

# wave

*Insights from Veolia Water Technologies*



## Sustainable Pharmaceutical Water Solutions

### **WATER TECHNOLOGIES**

#### **DIGITAL**

Smarter, safer, more reliable water

#### **PURIFIED WATER**

20 years of evolution

#### **MICROPOLLUTANTS**

Hidden toxic residues requiring treatment

#### **EVALED**

The tail that wags the dog: pharma-veterinary wastewater treatment

# INSIGHTS

## Sustainable water management is paramount.

*Not many industries, if any, were disrupted as much by COVID-19 as the pharmaceutical sector. However, the impact of the pandemic continues to be felt by all industrial sectors around the world.*

*From learning how to mobilize and then stabilize, industry in general needed to innovate — in many cases overnight. Now building resilience in everything from supply chains to resource availability, to better adapt to what our future holds is where our customers are requesting the most support.*

*We must continue to navigate these newer disruptions while also tackling the long-standing issues of climate change, resource depletion and biodiversity loss. And we are running out of time, as individuals and even more so as decision-makers and business leaders.*

*Partnering with our clients to help them achieve their environmental and performance goals is our mission. We have distributed our focus between helping customers combat current resource challenges and looking forward in order to tackle the challenges ahead to increase resilience, accelerate supply chain decarbonization in line with environmental regulations and increase efficiencies. All that ensures we and they maintain business continuity and efficiency, compliance with highly demanding regulations and an increased need of traceability.*

*Whether it's compliant purified water or sustainable wastewater systems for pharmaceutical companies, our expertise have proven to lower production costs while reducing the amount of water used, limiting the environmental impact of operations and ensuring regulatory compliance.*

*If you want to future-proof your business whatever the weather or crisis, let's take action together today, for tomorrow.*

### **Vincent Caillaud**

Chief Executive Officer  
Veolia Water Technologies



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# Global pharma: a disrupted market

*The importance of sustainability in business is no longer questionable. It is 2022 and it is a business-critical matter regardless of sector or location. In recent years, COVID-19 has understandably dominated much of the attention of the global pharmaceutical market; however, climate change has not disappeared.*

As we look forward, Luca Danesi, Chief Sales Officer, Pharma Division, shares his insight into the major trends shaping the pharmaceutical industry, what challenges customers need the most help with, and the increasing importance of environmental regulations.

## What are the major trends shaping the pharmaceutical industry when it comes to sustainability?

*“Waste reduction, reuse and recycling are the main topics shaping sustainable best practices in the sector. And these three endeavors are being applied across the spectrum of activities. From manufacturing equipment that must be recyclable — and recycled — at the end of its life to reducing the intake of natural resources, these are big actions that are already changing the face of the industry.”*

## Many other industries are focusing on water reuse as a means of limiting their impact on the environment. Knowing that reuse is limited in the pharmaceutical market, how do you see this being developed, if at all?

*“Many pharmaceutical processes require highly purified water which must adhere to strict regulatory standards. This understandably limits reuse options but we need to focus on the balancing act of reusing water for cleaning, cooling and irrigation.*

*For the companies that take in 11,000 to 15,000 gallons per day*

*(41 - 57 m<sup>3</sup>/day) of fresh water every day, there is a physical limitation, and one day soon water of this quantity will become unavailable — and not just in certain parts of Asia and Africa. Reuse is a tool companies can use to combat these physical limitations and hopefully more will invest sooner rather than later, as water scarcity threatens business continuity. This, coupled with public awareness of climate change and water scarcity, means businesses need to ensure the planet survives. To ensure this we need precautions to become mandatory, not just suggested as they’re in many parts of the world.”*

## When it comes to resource management challenges, where does the biggest risk lie?

*“Ensuring the uninterrupted availability of pharmaceutical-grade water. It is the most critical utility in the pharmaceutical environment, often required 24 hours a day, seven days a week, and without it, production stops. As more and more areas succumb to climate change and the prevalence of water scarcity increases, we see many companies adopting ambitious targets to cut water consumption to protect the water they do have access to as local resources are squeezed.”*

## How do you envision the next milestone in creating a greener planet through water advocacy?

*“Water reuse has several limitations in pharma but, within these boundaries, there are opportunities and so understanding these and*

*significantly reducing and reusing water wherever possible is the next milestone. For example, new equipment can greatly reduce the amount of concentrated water going to the drain.”*

## During the pandemic, what were the biggest changes you witnessed in the pharmaceutical market?

*“It was mass overnight globalization. The increase in production was vast — and this was not just in the pharmaceutical companies making finished drugs but medical device manufacturers and the contract development and manufacturing companies (i.e. CDMO) — everyone working in and on behalf of the pharmaceutical industry was impacted. As a result, these bodies needed services and support, from the increase in readily available materials and natural resources to waste management.”*

## How did you support your customers to deal with these changes?

*“The inability to travel, visit sites and inspect equipment had the potential to cause severe disruption; however, owing to our remote monitoring and inspection tools we were able to continue ‘business as usual’. Our Hubgrade offer combines digital tools with the expertise of our team which means even remotely we could guarantee key performance indicators (KPIs), continuously provide service and monitor any parts. Even in these difficult times, many of our customers, not just those in pharma, have*

*managed to grow, even some in double digits.”*

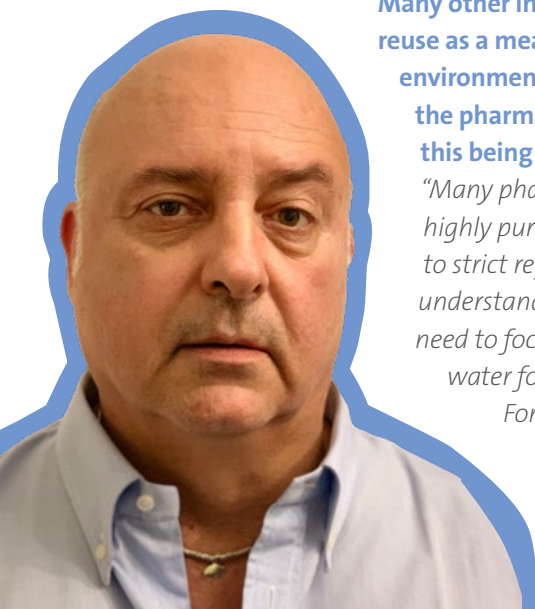
## What does the new normal look like for pharmaceutical manufacturers?

*“All business sectors are now facing very difficult issues in regards to materials availability and lead time, so we are working with many of our customers to optimize and extend the life of existing equipment to ensure business continuity. We are achieving this by ensuring equipment is maintained correctly which means more and more customers are requiring services such as the supply of spares, consumables and water treatment chemicals.”*

## Particular attention is being placed on preventing pharmaceuticals from entering the aquatic environment. How important a role do environmental regulations play in regards to overcoming this issue?

*“This is a critical subject for the sake of biodiversity and human health. We know better now than to throw wastewater contaminated with toxics and solvents into the incinerator or wastewater free from these substances into landfill; however, at the moment there is no legal requirement to do so, just good guidance and goodwill. We should be looking to those countries leading the way when treating and reusing wherever possible — remembering the limitations mentioned earlier — turning the wastewater into a resource, as opposed to relying on the tap.” •*

**Waste reduction, reuse and recycling are the main topics shaping sustainable best practices in the pharmaceutical sector**



# Micropollutants, the hidden toxic residues requiring treatment

*Currently, the most common practice for removing micropollutants from water is activated carbon adsorption. However, this only removes up to 30 percent of micropollutants. Now there's a post-treatment biological removal solution that can safely remove 50 to 80 percent of difficult-to-degrade pharmaceuticals from wastewater.*



Every time we use water it goes back into the environment less purified than it was and often contaminated with micropollutants.

Defined as man-made biological or chemical contaminants, micropollutants make their way into ground and surface waters at trace level quantities — equal to or below the microgram per liter. These can include everything from pesticides, pharmaceuticals and industrial chemicals that are continuously released into our wastewater systems from our homes, workplaces and industries.

Treating micropollutants is highly complex and conventional technologies cannot completely isolate them. In fact, during wastewater treatment at both municipal and industrial

sewage plants, some micropollutants end up in aquatic environments because they haven't been eliminated. When this happens and micropollutants are discharged into the environment, they can cause acute and chronic toxic effects even at very low concentrations. Even so, these residues are poorly assessed and regulated on a global scale, in part, due to their complex chemical formula and the previously mentioned limitations of conventional wastewater treatment plants (WWTP).

Action to prevent the release of micropollutants is needed both up and downstream and innovation can — and will — help improve the capabilities of conventional WWTPs.

One such innovation is eXeno™, an effective, economic and environmentally friendly solution. It is based on AnoxKaldnes™ moving bed biofilm reactor (MBBR) technology and relies on microorganisms growing as a biofilm on plastic carriers.

By using multiple reactors in series, the MBBR technology can select specific microorganisms specialized in removing difficult-to-degrade compounds like pharmaceuticals. This multiple reactor concept is broadly applied by AnoxKaldnes, a Veolia Water Technologies business unit, as a way to remove multiple and complex compounds from wastewater such as those found in the pharma industry.

**One industrial example** is JSC Grindeks (branded as Grindex), an internationally operating Latvian pharmaceutical company headquartered in Riga. They required a five-stage eXeno MBBR process for the degradation of difficult-to-degrade organic compounds from their drug production. The focus was on the removal of phenols and high concentrations of organically bound nitrogen compounds with a capacity of 500 cubic meters per day.

**Another example** is Warburg WWTP (Stadtwerke Warburg GmbH Warburg), which is situated in North Rhine-Westphalia, central Germany on the river Diemel. It receives municipal and industrial wastewater and so, to reduce the discharge of micropollutants, Warburg upgraded its WWTP treatment process with a new and advanced treatment technology, consisting of ozonation. However, ozonation only partially oxidizes micropollutants and, as a result, transformation products (TPs) with unknown properties can be formed. In order to minimize the risk of releasing unknown and potentially toxic TPs into surface water, we installed eXeno post-ozonation, resulting in the elimination of 95 percent of the TPs created through ozonation.

Additionally, following the success of this advanced treatment at Warburg, a second German plant was built in Rheda-Wiedenbrück with the same process scheme.

It is clear that there is an increasing concern regarding the impact of micropollutants in our wastewater and a growing call to action for those responsible to ensure wastewater discharge standards are maintained. As global understanding evolves it is vital new innovations are used to tackle new pollutants, not only to protect the environment but also to protect human health. ●



## eXeno™

*eXeno, an AnoxKaldnes™ technology, based on a MBBR (moving bed biofilm reactor) is used for the biological removal of drugs and other complex compound residuals in wastewater.*

### Years of experience

More than 30 years

### Worldwide references

More than 30

### Applications

Wastewater

Tertiary

### Markets

Municipal

Industrial

Healthcare

Pharmaceutical

### Benefits

High removal (50-80%) of difficult-to-degrade pharmaceuticals

Biological treatment

Compact

### Environmental benefits

Chemical reduction

Biological removal of toxic compounds

Avoids the release of by-products

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**Treating micropollutants is highly complex and conventional technologies cannot completely isolate them**

# Orion™: 20 years of evolution

*In 2002 the Euro became an official currency, the first camera phone was created and the Envisat environmental satellite was launched into space to start documenting climate change. It was also the year Orion™, the disruptive purified water production system, was introduced to the market.*

As the technology celebrates its 20th birthday, Ranj Rihal, Business Development Manager, explains what has changed, what hasn't, and what's next in the evolution of modular water treatment.

## 20 years since its birth, what has and hasn't changed in today's Orion?

*"The Orion has always been a skid-mounted unit comprising softeners, reverse osmosis and continuous electrodeionization (CEDI) as its core process, designed to produce purified water or cold water for injection (WFI). However, what is new is offering hot water sanitization of the pre-treatment and several nuances in the system to make it even more sustainable, reliable and robust. Another major step in Orion's evolution was its digitalization. Since 2016, it has been Hubgrade-enabled, meaning it can be remotely monitored and optimized."*

## What are the new trends in purified water systems?

*"The European Pharmacopoeia monograph update in 2017, approving a twin membrane system for cold WFI production — using a combination of reverse osmosis (RO) and ultrafiltration (UF) systems for cold WFI production — continues to be a big trendsetter. However, the importance of sustainability is also heavily swaying the design of systems. I suspect sustainable requirements will become the focal point as every pharmaceutical company creates their policy to combat climate change, reduce the carbon footprint of their operations and overcome water scarcity issues."*

## What are the biggest challenges customers are facing when it comes to meeting their purified water needs?

*"Three pressing challenges are on everyone's agenda: compliant performance in terms of quantity and quality; hot water sanitization to keep microbial control within the system; and increased sustainability and water energy savings."*

## When it comes to compliant performance, how does Orion help customers meet this requirement?

*"The international regulations are non-negotiable. This is why Orion guarantees all three main pharmacopeias: the U.S., Japanese and European, by utilizing RO, CEDI and UF — if necessary, for endotoxins. This is achieved through continual monitoring, before and after each process unit, and a final quality monitoring to make sure the water quality meets the specifications."*

## What are the main environmental benefits Orion delivers to customers?

*"There are two key features that boost sustainable performance. Firstly, an integrated recovery RO system where we take the concentrate of the existing unit and run it through a recovery RO, saving up to 50 percent of the water from discharge. The second is when the customer has no demand since we are able to fully recirculate the water at half the flow rate, saving energy while also preventing all of this water from going to the drain."*

## The pharmaceutical industry is under increasing pressure to meet tightening environmental regulations, how does Orion assist?

*"In addition to the other examples, Orion is digitally enabled so our customers have the ability to monitor any parameters they want. Then, should any of these parameters fail to be met, they're alerted in real time. We are able to provide full operational transparency that was specifically designed to prevent regulatory breaches and avoid shutdowns."*

## How should customers choose between the different Orion series?

*"It really depends on their purified water demand profiles and how they wish to operate the system. For example, if purified water is needed continuously the S series is the way forward since it will help save a lot of water during operation; however, if they only require purified water for two hours a day, which means the Orion would be recirculating water for 22 hours, the environmental series would be more suitable. It's all about finding the right balance for the customer."*

## What's next in the development of the Orion technology?

*"Undoubtedly we will keep evolving the unit in terms of increased sustainability — we are already working on nuances to improve efficiencies and therefore reduce the energy requirement of the unit. A second focus is improving control system operation with innovations from supplier components." •*

**Sustainable series:** This premier Orion meets the ultimate requirements for sustainability. Optimized technologies reduce overall energy and water consumption, offering long-term operational savings.

**Environmental series:** The mid-range Orion reduces wastewater during recycle mode and also conserves energy to meet good environmental practices.

**Classic series:** The classic offers the core Orion technology within the most economical investment package.



## Orion™

Reverse Osmosis and Continuous Electrodeionization (CEDI) for the compendial water market.

### Years of experience

20 years

### Applications

Purified water production  
Cold water for injection (WFI) production  
Pre-treatment for hot distillation systems

### Markets

Pharmaceutical  
Biotechnology  
Veterinary  
Healthcare  
Cosmetics  
Contact lens

### Size/footprint of unit

Smallest: 1.40 x 3.60 x 2.10 m / 5.04 m<sup>2</sup>  
Largest: 2.00 x 5.00 x 2.30 m / 10.00 m<sup>2</sup>

### Daily capacity

500 to 20,000 L/h  
12 to 480 m<sup>3</sup>/d

### Environmental benefits

40% of the water is recovered  
99% of the materials used are recyclable  
Chemical use is minimal  
E+S series emit 30% less CO<sub>2</sub>

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**Orion is digitally enabled so our customers have the ability to monitor any parameters they want**

# Services make a splash in the water market



*The pandemic has positively impacted the growth of the Everything as a Service (XaaS) market due to the almost overnight digitalization of several industries. The impact of COVID-19 saw companies from various sectors adopt new technologies to simplify their business operations, ease and optimize work processes and facilitate remote working. And, as we emerge, many are focused on reducing costs and safeguarding the life of their existing equipment. All of which continue to strengthen market expansion with no sign of slowing.*

The XaaS market — and mindset — is disrupting even the most traditional markets, such as the pharmaceutical market. The global XaaS market was worth \$349.71 billion in 2020 but by 2028 it is expected to be \$2,384.12 billion — a staggering compound annual growth rate of 28.2 percent.

In light of this, Celine Dronsart, Business

Development Executive - BioPharma, takes a closer look at service growth trends to see how the water industry is responding.

### What are the main trends causing the growth in service uptake?

*“The service market is growing across all sectors, globally, as our quality of life improves, and as innovation facilitates ease of use. The*

*consumption of materialistic items, such as cars, domestic appliances, cell phones, etc., has skyrocketed and consumers expect the same level of support services and quality assurances wherever they are in the world. The same applies to businesses and many see outsourcing the maintenance of their equipment as an assured way to maintain efficiencies. And a company with global manufacturing facilities rightly expects the same guarantees to mitigate business risk across all their locations.”*

### Are certain regions or industrial sectors leading in the update of water services?

*“As well as the continuous growth of the developed regions, there has been massive consumer growth throughout the Asia Pacific, Southeast Asia and LATAM regions, owing to a rapid pace in development and improvement to the quality of life. We’ve also seen a lot of business growth as well as established companies expanding operations to these areas.”*

### What are the three main highlights of Aquaservice™?

*“Our offering, Aquaservice™ is a full after-sales service contract offered globally. It features best practices, such as Hubgrade digital solutions, as standard, and tailored services specific to each market with support as per local capabilities. Next, we offer additional market-specific lifecycle bundles, which customers can select based on their needs such as compliance and response time, just like TV packages for movies and sports. Finally, we offer lifetime agreements for spare parts, chemicals and mobile response units to give our customers a 24/7 end-to-end service offer.”*

### Moving onto Water as a Service. What are the biggest benefits of this to clients?

*“This is where customers only pay for the amount of water treated. We provide the equipment and services as necessary and*

*the contract commits us — at Veolia Water Technologies — to provide a quantity and quality of water over an agreed period, giving the customer increased business assurances. It also helps those customers who need a new water system, but don’t have the instant capital, to improve their operations sooner rather than later as they can spread the costs. The consumer equivalent is a cell phone contract — they get the instant benefits of the phone, insurance and the agreed usage, and they pay the phone off as they go.”*

### Where do you see the biggest update in service offerings in relation to water?

*“It has to be the digital revolution which was accelerated by the pandemic as it significantly reduced the business risk posed by COVID-19 when engineers couldn’t get onto sites. Today, the ability to have 24/7 remote access and real-time insight into operations and the data to predict maintenance continues to change the face of the industry. When it comes to pharma, if a water system goes down in all likelihood they need to stop production which means businesses not only stop making revenue but also lose profits. Downtime is what keeps site managers up at night and mitigating this is where our digital solutions come into their own.”*

### How do you predict this will evolve? Will another service surpass digital solutions?

*“Digital is always going to be a cornerstone but chemical services when it comes to pharma wastewater management have a lot of untapped potential. For now, water reuse is limited across the pharma industry but there is a fast-approaching need to reduce water consumption to alleviate water scarcity. As well as cleaning systems and extending the life of reverse osmosis membranes, the correct use of chemicals can facilitate water reuse by cleaning water so it is fit for purpose, ranging from boilers to cleaning.” •*

*The service market is growing across all sectors, globally, as our quality of life improves, and as innovation facilitates ease of use.*

*We are heavily focused on our services offer in line with market trends but also customer feedback*



# Sustainable enhanced performance



## WATER TECHNOLOGIES

Orion®, providing innovative purified water to leading pharmaceutical and biotechnology companies for more than 20 years.

- > 30% reduction in CO<sub>2</sub> emissions
- > 40% water recovered
- > 50% energy reduction
- > 99% materials that can be recycled

The Orion combines its pedigree of providing Compendial Purified Water and cold WFI through tried and tested process excellence with additional sustainability features at its core, creating an unrivaled water technology package.



Scan the QR Code to Learn More about Orion

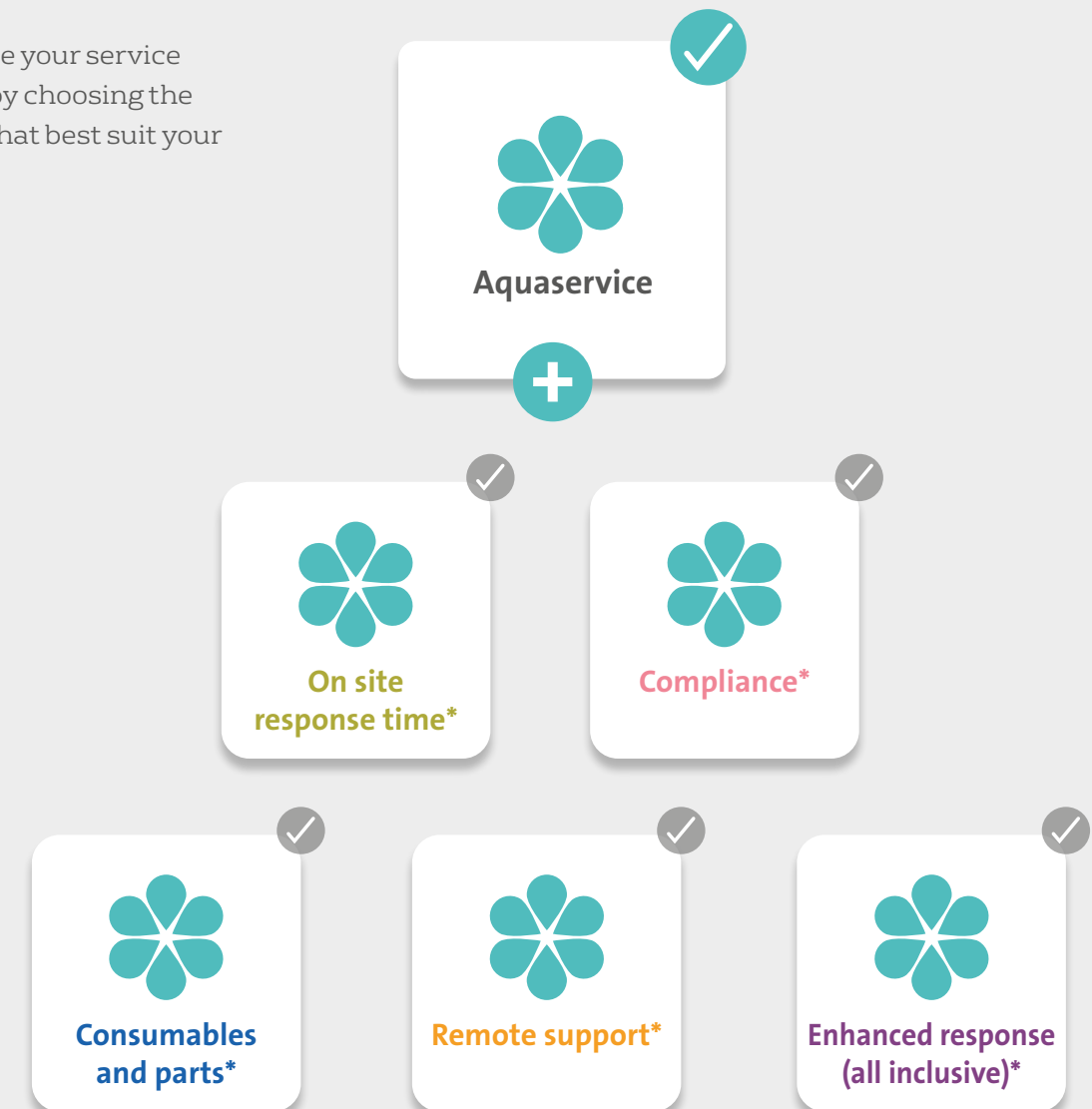
# Aquaservice™ for biotechnology and pharmaceutical industries:

## The performance of your water process is our business

In a world with tightening environmental regulations, water resource scarcity and a changing climate, more and more are relying on end-to-end water treatment technologies and services to:

- Maximize capacity, availability and system uptime.
- Optimize operating costs and environmental efficiencies.
- Exceed safety standards and comply with legislation.
- Extend the life of equipment.
- Maintain water quality and quantity requirements.

Customize your service package by choosing the bundles that best suit your needs:



\* Subject to local capabilities. Please contact your local Veolia Water Technologies representative to confirm available services.



## The tail that wags the dog: pharmaceutical veterinary wastewater treatment

**We spend a lot of money caring for our pets. Globally, the pet care market will surpass \$260 billion in 2022 — up from \$245 billion in 2021. Additionally, an estimated 6.1 percent compounded annual growth rate is expected to boost this figure to \$350 billion by 2027, so the market is one fat cat.**

The biggest submarket within pet care is vitamins which is part of the non-traditional but very important pharmaceutical market. Like during the manufacture of human medication, pet and animal drug creation also require water and consequently wastewater treatment to ensure safe discharge.

A global leader in the development, manufacturing and sale of veterinary medicines required help to find an effective solution for the treatment of large quantities of wastewater containing active pharmaceutical ingredients (APIs) that are not permitted for environmental discharge.

*“Located in the Netherlands, it is the client’s largest research and development facility as well as a production site of vaccines and medicines for animal use. Up to 350 products are manufactured there including the top 75 from their portfolio so ensuring business continuity is vital for this flagship location,”* explains Giovanni Silvestri, International Sales Director - Ehaled.

Following a preliminary study in 2016, the wastewater portfolio project started in April 2017. To address water and wastewater management issues, the wastewater containing APIs was to be segregated from the main site sewer at the relevant production buildings, thereby significantly decreasing the volume of water to be treated in the new wastewater treatment plant (WWTP)

and consequently significantly reducing costs.

*“Their situation presented a significant variability in the wastewater produced in terms of quality and quantity,”* adds Silvestri. *“The scope of work included an integrated set of modifications to the onsite wastewater management strategy to ensure compliance with the client’s environmental quality criteria.”*

The new water management strategy took into account the existing and expected future production capacities and related wastewater flows which the team addressed. Silvestri notes: *“Additionally, as well as future production planning, compliance was another major requirement for the customer.”*

After all water pollution was a widespread problem in the Netherlands in the 1960s and ‘70s and so the Government introduced strict conditions for discharging water. The issues were resolved by imposing far-reaching limitations on discharges by industry and improving the treatment of wastewater. This has seen the quality of the water in rivers, lakes and the sea, as well as the quality of groundwater, significantly improve in recent years.

The pet-loving customer had 13,400 cubic meters per year (899,000 gallons per year) — 61 tonnes per day based on 220 operational days — of wastewater to manage in line with these guidelines.

*“To meet this tonnage, and ensure the quality and uptime of over 98 percent, we provided the customer with three Ehaled™ RVF40FF evaporator units of 40 tonnes per day each,”* explains Silvestri. *“They generally just use the two units but having the backup is the way we guarantee that they can meet their daily peak and ensure business continuity. We also have a service contract with the customer covering the blower, which is the heart of the unit.”*

Before the offer was accepted, the team ran several tests in order to determine the committed water recovery rates and quality of the desolate, and chemical and power consumption were agreed upon.

*“If there ever was an issue with the unit it wouldn’t halt operations; however it would come with an extreme price tag: disposal costs where this site is located are notoriously high.”*

In 2017 the team planned ahead and essentially gave the customer more capacity than they needed. Now in 2022, they are in the first design stage of the system in terms of capacity and concentration. Silvestri adds: *“And the customer and units are still going strong”.*

Since Ehaled evaporation technologies are modular, as the customer continues to grow so can the system. Furthermore, by adding additional evaporation treatment steps there is the option of reducing not only the waste by an additional 10 times, reducing disposal costs, but it can also help save and reuse more water. *“We are seeing unprecedented water scarcity issues. More and more companies are realizing the vital importance of recycling their water to ensure the uptime of their operations and so are looking to repurpose what they already have. It’s safe to say, evaporation technologies are not a one-trick pony.”* concludes Silvestri. ●



### Ehaled™

Industrial wastewater treatment evaporators

#### Years of experience

Over 40 years

#### Worldwide references

Over 3,300

#### Applications

Industrial wastewater treatment

Reuse

#### Markets

Pharmaceutical

Cosmetics

Chemical

Automotive

Landfill

#### Size/footprint

From 0.60 to 22 square meters

#### Daily capacity

From 0.1 to 120 tons per day of distillate produced (22 - 27,000 gpd)

#### Benefits

Wastewater disposal volume and cost reduction

Low energy consumption

Remote control and monitoring

#### Environmental benefits

Water reuse

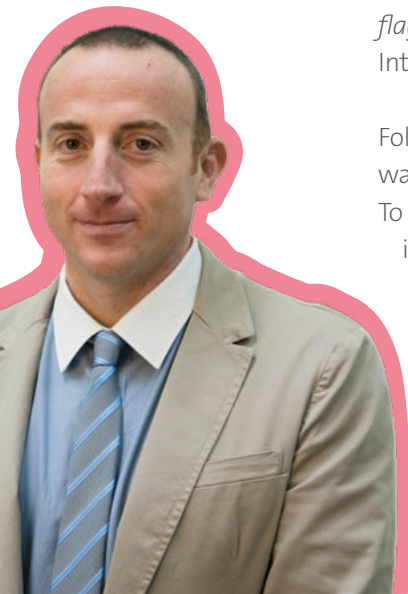
Zero liquid discharge (ZLD)

Low CO<sub>2</sub> footprint

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**As the customer continues to grow so can the system**







# A day in the life of a Hubgrade service engineer

**Hubgrade optimizes water operations for thousands of municipal and industrial customers around the globe which makes the role of a Hubgrade engineer vast and varied.**

From optimizing operations using real-time data to managing alerts and helping customers make informed decisions related to their facilities, Stephen Corrigan explains his day as a Hubgrade Senior Technical Support Engineer.

### What does your average day look like?

“Each morning my first task is to check all of my customers’ systems to ensure everything is running smoothly. I go through any and all alerts that Hubgrade has identified and either solve them remotely, work with the customer’s onsite team to manage the issue, or arrange for a service engineer to attend the customer’s site to investigate the issue further. I support a team of 13 service engineers and tend to be onsite myself twice a month with key customers.”

### When was this pharma client’s site Hubgrade-enabled and what have been the benefits of this?

“This took place in August 2019 involving the two Orion™ units we had onsite. There are numerous

benefits, but having the performance data was like turning on the lights. Overnight we increased transparency on how these systems were running, their performance health and where we could tweak them to optimize performance even further. Having these key performance indicators (KPIs) at the touch of a button proved invaluable — we pivoted from reactive to predictive asset management which has resulted in both cost savings and cost avoidance.”

### What was the customer’s challenge that Hubgrade helped solve?

“The main driver for Hubgrade was active risk management and increased reliability. Their previous system was flagging up several warning alarms that were not being actioned. By May 2021 we’d managed to reduce their alarms by 90 percent by looking at the root cause of the warnings, reviewing the parameters, making recommendations and then taking the correct preventative action. The reduction has given back the gift of time to our customer’s onsite team. Before Hubgrade they were dealing with

## The main driver was active risk management and increased reliability

a lot of nuisance alarms, quite literally, which was occupying a lot of their time and preventing quality work elsewhere.”

### How does Hubgrade help ensure compliant operations?

“All of the reporting that the solution provides supports and reconfirms the official readings required for environmental regulation purposes. It provides a historical performance record of everything from flows to pressures and conductivities, and gives a source for double-checking all environmental requirements.”

### What is your favorite Hubgrade feature and why?

“For me, it’s all about data comparison. With the graph comparison display, I can visually compare data from different units or different parameters over a period of time extremely easily. This means I get an instant clear picture of what has moved and how parameters are different against multiple units doing the same task which enables me to see improvement opportunities and potential fouling before it happens.”

### Which Sustainable Development Goal does your work most contribute to and how?

“Sustainable Development Goal number nine focuses on building resilient infrastructure and fostering innovation as the basis for sustainable economic growth, which is fundamentally my role. Using innovation, we can — and do — make water processes smarter, safer and more sustainable such as making sure purified water production systems are running to the very best of their ability and helping to reduce the carbon footprint of operations by initiating real-time system optimization.” ●

# Hubgrade

## PERFORMANCE

### Hubgrade digital solutions — Performance Plant module

The Plant module of Hubgrade Performance is an online digital twin of the wastewater treatment plant and sewer network. It uses real-time data and advanced algorithms to provide continuously optimized setpoints to the PLC control delivering insight to operators, process engineers and management teams.

#### Years of experience

More than 25 years

#### Application

Wastewater

#### Markets

Municipal

Pulp and paper

Food and beverage

Mining

Oil and gas

Pharmaceutical

#### Benefits

Reduce operating costs (energy and chemicals)

Increase hydraulic and biological capacity

Compliance and stable operation

#### Environmental benefits

Carbon footprint savings

Energy savings

Chemical savings

Compliance with environmental regulation

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# Sustainable pharmaceutical water management

Creating water solutions for industry

## 1 PRE-TREATMENT & PROCESS WATER

- Screen, drum and disc filtration
- Ultrafiltration
- Multimedia filtration: sand and activated carbon
- Reverse osmosis
- Continuous electrodeionization (CEDI)
- Photo oxidation ultraviolet
- Water treatment chemicals
- Softening

## 2 COMPENDIAL VALIDATED WATER

- ▶ **Critical and validated water production, storage and distribution**
- ▶ **Pyrogen-free water**
- ▶ **Pharmacopoeia compliant**

- Reverse osmosis and continuous electrodeionization
- Distillation:
  - Multi-effect distillation
  - Vapor compression
  - Clean steam
- Distribution and sanitization skid:
  - Thermal or ozonation

## 3 EFFLUENT TREATMENT

- ▶ **Meet increasing local discharge requirements**
- ▶ **COD, BOD, TSS, toxicity and chemical removal**
- ▶ **Endocrine (EDCs) and pharmaceuticals (PPCPs) removal**

- Coagulation/flocculation/decantation
- Flotation
- Evaporation and crystallization
- Biological treatment:
  - Anaerobic digestion
  - Activated sludge
  - Membrane biofilm reactor
  - Moving bed biofilm reactor
- Ozonation
- Reverse osmosis

## 8 SERVICES

- ▶ **Total validated system lifecycle compliance**

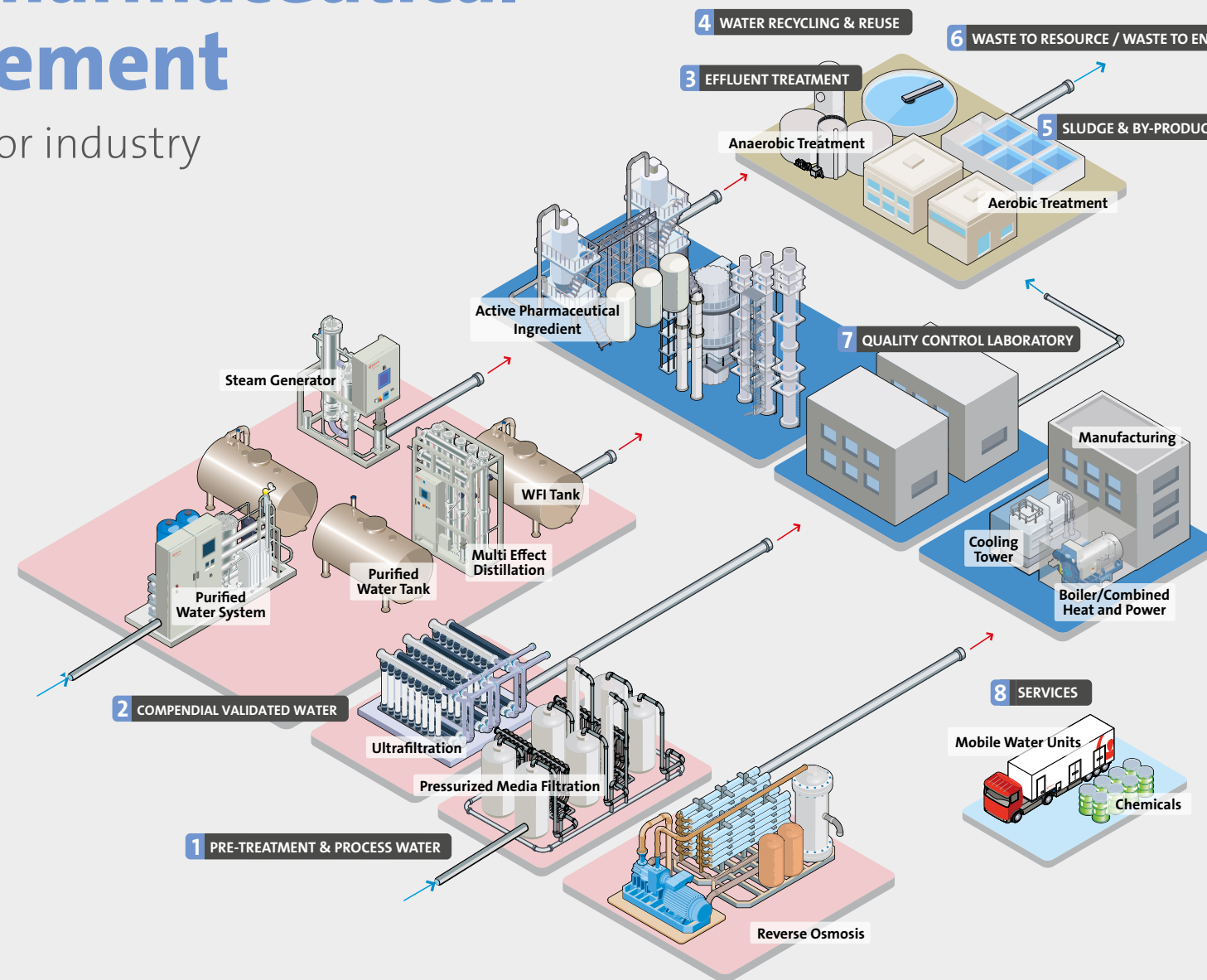
- Service contracts
- Re-validation of existing plant
- Digital 24/7 service and support infrastructure
- Remote monitoring of installations
- Local support staff
- Spare parts and consumables
- Replacement media
- Water analysis service

## 4 WATER RECYCLING & REUSE

## 6 WASTE TO RESOURCE / WASTE TO ENERGY

## 3 EFFLUENT TREATMENT

## 5 SLUDGE & BY-PRODUCTS



## 4 WATER RECYCLING & REUSE

- ▶ **Preserve natural resources**

- Tertiary filtration
- Multimedia filtration
- Evaporation and crystallization
- Membranes: nanofiltration and reverse osmosis
- Water treatment chemicals

## 5 SLUDGE & BY-PRODUCTS

- ▶ **Residuals management**
- ▶ **Energy recovery**
- ▶ **Product reuse (land disposal, composting, storage)**

- Drainage, centrifugation, filtration
- Anaerobic digestion (biogas recovery)
- Drying
- Fluidized bed incineration
- Water treatment chemicals

## 6 WASTE TO RESOURCE/WASTE TO ENERGY

- ▶ **Biogas generation for CHP and boiler**
- ▶ **Nutrient recovery**
- ▶ **Solvents recovery (phenol, ethanol, benzene and methanol)**

- Anaerobic treatment
- Biogas cleaning and handling
- Liquid/liquid extraction
- Macro porous polymer extraction (MPPE)
- Biopolymer
- Electrodialysis
- Water treatment chemicals

## 7 QUALITY CONTROL LABORATORY

- ▶ **Analytical techniques (microbiology, HPLC, ICP-MS, GCMS, atomic absorption, TOC)**
- ▶ **Quality analysis**
- ▶ **Water analysis**
- ▶ **Feed to ultrapure water**

- Activated carbon
- Electrodeionization
- Ion exchange
- Reverse osmosis
- Ultraviolet
- Sub-micron filtration

- Equipment leasing
- Service deionization
- Expansion and modification of treatment plants
- Refurbishment and update of validated systems
- Site audits
- Mobile and temporary solutions
- Water treatment chemicals
- Complete water cycle management and outsourcing

# End-to-end pharma solutions

*The definition of an end-to-end solution is an agreement that encompasses every feature necessary to execute the task successfully from beginning to end. When it comes to water management, the pharma industry is expressing great interest in a solution that will solve all their daily water issues: pre-treatment, wastewater treatment, maintaining regulatory compliance, equipment maintenance and optimization, etc., in order for them to focus on their task at hand: medicine making.*

Even though some processes are industry-specific or even company-specific, our experts have the knowledge and expertise to customize a solution for precise issues to make water management worries a thing of the past.

**1. Pre-treatment and process water** — pre-treatment is the removal of contaminants from raw water before the main water treatment process begins. Process water is therefore widely defined as water used in industry, manufacturing processes, power generation and similar applications. For the pharmaceutical industry, these waters must adhere to stringent regulatory requirements at all times.

**2. Compensial validates water** — water is one of the major commodities used by the pharmaceutical industry and different grades of water quality are required depending on the usage. Pharmaceutical waters — those used in the drug manufacturing process — must comply with non-negotiable pharmacopeia requirements. Orion™ is a purified water system that offers softening, reverse osmosis (RO) and continuous electrodeionization (CEDI) capabilities, ideal for the generation of purified water. Additionally, IonPro™ produces high-purity water with low bacteria levels also using RO and CEDI applications to deliver analytical grade II water for pharmaceutical use.

**3. Effluent treatment** — pharma wastewater treatment is the process of removing biological or chemical contaminants, including micropollutants, from effluent generated during the manufacturing process. Once treated, the water can either be released into the environment, discharged to the sewer or reused in plant processes; however, before these options become available, the likes of eXeno™ — a biological treatment process for the removal of drug residues— and MPPE® — a Macro Porous Polymer Extraction technology for the removal of dissolved and dispersed hydrocarbons— are required to ensure the wastewater is treated to protect human health and biodiversity.

**4. Water recycling and reuse** — while water reuse has several limitations in pharma, there are opportunities not only from an environmental and resilience standpoint but also as a way to significantly decrease the volume of water to be treated before discharge which significantly reduces costs. Evald™ evaporators are industrial systems that accelerate the natural evaporation process. They are suitable for pharmaceutical wastewater treatment to facilitate reduction and reuse.

**5. Sludge and byproducts** — we support all industry stakeholders to manage biosolids, an economic as well as environmental issue. Proven processes such as anaerobic digestion, thermal hydrolysis, co-digestion and thermal drying enable sludge to be converted into a valuable resource.

**6. Waste to resource/waste to energy** — within our portfolio, our valorization technologies turn biogas into biomethane using membrane technology to purify raw biogas to meet the requirements of its final use. One megawatt-hour of produced biomethane avoids 0.22 tons of CO<sub>2</sub> emissions.

**7. Quality control laboratory** — in pharma, this water must undergo processes to remove all contaminants and impurities as their presence can have a serious impact on laboratory data. Depending on the water quality required, a number of purification technologies are used to remove these impurities that guarantee ultrapure, pure water type II and type II+.

**8. Services** — Aquaservice™ is a comprehensive range of digital, chemical, mobile and spare part services that can be tailored to meet specific requirements with additional bundles. Full-time, in-house service engineers, dedicated support staff and an experienced technical support team are all focused on ensuring every system is operating in line with specifications and meeting operational requirements.

An end-to-end solution covers every drop of water within your network and all of this can be monitored remotely with Hubgrade digital solutions. A big benefit of an A to Z solution is that you get an overview of your entire water footprint which makes it easier to optimize water usage, identify reuse options, ensure compliance at every stage and recover resources. And, as a result, this insight facilitates decision-making, reduces downtime and helps future-proof operations.

# A new era for safer, cleaner and cooler WFI

**With the risks mitigated, the opportunities of cold WFI are significant, especially when comparing the available options**

*In April 2017 the European Pharmacopoeia Water for Injections (WFI) monograph was revised. For the first time, pharmaceutical manufacturers were able to choose between distillation systems (hot WFI) and reverse osmosis (RO) based membrane (cold WFI) systems. Five years later some are still shying away from cold WFI despite it being more economical and energy-efficient. So why should you make the switch to 25°C (77°F)?*

The update to the monograph was a considerable change and brought Europe in line with the United States Pharmacopeia and Japanese Pharmacopeia which have both long allowed non-distillation methods.

Since 2017 confidence in cold WFI has increased; however, after speaking to customers, there is still some hesitation due to contamination risks — even though cold WFI has been commercially available for decades and used extensively in other areas of the world for highly purified water production with low endotoxin levels in line with WFI water specifications.

*“Contamination is only a concern if systems are not managed correctly,” explains Lene Nordvik, Business Development Manager. “In addition, these concerns are reduced further by the increasing body of best practice advice.”*

The regulation requirement is for a ‘purification process equivalent to distillation’ and also recommends a RO system

coupled with electrodeionization and a suitable secondary membrane process. Rihal adds *“The membrane-based system achieves compliance with the WFI standard with these three primary technologies and, as such, it is sometimes referred to as Reverse Osmosis/Continuous Electrodeionization/Ultrafiltration (RO/CEDI/UF) solution. With these modern systems, they are completely hot water sanitizable regularly to prevent any risk of microbial growth.”*

As more pharmaceutical manufacturers get accustomed to these tried and tested technologies, which make use of existing systems, the cost savings become more attractive — especially as the market for pharmaceutical products and ingredients becomes more competitive. And so more businesses are willing to take on the measures required to mitigate these risks to achieve a more cost-effective output.

Lene expands: *“With the risks mitigated, the opportunities are significant, especially when comparing the available options. The cost savings achieved with cold WFI methods are vast since there is no need to heat the*

*water and so the energy costs associated with producing WFI are remarkably reduced, not to mention the lowered carbon footprint, increased sustainability, and consistent service and maintenance savings.”*

So how does it work? RO uses a semi-permeable membrane to remove up to 99 percent of the dissolved solids, particles, colloids, organics, bacteria and pyrogens from the feed water without the need for heat, and CEDI is a highly efficient, chemical-free process for creating low conductivity water. *“The system uses electricity, resins and ion exchange membranes to separate dissolved impurities (ions) from water and then UF uses membrane filters with microscopic pore sizes of 1 to 10 nanometer, which remove particles as small as*

*protein macromolecules,”* adds Lene.

The membrane system also reduces capital costs as existing pure water equipment can be enhanced to produce WFI, and these typically have a smaller footprint, ideal if space on-site is limited.

Lene concludes: *“Since both cold and hot WFI systems produce water that meets the specified standard for WFI, pharmaceutical companies should feel empowered to make the best choice for their organization based on their operational requirements, existing equipment and systems, available space, corporate sustainability initiatives, and of course CAPEX and OPEX budgets.”* •

**The system uses electricity, resins and ion exchange membranes to separate dissolved impurities**



# Fisherman's Friend: 157 years of growth

*Their story starts with the scratchy throat of a deep-sea fisherman in northwest England in 1865. Little did they know that this encounter would take them to 70 countries throughout the world. So how did Fisherman's Friend support their global growth from their hometown?*

Now in its fifth generation, Fisherman's Friend is still a family-run business. Following decades of success, the family has expanded its operations worldwide but has always been determined to stick to its heritage and so, as opposed to building global manufacturing sites, it has expanded its operations locally on several occasions.

As a result, today Lofthouse of Fleetwood has three separate production facilities, each supported by a validated water purification system that meets all global health regulator standards for exporting and importing its pharmaceuticals to 70 countries.

For example, to enter the U.S. market, they needed to ensure that the water used during its manufacturing process complied with the water quality standards for purified water. In U.S. Food and Drugs Administration (FDA) and Medical Health Regulatory Authority (MHRA) terms, this means conductivity of fewer than 1.3 microsiemens per centimeter ( $\mu\text{S}/\text{cm}$ ) at 25°C, total organic carbon of fewer than 500 parts per billion, and a total viable bacteria count under 100 colony-forming unit per milliliter (CFU/ml). All of this is achieved and guaranteed with the Orion™ — the very first Orion was installed at this facility in 2002.

*Three separate production facilities, each supported by a validated water purification system, meet all global health regulator standards for exporting and importing pharmaceuticals to 70 countries.*

*Their story starts with the scratchy throat of a deep-sea fisherman in northwest England in 1865. Little did they know that this encounter would take them to 70 countries throughout the world. So how did Fisherman's Friend support their global growth from their hometown?*

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## IonPro™

A compact and user-friendly system capable of producing high-purity water with low bacteria levels, ideal for critical applications, using reverse osmosis (RO) and continuous electrodeionization (CEDI).

### Years of experience

More than 20

### Applications

Industrial process water production  
Analytical water grade II production  
Purified water production

### Markets

Cosmetics  
General industry  
Hospitals/healthcare  
Laboratories  
Microelectronics  
Pharmaceutical

### Size/footprint

1.10 x 0.80 x 1.57 m / 0.88 m<sup>2</sup>

### Daily capacity

500 to 1,000 L/h  
12 to 24 m<sup>3</sup>/d

### Unique features

An integrated system including softening, degassing and CEDI  
Intuitive and easy handling user screen, including process information and performance calculations

### Environmental benefits

Integral automatic sanitization (AutoSan)  
Simple, reliable and compact footprint

### Contact:

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*Validated  
water  
purification  
system to  
meet all  
global health  
regulator  
standards*



# Making water smarter, safer and more reliable



**“To produce water, pharmaceutical and process industries need more than reliable equipment,” explains Cynthia Haddad, Head of Sales and Marketing Support - Hubgrade. “Digital is power,” and below she explains why.**

The COVID-19 pandemic and the experience of lockdown have highlighted the business case for solutions that facilitate remote working and ensure operational resilience. Both of these are underpinned by digital solutions that help companies increase their production, maintain operations with a small on-site presence, and utilize data analysis for better process control regardless of what is going on in the world.

When it comes to meeting production requirements, increasing production to respond to rapidly changing

consumer behaviors, and complying with stringent regulations and environmental challenges, having reliable equipment means very little without the people and the knowledge to operate and optimize them.

To respond to these challenges, for the chemical and pharma industry, we focused on predictive maintenance by designing a Smart Membranes digital service that combines the power of machine learning and our expertise for smarter reverse osmosis management. As part of our Hubgrade digital solution, Smart Membranes use data to predict when a reverse osmosis system needs cleaning to prevent irreversible

fouling, membrane damage and ultimately unexpected shutdowns — this proves invaluable when teams aren’t readily on-site or when dealing with supply chain issues as it gives our customers the gift of foresight and time to help maintain their operations.

Next, we are adapting a wastewater digital twin in order to comply with increasingly stringent regulations. The aim is to better facilitate the operational flexibility that many of our pharmaceutical clients are looking for. Having a wastewater digital twin helps ensure safe, compliant and optimized wastewater operations by using real-time and advanced algorithms to provide optimized setpoints to the PLC control and deliver insight to the operators, process engineers and management. We already have a ready-to-deploy solution: Hubgrade Performance Plant, which is currently optimizing more than 50 municipal wastewater treatment plants and can be easily adapted to industrial wastewater systems.

Our third focus is utilizing augmented reality (AR) especially when it comes to process monitoring. The pandemic exacerbated the need for digital solutions that ensure business continuity and help operators save time. Digital and human, our offering facilitates fast access to a worldwide network of experts who can tap into sustainable AR tools, giving them the ability to carry out everything from factory acceptance tests to troubleshooting, regular inspections and emergencies remotely.

In summary, in today’s world, even the very best equipment isn’t shielded from risk and is not sufficient to ensure uptime. Digital helps water operators overcome these daily challenges and avoid future changes to maintain operations, all the while making water processes smarter, safer and more sustainable. ●

## Hubgrade

### PERFORMANCE

#### Hubgrade Performance Insight, Smart Membranes module

*With Smart Membranes, Hubgrade combines our extensive process knowledge and artificial intelligence to normalize and predict the evolution of strategic operational parameters. It provides real-time and reliable assessments to confirm the fouling state of membranes to enable proactive and evidence-based decision making for the operating team.*

#### Markets

- Pulp and paper
- Food and beverage
- Mining
- Oil and gas
- Pharmaceutical

#### Applications

- Reverse osmosis
- Membrane plant

#### Unique features

- Veolia’s process expertise combined with advanced algorithms
- Access to Veolia’s latest internal tools and experience
- Leveraging machine-based learning

#### Environmental benefits

- Reduce chemical and energy consumption
- Prevent non-compliance events

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# Recycling polluted industrial wastewater

**Cristina Del Piccolo, Process and Research and Development Manager, discusses the current industrial wastewater management sector and how we must tackle new-age pollution with innovation.**

Del Piccolo has been with the company since 2002 and is responsible for the technical department within one of the company's technology-focused business units. Her work is focused on how Veolia's Ehaled™ evaporation technologies are able to recycle polluted industrial wastewater, helping global customers across the healthcare, pharmaceutical and automotive markets reap environmental, economic and financial benefits. Here she shares with us her thoughts.

## What is the current state of industrial wastewater recycling?

*"In terms of regulation, if we're talking about developed countries, we are all more or less on the same page. However, of course, some countries are doing better than others and some countries need to do more. Many of the businesses we see leading the way are those in countries with access to fewer resources overall, so they need to recover more water to ensure their business continuity. The good news is, there are a lot of industries that pay attention, not just to respect the regulations — which is essential — but who go further to proactively protect the environment.*

*In terms of what these regulations and companies are focused on, today there is a sufficient*

*focus on all known major pollutants and contributions; however, this is evolving. In the last few decades, we have developed so much in terms of new drugs and industrial chemicals so research is ongoing into new pollutants. As a result, our knowledge is constantly growing, such as awareness of endocrine disruptors which are gaining an increasing amount of attention with the authorities, and so regulations are constantly in review as the 'current state' is better understood."*

## How much of a focus is water reuse in the industrial sector?

*"There is a very large focus on reuse but also in finding other ways to think about wastewater as a resource. One way for sure is evaporation and crystallization technologies which recover until the very last drop. Evaporation is starting to be considered not only as the ultimate treatment step to achieve zero liquid discharge plants but it can also be applied inside the production line. In doing so, wastewater streams can be reused inside the production process itself. Evaporation can transform wastewater into a new stream for which alternative options are possible right up until recovery as a new resource. The success of this is dependent on the company, their industry, their utilities and the water quality grade needed. However, what is now widely understood is that there is a resource and so, together, we think about a way to use this. Reuse requires creativity but we are getting there."*



## What are the main benefits these "new" resources bring to the industrial sector?

*"There are many. Following evaporation and crystallization — where everything is recovered — you're left with a final residue which is the lowest volume you can achieve. This means all potential resources have been captured but the benefits don't stop there. In terms of waste management, the residue occupies less space and so results in lower transportation and disposal costs. Not forgetting a vastly reduced CO<sub>2</sub> footprint."*

## What is the biggest challenge facing the industrial wastewater sector?

*"Pollutants that are not easily treated by conventional technologies. Many conventional technologies, such as those developed to treat traditional markets like the food and beverage industry and their biodegradable compounds,*

*were developed years ago. Pollution then was different from what we have now owing to the new chemicals and drugs that industries use in manufacturing, or new metals, which come from new industrial processes and new products. Furthermore, our general understanding of all these contaminants is much better and we pay attention to a much longer list that requires different treatment approaches. This is where innovation is key so we can keep up with requirements, not only in terms of pollutant change but increased regulations."*

## How is the industry addressing these new-age pollutants?

*"The treatment of pollution at the source is an important topic. The idea is to tackle*

**The treatment of pollution at the source is an important topic**





*pollution where the concentrations are much higher and flows are reduced, straight out of the factory, as opposed to in the municipal wastewater system once they've dispersed. Yes, this treatment is done in the municipal system but technically speaking, we can face the two situations in completely different ways with two different process lines best suited to the level of parts per million (ppm) of a compound in the wastewater stream. This will give us a much better treatment rate. It makes a lot of sense to try to segregate them. What is clear is that evaporation is a very refined technology, especially for active pharmaceutical ingredients (APIs) — the very big and complex molecules — as a separation technology.”*

#### **How is the pharmaceutical industry addressing these new-age pollutants?**

*“It’s no secret that discharge from pharma sites, where the drug manufacturing takes place, can cause pollution risks in distant locations from the final user. And this is why treating pollution at the source is so important. Our customers answer this, once again, with evaporation,*

*which is an effective solution for all wastewater coming from pharma production that contains particularly challenging APIs which are very complex molecules and/or antibiotics.*

*APIs are not easily managed by traditional treatments such as biological plants; however, an evaporator can be installed within an existing wastewater treatment line so the most challenging streams can be segregated. What makes sense is to separate this stream so the traditional plants can keep treating the rest of the water which is easier to manage. This, in my opinion, is the main driver for the pharmaceutical industry since APIs are a relatively new obstacle. The pharmaceutical industry must continue to make existing plants adequate as limits are imposed on these particular substances — limits that until now weren’t foreseen or controlled.”*

#### **What does the future of industrial wastewater recycling and reuse look like to you?**

*“We will continue to push towards reduction of the water until it is a constant requirement. This will be underpinned by the technologies we now have, and we must continue to invest in order to make it easier to recover water with higher efficiency and reduced OPEX. Until very recently, if customers wanted to recover all their water, the process line that they needed to put in place was normally complex and costly — both in terms of CAPEX and OPEX. But technology is bridging this gap and making it much more accessible to small to medium companies, not just industrial giants.” •*

## **Dissolved and dispersed hydrocarbons banished with MPPE®**

***With energy and water savings, process efficiency and considerable operational advantages, MPPE is a technology that offers an efficient solution to some of the most testing industrial waste streams. Now it’s giving new life to pharma.***

The pharmaceutical industry faces particular and unique challenges when it comes to wastewater. Toxic waste components, like the hydrocarbon solvents used in production and synthesis processes, can make pharmaceutical effluent discharges difficult and costly to manage.

While the use of hydrocarbons depends on specific manufacturing requirements, they are in common usage in research and development laboratories, biotech clinical facilities and chemical synthesis of active pharmaceutical ingredients (APIs). Indeed, more than 30 solvents are regularly used in this industry, including chlorinated solvents, alcohols like

ethanol and methanol, other polar solvents like acetone, as well as aromatic components such as toluene.

In many jurisdictions, hydrocarbon discharge requirements are extremely stringent, and these limits are steadily becoming stricter over time. For some, removing these materials is simply a regulatory requirement if they are to operate their facilities.

However, the growing awareness and demand of corporate social responsibility mean that there is an increased focus on brand and image protection, especially where waste streams are relatively hazardous, as is the case with



***MPPE offers very high efficiency with almost 100 percent hydrocarbon recovery***



**MPPE allows pharmaceutical companies to guarantee their business continuity**

hydrocarbons. Typically, such waste streams are treated using distillation columns, but this approach is very energy-intensive and can present a number of operational issues if the distillation column needs to be cleaned, for instance. As a result, the pharmaceutical sector is looking for alternative solutions to hydrocarbon removal.

Our Macro Porous Polymer Extraction (MPPE®) is proven to be a highly effective technology for removing dissolved and dispersed hydrocarbons from wastewater. A fully automated process, it requires minimal operator attention, uses no chemicals and produces no sludges or gasses. It relies on an extraction liquid with a strong affinity for hydrocarbons that is fixed within a packed bed of porous polymer beads. As the wastewater passes through the bed, the hydrocarbons migrate from the water phase into the extraction liquid. Purified water can then either be further treated, reused or discharged.

As the extraction liquid becomes saturated with hydrocarbons, periodically, it is regenerated by gently heating it with low-pressure steam at about 112°C (233.6°F). The hydrocarbons within the extraction liquid are released through evaporation and subsequently condensed and removed as a liquid phase in a separator. Almost all of the hydrocarbons are removed, and as there are two columns in play within the MPPE process, simultaneous extraction and regeneration are possible. The wastewater stream is switched to the alternative bed during regeneration of the first, meaning no interruption in plant operations.

MPPE extraction technology can reach any required removal efficiency by simply adding more media to the column. And when compared to competing technologies, the efficiency MPPE can finally reach is significantly higher, and the

system is supplied with a guaranteed separation performance for the operational life of the unit.

For polar components, a different type of media can be used that is operated in the same way, enabling the removal of a larger range of hydrocarbons.

Removal of the more complex components from waste streams is a critical driver in deploying MPPE technology. Toxic materials, for instance, cannot be handled by the biotreater in conventional wastewater treatment plants. Efficiently removing those toxic components allows the bulk of the wastewater stream to be passed through a standard biological treatment process or reused on site. Furthermore, eliminating and concentrating the toxic materials by a factor of up to 200 significantly reduces the volume of waste that may otherwise need to be removed from the production site by a tanker truck for subsequent disposal.

The MPPE solution also consumes much less energy than a distillation process. In fact, only around 10 to 20 percent of the energy is needed during a full steam regeneration cycle of MPPE when compared with distillation treatment, even with associated energy recovery. These characteristics represent clear cost and environmental advantages over other solutions, but there are a number of additional benefits too.

Although typically it is used to remove all traces of hydrocarbon solvents, its recovery efficiency means MPPE can be used to extract specific high-value products from a wastewater stream. Where hydrocarbon solvent removal is the goal, further treatment and distillation — often by a third party — allows the recovered solvent to be reused in the pharmaceutical process: in some cases, the recovered solvent can be reused directly from

the MPPE separator.

There are also significant operational gains. Distillation columns can suffer from fouling, and when this occurs, the column must be cleaned using solvents. Under these circumstances, the unit must be taken out of service, which is both a fairly expensive exercise and also presents a number of health and safety challenges. However, the continuous operation of MPPE avoids these issues.

While MPPE is just one of a range of solutions in our portfolio of wastewater systems, it offers numerous advantages when treating the challenging hydrocarbon waste elements arising from the pharmaceutical industry.

Not only is the energy intensity much reduced when compared to alternatives, but the efficiency is very high with almost 100 percent of the hydrocarbons recovered from wastewater. Water treated with MPPE can then be further purified by other operations, where one of the requirements for those treatments is typical that the hydrocarbon content is very low. This helps pharmaceutical companies deliver important water savings on their processes but also supports resource recovery of materials like solvents and even specific high-value products within the waste stream. By effectively tackling just one element of the wastewater stream, MPPE can solve a major slice of the wastewater problems faced by pharmaceutical companies and deliver a whole host of benefits.

Ultimately though, the MPPE process allows pharmaceutical companies to guarantee their business continuity by ensuring that processes and projects are within environmental regulatory limits both now and in the future. ●



# Customer challenge:

## Toluene removal from process water

*Our experts were brought on board to help a pharmaceutical leader significantly reduce the concentration of solvent toluene — an aromatic hydrocarbon — in their process water to feed a downstream membrane process.*

The utmost importance was placed on ensuring compliance with stringent treatment and specification limits. The customer also wanted to reduce OPEX and operator time compared to their existing steam stripper which experienced regular operational issues and fouling.

They were planning several downstream purification units, including a membrane filtration step, but this could not handle toluene or other solvents. To deal with this issue, we proposed a Macro Porous Polymer Extraction (MPPE®) process since it is highly effective at removing dissolved and dispersed hydrocarbons from water through liquid-liquid extraction.

The equipment is assembled inside two stacked containers, acting as a standalone unit with a capacity of 4.4 cubic meters per hour (1,200 gallons per hour), reducing the toluene from 1,000 parts per million (ppm) down to one ppm. Almost pure toluene is sent to the toluene waste tank, ready to be exported to a third party. The unit has been on site since February 2021.

MPPE is one of the few, if not the only technology on the market capable of producing a 99.9 percent removal rate at this level of toluene concentration. ●



### MPPE®

*Macro Porous Polymer Extraction (MPPE) is a highly effective technology for removing dissolved and dispersed hydrocarbons from water on the basis of liquid-liquid extraction.*

#### Years of experience

28

#### Number of worldwide references

More than 40

#### Applications

Groundwater

Wastewater

Produced water

#### Markets

Chemical

Microelectronics

Oil and gas

Pharmaceutical

#### Daily capacity

12 - 3,840 m<sup>3</sup>/day per module (3,200 - 1 million gpd)

#### Unique features

Exceptionally high removal efficiency at every step

Simple and robust technology suitable for unmanned facilities

No sludge or waste except concentrated hydrocarbons, potentially for reuse

#### Environmental benefits

Low energy consumption

Very high removal efficiency

Possibility to recover pure components

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# Resourcing the world

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