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#23

Insights from Veolia Water Technologies

Hall A6
Booth 329

Water technologies that deliver performance and sustainability, without compromise

DECARBONIZING

Create clean energy to build resilience and adapt to climate change

DEPOLLUTING

Healthy communities, ecosystems and economies for a better future for all

SAVING AND REGENERATING RESOURCES

Improve access and renew resources to create sustainable opportunities

WATER TECHNOLOGIES

 **VEOLIA**

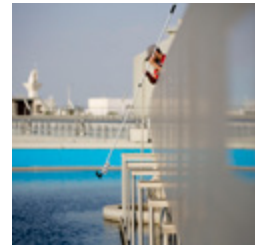
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Ion exchange technology sponsored by the German Ministry of Environment

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INSIGHTS

Embracing the ecological transformation

At Veolia, we are committed to driving the ecological transformation of our societies and economies. Our water technology experts spearhead this mission, delivering innovative solutions that prioritize both performance and sustainability in equal measure.

Our recently unveiled GreenUp strategic plan serves as a comprehensive roadmap, accelerating the deployment of affordable and replicable solutions that depollute, decarbonize and regenerate our resources.

Our focus is on offering you efficient solutions and state-of-the-art technologies that encompass the reuse of treated wastewater, the production of local, green energy from wastewater, the treatment of micropollutants and the production of safe, reliable drinking water.

DECARBONIZING

We can help you reduce your greenhouse gas emissions and progress towards a zero-carbon future. By harnessing previously untapped resources such as sludge and biogas, we provide local, decarbonized energy solutions. We can also help reduce the carbon footprint of your current activities by optimizing energy efficiency, providing low-carbon commodities and promoting wastewater reuse.

DEPOLLUTING

We can help you treat all forms of water and soil pollution to safeguard human health and the environment. Our solutions avoid creating pollution from the onset, reduce water pollution at source, and treat chemicals used in manufacturing processes. This ensures compliance with stringent environmental regulations, maintaining your license to operate.

PRESERVING AND REGENERATING

We can help you recover strategic raw materials and repurpose resources by regenerating manufacturing byproducts. We optimize processes to reduce water consumption and promote the recycling and reuse of wastewater. Our solutions help secure resource availability, enhancing resilience while keeping costs under control and fostering sustainable growth.

MULTIFACETED RESPONSE TO COMPLEX CHALLENGES

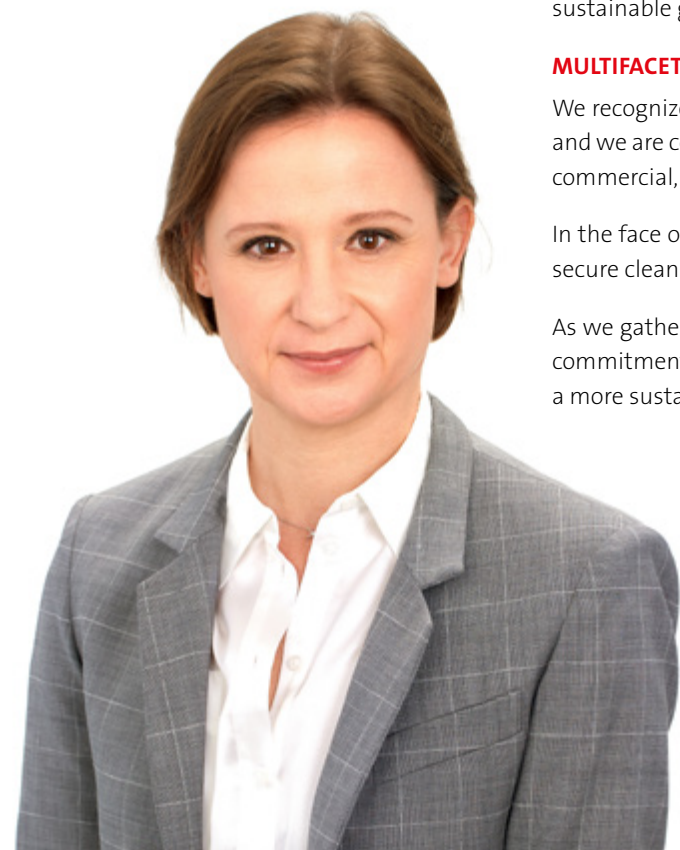
We recognize that the ecological challenges we all face are complex and interconnected, and we are committed to a multifaceted approach that considers our economic, financial, commercial, social and societal impact with equal importance.

In the face of the global climate crisis, the need for sustainable and resilient solutions to secure clean water, local energy and accessible resources has never been more pressing.

As we gather at the IFAT trade fair, let us celebrate our collective progress and renew our commitment to driving the ecological transformation. Together, we can pave the way for a more sustainable and desirable future, leaving a lasting legacy for generations to come.

Anne Le Guennec

*Veolia Senior Executive Vice President,
Worldwide Water Technologies*





DECARBONIZING

Water technologies that help decarbonize operations and create clean energy to build resilience as we adapt and respond to climate change.



Harnessing wastewater to produce renewable energy

In the face of the global climate crisis, the need for sustainable and resilient energy solutions has never been more pressing. Fortunately, innovative technologies are paving the way for a greener future, and one such solution lies in the often-overlooked resource of wastewater treatment plants (WWTPs). By harnessing the power of biogas, an increasing number of these facilities are transforming waste into a valuable renewable energy resource, contributing to decarbonization efforts, enhancing energy security through local production, and driving ecological transformation.

Climate change and environmental degradation pose an existential threat to Europe and the world. Through the Green Deal, the European Commission has adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. The end goal: become the first climate-neutral continent by 2050.

One initiative to reach this target is the REPowerEU plan, which responds to global energy market disruptions caused by geopolitical conflicts by promoting energy savings, clean energy production, and diversification of energy supplies. In addition to giving industries the ability to become energy-positive and treat complex waters, there is also a high-level continental drive on biogas. The €300-billion plan includes a significant push for renewables, especially the use of biomethane, with a target of 35 billion cubic meters set for 2030.

Historically, European biomethane has mainly been produced from agricultural waste. Yet there is enormous potential to produce it from municipal wastewater, with municipalities playing a central role in EU and global ambitions. According to the European Biogas Association, wastewater could contribute 170 terawatt-hour (TWh).

WWTPs have traditionally been designed to treat wastewater to the right purity to be released into the natural environment. Today, we see municipalities shifting to transform these facilities into energy production plants. Veolia has designed several such WWTPs in France, where wastewater is recovered as a source of energy and heat.

The Aeris plant in Cagnes-sur-Mer, operational since 2021, was the country's first energy-positive WWTP, consuming 8,7 gigawatt-hours per year (GWh/Year) while producing 10,5 GWh/Year through biomethane production. Following suit, the Maera and

Sival plants, under construction in Montpellier and Valenton, will also produce biogas to provide tens of thousands of residents with sustainable energy and heat. And the recently inaugurated Bonneuil-en-France WWTP, which has a capacity of 500,000 population equivalent, already injects enough biogas into the existing gas network to heat 1,750 homes, generating over €1 million in revenue in 2022.

We are well positioned to help utilities reach their carbon neutrality ambitions. As a company, we have many tools and technologies that go beyond biogas upgrading. For example, we can boost biogas production and also treat the wastewater from the digestate, to avoid high loads going to the water treatment plant.

The food and beverage sector has long been an advocate of anaerobic digestion to treat its organic waste and convert it into biogas. Doing so has allowed manufacturers to reduce waste, generate energy, recover nutrients, mitigate greenhouse gas emissions, and promote a circular economy.

This is precisely what Aptunion, a producer of gourmet inclusion, has implemented at its fruit processing facility in the south of France, where 11.4 Gwh of green gas is injected into the gas grid every year, avoiding 2,500 of CO₂ and generating €1.3 million in revenue.

By combining multiple Veolia technologies, industries are producing biogas as an alternative energy source while also helping to reduce waste disposal costs. Industries are looking for solutions to not only treat complex wastewater but also unlock its potential as a resource. Solutions are available to treat and valorize even the most complicated industrial wastewater.

From anaerobic biological treatment of wastewater and sludge digestion to biogas treatment and upgrading to biomethane, including capturing carbon from combustion gasses, we offer a complete suite of technologies to reduce the energy footprint in water treatment operations. Bundling these technologies, as Aptunion and several municipalities in France have done, is one way to make decarbonized energies shine.

By harnessing the power of wastewater and embracing the principles of a circular economy, we can unlock a future where sustainability is not just a goal but a way of life. ●



Memgas™

Membrane technology that purifies raw biogas into suitable biomethane.

7 years of experience

26 worldwide references

Applications

- Wastewater
- Sludge

Markets

- Industrial
- Municipal
- Agricultural
- Biowaste

Size/footprint

- Minimum 80 square meters

Daily capacity

- Variable from 30 to 10,000 normal cubic meters per hour (Nm³/h) of raw biogas

Benefits

- Up to 99.5% efficiency
- Low energy consumption of 0.3 to 0.4 kWh/Nm² raw biogas
- Turnkey technology with quick start-up and easy maintenance system
- High flexibility for fluctuation in biogas flow and composition
- Fully automated and remote-controlled
- Robust and very reliable with an availability rate over 95%





A low-carbon path to wastewater treatment intensification

Yorkville, a suburban city along the Fox River in the Chicago Metropolitan Area, is known for its scenic beauty and small-town charm. Over the years, Yorkville has witnessed significant population growth and the establishment of new industries, which led to the need for upgrades at its wastewater treatment plant. The city was committed to pursuing an economically and environmentally sustainable approach to meet its growing wastewater treatment needs.

The Yorkville-Bristol Sanitary District (YBSD) wastewater treatment plant serves a population of 22,000 and discharges to the Fox River. The plant is designed to handle an average flow of 3.62 MGD (13.7 MLD) and, until 2017, operated as a single-stage nitrifying activated sludge system. With the projected population growth and the addition of new industries, it was expected that the facility would exceed its rated organic capacity. Additionally, YBSD had to comply with a new total phosphorus limit of 1 mg/L.

To address these challenges, YBSD sought a retrofit solution that would increase its organic treatment capacity, implement phosphorus removal and avoid the need for constructing a separate treatment plant

on adjacent property. This intensification approach would minimize capital expenditure, avoid significant civil modifications to the facility and accelerate the implementation schedule by avoiding the time required for permitting and constructing a new plant.



YBSD chose to upgrade the plant using Veolia's ZeeLung™ MABR technology in combination with enhanced biological phosphorus removal (EBPR). The ZeeLung MABR is an energy-efficient solution that intensifies the treatment process while reducing energy consumption. It also reduces carbon emissions thanks to aeration energy savings, mitigation of nitrous oxide emissions and avoiding the construction of new concrete tanks.

The first phase of the MABR upgrade was completed in 2017 by reconfiguring the biological process from fully aerobic to A2O (anaerobic-anoxic-aerobic) and installing ZeeLung cassettes in the anoxic zone. This upgrade provided several benefits, including:

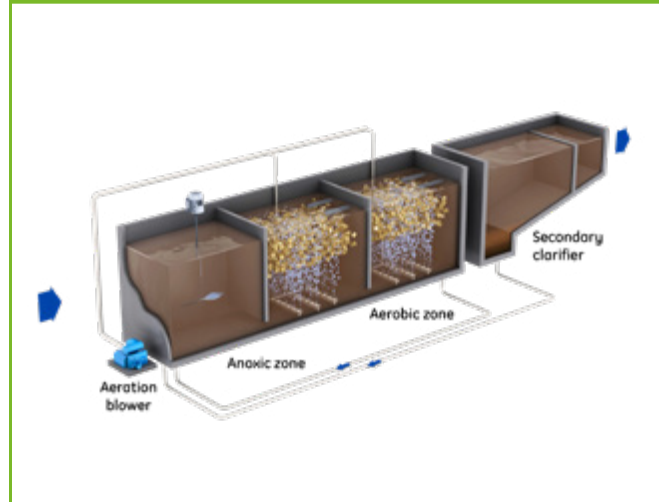
- 25% increase in organic treatment capacity in the existing bioreactor volume.
- Introduction of biological phosphorus removal.
- 75% capital cost savings compared to a conventional upgrade.
- Fast implementation with design and construction in 18 months.
- No net increase in energy consumption levels despite increased capacity and more stringent effluent limit.

Super intensification of activated sludge

Following five years of operation of the ZeeLung MABR system, YBSD identified the hydraulic capacity of the secondary clarifiers as the next treatment bottleneck. In 2023, the treatment plant was further enhanced with the implementation of zeeDENSE™, an innovative technology that combines ZeeLung MABR and continuous flow densification for super intensification of activated sludge.

ZeeDENSE increases the capacity of the YBSD secondary clarifiers by 40% by improving settling characteristics of the mixed liquor. Other anticipated benefits include optimization of biological phosphorus removal and operating cost savings related to chemical and energy consumption.

This is the first full-scale implementation of zeeDENSE, showcasing YBSD's commitment to adopting innovative, energy-efficient technologies to meet its wastewater treatment needs while minimizing its environmental impact. ●



ZeeLung™

An innovative solution that increases treatment capacity in existing tank volumes while also reducing energy consumption for simple and sustainable intensification of activated sludge.

8 years of experience

More than 30 worldwide references

Application

- Wastewater treatment

Markets

- Municipal
- Industrial

Benefits

- Process intensification: up to 50% more treatment capacity in existing tanks
- Simplicity: installed in existing tanks, no civil works, fast implementation
- Resilience: dependable in upset conditions
- Energy reduction: 4X reduction in aeration energy
- GHG mitigation: N₂O mitigation potential





Breaking boundaries: how AI transforms wastewater management

Artificial intelligence (AI) is undeniably pushing boundaries, quietly transforming processes, and enhancing efficiency everywhere we look. While we are mostly aware of the development and expansion of AI through ChatPGT, virtual assistants and chatbots, in reality, AI is also reshaping industries behind the scenes. Christian Pitavy, our Chief Digital Officer, explains more.

Throughout human history, several revolutions have significantly impacted our society, economy and overall way of life. The 20th century was shaped substantially by technology and the next frontier is AI.

Already AI has proven it can help our customers vastly improve their operations by resolving — or, at the very least, greatly relieving — the challenges they face. Regardless of where they're geographically located, wastewater treatment plant (WWTP) managers face the same issues: sustainability targets, OPEX savings, and keeping up with increasing environmental regulations. This is how the power of AI tackles all three:

Sustainability targets: decarbonization

The shift in environmental focus, from CO₂ (be it direct emissions or indirect emissions through power and chemical consumption) to non-negligible emissions such as N₂O (nitrous oxide, also known as the laughing gas), reflects a more comprehensive approach to tackling climate change and reducing overall greenhouse gas emissions. N₂O emissions are 300 times more harmful than CO₂ and are notably produced by WWTPs, especially in activated sludge processes. Recognizing the need to treat wastewater with lower emissions safely, we developed an advanced control using predictive AI models and the Hubgrade Wastewater Plant Performance N₂O Removal module was patented in 2023. By automatically adapting aeration phases in response to N₂O detection within the biological tank, we use AI data-driven wastewater treatment models predicting treatment efficiency. This breakthrough is a crucial step towards sustainable wastewater management practices.



Opex targets: nitrogen removal

Denmark's Køge-egnens WWTP faced significant challenges in optimizing nitrogen removal and reducing OPEX. For years it had tried to optimize nitrogen removal through online control of ammonium and nitrate meters without much success. Additionally, the plant needed to enhance its hydraulic capacity during rainfall events to manage increased water flow effectively.

To address these challenges, a feasibility study explored how to improve nitrogen removal as well as significant OPEX savings that would counterbalance the investment in the new control system.

Post-implementation, Hubgrade Wastewater Plant Performance facilitated a significant increase in hydraulic capacity, effectively managing peak flow periods during rainfall, by making better use of the existing hydraulic and aeration capacities. Moreover, the nitrogen removal process was optimized, improving effluent quality. These improvements translated into tangible OPEX savings, including reduced energy, chemical and additive consumption as well as decreased wastewater tax expenses.

Looking ahead, further enhancements, such as addressing carbon footprint taxes and optimizing N₂O emissions, promise to deliver additional OPEX savings and environmental benefits.

Environmental regulations: depollution

Ede is a municipality in the center of the Netherlands and their major WWTP was struggling to meet EU effluent standards due to increased load. To avoid costly expansions, they went digital and implemented Hubgrade Wastewater Plant Performance to optimize their biological treatment processes. Our digital solution achieved remarkable results: increased hydraulic capacity with total nitrogen and total phosphorus reduced below EU effluent standards helping to ensure local waterways remain safe.

These are just three examples but there are many, many more that emphasize the power of AI already. In a matter of years, it has made significant contributions to our world and there is plenty more to come in wastewater treatment and beyond. If handled correctly and with expertise embedded in its algorithms, AI could save us all.



Wastewater network operators face numerous challenges, exacerbated by climate change, such as flooding, sanitary sewer overflows and inefficiencies at pumping stations. Helping to overcome these obstacles, Hubgrade Sewer Performance is a digital twin that has the power to optimize the hydraulic capacity of the sewer network and treatment plants during extreme weather events. It does this by applying reactive strategies based on real-time measurements which it then integrates as a flow forecast to increase hydraulic capacity before rainwater arrival, avoiding or reducing non-compliant discharges. •



SEEING IS BELIEVING

Discover potential cost savings and carbon footprint avoidance for your wastewater treatment plant with the Hubgrade Wastewater Plant Performance Savings Calculator. From enhanced performance, reduced environmental impact and optimized savings, simply input your details to get an estimate.





DEPOLLUTING

Water technologies that protect human health, preserve ecosystems and sustain economies for a better future for all.



Tackling pollution and persistent chemicals to preserve water supplies

Water treatment has often been neglected over the past decades, leading to escalating water pollution and depletion of clean water resources. In an era marked by population growth and diminishing water supplies, addressing water contamination and revolutionizing water management is paramount.

Water treatment plays a crucial role in safeguarding our global water supplies and the environment. It is imperative to tackle the root causes of water depletion, one of which is pollution.

Decontamination requires a bilateral approach – treating water before use to ensure safety, and treating wastewater before discharge to mitigate pollution entering the water cycle. This inevitably helps reduce the spread of disease, food chain contamination, and damage to aquatic ecosystems.

However, compounding this issue further are various micropollutants, including bacteria, viruses, parasites, fertilizers, pesticides, active pharmaceutical ingredients and trace metals. These present a multifaceted challenge that demands a comprehensive approach, often requiring a combination of treatment steps such as coagulation, flocculation, sedimentation, filtration, advanced

oxidation, activated carbon treatment and disinfection, as well as biological treatment for wastewater.

Another significant concern is the presence of persistent, man-made chemicals known as PFAS (per- and poly-fluoroalkyl substances), often dubbed forever chemicals. These complex synthetic substances, used in products ranging from pizza boxes and non-stick cookware to fire-fighting foams, do not degrade and are highly mobile in water. As a result, they have been found in the most remote areas of our planet, raising concerns about their impact on human health and the environment¹.

Studies have shown that exposure to PFAS can have adverse effects, including links to various cancers². These chemicals also contaminate water and soil, posing a threat to entire ecosystems³. Consequently, there is a global effort to regulate and reduce their use, with nations implementing policies and

measures to eliminate or reduce the production of chemicals of concern, including PFAS.

Companies and manufacturers need to align their operations with evolving legislation and restrictions, taking action upstream to prevent PFAS from entering the water cycle and soils, and downstream to treat water before use or discharge to the environment. As standardized analysis methods exist for only about 50 PFAS compounds in water, it is currently not possible to assess global PFAS removal. Advancements in granular activated carbon, ion exchange resins, high-pressure membrane systems and in situ thermal solutions are our best line of defense for reduction of PFAS in water and soil.

TECHNOLOGY AT HEART: ACTIFLO® CARB

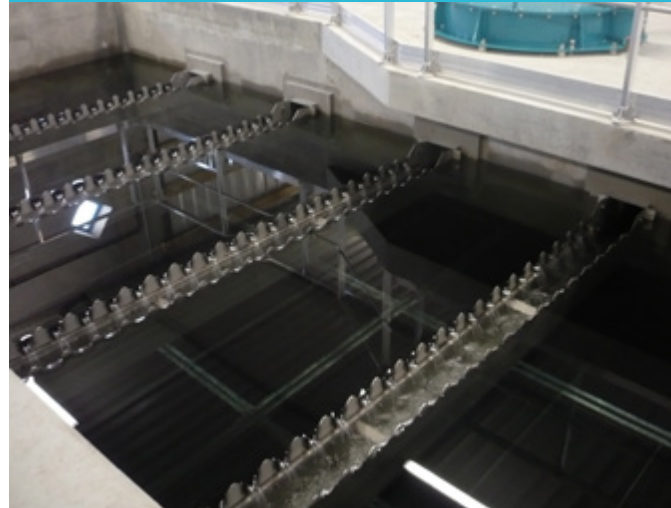
As a high rate clarification technology, Actiflo Carb is designed to treat and refine water. It combines fast flocculation and sedimentation performance with the adsorption capacity of powdered activated carbon to adsorb non-flocculable organic matter, taste and odor compounds, pesticides and emerging micropollutants, such as PFAS. It is specifically designed to efficiently treat pollutants resistant to traditional clarification methods to achieve superior treated water quality.

Prioritizing water treatment, recycling and safe reuse is crucial for a sustainable future. By investing in advanced technologies and comprehensive water management strategies, we can effectively address water pollution, persistent chemicals and water scarcity. This proactive approach not only safeguards our precious water resources but also protects human health and preserves the delicate balance of aquatic ecosystems for generations to come. ●

(1) CHEM Trust "PFAS – the 'Forever Chemicals'" - signatory to the "Zürich Statement on Future Actions on Per- and Polyfluoroalkyl Substances (PFAS)" (2018).

(2) Agency for Toxic Substances and Disease Registry: NTP (National Toxicology Program). 2016. Monograph on Immunotoxicity Associated with Exposure to Perfluorooctanoic acid (PFOA) and Perfluorooctane Sulfonate (PFOS). Last Reviewed: November 1, 2022.

(3) National Library of Medicine (NLM), National Center for Biotechnology Information: PFAS. Concentrations in Soils: Background Levels versus Contaminated Sites, Mark L. Brusseau, R. Hunter Anderson and Bo Guo, *Sci Total Environ*. 2020 Oct 20.



Actiflo® Carb

Combines the features and performance of high-rate clarification with the adsorption qualities of powdered activated carbon to remove refractory compounds at the clarification stage.

18 years of experience

Over 50 worldwide references

Applications

- Drinking water
- Process water
- Wastewater
- Reuse

Markets

- Municipal
- Industrial

Benefits

- Advanced powdered activated carbon treatment
- Maximum treatment of non-organic matter and emerging micropollutants
- Polishing of the treated water
- High sedimentation speed: ≥ 30 m/h
- Small footprint
- Simple to commission: start-up in a few minutes
- Easy, low-cost upgrading of existing installations





Harnessing ozone to safeguard the environment in Tübingen

Ozone technology is emerging as a crucial solution in the battle against micropollutants such as hormones and medicines contaminating our waterways. In October 2023, the European Commission proposed an amendment to the Urban Wastewater Directives, aiming to reduce the concentration of such substances by 80%. The city of Tübingen has already demonstrated the effectiveness of Ozone in achieving this requirement.

Nestled in the heart of Germany in Baden-Wuerttemberg, Tübingen is a picturesque city known for its commitment to sustainability. It has been hailed as Europe's fiercely vegan fairy-tale city by the BBC, showcasing its dedication to eco-friendly practices and a thriving vegan culture. Tübingen's forward-thinking approach extends to its wastewater treatment plant, where innovative solutions like ozone technology are employed to protect the environment and ensure the health of its residents.

The federal state of Baden-Wuerttemberg actively supports the implementation of a fourth wastewater treatment step to treat micropollutants. In 2021, the state witnessed

the successful commissioning of the largest ozone installation for this application. Veolia's Ozonia™ ozone system, combined with downstream sand filtration, was used at the Tübingen wastewater treatment plant. The solution ensures that the effluent discharged in the Neckar River contains significantly





reduced traces of medicines, hormones and other chemicals, minimizing the impact on aquatic life and preserving the natural balance.

Overview of the treatment plant:

- Flow rate: maximum of 2,880 m³/h (18.3 MGD)
- Ozone capacity: 20 kg of ozone per hour in total
- Ozone generator: two Ozonia generators (2 x M12)
- Treatment goal: micropollutant treatment, disinfection

Ozone is produced from liquid oxygen (LOX) at a concentration of 9.5% by weight. Dome diffusers are used to bring the ozone in contact with the effluent water at an adjustable dose ranging between 0.7 to 7.0 g/m². Any residual ozone in the off-gas from the contact chambers is safely converted back into oxygen using two ozone destructors of type DTCV-200.

As stricter regulations loom in Europe and beyond, ozone technology offers a sustainable and effective way to meet the challenge of micropollutant treatment, paving the way for cleaner waterways and a healthier environment for generations to come. The city of Tübingen is not only safeguarding its local environment but also contributing to a larger movement towards responsible wastewater management and environmental stewardship. ●



Ozonia™ M

Revolutionary, high-performance ozone system for water treatment.

8 years of experience

More than 200 worldwide references

Ozone capacity

- 3 to 20 kg/h per unit

Applications

- Drinking water
- Wastewater
- Municipal reuse (IPR, DPR)
- Cooling towers
- Aquaculture
- NOx emission reduction

Markets

- Municipal
- Industrial

Benefits

- Higher O₃ concentration
- Reduced energy consumption
- Increased capacity
- Efficient ozone production in a compact footprint



Membrane bioreactor technology fuels Stockholm's depollution efforts

Reinforcing its longstanding commitment to environmental stewardship, Stockholm is futureproofing its wastewater treatment facilities and elevating them to new heights of sustainability. At the forefront of this effort is the Henriksdal wastewater treatment plant (WWTP), which is being upgraded to treat up to 864,000 cubic meters (m³) of wastewater per day and help safeguard the Baltic Sea and Lake Mälaren.



For decades, Stockholm has been at the forefront of wastewater management, treating its effluents since 1932. However, with rapid population growth and stricter environmental regulations, the city recognized the need for a comprehensive upgrade to its infrastructure. The Baltic Sea Action Plan (BSAP) and EU Water Directive demanded more stringent discharge requirements, and the city was committed to reducing phosphorus and nitrogen emissions – which contribute to eutrophication – into the Baltic Sea, as well as protecting Lake Mälaren, its primary drinking water source and a beloved place of recreation for its residents.

Stockholm Vatten & Avfall (SVOA) is Sweden's leading water and waste company, servicing 1.5 million residents and businesses in the Stockholm area every day. It operated two large WWTPs: Bromma with 320,000 population equivalents and Henriksdal with 780,000 population equivalents. After extensive feasibility studies, the company embarked on an ambitious plan to close the Bromma WWTP and upgrade the Henriksdal facility with Veolia's state-of-the-art membrane bioreactor (MBR) technology. This decision was driven by a multitude of factors, including overall economics, potential new locations, long-term sustainability, the city's development plan, and the minimization of environmental impacts.

The Henriksdal plant, nestled within a mountain and surrounded by residential buildings, presented a unique challenge: the entire upgrade had to be executed within the existing footprint, with additional tank volume carved out of the rock structure itself. With double the capacity and significantly improved water purification, the upgraded facility is designed to treat anticipated 2040 wastewater flows and meet stringent effluent requirements, ensuring a future-proof solution for Stockholm's ecological needs.

At the heart of this transformation lies Veolia's ZeeWeed™ MBR technology, a solution that combines biological treatment with advanced membrane filtration. The plant's seven hydraulically separated biological lines will incorporate phosphorus removal through pre-precipitation with provision for post-precipitation in the membrane tanks, as well as nitrogen removal through pre-denitrification followed by post-denitrification using supplemented carbon. The 14 existing secondary clarifiers will be retrofitted with ZeeWeed MBR technology, providing a robust and efficient membrane filtration system.



The first phase of this ambitious project was commissioned in 2021, marking a significant milestone in Stockholm's ecological journey. The success of this project is a testament to the long-term collaboration and partnership between Veolia and Stockholm Vatten & Avfall, a model of cooperation that has paved the way for a sustainable future.

As the project progresses through its remaining phases, with completion expected by 2031, Stockholm is poised to become a shining example of how cities can remodel their wastewater treatment facilities into engines of ecological transformation. ●



ZeeWeed™ 500 MBR

30 years of experience

More than 2,500 worldwide references

Applications

- Wastewater
- Reuse

Markets

- Municipal
- Industrial

Benefits

- Process intensification – retrofit capabilities
- Low total cost of ownership
- Consistent high quality effluent
- Reuse ready
- Enabler of micropollutant removal

Environmental benefits

- Water reuse
- Small footprint
- Micropollutant treatment
- Reduce energy costs by 20%
- Reduce plant footprint by up to 50%



PRESERVING & REGENERATING RESOURCES

Water technologies designed to improve access to resources while protecting and renewing those same resources, creating sustainable opportunities for industries and cities.





In Vendée, circular water economy and innovation pave the way for the future

Vendée Eau and Veolia have inaugurated France's first unit for reusing treated wastewater to produce drinking water as part of the Jourdain program. This state-of-the-art facility is being hailed as a unique project in Europe and is fully in line with the French Water Plan launched in March 2023, which aims to increase wastewater reuse capacity in France from 1% to 10% within 5 years.

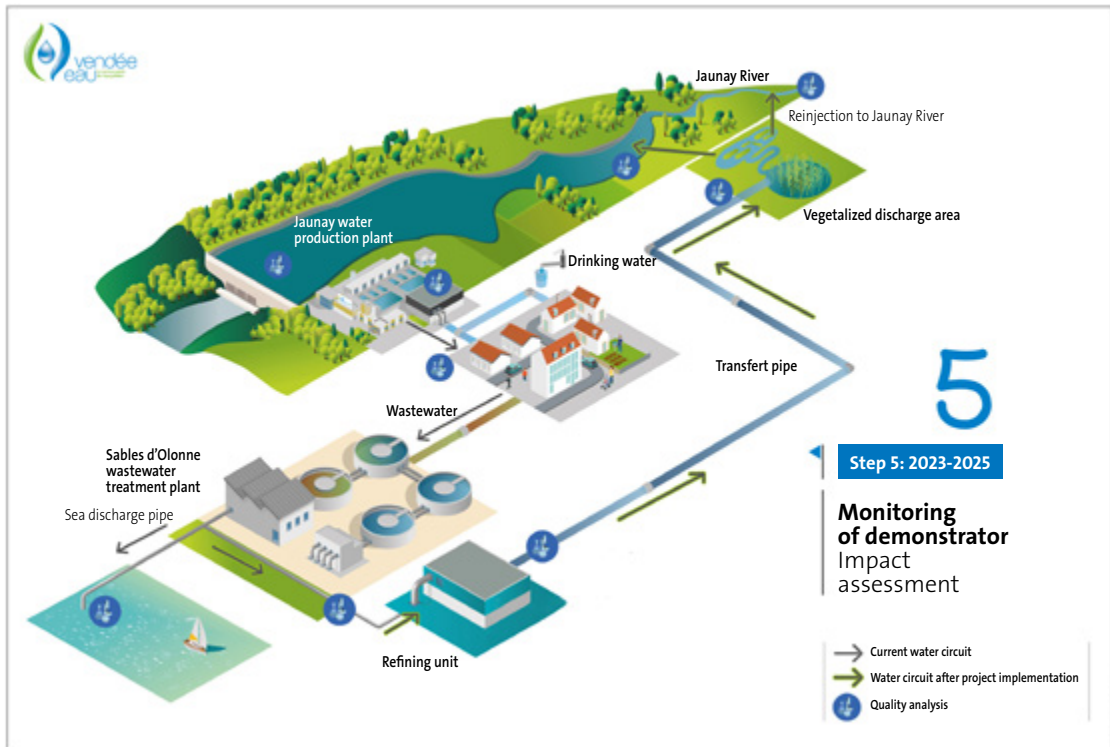
Located on the western coast of France, Vendée is one of France's most popular holiday destinations owing to its beautiful coastline, historic towns and picturesque villages nestled in idyllic countryside. However, water deficit is a pressing issue in the region, where the available water resources barely meet the needs of the 680,000 inhabitants. The potable water deficit is projected to reach 8 million cubic meters (m³) per year by 2025-2030, equivalent to the annual consumption of 150,000 residents.

Having faced severe water droughts over the past 20 years, several conventional investments had already been instated by Vendée Eau — the non-profit public body in charge of water supply — including a very effective water-saving program. Nevertheless, the region was still struggling to make the 50 million m³ of drinking water produced per year meet its needs as demand continued to rise.

Additionally, the authorities knew they needed to counteract the impacts of climate change since the water supply of Vendée was highly dependent on surface water which is more at risk of increased evaporation and convection. Indeed, as a direct result of climate change, projections showed this put an additional 100,000 inhabitants at risk of drinking water shortages during very dry years.

And so, Vendée Eau needed to act... and this is exactly what they did, showing vision and determination to prepare for the resource scarcity crisis by becoming a French pioneer in the production of drinking water from wastewater.

Vendée Eau was inspired by neighboring countries Belgium, Spain and Germany, who were reusing water for aquifer recharge. They wanted to take this concept further and began investigating indirect potable reuse (IPR) for surface water augmentation. This



avenue was deemed particularly interesting to explore because there was a significant volume of treated wastewater available in a nearby non-coastal touristic zone that was being discharged directly into the ocean.

After a decade of research and development, technical, regulatory and environmental studies, the Jourdain refining plant was inaugurated in November 2023 and is hailed as a European first. The facility treats wastewater that was previously discharged into the sea, allowing it to be reintroduced into the natural environment and then used for pumping and drinking water stations.



“A national first, the Jourdain program is the country’s flagship project, demonstrating that France has the technologies and the commitment at the local level to move ahead and to address the challenges posed by climate change. Its launch complements

and reinforces the importance of the Water Plan’s ambition to increase wastewater reuse from 1% to 10% in five years,” said Estelle Brachlianoff, Veolia’s Chief Executive Officer, at the time of the inauguration. *“Here we are concretely inventing the drinking water service of the future: a service of excellence, at*

the cutting edge of innovation, capable of responding to one of the greatest challenges in today’s water world: that of scarcity.”

The reuse scheme in Vendée aims to partly refill the Jaunay

reservoir with reclaimed water from the wastewater treatment plant of Les Sables d’Olonne, located 20 km away. Initially, from 2023 to 2025, the refining unit will reuse 1.5 million m³ – out of the city’s 4.5 million m³ – of wastewater. This capacity will then be gradually increased to reuse between 2 and 3 million m³ of wastewater by 2027, equivalent to the consumption of 60,000 inhabitants.

TECHNOLOGY AT HEART: THE BARREL™

Developed by SIDEM, a Veolia Water Technologies business unit, the Barrel is a groundbreaking modular technology designed for reverse osmosis or nanofiltration applications. This advanced membrane technology offers a secure, compact, optimized and connected solution that can be conveniently installed outdoors in a footprint reduced by 25% compared to conventional systems of the same capacity.

Lower pressure losses in comparison to traditional systems translate to lower electrical consumption and with the high-pressure connections safely housed within the vessel of the barrel, health and safety risks are significantly reduced. Additionally, the system is equipped with multiple intelligent sensors that accurately assess the efficiency of each membrane, resulting in reduced costs associated with membrane replacement.

Although it was initially developed for desalination applications, the Barrel's huge potential for treating drinking water and reusing wastewater through low-pressure reverse osmosis quickly became evident.

The Barrel is at the heart of the Jourdain program, France's first unit for reusing treated wastewater to produce drinking water. This water technology solution capitalizes on Veolia's expertise and the best of its global know-how to provide an additional resource of drinking water, contributing to alleviating the effects of climate change and water scarcity.

A key element of the project, the refining unit is a hub of high technology and innovation. In five stages, it removes particulate pollution, bacteria, viruses and micropollutants such as pesticides and drug residues to produce water of the highest quality. To achieve the highest degree of performance and efficiency, Veolia has employed the Barrel™, its patented technology based on low-pressure reverse osmosis. The refining unit, containing 200 membrane elements as well as an ultraviolet disinfection and chlorination process, guarantees the production of freshwater that complies with all relevant quality standards. ●



Barrel™

Next generation of reverse osmosis/nanofiltration membrane technology for desalination and water reuse.

7 years of experience

9 worldwide references

Applications

- Water reuse
- Seawater desalination
- Brackish water desalination

Markets

- Municipal
- Industrial

Footprint

- 25% reduction compared to conventional systems

Daily capacity

- Up to 50,000 m³/d per unit

Benefits

- Safer to operate
- Easier to install and maintain than a conventional RO skid
- Faster to install outdoors as a stand-alone, plug-and-play unit
- Enhanced sustainability through 0.05 kWh/m³ saved
- Allows for OPEX and CAPEX savings, offering a better return on investment





Ion exchange technology sponsored by the German Ministry of Environment

Contributing to Germany's Climate Action Plan 2050, Carix reduces energy consumption at the Moos waterworks drinking water plant by 50%. It has government backing in Germany and is gaining recognition throughout Europe where environmental and sustainable benefits are highly sought.

Germany's Climate Action Plan 2050 has set ambitious climate targets in line with the Paris Agreement — the United Nations' legally binding international treaty to limit global warming to well below two degrees Celsius, compared to pre-industrial levels.

Germany's 2050 plan details the criteria governments, industries and businesses must adhere to and what they must base their strategic decisions and growth on. The country has also set itself the target of reducing its greenhouse gas emissions (GHG) by 55% by 2030, compared to 1990, and this reduction has been mapped out revealing targets for individual sectors.

While local governments lack set targets, federal states enact climate protection laws in line with the Climate Action Plan



2050, allocating funds to regional bodies for environmental projects, including securing drinking water resources. One such project that has benefited from government back funding is Waldwasser in Moos in East Bavaria. The drinking water site near Deggendorf, Germany, began operation in 2018 and simultaneously became one of the most modern plants in Europe.

Utilizing Carix™, an ion exchange technology, the energy consumption of the Moos waterworks drinking water site — owned by Waldwasser - Wasserversorgung Bayerischer Wald, a municipality union — is reduced by 50%, when compared to the alternative reverse osmosis processes.

Carix achieves this by recovering its carbon dioxide (CO₂) exhaust gasses and reusing them as a regeneration agent instead of emitting them directly into the air. This relieves the atmosphere of 630 tons of CO₂ per year — equivalent to the CO₂ emissions of 6.6 million kilometers traveled in a car every year — and directly benefits the local environment and air quality.

“The basic principle of the Carix process has not changed since Veolia invented it. It’s an ion exchanger that can be regenerated with carbon dioxide to soften drinking water. However, the latest generation of the system is no longer proportional to older systems in terms of yield and energy consumption. With this latest technology, the Moos waterworks sets standards in terms of ecology, economy and drinking water quality,” explains Uwe Sauer, Business Development & Sales Manager Municipal Applications at Veolia Water Technologies Germany.

Carix is also the only ion exchange process for softening drinking water that does not require regeneration chemicals and, in addition to calcium and magnesium, it also reduces hydrogen carbonate, sulfate, nitrate and chloride. It produces soft water for the residents, protects the drinking water network — owing to less corrosion — and saves 80,000 private households costs of approximately €150 per year owing to energy savings and fewer cleaning agents.

Due to the large energy savings, especially when compared to traditional reverse osmosis technologies often found on drinking water plants, the German Ministry of Environment has sponsored the technology used at the waterworks in Moos countrywide.

Currently, 25 Carix systems are in operation across Europe, where environmental and sustainable benefits are highly sought. Compared to membrane processes such as reverse osmosis, as a basis, ion exchange produces around 60% less wastewater and uses 50% less energy. •



Carix™

The only ion exchange process for drinking water softening without harmful regeneration chemicals. The exchanger resins are regenerated by the produced carbon dioxide while simultaneously reducing sulfate, nitrate and chloride.

More than 35 years of experience

25 worldwide references

Applications

- Drinking water
- Hard water
- Economic softening

Markets

- Municipal
- Food and beverage (mineral water and breweries)

Size/footprint

- 200 to 2,000 square meters

Daily capacity

- 1,000 to 30,000 cubic meters per day

Benefits

- Low OPEX
- Cations and anions removal without corrosive effects on the water quality
- Up to 50% savings in detergent and cleaning agent usage
- 60% less wastewater consumption*
- 50% less energy consumption*
- Overall lower carbon footprint*

* compared to membrane desalination.



Resourcing the world