operation reliability, the pre-treatment process is divided into two lines each receiving 50% of the water intake.
In addition, to reduce the plant's energy costs, the racks of the first reverse osmosis pass are equipped with Pelton turbines.

MELBOURNE, Australia

One of the biggest reverse osmosis desalination plants in operation
The Victorian desalination plant can produce and supply 450,000 m^3 (extendable to 600,000 m^3) of drinking water to the city of Melbourne per day.

Environmentally friendly...
The equipment was selected for its minimal power consumption. Besides the hydroelectric energy recovered and used for the reverse osmosis, the energy needed for the operation of the plant is entirely offset by the green electricity produced by two wind farms. The plant has the biggest green roof in Australia and it is surrounded by a 225-hectare ecological reserve creating a biosphere for local flora.

... and a challenge for human resources
The project was also a challenge in terms of human resources: at peak construction time, 4,200 workers of 20 different nationalities were employed on site every day.

Features of this BOT contract

- **2 undersea tunnels** with a total length of 2.7 km
- **84 km** of treated water pipelines, composed of 7,000 pipes
- **87 km** of 220kV underground cables, a world record
- **29** buildings
- **51** reverse osmosis racks
- **55,000** membranes
- **72** pumps for the dual media filters
- **486** ERI® PX 260 energy recovery systems
- **37 months:** record construction time
- **27 years:** duration of plant operation by SUEZ

BARCELONA, Spain

Innovative treatment of brines and an optimal environmental footprint
The plant is a key element in the supply of drinking water to the Barcelona region. It can produce up to 200,000 m^3 of desalinated water per day, making it the biggest desalination plant in Europe.
It was built in just two years and provides high-quality water.
All the pilot studies and laboratory analyses were both profitable for optimising the design and operating costs, and minimising the impact of brines on the marine environment.

Features

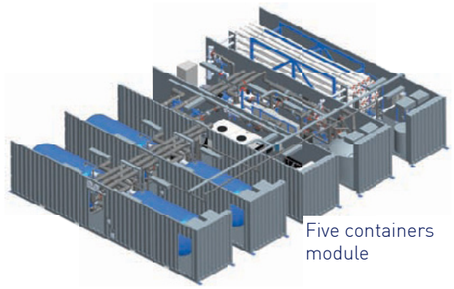
Innovative treatment of brines by:
- **mixing brines with** water treated by the Baix Llobregat wastewater treatment plant
- **treating all brines** before dispersing them more than 3 km from pumping at a depth of 50 metres

Optimisation of the plant's environmental footprint by:
- **recovering energy** from the first reverse osmosis pass using a system of 23 PX220 ERI® per rack
- **wind energy**
- **photovoltaic panels** installed on the roofs of all the buildings and reservoirs

Annual CO_2 savings of over 850 tonnes.

RIYADH, Saudi Arabia

Modular units in containers
33 brackish water desalination plants were installed in just five months, at 14 sites, to treat the 165,000 m^3/day supplying drinking water to the population of Riyadh and the surrounding area.


Five containers module

Collaboration between the experts of the International Division of SUEZ in the Middle East and those from the Industrial Solutions Metier in the United States - specialized in modular units in containers - was the key to accomplishing this project, which responds to the local authorities' aim of sustaining strong demographic growth in a country of scarce freshwater resources.

Features

- **Modules in containers** with an individual capacity of 5,000 m^3/day;
- **Each module** is composed of five containers: two for pre-treatment on dual media filters, two for treatment by reverse osmosis membranes and one for final treatment and supply pumps;
- **26 containers** located at 13 sites, the biggest being at Salboukh with a drinking water production capacity of 30,000 m^3/day;
- **7 containers** supply the site of Al Buwaib with 35,000 m^3/day of drinking water.

flagship realisations
for industry

MINERA ESCONDIDA, Chile
The reverse osmosis seawater desalination plant at Minera Escondida (Chile's second biggest copper producer/exporter) produces 45,000 m³/day of process water for its mine in the Antofagasta region at an altitude of 2,800 metres. Desalination enables the mine's production capacity to be increased to meet the sector's future development and at the same time saves using surface water in this desert area. Pre-treatment is carried out in various stages integrating the SeadafTM rapid flotation process which is able to deal with the chronic "red tide" phenomenon (proliferation of red microalgae).

FPSO* units
In the oil offshore exploration and production field, SUEZ offers to supply FPSO vessels with innovati systems: nanofiltration systems able to extract sulphates from seawater injected into the wells to bring the oil to the surface and with reverse osmosis refining. In 2013 and 2014, SUEZ has equipped six vessels.

* FPSO = Floating, production, storage and offloading

KONIAMBO NICKEL SAS, New-Caledonia
A seawater desalination plant supplies freshwater to the Koniambo Nickel SAS complex, an industrial site near Koné in New Caledonia, set to become one of the world's biggest nickel producers. Producing 129 m³/h of drinking water and 53 m³/h of demineralised process water for boilers and cooling circuits, this plant is vital for the growth of Koniambo's mining activity.
The plant is composed of 30 units, assembled, wired and fitted with remote entry/exit systems, the necessary instrumentation and electrical control cabinets, all totally automated. State-of-the-art technologies for pressure exchangers (ERI) and electrodeionisation are integrated in autonomous units which meet oil and gas industry standards.
Omobile units were ordered to provide the excess production needed during the plant and power station commissioning.

CHENGDU, China
The oil refining industry in China is facing major challenges: rapid growth of the market, increasingly limited water resources, and increasingly rigorous legislation on discharge.
The principal challenge for Petrochina's Chengdu refinery was to have a treatment plant for wastewater that would enable re-use of the treated water as industrial process water. The plant has a complex tertiary treatment line with total capacity of 67,000 m³/day. The performance of this treatment has enabled a reverse osmosis stage to be included on the main water line.
Separately, a specific treatment line with a capacity of 10,300 m³/day, also by reverse osmosis, is dedicated to the treatment of brines.
The quality of the treated water allows the reuse of 23,300 m³/day for the plant's processes, saving the region's water resources and ensuring that the wastewater discharged complies with regulations.

Global Water Awards*...
... recognition from our peers

2007
Desalination plant of the year
Perth (Kwinana), Australia
Desalination plant of the year
(highly commended)
Wadi Zarqa Ma'in, Jordan

2010
Desalination company of the year
Desalination plant of the year
Barcelone-Llobregat, Spain
Desalination project of the year
Victorian desalination plant, Melbourne, Australia
Energy and Water, plant of the year
Barka II, Oman

2012
Water company of the year
(distinction)
Desalination plant of the year
(highly commended)
Al Dur, Bahrain

2013
Desalination company of the year
(distinction)
Desalination plant of the year
Victorian desalination plant, Melbourne, Australia

2014
Desalination Deal of the year
Victorian Desalination Project refinancing, Australia
Water Project of the year
Riyadh water supply enhancement programme, Saudi Arabia

2015
Desalination company of the year
(distinction)

* Organised by the journal Global Water Intelligence, the Global Water Awards recognise excellence in business, projects and technologies, as well as teams that have made the di! erence in the water treatment industry worldwide in the past year. They are judged by the water sector experts.

a partnership strategy and a proximity commitment

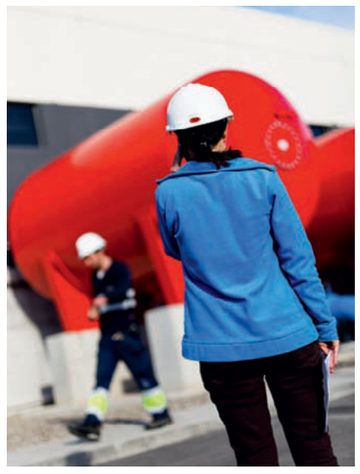
to consolidate and enhance the added value of its products and services,
SUEZ is committed to genuine partnerships and maintains constant dialogue with clients

Technological cooperation creates value and differentiation

With its expertise in desalination and experience acquired at numerous plants, SUEZ teams up with appropriate equipment manufacturers to develop and optimise new treatment solutions, new reverse osmosis membranes, new energy-recovery systems and new sources of alternative energy.
In addition, by calling on partners to contribute on know-how outside its own areas of expertise, SUEZ has extended its scope and competitiveness. Being competitive is not just a question of price. It also means acting on a whole set of parameters such as timescales, quality and technological differentiation.

Programmes with local authorities and industry

SUEZ develops partnerships with some of its major clients, especially through research programmes and in the field of social and environmental responsibility. This approach helps SUEZ to understand the challenges they face.



Customised associations

SUEZ is committed to Alliance contracts with some of its clients, especially for the joint management of water and wastewater services, with the aim of optimising costs and delivering environmentally friendly performance.

Constantly listening to clients

Understanding their stakes, anticipating their needs, innovating and controlling costs... by being always in tune with its clients, SUEZ offers treatment solutions which match their objectives and address the challenges that water represents for them. In this way:

- local authorities can provide the population with desalinated drinking water of guaranteed hygienic quality, in accordance with local health, safety and environmental standards;
- industry can increase their competitiveness thanks to reliable process water and effective purification of their effluent, while reducing environmental impact and continuously complying with the ever so stringent regulatory standards.

a culture of innovation and industrial excellence

SUEZ's water treatment specialists create the best technological, commercial, logistical, financial and contractual solutions to address its clients' requirements

Customers are the source of anticipation and innovation

SUEZ's global reach enables it to anticipate and detect early indications of major changes that will affect everyone with an interest in desalination. For the water treatment specialists, innovating means putting customers and their needs at the heart of the process. SUEZ's teams are perfectly positioned to analyse evolving requirements, devise tomorrow's solutions and adapt to local conditions. This approach is conducive to generating original solutions – not only from a technological, but also a financial, contractual and logistical standpoint – that best respond to global or local needs.

Dedicated specialist teams

Having desalination experts in design, build, equipment and operation, SUEZ is able to draw on the particular skills of its employees for each project to create a response that meets the specific needs of its clients.
The commitment and motivation of its teams enable SUEZ to deliver efficient and reliable desalination plants and units to its customers, within short timescales and at an optimal capital and operating cost, and to guarantee the quality of water they require whether for consumption, industry or agriculture.

Responsible involvement at all stages of the project

For example, by signing a BOT (Build, Operate, Transfer) contract, SUEZ is committed:

- over the long-term, from design, during operation and through to transferring the plant;
- to integrating responsibility for raising the necessary finance;
- to establishing the legal framework for the project;
- to securing completion of the project by involving selected partners to contribute added technical or financial value, specific know-how and local knowledge.

A BOT contract involves SUEZ in long-term commitment and service to the customer, guaranteeing the performance of the plant in terms of volume and quality of the treated water.

contacts

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