The AIGUANEIX newsletter

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CONSORCI D'AIGÜES COSTA BRAVA GIRONA

Diputació de Girona

INTERVIEW

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When water puts us to the test

Water management is one of the great challenges of the 21st century. Access to water can no longer be taken for granted, especially in contexts of drought such as those we will undoubtedly experience more often due to climate change. On this scenario, we need to rethink not only where we get our water, but also how we treat it and what route it needs to take before being used again.

Water reuse is an alternative with great potential, but also great complexity. Treating wastewater to convert it into water suitable for human consumption involves dealing with pollutant loads that go far beyond the usual levels. Conventional treatment technologies, designed to purify water originally of good quality, prove insufficient in this case. We need to go further, intensify processes, innovate, and often explore the limits of current knowledge.

When we talk about emerging pollutants, such as hormones, heavy metals or disinfection by-products, we are not talking about substances present in concentrations of milligrams per litre, but in minute concentrations, of micrograms and even nanograms per litre. Detecting and eliminating these substances requires advanced technology, but also a new way of thinking about water management: more precise, more demanding, and above all, more collaborative.

It is at this intersection of perspectives that the AIGUANEIX project is structured and developed, as an alliance between research centres such as the Catalan Institute for Water Research (ICRA), water sector companies and public authorities such as the Costa Brava Girona Water Consortium and the Girona Provincial Authority. This joint, multidisciplinary approach provides the key to realising a goal that until recently seemed utopian: obtaining analytically drinkable water from treated water. It is not just a technological milestone; it is a commitment to resilience and a future in which water becomes a circular and valued resource.

According to a wise African saying: "If you want to go fast, go alone; if you want to go far, go with others." And on this path, both technical and profoundly human, progress can only be made through this multidisciplinary collaboration.

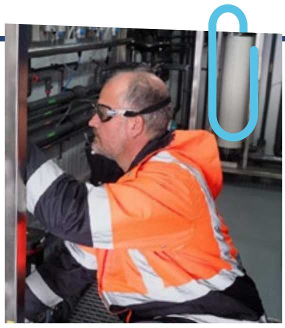
"We need to rethink not only where we get our water, but also how we treat it and what route it needs to take before being used again"

"It is at this intersection of perspectives that the AIGUANEIX project is structured and developed, as an alliance between research centres, water sector companies and public authorities"

Getting to know the project

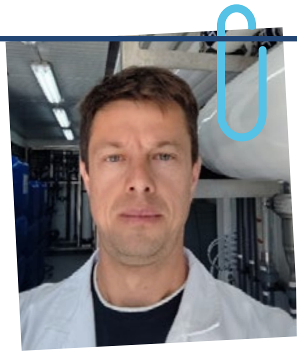
The team managing the pilot plant

The AIGUANEIX project continues to advance with the aim of achieving purified water that meets all standards. The experimental phase is currently under way, and in this newsletter we present the team from UTE Transparenta Sanejament Costa Brava, the joint venture operating the Roses wastewater treatment plant (WWTP), in charge of experimental operation of the pilot plant.



Toni Rosselló Ramisa

- Plant operation coordinator.
- Environmental sciences graduate Toni Rosselló has twenty-four years of experience in the water sector, from sanitation to purification.



Dan Mihai Cozma

- Plant operator.
- Environmental sciences graduate Dan Mihai is interested in the management and conservation of water resources. He is currently studying for a master's in water resource science and technology at the University of Girona.

Bianca Zappulla Sabio

- Researcher.
- Industrial chemical engineer Bianca Zappulla is doing her doctoral thesis on reverse osmosis membrane recycling at the University of Girona's Environment Institute.

Tomàs Lock Feixas

- Researcher.
- A chemistry graduate with a master's in environmental engineering, Tomàs Lock is currently doing his doctorate at the Catalan Institute for Water Research, where he specialises in advanced oxidation processes.

What stage are we at?

"The goal of the Costa Brava Girona Water Consortium (CACBGI) is to have a full-scale facility by 2027"

Lluís Sala

Construction

April 2024. Arrival of the base container for the pilot plant at the workshop.

May-November 2024. Assembly of the pilot plant and the treatment and control systems.

July 2024. Modifications to the Wastewater Treatment Plant (WWTP) at Roses.

November 2024 - January 2025. Installation of the pilot plant at the Roses WWTP.

January-May 2025. Commissioning of the pilot plant at the Roses WWTP.

Experimentation and analysis

May-September 2025. Start of the experimentation stage. The technical team tests the different operating conditions, takes samples and analyses the water, to make the necessary adjustments to achieve the project's ultimate aim.

September 2025 - May 2026. Analysis of the results obtained. Additional tests to assess the ongoing viability of the system of operation chosen.

Completion

May 2026. Assessment of the plant's operation and application of the project at full scale, and presentation of results.

2026-2027. Construction of a full-scale purification plant to recharge aquifers in the northern Costa Brava region.

General information

The six stages ensure very complete treatment, aimed at recharging aquifers for drinking water supply

The AIGUANEIX project is committed to a multi-barrier treatment train in order to achieve safe, high-quality water

The path to purified water

To achieve safe, high-quality water, the AIGUANEIX project is committed to a multi-barrier treatment train. This combination of technologies works sequentially and in coordination to eliminate a wide range of pollutants, both biological and chemical. The process includes six stages that ensure highly complete purification, aimed at recharging aquifers for the drinking water supply.

The first stage begins with the addition of monochloramine, a disinfectant that prevents the growth of microorganisms in the initial phases of treatment. This substance does not damage the membranes used later, unlike other more aggressive disinfectants.
The next step is ultrafiltration (UF), which acts as a physical barrier against bacteria, viruses and suspended solids. Although it does not eliminate dissolved chemical compounds, it does greatly reduce the microbiological and particle load, thus protecting the reverse osmosis (RO) membranes.

Reverse osmosis is applied in two consecutive phases that serve to eliminate more than 99% of dissolved salts, pharmaceuticals, micropollutants and other chemical compounds. This is a key stage in guaranteeing extremely pure water, with the second application further refining the result of the first filtration.

The combination of technologies works sequentially and in coordination to eliminate a wide range of pollutants

Synergies that guarantee safety and sustainability

Once reverse osmosis is complete, the water goes through an advanced oxidation process. This technique combines hydrogen peroxide and ultraviolet light, generating radicals that destroy the most persistent organic pollutants. It is a highly effective additional barrier, especially for compounds that can cross through osmosis membranes.

The purified water is then fed into granular activated carbon filters, to provide a final polish. This stage eliminates compounds that affect taste, odour and chemical quality, and adsorbs any remaining by-products that may have been generated in the advanced oxidation process.

The last step is remineralisation, in which essential minerals such as calcium and magnesium are reincorporated. This phase ensures that the water is non-corrosive, compatible with pipes and infrastructure, and suitable to be safely injected into aquifers.

The multi-barrier model adopted by AIGUANEIX not only offers numerous layers of protection, but also guarantees a robust response to any type of pollutant. Furthermore, the chosen technologies work in synergy: each reinforces the one before, and facilitates the task of the next. This makes for efficient and sustainable operation, and ensures that the final water meets the highest quality standards for human use and the protection of water resources.

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Debunking myths

In this section, we aim to debunk some of the most common misconceptions about water purification through the use of facts and scientific studies

1 "There is no need to purify water, now it has rained"

March 2025 saw the end of the drought that Alt Empordà had been suffering since 2021. The Darnius Boadella reservoir recovered almost 21 hm^3 and exceeded 50% of its capacity for the first time in more than two years. However, droughts are cyclical in the Mediterranean climate, and we need to prepare for the future. One key strategy is the regeneration of treated water to recharge aquifers intended for supply, especially in a context of global warming and increasing pressure on water resources.

2 "It is better to solve the problem of scarcity by drilling more wells"

The recent drought has shown that we can go for months or years with rainfall figures much lower than usual. These figures have caused water tables to drop sharply, and saline intrusion has occurred in coastal aquifers. Sinking more wells is no guarantee of more water unless it rains. Meanwhile, purifying water and artificially recharging aquifers, especially on the coast, does provide a valuable additional resource. This measure will help keep aquifers in optimal condition, both in quantity and quality, and will become vital in dealing with future periods of drought.

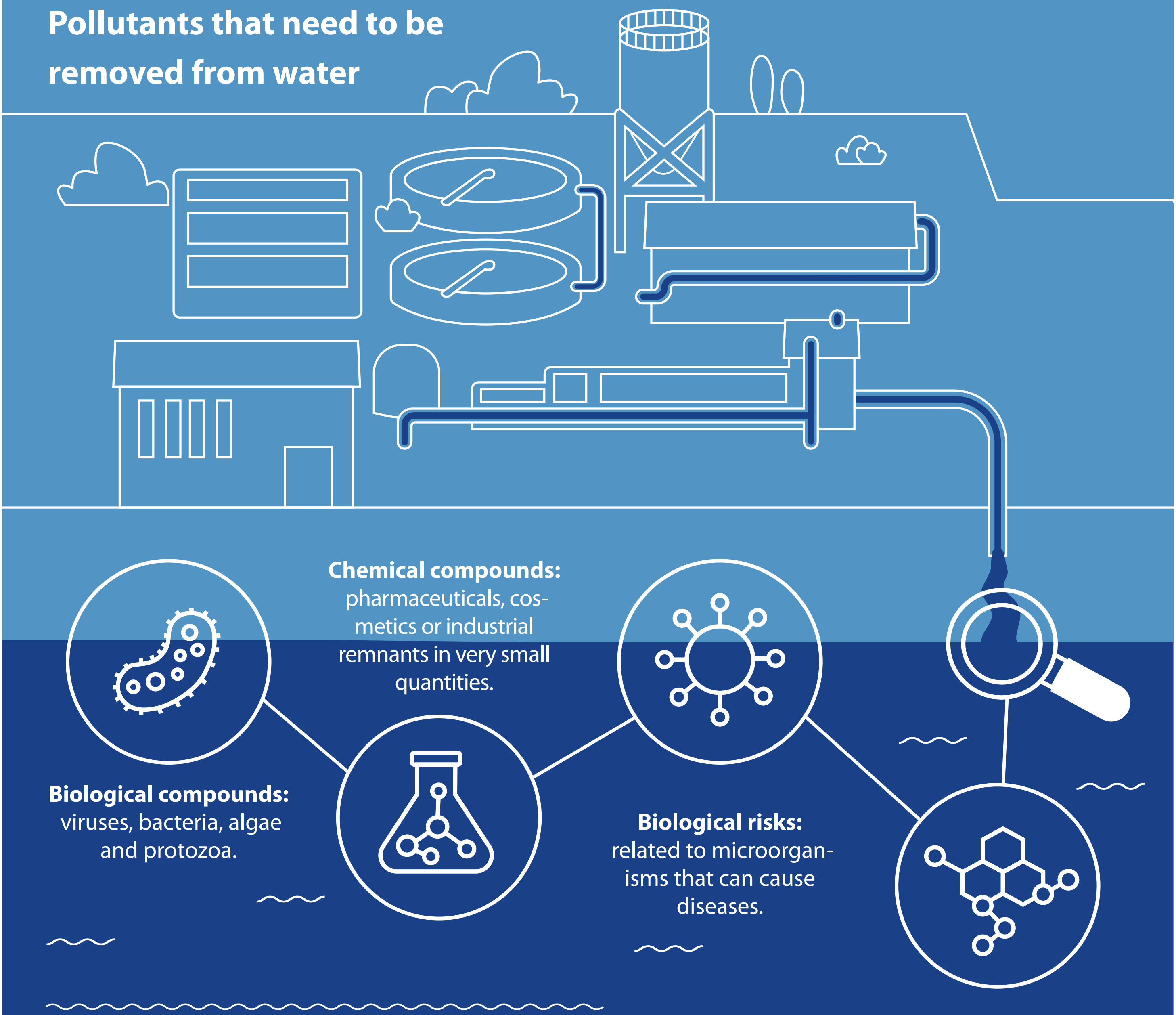
3 "This expense is unnecessary; the plants could be built at real scale from the outset"

Purifying wastewater to obtain distilled water is a complex process, since many types of pollutant must be eliminated. Although we have efficient technologies, they must be combined correctly, in terms of both design and operation, to guarantee safe water for subsequent reuse. These facilities are very expensive and can only be built with well-defined projects, not off the cuff. Pilot initiatives like AIGUANEIX are essential, in serving to validate technologies and ensure that future investments are efficient and effective, and avoid any waste of economic and technical resources.

Taking a look at AIGUANEIX

The water that leaves the treatment plant after conventional treatment may still contain unwanted substances that can pose different risks.

Pollutants that need to be removed from water



Biological compounds: viruses, bacteria, algae and protozoa.

Chemical compounds: pharmaceuticals, cosmetics or industrial remnants in very small quantities.

Biological risks: related to microorganisms that can cause diseases.

Chemical risks: related to substances that can have harmful long-term effects, even in very low concentrations.

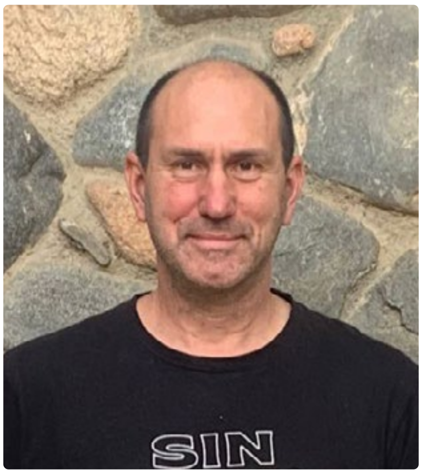
To obtain safe and reusable water, it is essential to apply advanced treatments that guarantee the elimination of these pollutants.

The interview

Alfredo Pérez

Physicist and expert in underground hydrology

"Water management should be addressed as a national challenge, promoting collaboration and trust between the scientific world, institutions and managers"



Alfredo Pérez is a physicist by training and has a doctorate in hydrogeology, specialising in backfilling in managed aquifer recharge facilities.

With more than twenty years of experience in the water sector, Alfredo Pérez has been a member of the Catalan Water Agency (ACA) since it was first founded, and is currently responsible for the Technical Unit of the Concessions Department in the Water Supply Area, working towards the sustainable management of water resources in Catalonia.

What is the current state of aquifers in Catalonia?
In the river basin district of Catalonia, where the ACA has full powers, the general trend is not a positive one. In each of the three six-yearly planning reviews carried out, an increase has been observed in the number of groundwater bodies with poor quantitative status. Furthermore, many of these bodies have an excess of nitrates, a problem that is compounded by salinisation due to marine intrusion and the presence of emerging pollutants.

What regulations are there for aquifer recharge?
For years, regulations on aquifer recharge have been rather unfavourable. However, the recent update of the State Public Water Domain Regulation no longer considers such actions to be discharges. And the new state reuse regulation establishes that the artificial recharge of aquifers with reclaimed water is not considered a use, but an environmental destination.

Catalonia is in the vanguard when it comes to water, and aquifer recharge is no exception

What are the main challenges in implementing water reuse projects for aquifer recharge?
The main challenge is the control of discharges, since sewage treatment plants are not facilities designed to eliminate salinity or pharmaceutical compounds, pesticides or industrial chemicals. We also have to implement regeneration systems that improve water quality, combining technological systems with nature-based solutions.

Which aquifer recharge projects are relevant?
Catalonia is in the vanguard when it comes to water, and aquifer recharge is no exception. For example, Aigües de Barcelona implemented the second "dual well" injection and extraction system anywhere in the world in the late 1960s, in the Baix Llobregat.

We should also mention the DEMOWARE project: infiltration of regenerated water into ponds in Port de la Selva; the DESSIN project: change of origin of the water injected into one of the old dual wells of Aigües de Barcelona in Baix Llobregat; the reuse of regenerated water from Prat de Llobregat in the ACA ponds in Sant Vicenç dels Horts, and the initiative of the Baix Camp Regional Council and COMAIGUA with treated water from the Cambrils WWTP to test the effectiveness of reactive barriers in eliminating pollutants.

What role should public outreach be playing?
Outreach must begin in primary schools. It is vital that new generations value the luxury of having water on tap or light at the touch of a switch, and that they think about what would happen if this were no longer so straightforward.

What role do academic institutions and research play in developing effective water management policies?
We need more involvement of experts and a better connection with public authorities. Water management should be addressed as a national challenge, promoting collaboration and trust between the scientific world, institutions and managers.

News roundup

We bring you the latest updates for the water sector, featuring the most significant local, national and international news from recent months.

AIGUANEIX pilot plant opens at Roses WWTP

On 28 March, the pilot plant of the AIGUANEIX project had its official opening at the Roses WWTP, at an institutional event attended by representatives of the Girona Provincial Authority, the Autonomous Government of Catalonia, Roses Town Council, the Costa Brava Girona Water Consortium and collaborating entities.

The plant is already in operation, purifying 6 m^3/h of regenerated water using advanced technologies, such as ultrafiltration and reverse osmosis. The project aims to obtain purified water to recharge aquifers and strengthen the water resilience of the region.

Drought speeds up technological innovation on northern Costa Brava

The persistent drought of recent years has driven an unprecedented technological transformation in the supply facilities of the northern Costa Brava. We have seen the implementation of treatments such as ultrafiltration, reverse osmosis and advanced oxidation, previously reserved for very specific cases.

It is worth highlighting the new drinking water treatment plant (DWTP) in Portbou, the renovation of osmosis modules in Port de la Selva, and support for the DWTP in Empuriabrava. The AIGUANEIX project, with its Roses pilot plant, holds the key to the future aquifer recharge and a new source of drinking water.

Photo from www.epwater.org/

El Paso begins construction of first direct potable reuse plant in USA

The first stone has already been laid at the El Paso Water direct drinking water reuse plant in the United States, a pioneering project that will supply reclaimed water directly to the distribution network.

The new facility in Texas will have a capacity of up to 38,000 m^3/day, and will use advanced treatments such as reverse osmosis and ultraviolet light disinfection. The initiative shows El Paso's commitment to sustainability and water self-sufficiency in the face of growing water shortages, and is positioning itself as a benchmark in reuse internationally.

The important function of chloramine

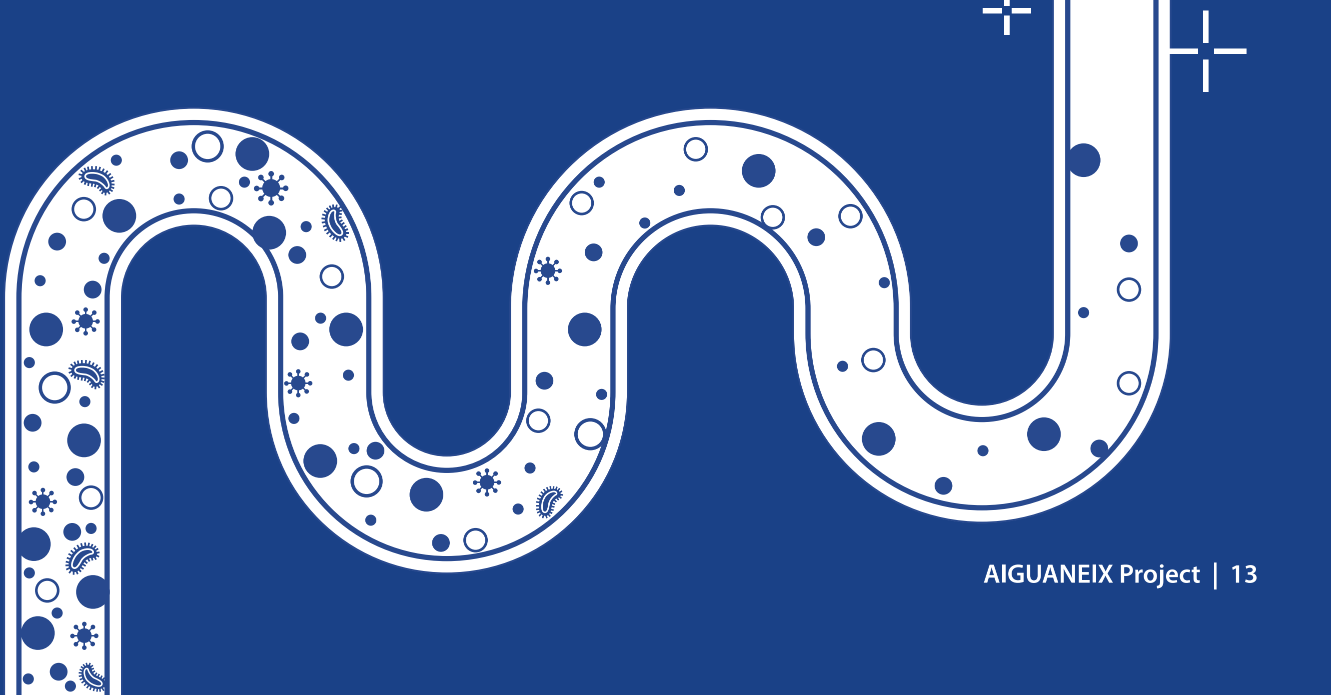
When we talk about drinking or purified water treatment, we often think of chlorine as the primary disinfectant. But there is another, less well-known substance which is highly effective: chloramine.

Chloramine is formed by combining chlorine with ammonia, and is widely used to disinfect water. In conventional distribution networks, such as those in Madrid or Cordoba, it serves to guarantee that safe water reaches homes, as it maintains its disinfectant action for longer than chlorine alone, and generates fewer harmful by-products.

In addition, chloramine plays a key role in advanced processes such as reverse osmosis, a technique used to obtain highly purified water. Such systems need to avoid the formation of biofilms —such as small layers of microorganisms— which can damage the filtration membranes, but these membranes are very sensitive to highly oxidising agents, such as chlorine or ozone.

This is where monochloramine comes into play, a stable and less aggressive form of chloramine, which can control microbial growth without damaging the membranes, thus promoting more sustainable and efficient operation.

Thanks to its stability and effectiveness, chloramine is a discreet but powerful ally to ensure safe, quality water.



Water quality: a challenge of precision and responsibility

When we talk about water quality, we often refer to whether it is drinkable or not. But this concept is much more complex than it might seem at first glance. The quality of water for human consumption is measured using physical, chemical and biological parameters, included in the current regulations (Royal Decree 3/2023, of January 10), which establishes the maximum permitted values, the required analytical sensitivity and the precision of quantification.

A look at the physical parameters

The physical parameters include temperature, turbidity, colour, and electrical conductivity (an indicator of salinity). Measurements such as transmittance and absorbance are also included, indicating the water's ability to let through or absorb ultraviolet light. The more light that passes through the sample, the purer the water is considered.

The chemical world of water

Chemical parameters evaluate the presence and concentration of dissolved substances. The most significant include:

- **Dissolved salts:** Ions such as sodium, calcium, magnesium or potassium (cations), and chlorides, bicarbonates, nitrates or sulphates (anions).
- **Radionuclides:** The regulations require the quantification of radioactivity using parameters such as alpha and beta activity, tritium, radon and indicative dose.
- **Substances of natural or metabolic origin:** Humic and fulvic acids, chlorophyll, algal toxins or hormonal residues from wastewater may appear in surface waters.
- **Synthetic pollutants:** A wide range of industrial compounds, such as biocides, solvents or pharmaceuticals. Perfluoroalkylated and polyfluoroalkylated substances (PFAs) stand out, known as *forever chemicals* due to their persistence in the environment.

Biological indicators

Biological parameters focus on the detection of microorganisms that can cause diseases. Microbiological indicators are used, especially those that reveal faecal contamination. These microorganisms must be absent in at least 100 millilitres of water. Current regulations include bacteria (such as coliforms or enterococci), but also viruses (somatic coliphages) and protozoa (such as *Cryptosporidium*).

The pilot plant at the Roses WWTP uses six different treatments to ensure that the parameters of the resulting water comply with existing regulations, so as to guarantee very high quality water.

The analytical revolution

The progress seen in analytical chemistry since the 1960s has been spectacular. According to Dr Rhodes Trussell, the precision of analytical techniques has increased by three orders of magnitude every twenty years (Trussell, 2013, address given as part of the Clarke Awards ceremony, at the National Water Research Institute in California, United States). This means that substances once detected in milligrams per litre can now be found at levels of nanograms per litre: a million times greater resolution.

The incorporation of purification and real-time monitoring systems ensures regulatory compliance and allows resources such as regenerated water to be recovered.

How extreme is this precision?

To detect 1 nanogram per litre (ng/l) of sugar in water, we would have to dissolve an 8-gram sachet of sugar in 8 billion litres of water. This is equivalent to filling a football field with a column of water 1,000 meters high.

Such sensitivity has forced us to constantly review the thresholds considered safe for human health, especially since the level of toxic effects or temporary exposure is still unknown for many substances.

Towards indispensable purification

In a context of demographic pressure, climate change and the worsening quality of supply sources, regulations increasingly require purer water, which increases the complexity of the treatment and management of the waste generated. The substances eliminated often return to the environment, which complicates drinking water treatment for systems that capture water downstream.

Faced with this challenge, purification emerges as a key solution. Facilities such as the Abrera and Sant Joan Despí DWTPs, which supply much of the metropolitan area of Barcelona, already use advanced technologies to treat surface water with a high proportion of treated effluents, especially in situations of drought.

The incorporation of purification and real-time monitoring systems within the water cycle not only ensures regulatory compliance, but also allows resources such as regenerated water to be recovered. This approach will be essential to guarantee supply in a 21st century marked by hydrological uncertainty.


PROJECTE


PROJECTE AIGUANEIX
Nova planta pilot per

Relevant experiences

Torreele Project (Belgium)

A sustainable groundwater management project

Photograph courtesy of Aquaduin (https://www.aquaduin.be/).

€0.46-0.62/m³
production cost

30%
of
drinking water demand

>99%
efficiency in eliminating pathogens

2 ha
surface area of infiltration lagoons

The Torreele project is an international benchmark in sustainable groundwater management through alternative sources

In Torreele, on the coast of Flanders, Belgium, an innovative project to reuse purified water to artificially recharge the aquifer of the Saint-André dunes has been under way since 2002, with the aim of guaranteeing the supply of drinking water and protecting the local ecosystem.

The plant, managed by the Intermunicipal Water Company of the Veurne Region (IWVA), now Aquaduin, treats the secondary effluent from the Wulpen WWTP using advanced processes including ultrafiltration, reverse osmosis and disinfection with ultraviolet light. Once purified, the water infiltrates into the subsoil through natural lagoons.

In 2014, another subsurface infiltration process was added.

This system serves to reduce direct extraction from the aquifer, avoid saline intrusion and preserve fragile dune habitats. It furthermore increases the region's water resilience, ensuring supply during periods of drought.

Profile

Wolfgang Gernjak
Researcher at the ICREA (Catalan Institution for Research and Advanced Studies) of the Catalan Institute for Water Research (ICRA) and scientific director of the AIGUANEIX project

"Instead of wasting water and losing it out to sea, what we want to do is take advantage of this resource, and move towards circular solutions"

Wolfgang Gernjak is a research professor at ICRA and leader of the Water Supply and Advanced Treatments group. With a master's in analytical and physical chemistry from the Vienna University of Technology (2002) and a doctorate in land and water management from BOKU Vienna (2006), he has built his career between Spain and Australia, including notable periods at the Almeria Solar Platform and the University of Queensland.

His research focuses on technological innovation for the treatment of drinking and regenerated water, specialising in advanced oxidation processes, catalytic ozonation, plasma treatments and membrane filtration. He has led projects such as SUGGEREIX, developing tools to manage water reuse in Catalonia, and iWAYS, aimed at water and heat recovery in industry. He currently also directs AIGUANEIX's scientific research.

Gernjak combines scientific knowledge with technology transfer, helping to realise a vision of cities that are smart and resilient in terms of their water management.

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This initiative has been developed by the Costa Brava Girona Water Consortium and has received a subsidy from the Catalan Water Agency under file no. REU001/20/000139. This subsidy was awarded within the framework of the call for investments in the implementation of actions designed to reuse recycled water, as published in Resolution TES/642/2021 of 4 March (Official Gazette of the Government of Catalonia (DOGC) no. 8362, of 11 March 2021, ref. BDNS 552136).

Project management and funding:

With the support of:

Scientific management:

Construction and maintenance:

Works management:

Experimental operation:

Creation of outreach materials: