micropollutants

anticipating future challenges

ready for the resource revolution

suez

micropollutants,
an environmental challenge...

The change in our consumption patterns is leading to the appearance of new pollutants in water. Called "micropollutants", these emerging pollutants are found in very low concentrations, by the micro or nanogram per litre. Even at trace levels, they are becoming a hot topic for local authorities and industries in the protection of receiving environments.

The progress in the field of laboratory testing increasingly highlights the presence of micropollutants in the aquatic environment. They encompass tens of thousands, or perhaps even hundreds of thousands of molecules likely to have direct or indirect potentially chronic effects on ecosystems, even at very low concentrations.
As a specialist in water treatment, SUEZ anticipated this problem and developed the treatments needed to reduce the impact on the natural environment and to promote the increased protection and preservation of water resources.

Widespread awareness

- **In Europe,** the Water Framework Directive (Directive 2000/60/EC) promotes the principle of rectification, by focusing on the source, of environmental damage. Europe still does not require that wastewater treatment plants treat micropollutants. It has drawn up a list of substances that member states must monitor by implementing appropriate programmes of measures. These efforts are also enhanced by the REACH regulation, a system established in 2006 requiring the risks of 30,000 chemical substances to be identified and assessed.
- **In France,** while the directives do not yet require the implementation of specific treatment for micropollutants by wastewater treatment plants, controls on outflows of micropollutants have been mandatory since 2011 for wastewater treatment plants with a capacity of more than 100,000 population equivalent (PE) and since 2012 for those with a capacity of more than 10,000 PE.
- **In Switzerland,** the ordinance on water protection ("OEaux") defines an average purification rate of 80% in relation to raw water for some indicator substances belonging to the following areas of application: household chemicals, medicines and biocides. This requirement relates to some one hundred Swiss wastewater treatment plants which should also have a process in place to remove trace amounts of organic substances.

Limiting the impact on the ecosystem

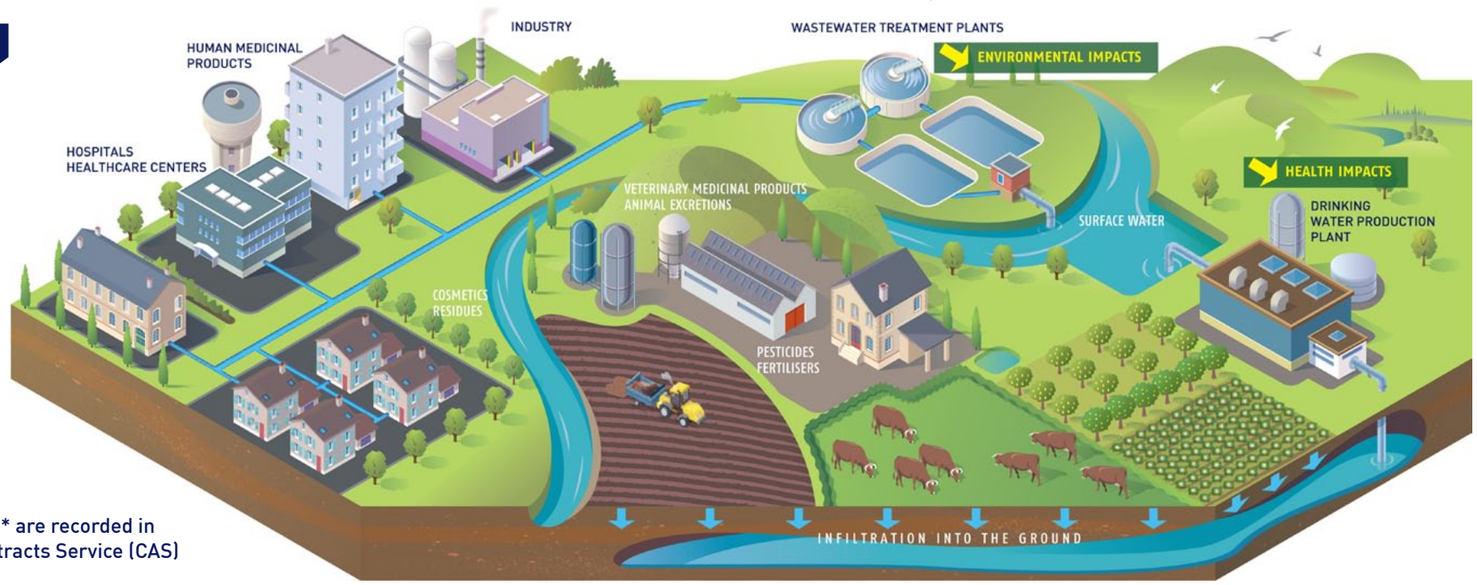
- **Reduce emissions at source:** rational use of micropollutants in our daily activities (industries, hospitals, the medical sector, agriculture, at home, etc.).
- **Preserve resources:** by reducing micropollutants, we can protect the environments and resources used in the production of drinking water.

65
million molecules* are recorded in the Chemical Abstracts Service (CAS) database.
* end of January 2012

30,000
substances, imported or manufactured in quantities of more than 1 tonne/year have been identified and had their risks assessed. (European "REACH" regulation)

100,000
chemical substances on the European market in 2012

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®.



Origines could be multiple, one-off, diffuse...
Micropollutants arrive in the natural environment mainly through municipal or industrial wastewater, agriculture, hospital activity, transport and machinery, direct emissions and atmospheric fallout.

Major families of micropollutants
- mineral micropollutants such as metals and metalloids, radioactive elements: lead, cadmium, mercury, arsenic, antimony, radon, uranium, etc.
- organic micropollutants: pesticides, hydrocarbons, solvents, detergents, cosmetics, medicinal substances, etc.

...anticipated by SUEZ

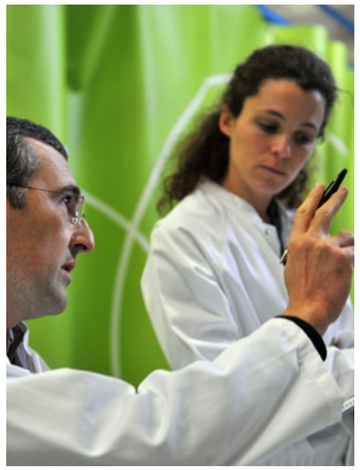
Ambitious research programmes

For more than ten years, SUEZ, has been participating in various research programmes* that the group conducts with its partners (institutions, universities, local authorities, etc.) in the field of micropollutants.
Controlling industrial, urban and storm water discharges, measuring concentrations of micropollutants in water, and assessing the removal capabilities of different purification systems, are just some of the facets of the various national and international programmes seeking to guarantee the good condition of aquatic environments and the water distributed, and to maintain all water activities and uses in a way that is both sustainable and cost effective. Ultimately, they are reflected by the development of innovative processes and methods in order to control the whole water cycle: drinking water, urban wastewater, storm water and industrial waters.

*(AMPERES, Poseidon, Rhodanos, Mediflux, PCB-Axelera, PRISTINE Wastewater, ARMISTIQ, SIPIBEL, Nanosep, etc.)

Effective solutions are already available

As a specialist in water treatment, wastewater treatment and drinking water production, with detailed and in-depth knowledge of numerous existing processes, technologies and equipment, SUEZ already has the solutions and the expertise needed to offer effective combinations for the treatment of micropollutants present in water.



treatment processes

mastered by SUEZ

Micropollutant removal mechanisms involved depend on the physicochemical features of each compound present in water. Within the same family, the compounds can be hydrophilic or hydrophobic, adsorbable, volatile or semi-volatile, biodegradable, refractory, with a high or low molecular weight.

Biological degradation

It uses a wide variety of micro-organisms, principally bacteria which make up the purifying biomass. They convert biodegradable materials through the absorption of soluble and suspended particles contained in wastewater to make simple products such as carbon dioxide and additional biomass, or nitrate and nitrogen gas. Some bacteria mineralise the micropollutants by using them as a source of carbon and energy. Aeration and stirring also cause certain molecules to volatilize. The more thorough the biological treatment is, the more effectively it removes micropollutants.

Physicochemical oxidation

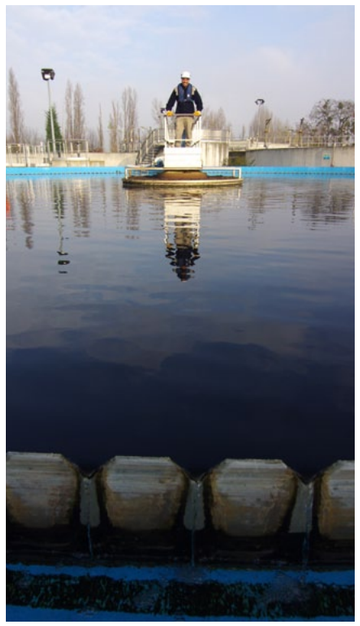
Beyond disinfection, physicochemical oxidation is also used in water treatment to degrade organic compounds and to convert non-biodegradable pollutants into substances that can be assimilated by bacteria.
The choice of oxidant to be used is dictated by its good selectivity for the targeted pollution.

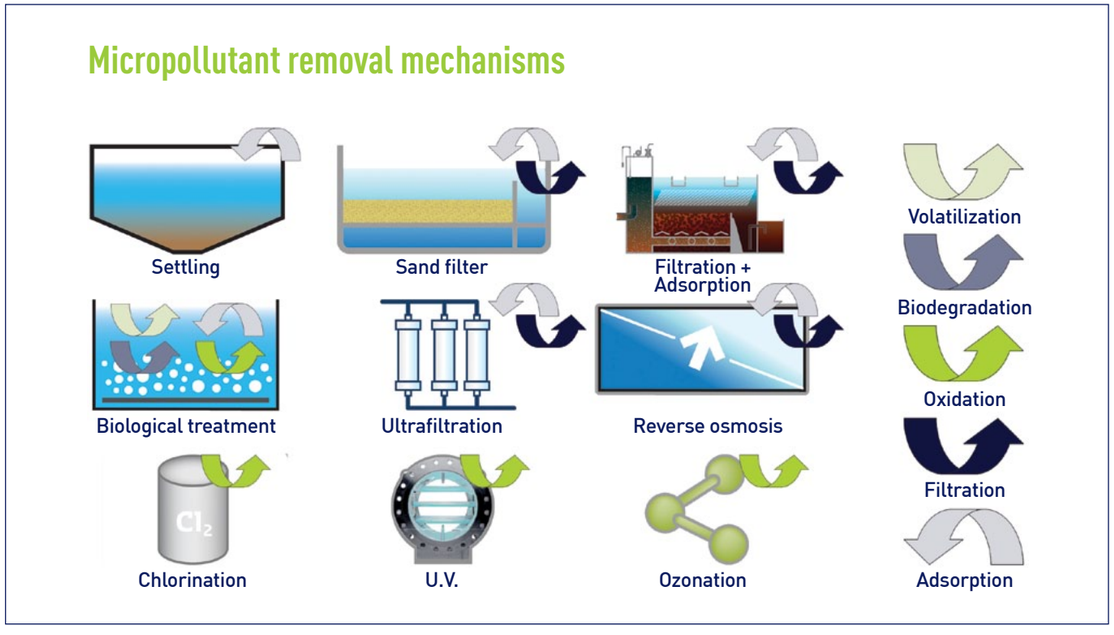
Adsorption

It results in attaching molecules on the surface of an adsorbing solid according to different processes that vary in intensity. In the case of water treatment, activated carbon tends to be used for the adsorption of micropollutants. This material is presented either in granular form in a filter, or in a powder form generally in an activated carbon contactor/separator.

Clarification

Settling and filtration remove micropollutants from water, mainly by trapping the suspended solids on which they are attached.





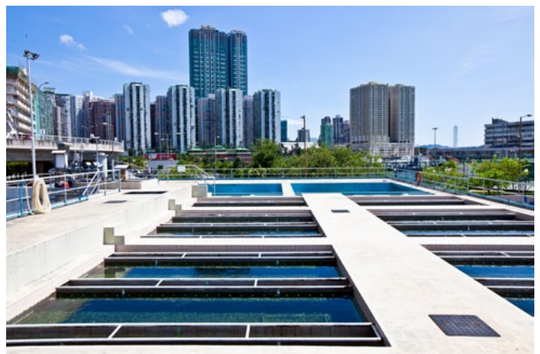
High potential for the removal of micropollutants by wastewater treatment plants

Wastewater treatment plants

Wastewater treatment plants constitute a major point of transit for micropollutants. Conventional biologic treatment technologies partly remove wastewater micropollutants before returning to the natural environment. The various removal mechanisms involved have variable performances (from 20 to 95 %) depending on the type of the treated compound, the treatment process parameters and the conventional level off treatment (carbon and/or nitrogen removal). Additional treatments can be necessary according to the compulsory discharge concentrations. Considering these requirements and considering the various compounds, it will be more effective to implement a combination of micropollutant removal mechanisms. Presently, using adsorption and/or chemical oxidation as refining treatments is a good technical and economic compromise.

Drinking water production plants

In drinking water production, conventional refining processes remove numerous micropollutants, including pesticides.
In France, the national campaign for analysing medicinal residues in water conducted by the National Agency for Food, Environmental and Workplace Safety (*l'Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail* – ANSES) showed that 75% of the treated water samples analysed did not contain any of the 45 molecules sought, whereas the cumulative concentrations were significant in raw water.



degremont® technologies are ready to meet the challenges of the future

For each requirement, a solution

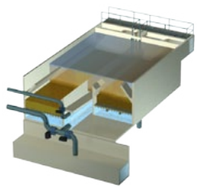
As designers and integrators of efficient technologies and processes, SUEZ's water treatment experts are developing customised technological solutions. Moreover, thanks to their wide range of proven technologies, they are formulating the best technical combinations to anticipate future issues and rise to the challenge of micropollutants.

The choice of a treatment technology, whether it be conventional or advanced, depends upon the molecules to be removed, the objectives sought and the investment and operating costs.

In single or combined use, these treatments can reduce by more than 95% the flow of micropollutants quantified when entering the wastewater treatment.

Tertiary filtration treatments

Filtration traps micropollutants fixed on suspended solids

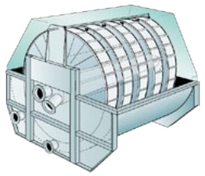


Aquazur™ V

Open sand filter trapping suspended solids and particles. Besides providing fast descending current filtration rates, the Aquazur™ V is simple to use, making it a process suitable for all water treatment plants. Placed either above or below a settler, for drinking water production or wastewater treatment, it helps to trap micropollutants fixed on suspended solids and contributes to the production of high-quality filtered water.

Ultrablue™

Ultrafiltration membranes allowing small molecules (water and salts) to pass through and stopping molecules with a high molar mass (polymers, proteins, colloids). The water treatment systems in this range are used in a treatment process for their efficiency in terms of reduction of suspended solids, disinfection and removal of the micropollutants fixed on trapped particle matter.

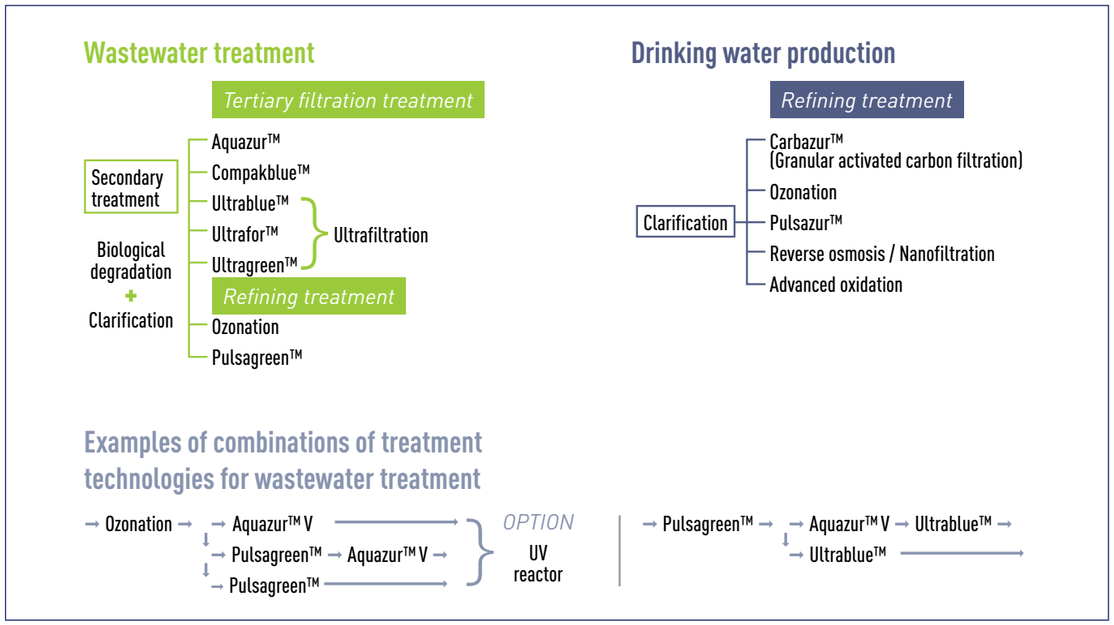


Compakblue™

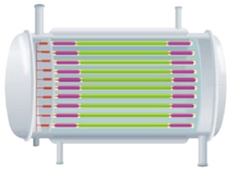
Immersed disc filter recommended for the reduction of suspended solids and associated pollutants in tertiary filtration of urban wastewater. This solution, an alternative to conventional filtration on a granular media, is particularly suited for discharge into sensitive areas and offers the same performance for a footprint a quarter of the size.

Ultrafor™ and Ultragreen™

Membrane bioreactors (MBR) combining advanced clarification through ultrafiltration membranes (hollow fibre membranes for Ultrafor™ and flat-sheet membranes for Ultragreen™) and biological degradation of pollution. The macromolecular metabolites stopped by the membranes are gradually biologically degraded. The effluent is of high quality, compliant with the standards for discharges in sensitive areas or for re-use. The MBRs seem more effective for 20% (results of the AMPERES project) of the substances partially eliminated in conventional activated sludge or very adsorbable.



Refining treatments used in wastewater treatment and drinking water production



Ozonation

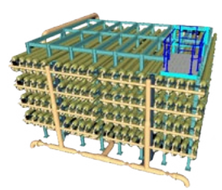
Ozone, made up of 3 oxygen atoms, has a very high oxidising capacity. By oxidising the organic substances, ozone destroys a number of micropollutants (or makes them more easily biodegradable) and pathogens (viruses and bacteria).
It breaks down a wide spectrum of persistent organic micropollutants in effluents and also acts on the colour and organic macropollution.
Regulatory changes in recent times have brought about its deployment in Europe to combat micropollutants.
Advanced oxidation technologies (AOP type - Advanced Oxidation Processes) can also be used.

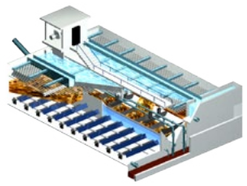
Reverse osmosis

Membrane process using semi-permeable membranes that allow water to pass through and prevent all salts and almost all micropollutants from passing through due to the cut-off thresholds of the membranes adapted to the molecular sizes and weights of compounds to be trapped.

Nanofiltration

Membrane process ensuring the separation of compounds in solution with a size similar to that of the nanometre. This technique can also be used to soften water.





Pulsazur™ and Pulsagreen™

Lamellar clarifiers using a powdered activated carbon (PAC) pulsed blanket dedicated respectively to the treatment of water for drinking water production and wastewater treatment. These clarifiers allow the reduction of the majority of micropollutants. Their effectiveness is even greater on adsorbable compounds such as pesticides and alkylphenols. Previously conditioned, water circulates regularly and uniformly in the structure, from the bottom to the top, by crossing the PAC blanket. The pulsations optimise the contact of the dissolved organic matter and the micropollutants with the activated carbon, promoting their adsorption, then their removal during the lamellar settling.
Effective and economical, they are also environmentally-friendly: they can operate with or without polymers and they use fewer reagents and consume less energy. The activated carbon is being continuously renewed.

flagship realisations for local authorities and industry

Valbonne-Sophia Antipolis (France)

Biofiltration + Ozonation + Biofiltration

The new Les Bouillides wastewater treatment plant at the Sophia Antipolis site, commissioned in spring 2012, is the first facility in France, and one of the first in the world, to have a process designed to remove micropollutants from water. Thus, the plant guarantees that the receiving environment and the water table used for drinking water production are protected. Placed between the nitrification and denitrification biological treatment stages performed by biofiltration, ozonation fits perfectly into the existing design. SUEZ proposed a CFV-10 generator from its ozonia® line of products. This type of generator is scalable in terms of capacity and which is perfectly suited to the plant's challenges as it develops.
SUEZ is participating in the ongoing Micropolis project at the plant. This project aims to optimise operating conditions and to assess the efficiency of removing micropollutants using chemical and biological indicators.

Dübendorf, canton of Zurich (Switzerland)

Ozonation + Aquazur™ V

In spring 2014, the ARA Neugut wastewater treatment plant in Dübendorf in the canton of Zurich became the first in the country to treat micropollutants. The objective: protect its receiving environment and particularly Lake Zurich, in accordance with the new legislation in effect in Switzerland, a pioneer country in the fight against micropollutants. By selecting an ozonia® product, the town of Dübendorf chose the know-how and expertise of SUEZ to make optimal use of ozonation. The ozonation stage was integrated upstream of the existing sand filters.

Colmar (France)

Clarifier on a pulsed PAC blanket - Pulsagreen™

At the Colmar wastewater treatment plant, the water treatment specialists of SUEZ are conducting industrial validation tests on the performance of the Pulsagreen™ system, lamellar clarifiers using a powdered activated carbon pulsed blanket, for the treatment of macro and micropollutants. The tests relate to performance characterisation and operating specifics (types and doses of carbon, contact time, etc.) in accordance with the characteristics of the water to be treated and the quality objectives to be achieved.

EUREKA LABEL

As part of the Triumph project conducted at the SIPIBEL(1) pilot site in Bellecombe (74), France, SUEZ and its partners were awarded the Acqueau Eureka(2) label in 2012. Led by Degrémont at that time, this project involves new technologies for treating urban micropollutants and pharmaceuticals in wastewater.

The SUEZ expertise

The SUEZ's teams specialised in disinfection, are pioneers in the field of micropollutant treatment by ozonation, with for example the pilot scheme in Lausanne (Switzerland), as well as operational reactors at the plants in Sophia Antipolis (France), Dübendorf (Switzerland) and Montreal (Canada). To produce the ozone required for all types of applications, SUEZ developed a complete range of reliable, flexible generators that are easy to install and use.

(1) SIPIBEL (Bellecombe pilot site) is a federator observatory funded by French and European public partners. It involves scientists and territory's actors.
(2) Acqueau is the Eureka cluster focused on industry and dedicated to technologies for the water sector. Its purpose is to promote and fund innovation.

SIPIBEL(1) - Bellecombe pilot site (74)

SUEZ is the industrial partner of the SIPIBEL research programme, a project dedicated to the in-depth study of micropollutants at wastewater treatment plants. This project studies the additional treatments to be offered to upgrade the performance of existing wastewater treatment plants. It is focused on the physicochemical, microbiological and ecotoxicological characteristics of effluents, discharges and the receiving environment, with a specific monitoring of micropollutant flows and medicinal residues at the Bellecombe experimental pilot site.
Thanks to the EUREKA label, via this project, SUEZ's water treatment specialists test innovative integrated technologies to treat urban micropollutants and those found in hospitals through ozonation coupled with biological oxidation. The fate of micropollutants in sludge from wastewater treatment plants is also studied.

17 drinking water production plants in France

are equipped with **Pulsazur™**, technology, a lamellar clarifier using a powdered activated carbon (PAC) pulsed blanket, for the refining treatment of organic matter, disinfection by-products and micropollutants.

References	Capacity (m³/d)
Montours	3,000
Gorron	3,600
Le Houlme	4,000
Saint-Hilaire-du-Harcouët	4,000
Belle-Île-en-mer	5,000
Vire	5,000
Avranches sud	8,000
Vierzon	10,000
Châteaubourg	12,000
Plouenan	12,000
Saumur	19,000
Bellac	20,000
Côteaux du Touch	24,000
Rennes Mézières	25,000
Apremont	40,000
Rennes villejean	80,000
Saint-Étienne	100,000

SUEZ 's test platform to master micropollutants in drinking water

a partnership strategy and a proximity commitment

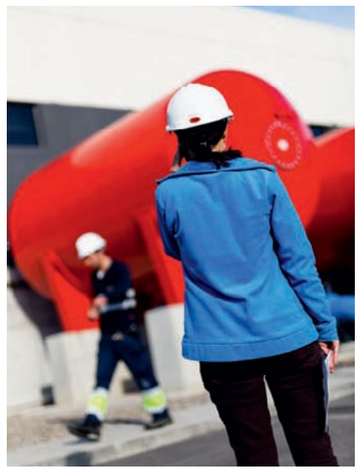
to consolidate and enhance the added value of its products and services,
SUEZ is committed to genuine partnerships and maintains constant dialogue with customers

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 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 customers, 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 drinking water to the population and treat wastewater 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 customers' 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 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 customers. The commitment and motivation of its teams enable SUEZ to deliver efficient and reliable 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.

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ready for the resource revolution

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