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*Insights from Veolia Water Technologies*

## **AQUAVISTA™**

Your new digital service

**DISCOVER OUR TECHNOLOGIES  
TO BOOST YOUR WATER VALUE**

**FIND SOLUTIONS TO YOUR  
COMPENDIAL WATER CHALLENGES**

**WATER TECHNOLOGIES**



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# AQUAVISTA™

DIGITAL SERVICES



## Next Generation Critical Utilities

In the pharmaceutical industry, water is used in the manufacturing process as an ingredient but also as a cleaning agent. Production of purified water, pyrogen-free water and water for injection to international pharmaceutical standards is widely recognized as a critical process. In collaboration with our clients we develop efficient water generation systems that meet and exceed these international standards.

No matter the application - pre-treatment, generation of purified water, production of water for injection, storage and distribution or wastewater treatment - we use the best available technologies to improve manufacturing efficiencies and reduce costs without compromising process security or product quality. All aspects of our product development, project management and service offerings are managed to a high quality standard to ensure that our dedicated team of experts is in tune with market needs.

In today's manufacturing plants our customers require reliable data to optimize their manufacturing process. AQUAVISTA™ is Veolia Water Technologies' solution solution. Entirely dedicated to water treatment applications it offers expert insight via a secure cloud platform available 24/7.

AQUAVISTA™ is built on the back of a worldwide network of service personnel dedicated to maintaining and optimizing compendial water treatment systems and pharmaceutical wastewater plants. Veolia maintains thousands of systems worldwide to ensure that clients' compliance and uptime objectives are always met.

In the following pages, discover more on how we can help you to address your water challenges.



## INTERVIEW

# Jean-François Nogrette, CEO & Aude Giard, Chief Digital Officer Veolia Water Technologies



## What are the main challenges of the water world?

Jean-François Nogrette: *We often talk about the issue of access to water. This is of course a very important topic that needs to be addressed, along with access to sanitation and the importance of water reuse. But there is another topic that we don't address as much, and that I feel is very important, and that is the issue of trust.*

*In many parts of the world, we are sharing, exchanging and reusing water in various ways, through many different partners at a much faster pace than ever before. These exchanges must be based on trust, and trust can only be established through information.*

*Information about water quality, of course, quality of the water coming in, quality and composition of the water going out, but also information about chemical consumption, about the amount of sludge generated, of biogas produced and energy used. Information about hydraulics, about the network, even about the weather.*

*This information must be accurate and reliable, it must be available in real time, over a long period of time.*

## How can we get an accurate and reliable information?

JFN: *This information can be obtained by establishing the digital plant.*

*For me, the digital plant is a lever to boost operational performance and it is also a way to solidify a long-term pact with the client. This pact of trust is based on real-time data paired with water treatment expertise and a worldwide benchmark.*

*The world is changing fast, technologies need to respond to an increasingly complex environment and help us address the challenges of water scarcity and water reuse. And as I mentioned before, they need to secure the trust of the client and of the end-user.*

*Water is either an ingredient of customers' value creation or a cost of compliance but either way, it needs to flow as per expectations. Implementing a digital plant can help clients focus*

*on their own business value and on the performance of their daily operations.*

*These digital tools need to be flexible, they need to be available 24/7, and most importantly, they need to be available on a highly secured Cloud platform. This is how we can provide information to our clients and establish a long-term relationship based on trust.*

## Could you give us an example of the benefits of a digital plant?

Aude Giard: *Yes of course, we have several projects. One example is our customer BlueKolding who optimized its energy consumption thanks to our digital offer AQUAVISTA™.*

*BlueKolding is an environment, energy, and climate company which covers the entire municipality of Kolding in Denmark. They are inspired by the concept of blue economy and are constantly working to find new ways of exploiting the resources in wastewater and improving processes to clean it.*

*Veolia has been working with BlueKolding for several years. In 2017, they decided to adopt our digital service offering Aquavista. Doing this gave them access to a sort of digital autopilot at the service of energy optimization, while maintaining robust and sustainable water treatment.*

*They had the flexibility to choose which features of AQUAVISTA™ they wanted to activate on the processes in their plant. They have access to real-time cloud-based information that optimizes energy use and energy production through biogas. It also optimizes sludge production and recirculation, and it optimizes chemical usage.*

**How far does Aquavista help the municipalities and industrial companies to better operate their plants?**

*AG: AQUAVISTA™ is a complete suite of digital services using internet-of-things, advanced analytics and our water treatment expertise. We developed Aquavista on several of our existing technologies, on solutions provided to our customers during these past few decades and on our design & build experience.*

*We are really lucky to be able to take advantage of these VWT long-term experiences. Innovation is in our DNA and we count on this new offer to improve the operations of our clients' plants.*

*AQUAVISTA™ is not just one offer, it presents four different modules which can be adapted to our different clients' needs.*

*A customer portal which provides real-time remote monitoring of equipment and alert management to our clients.*

*The AQUAVISTA™ Plant, our most complete offer, is a stack of remote controls algorithms that embed twenty five years of process knowledge of our engineers in Denmark. This product provides real-time remote controls on drinking water & wastewater treatment plants (municipal and industrial).*

*We have some other modules in the pipeline, for example, a module called "Assist" which aims to provide our customers with remote expertise by giving access to the network of VWT process and commissioning engineers (water quality reports, compliance reports, online expertise, etc.).*

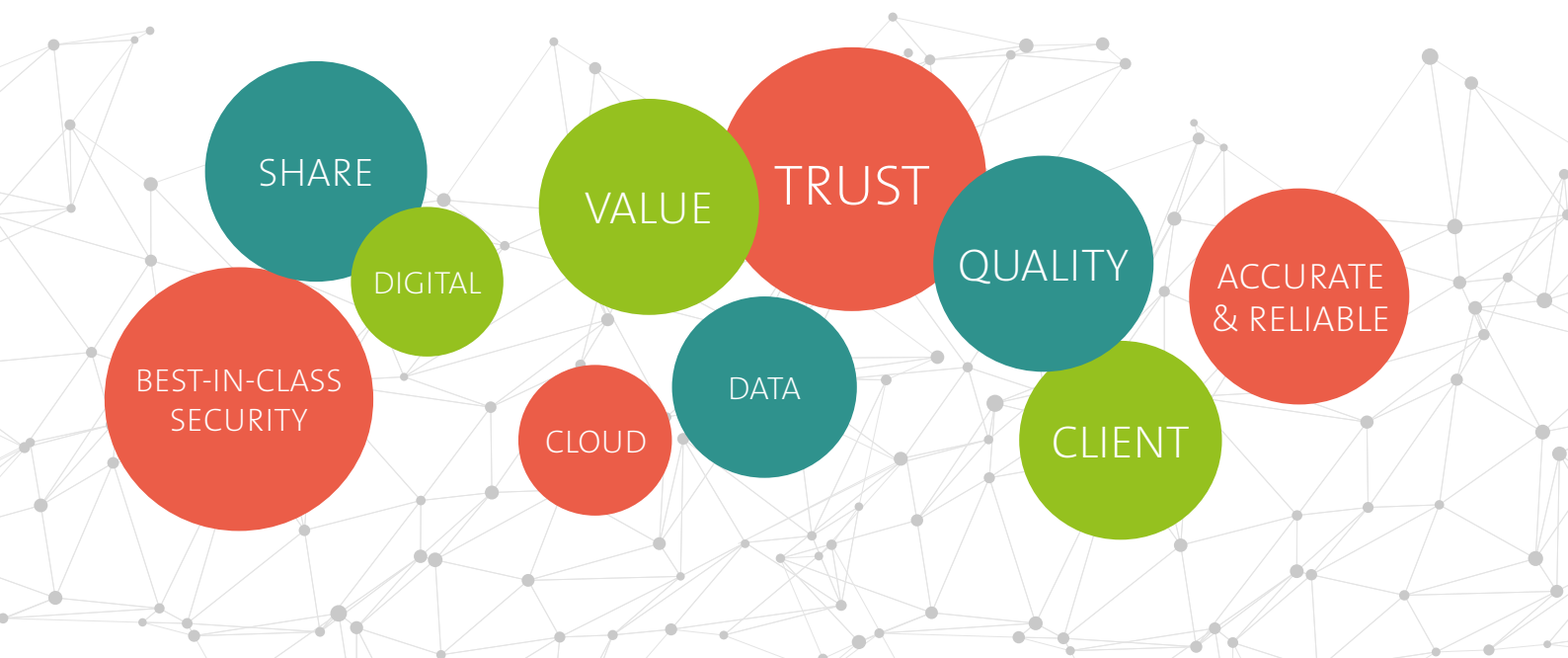
*And we have an "Insight" module, based on more advanced analytics, looking at long-term data, liaising operational information and financial information to deliver business decision KPIs and enable operators and managers to simulate the impact of an operational decision.*

*As a digital services solution, AQUAVISTA™ is value driven.*

*Our ambition is to deliver high value services to our customers and address their key business stakes and industrial challenges :*

- increase their operational efficiency and plant uptime,*
- improve their water quality anytime anywhere*
- ensure the output effluent complies with regulation for a better environmental footprint*
- work on the complex energy exchanges the plant perimeters: biogas management optimization, SMARTGrid and energy balance, water network optimization, etc*

*Connecting our customers to Aquavista will make them better operators of our technologies and will boost their own value creation! ●*



# AQUAVISTA™

*the water digital service*



## AQUAVISTA™ Portal

### KEY FEATURES

- Single point of reference for all information relating to your water treatment system:
- real-time remote monitoring of equipment data,
  - dynamic alarm management and information for operators,
  - key information about service contracts and reports,
  - archive of all service and sales orders,
  - access to equipment data: user guides, performance documents, calibration certificates, documentation for a specific site, O&M manuals and training videos/ materials for operation of selected technologies,
  - notification of events for equipment.

### ADDED VALUE

- Improvement of preventive maintenance through dynamic alarm management,
- access data from multiple sites via a single point of entry,
- private and secure,
- 24/7 managed service,
- ATAWAD: Any Time, AnyWhere, Any Device,
- improves convenience and simplifies operations.



## AQUAVISTA™ Insight

### KEY FEATURES

- Through remote access to an information dashboard, benchmarks and suggestions for process optimization, AQUAVISTA™ provides:
- key operational information overview,
  - analysis of technology units performance,
  - global benchmarks (comparison, scenario and optimization).

This data-driven optimization of equipment performance could ultimately result in a full auto-pilot solution.

### ADDED VALUE

- A dashboard for managers, operators and engineers, built in conjunction with the existing AQUAVISTA™ Portal and leading to:
- global benchmarking,
  - continuous optimization review,
  - monitoring of key performance indicators.



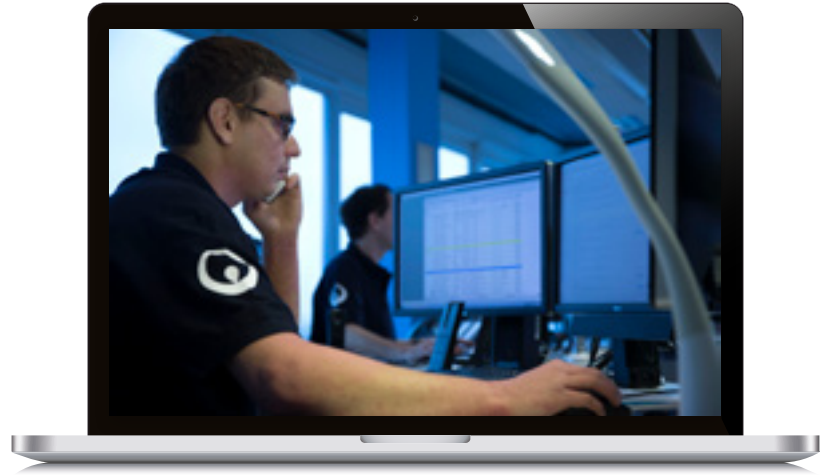


## AQUAVISTA™ Assist

### KEY FEATURES

Support operators' treatment processes through access in real time to knowledge, digital training and a network of process engineers for:

- › advice in a timely manner, enabled by data as well as a consistent platform,
- › a better understanding of the specific end users' operations,
- › an improved risk mitigation to meet your challenges (compliance, plant shutdown, etc.).



### ADDED VALUE

- › Community management where operators can communicate and share knowledge with other operators and Veolia process engineers.
- › Operators can request support from Veolia Water Technologies (site visit, online assistance for maintenance service, troubleshooting, emergency support).

## AQUAVISTA™ Plant

AQUAVISTA™ Plant is a holistic solution:

- › a suite of intelligent software solutions,
- › a state-of-the-art plant overview,
- › an online control & forecasting tool.

AQUAVISTA™ Plant is implemented across several countries with hundreds of plants already connected.

It is suitable for small and large municipal and industrial wastewater plants.



# Water quality for a laboratory monitored by AQUAVISTA™

## **The Biochemical & Molecular Biology laboratory at Nîmes University Hospital**

has four main activities: the Biochemistry, Hormonology, Biological Oncology and General Toxicology-Pharmacology sectors, for both routine and emergencies; the Toxicology and specialized and forensic Pharmacology sector; the Molecular Genetics sector (somatic oncogenetics, neurogenetics, constitutional pharmacogenetics) and finally a delocalized Biology sector.

The laboratory team is composed of 41 staff, of which 26 technicians who are mainly in charge of the maintenance of the analysers and the technical validation of the examinations and also nine medical biologists who ensure, among other things, the medical expertise of the laboratory examinations through the provision of advice to clinicians and a university teaching activity.

The laboratory operates 7 days a week and 24 hours a day and on average the laboratory processes 1200 samples/day and produces 2.4 million procedures/year.

The Biochemical & Molecular Biology laboratory at Nîmes University Hospital has been using Roche Diagnostics and Veolia solutions since 2013. This solution is differentiated by a complete analytical

offer that allows laboratory technicians and medical biologists to have real-time access to water quality monitoring and to intervene within the scope of preventive and curative maintenance actions.

## **Traceability at the heart of the laboratory**

The current era of medical biology laboratories is the consolidation of analytical solutions (grouping of several analysers into a single one) for medico-economic aspects to ensure greater traceability in sample processing procedures, while optimising the analysers' performance and production.

*“Previously, each analyser had a dedicated water supply, today a single water production plant must be able to produce a sufficient volume of water while ensuring an irreproachable water quality, as this is an essential part of the analytical process at the origin of the production of patient examination results”,* explains Dr David-Paul De Brauwere, hospital practitioner at the Biochemical & Molecular Biology laboratory. These automated technical platforms are at the heart of the laboratory's organisation; they make it possible to manage high flows while meeting the quality and traceability standards required by regulations.

Roche Diagnostics France supports laboratories in this evolution by offering high-performance, proven analytical solutions for automated technical platforms.

Clinical analysers need a constant, safe and compliant supply of water to produce and reproduce reliable diagnostic tests. Roche and Veolia's offer meets this requirement for quality and traceability. It includes both the Roche product lines (cobas®8000), Medica Pro for water supply and the user interface with the AQUAVISTA™ portal for real-time water quality monitoring.



### An interface that facilitates the accreditation process

By 2020, 100% of the NABM examinations produced by a laboratory must be certified. The COFRAC (COmité FRançais d'ACcréditation - French Certification Authority) is in charge of issuing these certificates to medical biology laboratories who must meet the specific requirements concerning competence and quality required by standard NF EN ISO 15 189.

With a view to full accreditation in 2 years: *“access to an interface that centralises water quality histories and allows us to view all these main parameters on a single page - temperature, conductivity, resistivity - provide a guarantee of traceability; as well as access to the calendar of events, allowing us to view the history of alarms. We become more efficient! We can immediately provide all the information requested during the COFRAC audits”,* says Dr De Brauwere.

### Anticipating risks: preventive maintenance

Every day, the technicians check the water quality from the AQUAVISTA™ Portal. Thanks to the graphs, they can see if the water quality is deteriorating, and if necessary, act preventively by changing the Medica Pro filtration cartridges.

*“For example, regarding resistivity, we evaluated at 18 hours the interval between the beginning of its deterioration and its impact on water quality and therefore on the results of patient examinations. Water quality is at the heart of the laboratory's activity in order to ensure a constant quality service in the production of test results while guaranteeing the performance of our production: over 1,000 samples are processed every day; 24/7 reproducibility of analytical processes is essential for rigorous monitoring of patients' biological parameters.”*

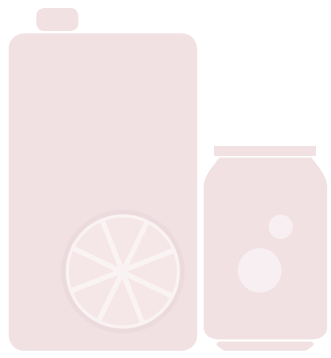
When an alarm sounds, or when one of the water quality monitoring parameters shows a deterioration of the water quality, the technicians intervene immediately as part of a preventive maintenance action.

*“This type of early warning has enabled us to reduce the number of alarms since the solution has been deployed in our department”,* concludes Dr De Brauwere. ●

**Customer:** Roche Diagnostics

**End user:** Biochemical and Molecular Biology Laboratory at Nîmes University Hospital (CHU de Nîmes)

**Solutions:** cobas®8000 (Roche Diagnostics), Medica Pro & AQUAVISTA™ Digital Services from Veolia Water Technologies



# AQUAVISTA™ for a soft drink manufacturer,

## Portal, Insight & Assist

**Food and Beverage companies** currently face several challenges with water management, which is especially true concerning ingredient water used in the actual product. It is a key challenge to monitor in real-time the quality of their ingredient water in order to ensure the maximum traceability of the production processes to ensure compliance to increasingly stricter regulations.

### Project Scope

In September 2015, a 100m<sup>3</sup>/h water treatment plant for a global beverage leader was installed in North Africa. The solution implemented is BERKEFELD PurBev®, a range of hygienic water treatment solutions for the food & beverage industries consisting of reverse osmosis, activated carbon and ultrafiltration technologies. This beverage company was looking for a way to considerably improve the monitoring of their ingredient water. One of the client's main objectives was to improve their water consumption KPI liter to liter.

### The Problem

During operation the performance of both ultrafiltration units had severely and abruptly declined. Discussions, analysis and various counter measures such as CIP procedures on site had been carried out without sustainably solving the problem. Since a further degradation of the UF performance would have led to a shutdown of the plant causing considerable damages and costs, an action plan was defined by Veolia Water Technologies engineers. The main objectives:

- Determination of root causes of rapid differential pressure increase
- Reduction of the differential pressure of the UF systems by performing modified CIP
- Inspection of the dosing equipment and dosing rates
- Check of chemical quality and concentration

### The Action

As Aquavista Portal, Insight and Assist was implemented, process experts were able to investigate the causes based on the available data and trends from the previous months and to suggest counter actions in a timely manner. The Aquavista digital services modules provided are Portal, Insight and Assist. The Aquavista Services has successfully allowed the company to closely monitor their ingredient water in real-time by monitoring the parameters of PurBev, with an ATAWAD (AnyTime, AnyWhere, Any Device) access to this information.

### AQUAVISTA Key Features:

- Remote monitoring of parameters
- Remote control on demand
- Operations reporting



- Feedback on performance and recommendations for optimization
- Training in local language
- HYDREX® service with special chemicals



### Client Benefits

The introduction of digital services in the water treatment plant at this production site has provided technical and operational benefits for the client. Their processes and plant is now more reliable and they were able to reduce their operating costs.

They are able to now fully access real-time data on their ingredient water and monitor the quality of it according to the regulations, and more importantly, to their specifications. A full team of Veolia experts are in charge of analysing the reports generated from the KPIs and send out immediate feedback in case of any problem. These experts also provide recommendations and advice on how to improve operations.

The client benefits from more process support and expertise to operate the water treatment plant, as well as from high value digital services.

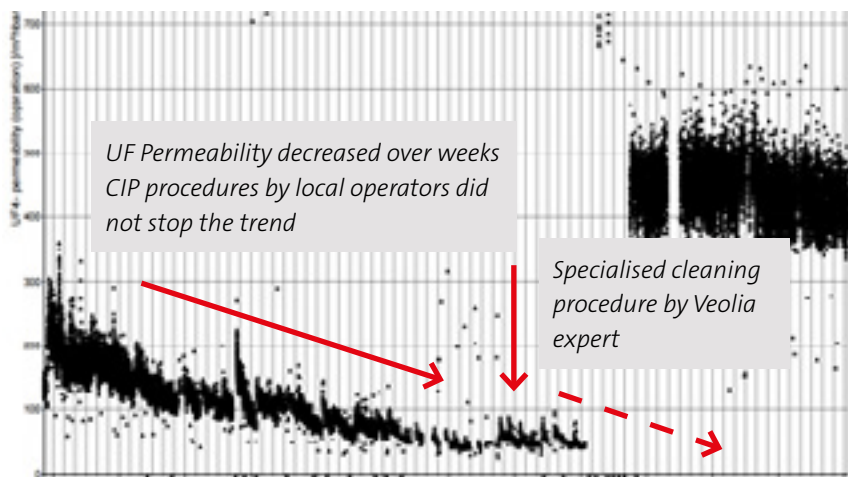
*“We are very satisfied with the new Veolia performance monitoring service. This really is a high value service which helps us to reduce operational cost and improve the reliability of our water treatment plant. Veolia’s digitalisation strategy is the right step to differentiate its services further from competition”* engineering director, April 2017.

This project has not only allowed for the client to benefit from increased reliability but also from increased plant uptime and an overall improvement in performance. The client feedback and testing has allowed us at Veolia to considerably improve our technologies, services and the PurBev design. ●

### KPIs

#### Benefits

- Increased membrane lifetime from 8-12 months to 2,5 y
- Reduced liter-to-litre KPI from 3,0 to 1,8l
- Prevented 5-8 days downtime, equivalent to many thousands kilo €



# A volatile pharmaceuticals company gets a cost-effective remote monitoring solution

## The client

Our client is an industry-leading contract manufacturer that specialises in handling volatile pharmaceuticals.

## The needs

A new ORION™ water treatment system was installed by Veolia Water Technologies to upgrade the client's existing plant, which, in the near future wouldn't meet the required pharmaceutical standards. As part of this project, the client also wanted to address a number of logistical problems; firstly, the plant room was in an isolated location, making routine monitoring by staff inconvenient, and secondly, remote monitoring via their existing business management system (BMS) was difficult to manage and not straightforward.

## The solution

Veolia Water Technologies recommended its AQUAVISTA™ digital services platform, which is specifically tailored to the client's requirements, offering real-time, 24/7 monitoring and direct access via a secure, private portal using a smartphone,

tablet or PC. A bespoke control panel was also installed and fitted with a paperless chart recorder, to automatically capture data trends allowing engineers to use their time more efficiently.

The platform supports improved asset management and performance, leading to optimised efficiency, lower operational costs and reduced chemical and energy consumption. In addition, intelligent tools use the data to help minimise manual maintenance, as well as costly downtime and non-compliant events, by supporting a proactive, data-driven approach to plant management.

## The results

AQUAVISTA™ overcame the difficulties associated with the plant room's isolated location and integrating the existing BMS, providing a cost-effective, remote monitoring solution. The system is easy to manage and can be accessed by multiple engineers, who are automatically notified of any plant alerts and alarms.

The alarms are colour-coded using a traffic light system to reflect the urgency of response required and are also copied to Veolia's technical support team, which helps Veolia to support, manage and optimise plant performance, maximise uptime and maintain production. In addition, a consistent data history will provide a good foundation for moving to predictive maintenance within a 12 month timeframe, supporting improved safety, mitigating critical issues and, ultimately, leading to better customer service and further efficiencies.

## Benefits

- Remote monitoring of new water treatment platform; Anytime, Anywhere, and from Any Device
- Direct access to engineers via Smartphone, tablet or PC, complementing manual control
- Automatic and programmed alerts enable fast responses and improved operational efficiency and maintenance
- Data collection supports process optimisation and predictive maintenance to mitigate critical issues



# AQUAVISTA™

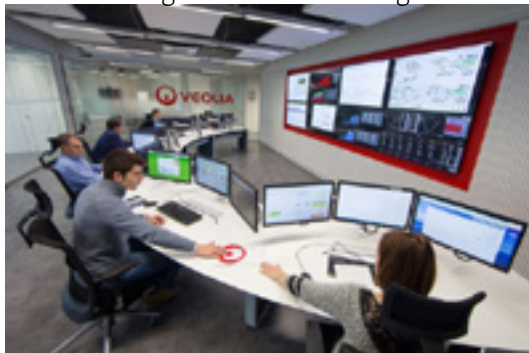
## for the Oil & Gas Industry

*a new era in service solutions for Water Injection  
Asset Integrity Management*

**Veolia's unique combination** of a digitized system with expert engineers now provides upstream water injection assurity.

Our expertise in facility asset management has been gained from decades of experience in operations enabling us to balance conflicting drivers and deliver pragmatic outcomes based on the actual production needs of the Industry.

In the challenge to meet the oil & gas



industry's need for improved operation and reduced OPEX, Veolia has developed the AQUAVISTA™ digital services platform that allows smarter management of our client's upstream water injection systems; improving performance, minimising operational risk, whilst reducing OPEX.

Existing methods of handling and assessing upstream asset data was problematic as a service provider onshore. Aquavista, Veolia's real time monitoring service, delivers early warning of deteriorating performance and operational issues, giving unprecedented

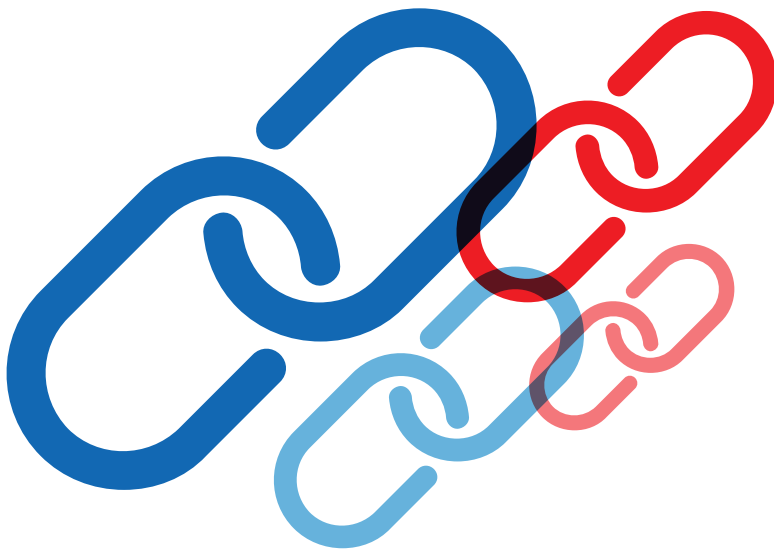
visibility into the performance of the water injection system. Combined with the onshore process specialist delivered by Veolia through Aquavista Assist, a service of true value is integrated into the customer's teams, both onshore and offshore.

Using OSIsoft PI, Aquavista will transform upstream water injection operations; unlocking the value of your data to transform it into relevant business driven operations. Aquavista improves water injection system performance:

- Real-time upstream data capture onshore
- Business KPI's for water injection
- Laboratory analytics and manual offshore batch control inputs
- Generates "benchmarking" performance KPI's.
- Technical and process support by Veolia specialists.
- Bespoke water injection operational support for unlocking availability and reliability
- Optimised chemical consumptions and performance
- Early event detection notification for operational risk reduction

**The key benefits to our clients: water injection assurity - providing increased oil recovery and reduced OPEX**





## EVA Link remote control

### *The new smart EVALED evaporators management.*

*EVA Link is the new service pack dedicated to EVALED evaporators which allows to monitor your water treatment unit from smartphone, tablets and PC.*

#### APPLICATIONS

- Ideal to optimise EVALED evaporators' water treatment performances and reducing running costs.

#### BENEFITS

- Real time data and trends check-up
- Monthly data check-up and back-up (with technical comments only with the GOLD level service pack)
- Alarms notification via e-mail/ SMS
- Minor modifications on PLC and HMI's softwares upgrading
- Veolia's technical personnel will intervene via online request.

- Alarm notification can be set up for rapid troubleshooting from Veolia personnel (available in the GOLD level service pack).

#### FEATURES

- Access to your water treatment unit from any device (PC, tablet, smartphone)
- No software or license to buy
- Password security protocol with double access level.

#### REFERENCE

##### **Chemical, Detergents production (ITALY)**

Remote operation and assistance, immediate support and troubleshooting, Reduction of non-scheduled maintenance activities and consequent downtimes.



# ACTIFLO<sup>®</sup>,

**one of the highest performing clarifiers  
in the world boosted by digitalisation**

Actiflo is a **high rate compact water clarification process** in which water is flocculated with microsand and polymer in a Turbomix<sup>®</sup> draft tube. The microsand enhances the formation of robust flocs and acts as ballast, significantly increasing their settling velocity. The unique characteristics of the resulting microsand ballasted flocs allow for clarifier designs with very short retention times, high rise rates and extremely compact system footprints that are **up to 50 times smaller than other clarification processes of similar capacity**. It counts **more than 1,000 references all over the world**, for municipal and industrial water and wastewater treatment over the past 25 years (see page 25 to know more about Actiflo).

The **AQUAVISTA™** team works with the technical department and the data scientists of Veolia to improve the performance of the Actiflo thanks to the digitalisation. In light of the market needs, are developed Aquavista Insight and Assist.

## AQUAVISTA™ Insight

Plant operators are faced with increasing demands for continuous process optimisation, reduction of water, wastewater, chemical and energy consumption, while not jeopardising the process stability and meeting strict regulations. To support clients in this crux, Aquavista Insight aggregates historic data acquired from multiple Actiflo around the world and real-time data from site, and applies analytics developed based on Veolia's experience in designing and operating water and wastewater treatment plants worldwide.

### Features

- **Asset monitoring:** Correlation of process data with operational costs

- **Asset improvement:** scenarii for
  - Operational cost savings
  - Effluent quality improvement and stability
  - Throughput increase
- **Asset Benchmarking:** Comparison of multiple sites or the same site over different seasons

### Benefits

Aquavista Insight gives the plant managers more peace of mind by:

- **An improved operation of the Actiflo:** real-time optimisation of the plant based on historical data and intelligent algorithms.
- **Having a greater stability of downstream treatment:** by an optimised clarified water quality, the lifetime of the downstream filters are increased and the process stabilised.
- **Reducing operational costs:** reduced polymer and coagulant consumption. In one plant 19,8% chemical savings.
- **Increasing resilience of the operation:** improved up-time of the operation and increased predictability of the operation.
- **Ensuring compliance** by increase operational resilience.
- **Learning from comparable sites:** Evaluate the performance of different sites to apply lessons learned throughout.

*“By adding Veolia’s process expertise to the new digital tools we can go much further in monitoring and optimizing the quality of treatment. We have access to an “enhanced” process control adapted to each site, which represents a real optimization compared to what we had with scientific formulas alone.*

*In addition, thanks to the Aquavista Insight dashboard, operators have a global and comprehensive vision of their installations. The operator thus benefits from a continuous supervision and optimization service.” Philippe Bréant, projects department director, Veolia Research & Innovation.*

*In cooperation with our customers, we have carried out several tests on their Actiflo. Aquavista Insight has a real impact on their operating expenses, the processes carried out on the various operations are optimized, which in turn extends the equipment’s durability. We can see a real optimisation of the operation of the plant and water quality”, Philippe Sauvignet, water industrialization manager, Veolia technical & performance department.*

### AQUAVISTA™ Assist

The framework under which a plant is operated is challenging: technologies are highly complex, new developments occur at a fast speed, the number of operators is declining and there is often little time for training. In a day to day operation it is thus challenging to solve complex problems or improve operation.

#### Features

- **Communication platform:** Channels to exchange with operators from different sites
- **Virtual process engineer:** Specialized support from a network of experienced Veolia experts

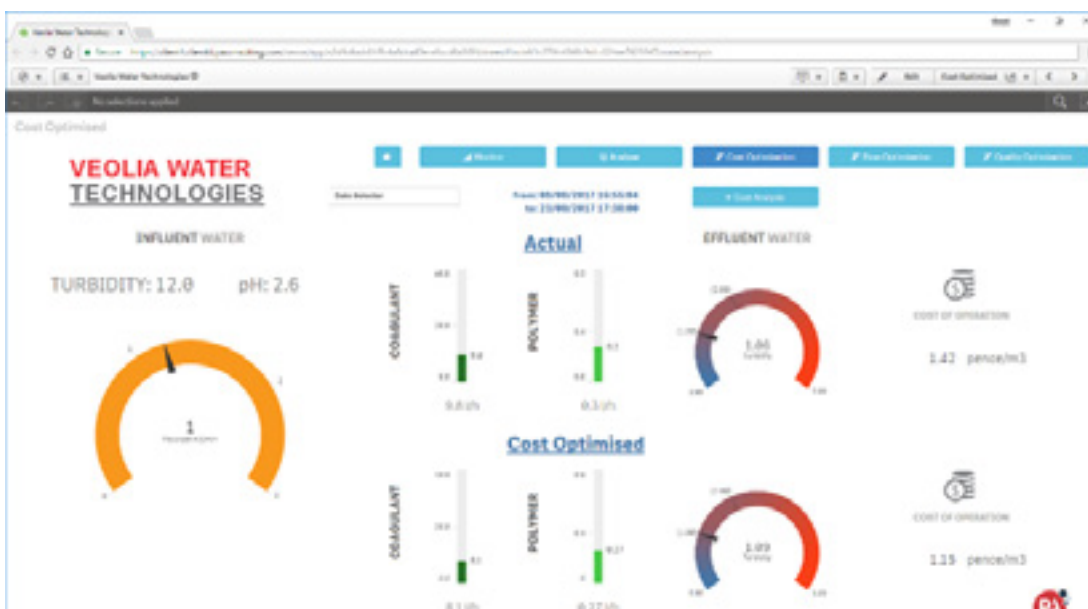
- **Online training materials:** Documents/ videos on process troubleshooting, maintenance etc.

#### Benefits

To support you in this, Veolia is developing AQUAVISTA™ Assist, a suite of digital communication channels and training modules. It is based on a long-term experience of troubleshooting, maintenance and process knowledge that have been compiled into training materials, as well as access to experts at your own convenience. AQUAVISTA™ Assist will give more agility to Actiflo operators, and will secure the equipment by:

- **Having a direct line to process experts from Veolia** to support with day to day questions, pro-actively ensuring that problems are resolved avoiding plant downtime
- **Knowledge sharing** with other sites
- **Providing continuous development of operators**, by attending training sessions or revising materials at the operator’s own speed and time
- **Facilitating onboarding of new operators** by giving them access to a library of step-by-step training videos, troubleshooting support and process knowledge

If combined with AQUAVISTA™ Portal, Veolia experts can access real-time data and provide even more powerful advice. ●



# AQUAVISTA™ Certification



AQUAVISTA™ is embedded by design in standard equipment made by Veolia Water Technologies.

All our

AQUAVISTA™-compatible technologies will be stamped and certified by Veolia Water Technologies as able to be integrated within the AQUAVISTA™ environment.



Scan the QR Code and discover new digital features for your technology ►



# AQUAVISTA™, digital trust

**Digital transformation** is no longer a buzzword: it has become a reality. The growing connectivity of equipment, people and businesses has profoundly changed the entire landscape in which businesses are operated and is quickly becoming a key parameter of success for companies all over the world. The amount of data captured through these connected systems, the big data, processed with intelligence in cloud gives a way to optimise the processes and increase the overall efficiency. Hence it needs to be protected and the channels through which it transits must be controlled and secured to ensure that it is only available to those for whom it is meant.

The increasing digital connectedness of the entire value chain creates agility and procures flexibility, but it also demands that cybersecurity risks and threats be effectively assessed and thwarted. The key is to address these challenges by embedding security at the core of platform design.

At Veolia Water Technologies, we believe that security is better and stronger when it is built in and not bolted on. Our Digital Platform, AQUAVISTA™, is built with security at its core. Cybersecurity aspects are considered as vital to the design and architecture of the platform, and we ensure that best-in-class security practices are enforced over the entire infrastructure.

Physical Security, Network Security and Cloud Security: the complete digital landscape is addressed.

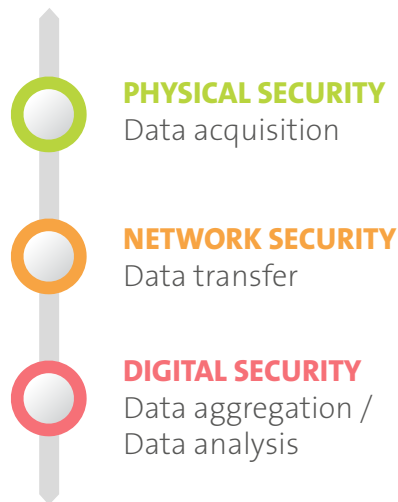
**Physical security** means that the phase where the data is acquired is safe. This is achieved by ensuring the physical security of the device or equipment, of course, but also through secured accessibility and data encryption. Veolia Water Technologies complies with all industry standards.

**Network security** covers data transfer. We ensure that the data transits through secured tunnels and that the protocols used for data communication are secured and recognized by registered regulation entities. Moreover, network-enforced policies are put in place.

**Cloud security** is all about safe data aggregation and safe data analysis. On a cloud architecture, security is in place by design. A dedicated team of security experts with access to state-of-the-art tools manages the security and applies continuous security improvement strategies, while also conducting penetration tests and security audits. We ensure cybersecurity compliance (NSIT/IES

Standards) and apply industry-proven security architecture practices.

The value and the volume of data have never been higher, affording users with a level of information and flexibility that has never been seen before, but which could also potentially make businesses more vulnerable than ever before. It is imperative that we maintain confidentiality, integrity and availability of the data and Veolia Water Technologies is committed to do so in partnership with our clients. ●



# Smart glasses:

## *how to support your plant's operations?*

### VIRTUAL SUPPORT

#### User

Operator or technician on site

#### Features & Added Values

- Access to manuals and checklists (document/videos) → Remember to perform all tasks in the correct order
- Live video calling → Troubleshooting support from the back-office, enabling them to see exactly what you are seeing and instructing you
- Shoot pictures or videos → Record your steps for quality assurance
- Hands-free glasses → Increased safety precaution, focus on tasks

### 3D/AUGMENTED REALITY

#### User

Engineer, operator, technician during training or inspection, off-site

#### Features & Added Values

- Walk around a 3D image of a plant on a computer → no need for glasses
- Familiarise and train operators on a new plant → increased safety, time savings
- Tag equipments with datasheets or points of precaution → ease of use, ensure data transfer, increased health and safety

### MIXED REALITY

#### User

Operator or technician on site

#### Features & Added Values

- Instructions superimposed on your actual field of view → Read instructions and highlights while seeing the equipment in front of you

- Live video calling & annotations → Support from back-office that can instantaneously annotate things in your field of view
- Hands-free glasses → Increased safety precaution, focus on tasks

### VIRTUAL REALITY

#### User

Engineer, operator, technician during training or design phase, off-site

#### Features & Added Values

- Simulated image of an equipment/plant in 3D → walk inside a plant before doing it in real life, increased safety
- Explode the equipment → Understand how the equipment is built, facilitating maintenance services
- Build 3D representation of the build environment, e.g. for refurbishments before implementing them in real life → time savings, cost savings, safety precautions



# *Innovative Water Solutions*



## **WATER TECHNOLOGIES**

Through its innovative solutions, Veolia Water Technologies enables industry, local authorities and citizens to optimize their use of resources for more efficient, environmentally-friendly and socially responsible outcomes.

We understand the importance of increasing the value of water and we do so by supplying high quality water, treating and reusing wastewater, producing and/or recovering energy, extracting raw materials and capitalizing on valuable byproducts.

[www.veoliawatertechnologies.com](http://www.veoliawatertechnologies.com)

Resourcing the world



# Wastewater: choose the right supplier to gain competitive advantage

*Shaun Summers, Pharmaceutical Market & Key Account Manager at Veolia Water Technologies*

Pharmaceutical wastewater treatment is a growing market. Over the last couple of years the industry has begun to realize that wastewater treatment is a way of gaining competitive advantage in an industry where margins are increasingly tight. An optimized treatment line can reduce operating costs, remove production constraints, reduce non-compliance risks and provide options for water reuse. But it is not an easy area for clients to find suitable suppliers...and here is why:

## **Wastewaters differ greatly between projects**

This means that it is time consuming and hence costly for suppliers to respond to one-off calls for tender. The characteristics of wastewaters may be so specific that lab tests and pilot plants are required in order to minimize risk and optimize the solution. Furthermore the combination of variability and complexity do not fit well with standardized solutions, which are regularly deployed in other markets to control costs and risks. Only suppliers with significant experience in the market, good analytical capabilities and solid relationships with their clients manage to deliver standardized units and their associated advantages.

## **Projects are relatively small for the risks/costs involved**

Wastewater projects range in value from 1 – 10M€ depending on the size, scope and type of project; with the majority of projects being around the 2-3M€ range. However, the cost

of bidding and the risks are comparable to major design/build projects but with a much lower return – this discourages suppliers from bidding and thus limits the choice for clients.

## **There are many projects by region but few by country**

We estimate that there are 20-30 projects a year in Europe for example. But at a country level that translates to 2-3 per year. As such, country level suppliers mostly avoid this market and those that do respond pose a risk for clients due to their lack of experience. Regional or global suppliers are better positioned to centralize expertise and respond through their local entities – reducing risks and costs for all concerned.

## **Industry knowledge is the key to success**

Knowledge of wastewater treatment alone is not sufficient to meet clients' requirements in this market. It is also essential to understand clients' products, production techniques, and the legislative trends that may impact their industry. As such, suppliers who dip in-and-out of the market are of less interest to clients than those that have daily exposure to the market. The latter often translates into global partnerships and co-development initiatives.

At Veolia we have the technologies, we understand the market - as we are exposed to it on a daily basis - and we are in a good position to reduce risk and optimize cost for clients through regional/global initiatives and standardized solutions.



# Supporting personal care product manufacturers in their wastewater treatment challenges

In today's Personal Care Products (PCPs) facilities, an effective wastewater treatment is essential. Here are some points for consideration.

The production of shampoos, perfumes or skin moisturizers uses water and a variety of compounds inevitably find their way into plants' effluent streams in varying concentrations.

Although the human health effects of many of these compounds can often be seen as positive, their environmental impacts to various wildlife and the broader impacts from widespread environmental exposure are uncertain.

For PCP manufacturers, implementing a wastewater treatment process that meets legal requirements is the main challenge. But increasingly it is also the key to the sustainable development of the business as well as for cost control. The first step in meeting these challenges is knowledge:

- What is in the wastewater?
- What options exist for treating pollutants?
- What are the pros and cons of different techniques?
- What are the typical treatment lines?

Veolia Water Technologies is highly experienced in water treatment and has hundreds of wastewater and reuse references. This has been captured in a special PCP Wastewater Treatment Guide that is now available. To request your copy email Shaun Summers, Pharmaceutical Market Manager at [shaun.summers@veolia.com](mailto:shaun.summers@veolia.com)



# Distilling Experience:

*Veolia Water Technologies Industrial Sales Manager, Kalpesh Shah, explains how evaporation can help smaller cosmetics facilities to save money on wastewater disposal.*

Energy Managers are starting to realise that wastewater from cosmetic production is a potential source of money instead of an unwelcome expense. Evaporation for smaller cosmetics manufacturing facilities that currently dispose of liquid waste offsite will reduce wastewater disposal costs and offer opportunities for recovering raw materials (such as disinfectants, proteins and glycols) as well as recycling water. The article will explain how evaporation works and demonstrate a customer that is using the technology.

## How Does It Work?

Evaporation is a very old technology – think extracting salt from sea water – and this concept has been applied in many industries but, in the context of wastewater treatment it has all too often been dismissed as uneconomic. However, things are changing. As alternative disposal routes such as sewer discharge and landfill become more expensive, evaporation is looking more and more attractive. Offsite disposal of wastes containing Active Pharmaceutical Ingredients (APIs) and similar ingredients, often involves incineration or complex chemical treatment: evaporation is a sustainable and environmentally friendly alternative that can reduce the waste volume by up to 90% giving a significant cost saving.

Cosmetics and pharmaceutical manufacturing facilities that currently dispose of liquid wastes offsite can use evaporation to minimise operating costs and recover raw materials including APIs, disinfectants, proteins and glycols, as well as recycling water. How? Well, evaporators work by converting water into vapour, which needs heat to overcome the latent heat of evaporation.

This water vapour can then be condensed by cooling to remove the latent heat, producing distilled water for re-use. What is left behind in the evaporator is a concentrated liquid, around only 10% of the original volume which substantially reduces off-site disposal costs. For this process to work the water has to be at its boiling point and, at atmospheric pressure, this is 100°C, a temperature which can break down many pharmaceutical and cosmetic ingredients. The latest generation of heat pump evaporators operate under vacuum, which means that water boils in the range of 30-40°C. The resulting low temperature evaporation means that it is possible to recover even heat sensitive raw materials from wastes.

Heat pump evaporators use a compressor driven refrigerant circuit to extract the latent heat from the water vapour, which condenses it, and then transfers it to the liquid to evaporate it. This is a highly efficient way of recovering the latent heat and means that there is very little additional heat required for the process. Any additional heat that is

required can be provided by an internal electric heater or an external hot water supply. The result is a process that uses, typically, 0.15 kWh per litre of distillate.

## Forced Circulation or Scraped Surface?

There are two principal technological options for evaporation: forced circulation and scraped surface. In forced circulation units, the liquid is pumped through a heat exchanger to increase the temperature to about 40°C but, because it is under pumped pressure, it does not boil. The hot liquid then enters the evaporator body, which is under vacuum,

where the liquid “flashes” to form vapour leaving behind a concentrated liquid stream. The recirculation velocity maintains turbulent conditions in the heat exchanger tubes to keep the heat transfer surfaces free from deposits which could adversely affect heat transfer efficiency. This type of evaporation means that the liquid and vapour phases are easily separated under gravity, producing the highest distillate quality.

Forced circulation evaporation is about distillate quality, but scraped surface technology is about minimising the volume of concentrate for disposal. It can even handle high viscosity or foaming wastes. Scraped surface is like reducing a sauce in cookery – if you don’t keep stirring it, it is going to burn. Heat is transferred rapidly by conduction from the cooker through the bottom of the saucepan to the liquid. The heat is then transferred from the hot saucepan into the liquid. This hot liquid then moves away from the heating surface by convection into the bulk of the liquid. As the liquid viscosity increases, the rate of convection is reduced, so more heat is going into the liquid than can be removed; with the result that the viscous liquid at the bottom of the saucepan overheats and burns. Stirring removes the liquid from the hot saucepan doing the job of convection currents. In a scraped surface evaporator the internal heat transfer surface is continuously scraped by a rotating blade that prevents viscous liquids clinging to the surface and overheating.

### A Case in Point

Looking at a case study will help to explain the difference. A multinational company with more than 250 manufacturing facilities

worldwide, with their main facility in Italy, manufacture hair care products operating 24 hours a day for six days a week. The plant produces 36TPD (Tonnes Per Day) of wastewater with a Chemical Oxygen Demand (COD) in excess of 30,000mg/l. This was originally treated by a membrane bioreactor (MBR) producing a high quality treated effluent fed directly to a reverse osmosis plant for recovery. The MBR also produced about 0.5tpd of excess biological sludge. The company’s global sustainability targets set goals for water and raw materials reduction, which led the facility to search for an effective solution that would allow them to reduce both water consumption and MBR sludge production. Initially they installed a small heat pump evaporator to concentrate high density wastewater for off-site disposal. This was so successful that they decided to see what other evaporation technology could be implemented.

After a review of the site operations and wastewater characterisation, Veolia’s engineers developed a scheme using two stages of evaporation. The first stage uses a TC30000 FF MVR evaporator to treat 30TPD of dilute wastewater producing 27TPD of distillate and 3TPD of concentrate, which is mixed with 6TPD of concentrated process waste and sent to a RW 12000 FF scraped surface evaporator, which is fed with hot and cold water from the on-site Combined Heat and Power (CHP) plant. Subsequently this produces a further 7.5TPD of distillate and reduces the concentrate to only 1.5TPD, which is taken off-site for incineration. The plant performance is summarised in the table:

Parameter	Units	Wastewater	Distillate	Concentrate
Flow	tpd	36	34.5	1.5
COD	mg/l	> 30,000	< 1,000	> 200,000
Conductivity	µS/cm	2,500	< 50	
Suspended solids	mg/l	10,000	< 1	250,000
Silica	mg/l	70	< 1	> 200,00
Surfactants	mg/l	> 50,000	< 50	

Both evaporators are constructed in SAF 2507 super-duplex (austenitic-ferritic) stainless steel and each has a footprint of 14.5m<sup>2</sup>. The condenser cooling water and hot water for heating the scraped surface evaporator are supplied from the on-site CHP plant.

The combined 34.5tpd of distillate is further treated in the membrane bioreactor (MBR) but sludge production has been reduced from 500kg/day to less than 20kg/day with an improvement in treated wastewater quality resulting from a lower COD loading on the plant.

The new plant slightly increased energy consumption but this was more than compensated for by the recovery of some 96% of the wastewater for reuse and a large reduction in off-site disposal costs. The overall result is a reduction in total treatment costs of 75% giving a payback on the investment in less than a year.

### Conclusion

Evaporation can reduce off-site disposal costs and recover not only good quality distilled water but also valuable ingredients. With low capital and operating costs, evaporative technologies, such as Veolia Water Technologies' range of EVALED™ PC heat pump evaporators, the result of three decades of evaporation experience, are now well within the reach of even small cosmetics facilities.



# New WFI Monograph teases with cost reductions

Since April 2017, the revised European Pharmacopoeia monograph 0169 allows the generation of Water for Injection (WFI) by distillation or by a purification process that is equivalent to distillation such as reverse osmosis(RO) coupled with appropriate secondary membrane system.

## Towards a greater choices of techniques

Historically distillation has been the preferred method for producing WFI in the biopharmaceutical industry even though the US and Japan Pharmacopoeias have allowed alternatives for some years. The authorisation of equivalent techniques to distillation by Ph. Eur. offers the industry more choice.

## Production Techniques

Distillation offers the reassurance of a phase change from water to steam that removes impurities and results in product water compliant with microbial and endotoxin limits for WFI. RO based systems achieve compliance through the use of CEDI and Ultrafiltration (UF) downstream of the RO. UF reduces endotoxin levels and removes any prevailing microorganisms.

## Storage & Distribution

Regardless of production technique, a storage and distribution system should be well

designed so as to minimize risk of microbial growth and facilitate regular sanitization. The advantage offered by distillation is that it is possible to operate the loop at a continuous high temperature thus ensuring microbial control. RO system loops run at ambient temperatures therefore require regular hot water sanitization or ozonation (coupled with UV) to control the risk of microbial contamination.

## Cost vs Risk

The selection of WFI production method is ultimately about finding the correct balance between cost and risk. Multiple effect distillation (MED) is seen as less risky than Vapour Compression Distillation (VCD) as there are no moving parts. Likewise both distillation techniques are viewed as less risky than RO based systems, which may be susceptible to biofilm formation if not maintained correctly. However, in a market where margins are under pressure the OPEX savings offered by RO based system and VCD units are highly attractive and an increasing number of clients are looking at ways to reduce operating costs without affecting the integrity of the system.

## Overcoming Risks

Any system for WFI production - regardless of technology - must be well designed by an

experienced company in line with the current regulatory guidelines, correctly installed and then monitored and maintained to a high standard. For RO based systems, some extra care and attention is required to monitor the condition of the membranes. This would include regular sanitization of the membranes using hot water and multi-point in-line monitoring of TOC, conductivity and possibly rapid microbiological testing. As cited above, storage and distribution risks also need to be assessed and controlled appropriately

### Veolia, 30 years of pharmaceutical experience

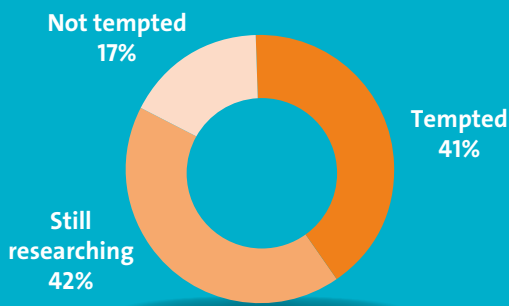
Whether you decide to produce Water for Injection using distillation with the POLARIS™ range or with the ORION™ RO based system, you can be assured that the system will produce EP, USP and JP compliant WFI. Performance optimization, risk reduction, compliance and preventative maintenance are second nature to Veolia.

**Quick Comparison table**  
 Veolia Water Technologies also has extensive experience in storage & distributions and turn-key projects.



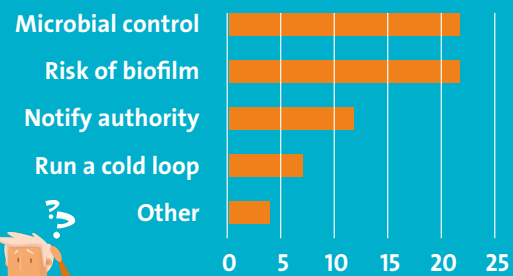
Description	Polaris VCD Vapour Compressor Distiller	Polaris MED Multi Effect Distiller	Orion™ Reverse Osmosis
High efficiency distillation, with high compression ratio's and ultra low droplet separation.		Multiple effect stills with energy efficient falling film technology	Skid mounted multi-technology system. Comprising of softening, reverse osmosis, CEDI & UF.
WFI water quality production according to current USP,EP and JP	✓	✓	✓
Up to 20,000 litres/hour production	✓	✓	✓
WFI production with membrane based system	✗	✗	✓
WFI production by distillation/water to steam phase change	✓	✓	✗
Product monitoring with calibrated instruments	✓	✓	✓
cGMP validation documents including IQ/OQ/commissioning	✓	✓	✓
Cold WFI production	✓	✗	✓
Hot WFI production	✓	✓	✗
Combined WFI and Clean Steam production	✗	✓	✗
Independent PLC control with 21CFR Part 11 Compliance	✓	✓	✓
Pressurised discharge	✓	✗	✓
Low water footprint	✓	✗	✓
Hot water sanitisation capability	✓	✓	✓
Low steam pressure requirement	✓	✗	✓

# RO based systems for WFI production: *what companies say?*



41 % are tempted to use RO based systems for WFI production\*

## COMMON WORRIES\*



## THE APPEAL\*

- 1 Cost savings
- 2 Single system for both PW/WFI
- 3 Space saving

In a market where margins are under pressure the OPEX savings offered by RO based systems are highly attractive and an increasing number of clients are looking at ways to reduce operating costs without affecting the integrity of the system.

\*Source: Veolia Water Technologies 2017 Survey: 36 respondents



## New purified water and water for injection system for **BAYER**

### The client

Bayer Animal Health is one of the world's leading producers and suppliers of animal health products. In New Zealand, Bayer Animal Health supplies a wide range of products for both livestock animals and companion animals.

### The needs

In the effort to continuously produce high-quality animal health medicines in New Zealand, Bayer commissioned a new water treatment plant at its Manukau production site, which was going through a series of upgrades.

The plant was designed and constructed by AB Mandal Pty Ltd, Pharmaceutical process engineers. Veolia Water Technologies was contracted to provide the equipment to produce purified water (PW), water for injection (WFI), and pure steam for the use in the manufacture of veterinary drug products. It meets the demanding requirements of the European Pharmacopeia, produces water

suitable for human therapies and is the most advanced facility of its kind in New Zealand.

### The solution

Purified water is produced by the Orion™ 2000 system. The Orion™ 2000 is a single skid mounted system, including softeners, 5 micron filter, multi purpose tank, single pass Reverse Osmosis, and Continuous Electro Deionisation (CEDI). The RO and CEDI are hot water sanitised.

The resulting treated water is further refined and distilled to create Water For Injection (WFI) using a Polaris™ multiple effect still. Polaris™ produces WFI according to EP and USP, using an innovative falling film technology, that reduces energy costs and start up times. The same Polaris unit is also used to produce pyrogen free clean steam.

### The results

Veolia's overall approach provided a well-designed and robust water treatment system that will ensure

the treated water specification is met at all times.

Bayer New Zealand managing director Derek Bartlett says the new water treatment plant is a major leap for the production site. *"Previously it would take about six hours to produce 2000 litres of Water For Injection. Now we can produce 2000 litres in one hour. We can now get high quality water whenever we want without any restrictions, which will impact positively on our production times."*

The packaged plant will also allow Bayer to reduce capital and ongoing operational costs and eliminate interface risks for both the Purified Water Generation and WFI generation plants.

### Added value for the client

- > Minimising operating risks by ensuring water supply meets the required water standards
- > Saving costs through maximum steam and water efficiency
- > Local service support
- > Low carbon footprint and low energy usage







## Reliable, FDA compliant, water system for Fisherman's Friend manufacturing

### The client

Lofthouse of Fleetwood have been making Fisherman's Friend since 1865 when chemist James Lofthouse of Fleetwood in Lancashire (UK) first formulated a menthol and eucalyptus syrup. The company developed Fisherman's Friend into the familiar lozenges which are now available in over a hundred countries around the world.

The enormous popularity and success of Fisherman's Friend has led to Lofthouse of Fleetwood receiving the Queens Award to industry for Export Achievement on three separate occasions, along with many other awards for export success.

### The needs

The success of Fisherman's Friend worldwide has meant several expansions to the manufacturing facility over the years. But exporting has made other demands: some countries require the product to meet with the regulations of the US Food and Drugs Administration (FDA) and the Medical Health Regularity Authority (MHRA).

This means that water used in manufacture must comply with the water quality standards for Purified Water, that is conductivity  $<1.3\mu\text{S}/\text{cm}$  at  $25^{\circ}\text{C}$ , Total Organic Carbon  $<500\text{ppb}$  and total viable bacteria count  $<100\text{cfu}/\text{ml}$ . Lofthouse of Fleetwood has three separate production facilities, each supported

by an Veolia Water Technologies validated water purification system.

Now they were installing another new production facility to meet expansion needs for new 'zip' packaging for the overseas market and, several million Fisherman's Friends being consumed globally every year, reliability was top of the wish list. Once again, Lofthouse of Fleetwood turned to Veolia Water Technologies.

### The solution

The main Fisherman's Friend production facility, where water is used as an ingredient, is supplied with Purified Water by a Veolia Water Technologies Orion™ packaged water treatment solution system, whilst the sugar free facility has an IonPRO™ LX system to supply up to 1000 litres/hr water for final rinse following cleaning. Veolia Water Technologies' solution for the new Pharma suite facility was a second IonPRO™ LX,



together with full support provided by a 24 hour response service agreement and a 'Disaster Recovery Plan'.

### The results

The IonPRO™ LX is **fully compliant with FDA and MHRA regulations** and, as Lofthouse of Fleetwood knows from experience, it is a very reliable plant. However, engineering section leader Paul Grassie is aware of the cost of lost production, so to ensure that all the water systems operate at peak performance he took out a five-year AQUAservice Diamond - 24 hour response service contract which covers all four plants. This means that Veolia Water Technologies' engineer can **prioritise any issues, reduce down time and minimise disruption to manufacturing.**

The contract includes emergency breakdown cover, parts and consumables, media/membrane replacements, calibration and an in-depth annual report for regulatory compliance. By taking up a multi-year agreement, Lofthouse of Fleetwood benefit from fixed price for the duration, providing cost savings and reducing admin time.

In addition, Lofthouse of Fleetwood has registered under the Mobile Water Services ReACT scheme for disaster recovery planning. This is where modifications have been made to the inlet/outlet, so that **in the event of a major failure, a mobile treatment plant can be on site, connected to the system and operational within a few hours.**

# GRINDEKS *Rising to the challenges of a difficult pharmaceutical wastewater*

## The client

JSC Grindeks is the leading pharmaceutical company in the Baltic states, based in Riga, Latvia.

## The needs

The wastewater from the production plant is highly polluted and contains difficult-to-degrade and toxic organic compounds (including phenols). High organically bound nitrogen concentration is just one challenge of this wastewater. The requirement was to build a new, compact, and efficient wastewater treatment plant and comply with regulations for discharge to the municipal treatment plant for chemical oxygen demand, total nitrogen, total phosphorous and suspended solids.

## The solution

AnoxKaldnes, a subsidiary of Veolia Water Technologies, began the project in the laboratory through

feasibility studies and for the optimization of the process design of the MBBR technology. The laboratory trials helped to identify the maximum concentration of toxic compounds that could be fed to the biological process without interfering with the treatment processes. A “toxic” tank for storage of the effluents rich in toxic compounds was proposed as part of the solution. The effluent stored in the toxic tank was designed to be slowly fed to the biological treatment without exceeding a maximum allowed concentration.

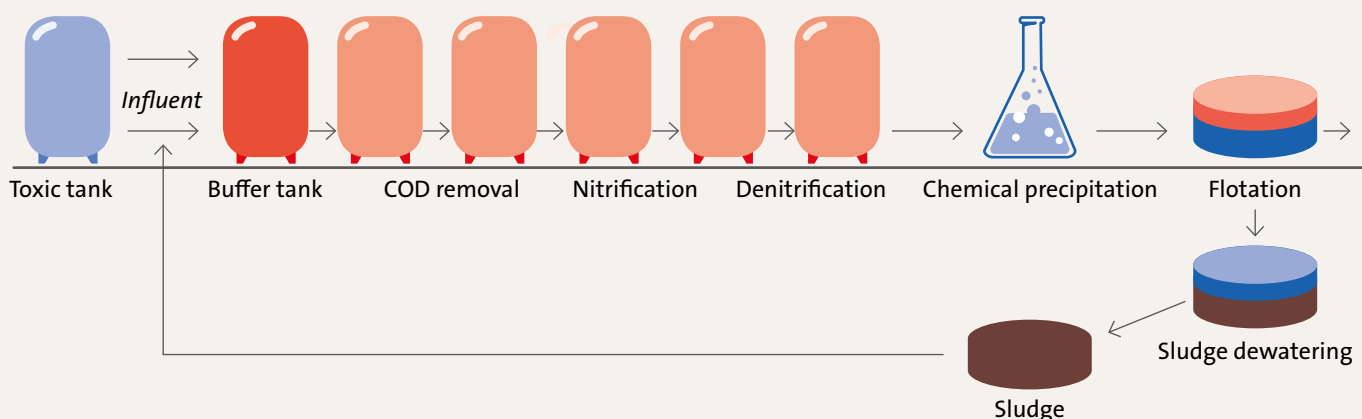
## The results

The first MBBR reactor is primarily for the reduction of COD. About 60-70% of the COD is removed in this reactor with the final effluent COD removal typically over 90%. The second MBBR reactor is used for reduction of large molecules that are a waste unique to the production of certain

pharmaceuticals. Reactor three continues the removal of hard to reduce organic compounds. The three upstream reactors act as a buffer ahead of reactor 4 where nitrification takes place. The final reactor is a post-denitrification reactor where solvents from the production process are utilized as an effective carbon source.

Total nitrogen treatment efficiency varies between 45-88%. Nitrification is the most sensitive step of the process treatment and it is periodically upset during production stops and when disinfectants are used for cleaning. The average phosphorous concentration in effluent is usually around 2 mg/l. Wastewater containing phenols are pumped to a buffer tank with controlled flow rate so that phenol concentration in the buffer tank is 20-30 mg/l and in effluent phenol concentration do not exceed 0,8 mg/l.

## MBBR reactors



# ZIMMER, 100% recovery of the wastewater generated



## The client

Zimmer Orthopaedics manufacture products that restore mobility, alleviate pain and improve the quality of life for patients around the world. In order to produce products of the highest possible quality Zimmer rely on a continual supply of Purified Water at every stage of their production. Zimmer has operations in more than 24 countries around the world and sells products in more than 100 countries.

## The needs

With increased demand for their products world-wide, a new manufacturing facility required a dedicated water solution that would not only ensure a highly efficient and sustainable supply of Purified Water that would also be innovative and adaptable to meet the facility's growing needs.

In May 2011 an agreed design was in-place that would see a single-unit Recovery RO (Reverse Osmosis) solution being added to the Pure Water infrastructure that is today recovering 100% of the waste water generated. 75% of this is sent back once again to begin the purification cycle as raw water; the remaining 25% is re-used within the plant for other services.

## The solution

This solution is comprised of an RO Concentrate Recovery System consisting of a 2,000L Polypropylene Concentrate Tank, a booster pump and a MegaRO™ unit. The waste produced by the MegaRO™ unit is further treated using UV sterilising technology enabling it to be used in alternative applications by the customer.

The MegaRO™ Mk2 reverse osmosis systems produces high purity water, removing up to 98% of dissolved inorganic and over 99% of large dissolved organics, colloids and particles.

The system has been standardised and optimised in order to fulfil the essential demands of the relevant applications and minimise operating costs. With its high output, low-energy membranes it achieves a desalination rate of about 96 to 98% and at the same time, a water recovery of 100%.

## The results

- > 100% Water Recovery
- > Water footprint reduction
- > Adaptable to meet the facility's growing need

*"The success of our company and our products is built upon a spirit of innovation. We are constantly striving to do things differently and as such we demand this same progressive thinking from our business partners and suppliers. Veolia Water Technologies have proven themselves to be highly capable in the area of Pure Water solutions and what is more, their forward thinking with regard to 'Green Solutions' creates ideal synergies between our two teams. The net result of this project has led to sustainable development and on-going financial savings"* Michael Finn, Facility Manager, Zimmer Orthopaedics Manufacturing



# MARKET LEADING PHARMACEUTICAL COMPANY IN SPAIN *relies on us for the production of purified water, water for injection and maintenance service.*

Since 2004, the Spanish biotechnology center of one of the world's largest pharmaceutical companies, has trusted the Spanish subsidiary of Veolia Water Technologies for the compendial water requirements.

The most recent project awarded to Veolia, in 2016, comprises two plants, one for the production of purified water and the other one for the production of water for injection that feeds a new freeze dryer manufacturing plant of their production plant. This lyophilization equipment allows water removal in medical solutions at low pressure and temperature. This water purification installation starts with the pretreatment of the raw water by means of filtration, duplex softening and chlorine reduction. Then, the pretreated water feeds an ORION™ system, which features the stages of reverse osmosis, continuous electrodeionization and UV disinfection. All this process is sanitisable with hot water at 85°C to ensure the microbiological quality of treated water.

The ORION™ system has a production capacity of 2 cubic meters per hour of purified water. Part of the purified water is sent to distribution loops and the remaining flow feeds a POLARIS™ MED plant, which has a production capacity of 700 liters an hour of water for injection.

Polaris™ MED is part of Veolia's family of distillation products. All Polaris™ solutions are designed in accordance with GAMP, cGMP, ISPE and FDA guidelines and meet the product quality specifications of all of the world's

major pharmacopeia, including the USP and Ph. Eur.

## **Water reuse to increase efficiency and reduce costs**

The partnership with the Client started in 2004, when the first ORION™ system for 500 liters an hour of purified water production was installed. Six years later, the Client ordered the extension of this plant to 1,000 liters an hour and a new ORION™ system of the same capacity.

Additionally, the Client employs a reverse osmosis for water reuse. The rejected water from the reverse osmosis stage of the 3 ORION™ systems is treated and sent back to the inlet as raw water for the production of purified water. This allows the Client to increase the efficiency of the installation, reduce water costs and its water footprint. Today, all of the purified water and water for injection produced at this factory bears the Veolia Water Technologies seal. The Spanish team is also responsible of the design and installation of nearly all the distribution loops at the factory.

## **Providing maintenance service for the whole water cycle**

Veolia's Spanish team also provides Pfizer with 24/7 response service. The scope includes the predictive, preventive and corrective maintenance of the 3 ORION™ plants and the Polaris™ MED system, distribution loops, cold and hot water closed circuits, cooling



towers circuits as well as water for human consumption circuits, supplying also Hydrex™ water treatment chemicals. Additionally, since January 2018, Veolia also provides operation and maintenance service to the Client's wastewater treatment plant that treats the pharmaceutical effluents.

### The reference in the Pharmaceutical Industry

With more than 35 years experience in the market, the Pharmaceutical team in the Spanish subsidiary of Veolia Water Technologies has gained vast experience and great knowledge of the market and clients' specific needs. This know-how, together with

the most advanced technological offer and greatest service capabilities, allows Veolia to make the most professional and competitive offer in the market, backed by a highly qualified team.

In Spain and Portugal, Veolia is responsible for a significant number of installations with major pharmaceutical and cosmetics companies, reinforcing Veolia's renown for the production, distribution and maintenance of process water and wastewater treatment systems in this sector. Among its clients, Veolia is trusted by Pfizer, Boehringer Ingelheim, Merck, Nivea, Rovi, Normon, Lilly, Basi, Labesfal, Novartis, Hipra, Esteve Quimica, Syva and L'Oreal just to mention some of them.

## Milestones with the Client

2004

The Spanish subsidiary of Veolia Water Technologies is awarded a contract for the design, installation and commissioning of an ORION™ system for 500 liters per hour of purified water production.

2010

A new installation is entrusted to Veolia. The existing ORION™ system is extended to 1,000 liters an hour plus a new ORION™ system for a production capacity of another 1,000 liters per hour. Also, Veolia is awarded a reverse osmosis plant for water reuse.

2016

The latest contract with the Client comprises the production of purified water (2 m<sup>3</sup>/h) and water for injection (700 l/h).

2018

Veolia is in charge of the operation and maintenance of the wastewater treatment plant as well as distribution loops and the complete water cycle of the biotechnological center.

# LINHARDT *reliable neutralization of highly fluctuating wastewater volumes*

## The client

Linhardt GmbH & Co. KG produces products for manufacturers in the pharmaceutical, cosmetics, food and consumer goods sectors. The company develops and produces high-quality tubes, cans and other packaging made of aluminum and plastic at three German and two international sites.

## Advantages

- Reliable treatment of highly fluctuating wastewater volumes
- Fully automated operation due to the compact SIMATIC S7-1200 controller
- Cost-effective plant

## The Requirement

Linhardt required an operationally reliable concept for construction of a fully automated treatment plant for neutralization of wastewater from production. The amount of wastewater varies greatly, depending on different cleaning processes. Nevertheless, the new neutralization plant had to be able to reliably meet the requirements for wastewater discharge at the site. Wastewater produced during production is passed from the washing plant to the neutralization plant at a pH of about 10 and approximately 45 °C. The average amount of water is 10 m<sup>3</sup>/h, the hydraulic peak power is 20 m<sup>3</sup>/h.

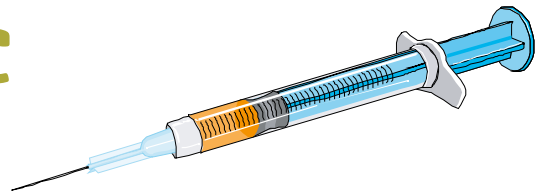
## The Solution

Veolia Water Technologies Germany developed an economic and fully automated two-stage plant for continuous neutralization. The wastewater is fed into the neutralization tank. An upstream surge water tank absorbs wastewater accumulating at the top and buffers it, then ensuring a uniform, continuous supply of wastewater to the neutralization tank. Wastewater is neutralized via pH-value control by the addition of hydrochloric acid.

A pH end controller ensures that the parameters for sewerage are met. Wastewater parameters are documented by an automatic recorder. The plant has been operating successfully since 2016.



## A first with EGY VAC



### The client

EGY VAC specialises in the production and distribution of vaccines. Market leader in Egypt, EGY VAC also exports to countries in the Middle East, Far East, Africa and some parts of Europe, which accounts for approximately 20% of Egypt's total drug exports.

### The needs

Veolia Water Technologies was awarded a contract to supply, install and commission a 3m<sup>3</sup>/hr purified water generation plant to comply with latest USP standards.

### The solution

Veolia upgraded the existing PW & WFI system. The competitive technical and commercial proposal comprised the Orion™ 4000, a pre-treatment system, WFI & Clean Steam Generators meeting the required treated water quality. The equipment package included:

- › Raw water tank
- › Raw water pumps
- › Sand Filters
- › Carbon filters
- › Orion™ 4000 System
- › Polaris™ Multiple Effect Still
- › Polaris™ Clean Steam Generator

### The benefits

- › 100% Water Recovery
- › Water footprint reduction
- › Adaptable to meet the facility's growing need

Meeting the Client's main requirement, EGY VAC remains compliant with European & US Pharmacopoeia standard.

Veolia's new treatment system allowed EGY VAC not only to reduce the running costs of maintaining the old system but also allowed it to double production output, resulting in a market share increase in the Egyptian and African markets.

Veolia offered the Client a turnkey solution from project execution through to service contract.



# The biggest purified water generation system to **PISA** Pharmaceutical in **MEXICO**

Once again, PISA Pharmaceutical chose VEOLIA to cover a new demand for purified water to supply Electrolit® processes. PISA built a new building, which will concentrate the Electrolit® production.

Electrolit® is a rehydrating oral solution. Electrolit® is a rehydrating oral solution indicated to treat and prevent hydroelectrolytic imbalance caused by excessive heat, intense physical exercise, vomiting and diarrhea, in patients older than 6 years of age. Packaging on Plastic bottle with 300 ml, 625 ml and 1150 ml. The solution considers the following filtration cascade, starting with the Ultrafiltration process, for the removal of particulate matter

and from the well water dragging, which includes the “Clean In Place – CIP”. Subsequently, we treat by Reverse Osmosis system, in order to reduce the dissolved salts and high Silica contents present in the supply water. This is considered a Pre-treatment for the sanitary package system, RO-CEDI, based on SPA platform, sanitary system platform with hot water sanitization, which will produce 75,000 lph of purified water.

Our differentiator is in the strict compliance with the National and American Pharmacopoeia, plus the high commitment of the project team with a timely delivery, exceeding the technical and assistance expectations.

The client can count on a documentary support compliant with section 21 CFR part 11, according FDA. Therefore, they will have a reliable documentary evidencing, before any auditing entity, ensuring the high quality in one of their critical processes, such as the purified water.







# ORION™

## Hot Water Sanitisable Solution for the Pharmaceutical Industry

Orion packaged systems are pre-validated, skid-mounted and hot water sanitisable. Developed specifically for the pharmaceutical market for producing Purified Water and cold WFI water, they are compliant with all industry requirements. Orion systems have over 80 standard configuration options in order to best meet the unique needs of each client. Nominal flow rates from 500 to 20 000 l/hr.

### APPLICATIONS

#### Purified Water

- Ophthalmics
- Antibiotics
- Tablet coating
- Granulation
- Diagnostics
- Veterinary products

#### Highly Purified Water

- Nasal/ Ear preparations
- Nebuliser solutions
- Haemo filtration solutions
- Irrigation solutions
- Cold WFI Production

### FEATURES & BENEFITS

- Regular hot water sanitization at 85°C; guaranteed microbial compliance
- Designed, manufactured and validated to GAMP
- Fully compliant with latest ISPE, USP and Ph Eur specifications
- Automated PLC control; minimizes operator involvement
- HMI has secure access keys and alarms; prevents accidental or unauthorized usage
- Unique CEDI design; efficiently and reliably ensures water quality
- Skid-mounted, pre-assembled, pre-tested; space saving, short lead times, quick start-up
- Comprehensive and standardised validation pack (FAT, IQ, OQ); reduces validation time

# THE NEW ORION OFFERING, SUSTAINABILITY AT THE CORE

Delivering critical high performance in a sustainable manner is key to this high technology product, the Orion comes with a number of sustainability features including low energy membranes Reverse Osmose (RO), integral recovery RO and concentrate recycle. All products and materials have been selected for optimum recyclability. As microbial control is paramount in any purified water treatment system the Orion retains the proven Hot Water Sanitisation (HWS) of the main treatment system as well as the pre-treatment softeners.

## An evolution in modular water treatment

Available in three models with an expanded range of flow rates from 0.5 to 20m<sup>3</sup>/hr the Orion is an evolution in modular water treatment.

**S-Series** - Our premier Orion meets the ultimate in sustainability, optimising our technology we can reduce overall water and energy consumption whilst also delivering long term operational efficiencies.

**E-Series** - Our mid-range Orion provides standard features of reduced water to waste during the recycle process and conserves both water and energy use for environmental best practices.

**C-Series** - Our

Classic Orion offers the core Orion technology within the most economical investment package whilst continuing to produce industry standard purified water.

As with all Veolia pharmaceutical systems the unit comes complete with a validation pack covering all requirements for your system to meet with GAMP and ISPE guidelines as well as inspection bodies the FDA and MCD.

To further improve your plants operation the Orion can be linked to the new Veolia technology AQUAVISTA™. This web based customer portal is a private secure web based platform that allows you to access all information regarding your Orion its products and services. AQUAVISTA™ allows for remote monitoring giving you further control and enabling you to access real-time encrypted performance data including alarms and equipment status.

The new Orion is reliable with proven purified water technology and created with intelligent innovation in the age where sustainability is of paramount importance.

## Related Services

Local after-sales service and support teams offer preventative and corrective maintenance programs to ensure the long-term, efficient operation of installed plant.

## Hydrex® Chemicals

Hydrex® 4000 water treatment chemicals from Veolia Water Technologies should be used for optimised operation.





## POLARIS™ MED

*Polaris is Veolia Water Technologies' family of distillation products for the production of water for injection and highly purified water. The Polaris MED (Multiple Effect Distiller) equipment are efficient and effective WFI solutions. Polaris MED multiple effect stills with energy efficient falling film technology.*

### Quantity and quality for water

- Standard units are available from 50 - 15.000 l/hr.
- Column geometry, design and efficient droplet separation gives the MED excellent decontamination performance.
- Labyrinth baffles reduce steam velocity and optimize droplet separation.
- Evaporator columns are dry running, avoiding the risk of bacterial contamination associated with static water.
- High running pressures and ease of balancing offers excellent steam and water quality, with low industrial steam and cooling water consumption.

### Opex - Cost of ownership

- High efficiency, dry running, falling film evaporator columns.
- 3-8 columns.
- 10% blowdown offers a small water footprint.

- Tall heat exchangers to optimize heat transfer performance.
- Super fast start-up, minimizing water losses.
- Hot standby not required, saving energy, but maintaining fast start-up times.

### Service and Support

- Local support & service from our global offices.
- Yearly service and protection plans.

### Flexibility and Choice

- Combi units - producing steam and water from the same unit.
- Uplift frames & raised cooler / condenser sub assemblies.
- Siemens or Allen Bradley PLC, with large touchscreen panel, complete with SCADA option.



## POLARIS™ VCD

*Polaris is Veolia Water Technologies' family of distillation products for the production of water for injection and highly purified water.*

*The Polaris VCD (Vapour Compression Distiller) equipment are the ultimate in energy efficient distillation technology. Polaris VCD vapour compression stills are the ultimate in high efficiency distillation, with high compression ratios and ultra low droplet separation. It is ideal for low steam pressure & softened feedwater applications.*

### Quantity and quality for water

- Standard units available between 50-15.000 l/hr.
- High decontamination efficiency.
- 3 stage NCG removal (feedwater, condenser & degassing tank).
- Low velocity solution for optimizing impurity separation.
- Dry running FDA approved compressor seal.

### Opex - Cost of ownership

- Low steam consumption.
- High efficiency, low power consumption, multi stage blowers.
- High thermal efficiency.
- NCG used for pre heating.
- No cooling water system required.

### Service and Support

- Local support & service from our global offices.
- Yearly service and protection plans.

### Flexibility and Choice

- Hot & cold water production (25-95°C).
- Low pressure steam supply (3barg).
- Integrated pre treatment, dosing & RO.
- Steam production through integrated steam generator.
- Siemens or Allen Bradley PLC, with large touch screen panel complete with SCADA option.
- Pressurized water discharge.



## POLARIS™ CSG

*Polaris is Veolia Water Technologies' family of distillation products for the production of water for injection and highly purified water.*

*The Polaris CSG (Clean Steam Generator) sets the standard for high capacity, high purity clean steam applications.*

### Applications

- Up to 6 barg Clean steam for autoclave steam supply
- SIP (Sterilization in place), Bio reactors, make up vessels.
- Sterile facility HVAC humidification.
- Lyophilizer sanitization.

### Quantity and Quality of Steam

- Standard units available between 50 - 10,000 kg/hr.
- Rapid response steam production.
- Low velocity, droplet free steam production via internal labyrinths.
- Integrated thermal degasser for non condensable gases removal, in compliance with HTM 2010, 2031 & EN285 compliance.

### Service and Support

- Local support & service from our global offices.
- Yearly service & protection plans.

### Flexibility and Choice

- Vertical and horizontal (Kettler) steam generators.
- Additional condenser units for small scale,
- Simultaneous steam & WFI production - Siemens or Allen Bradley PLC, with large touchscreen panel & SCADA option
- Electric or steam heated units
- Integrated pre treatment, RO's, CEDI's & - UF for custom build packages.



## IONPRO™ LX

### Reverse osmosis & CEDI

*The IonPRO™ LX systems produce high purity water with low bacteria levels. Flow rates from 500 to 1000 l/hr..*

#### Applications

- Pharmaceutical
- Microelectronics
- Central laboratory (analytical water grade 2)
- General manufacturing

#### Features & Benefits

- Ionpro™ LX - High Purity Water Production
- Integral automatic sanitization (AutoSan) ; minimal operator involvement, reliable & repeatable
- Supplied with full Factory Acceptance Test (FAT)
- Validation pack with schedules, Installation Qualification (IQ) and Operational Qualification (OQ)
- I-Button security protection
- HMI: intuitive & simple to use ; process information, performance calculations, warnings, alarms displayed on screen
- Compact skid ; small footprint
- Standardized single-skid design; short lead times and quick start-up
- Configurable set points
- Stainless steel skid ; longevity

- Aesthetically pleasing ; moulded covers
- Combined drain ; simplicity
- Degasser for performance enhancement
- Flexible design solutions ; easy upgrade options

#### Options

- Validation pack with schedules, Installation Qualification (IQ) and Operational Qualification (OQ)
- Degasser for performance enhancement

#### Related Services

cal after-sales service and support teams offer preventative and corrective maintenance programs to ensure the long-term, efficient operation of installed plant.

#### HYDREX®

Chemicals Hydrex® 4000 water treatment chemicals from Veolia Water Technologies should be used for optimised plant operation.



# RAPIDE STRATA™

## Short cycle regeneration ion exchange deionisation

*Rapide Strata two-bed or three-bed units produce high purity water for a range of industrial applications. The unique design offers savings of up to 40% on operational and wastewater costs compared to conventional deionisation systems. Flow rates from 2.5 to 60 m<sup>3</sup>/hr.*

### Applications

- Pharmaceutical
- Beverage
- High and medium pressure boiler feed
- Surface finishing
- General industry

### Features & Benefits

- 3 models available: Rapide Strata, Rapide Strata+ and Rapide Strata+ Extended. Regeneration in varying sizes
- Standard regeneration in 35-45 minutes: minimizes down time, enhances bacterial control, improves chemical usage efficiencies
- Control system PLC, Touch Screen HMI, AQUAVISTA™: facilitate monitoring and operation
- Duplex operation mode for continuous water production: increased production capacity
- Continuous conductivity monitor with auto service shut-off and alarm: ensures water quality
- Continuous, intermittent or zero recirculation of water when tank reaches high point: operational flexibility
- Skid-mounted, standardised systems: short lead

- times, quick installation and start-up
- Variable frequency drive (VFD) on the pump on larger models (23/23+ to 60/60+)

### Rapide Strata+ Model

- Integrated polishing device (Hipol™)
- Eliminates need for separate post deionisation step
- Produces water exceeding Ph Eur and USP conductivity requirements

### Extended Regeneration Option on Strata+ models

- Capable of producing water with <20 ppb of reactive silica; suitable for high and medium pressure boiler-feed
- Produces water of <0.1 µS/cm; polishing RO water

### Related Services

Local aftermarket service and support teams offer preventive and corrective maintenance programs to ensure the long-term, efficient operation of installed equipment.



## SIRION™

### Reserve osmosis systems

*The SIRION™ reverse osmosis systems are developed for pure water production, sea water desalination and water re-use applications, and for all Water Applications and Budgets.*

#### Reverse Osmosis process

Reverse osmosis is a process that uses membranes to remove over 95% of dissolved salts, such as calcium bicarbonate and sodium chloride, from water. It is used either alone or in combination with processes such as ion exchange in a variety of applications where the total dissolved solids (TDS) concentration in water has to be reduced. The RO membrane also acts as a very fine filter removing 99% of suspended and colloidal solids, bacteria and organic molecules with molecular weights in excess of about 200Da. This makes the process particularly attractive for applications where treated water not only has to be low in TDS but also of high clarity and free from bacteria, such as that used for soft drinks and pharmaceuticals manufacturing

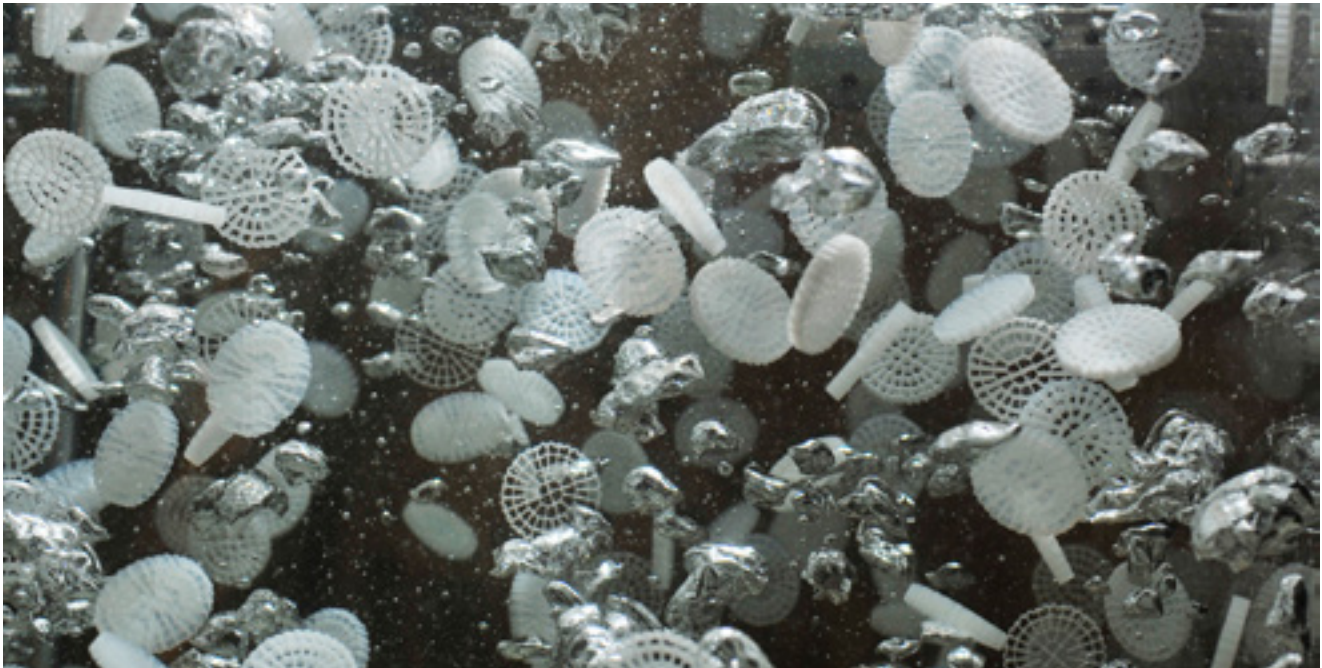


#### Features & benefits

Our products are manufactured to strict quality standards using the best materials, have short lead-time and can be quickly installed on-site.

- Compact and skid-mounted systems
- For brackish water and sea water desalination
- Flow-rates from 10 L/h to 105 m<sup>3</sup>/h
- Complete range from basic to upscale units
- Modular in design, can be easily integrated into existing plants
- Options, flexibility, adaptability
- Total water management, related services
- We meet the most demanding standards of reliability, safety and quality





# ANOXKALDNES™ MBBR

## *The next generation polishing technology*

### EXPERTISE

- 1000+ references Worldwide
- 30+ years of experience
- +27 years, longest plant in operation-with original AnoxKaldnes media
- References in municipal and most industrial sectors

### CUSTOMIZED FOR YOU

- Biological expertise allows AnoxKaldnes to find the best solution to fit your needs
- For BOD/COD and nitrogen removal
- But also for complex compounds like pharmaceuticals, EDTA, Selenium and Phenols
- Side stream and mainstream anammox solutions

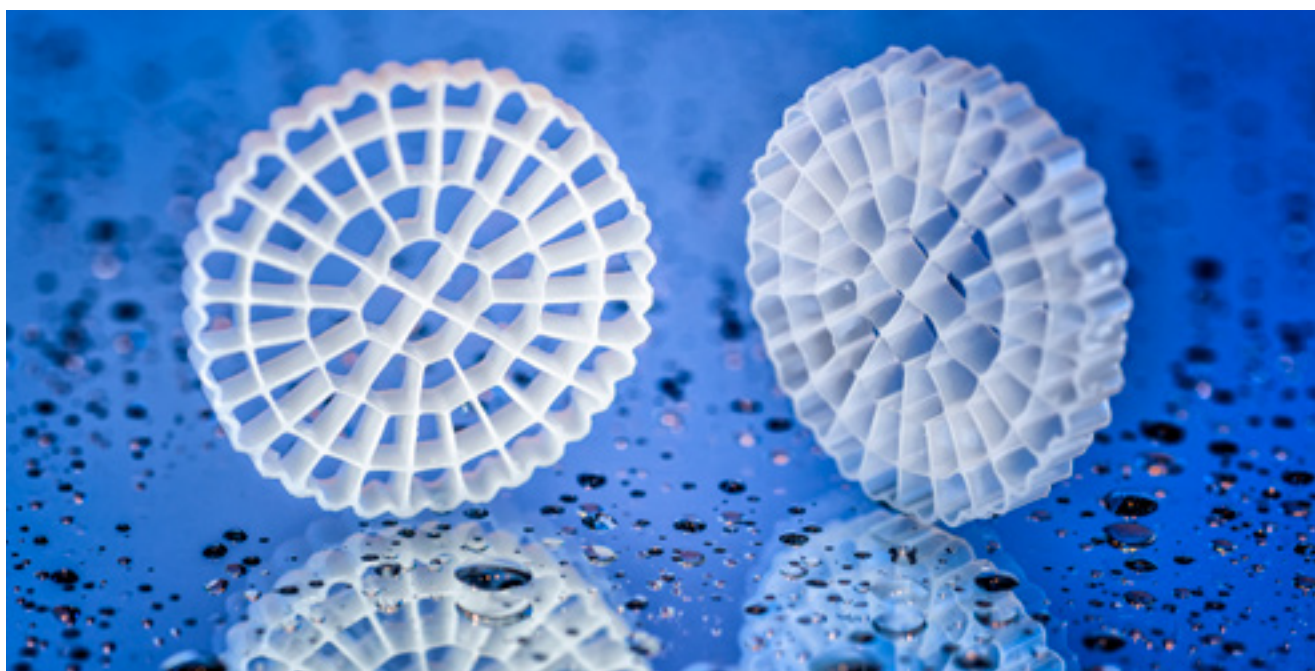
### ADVANTAGES

- Biofilm expertise applied using MBBR technology
- Retrofit and Increase Capacity
- Compact Footprint
- Robust and Tolerant
- Flexible Configurations

### REFERENCES

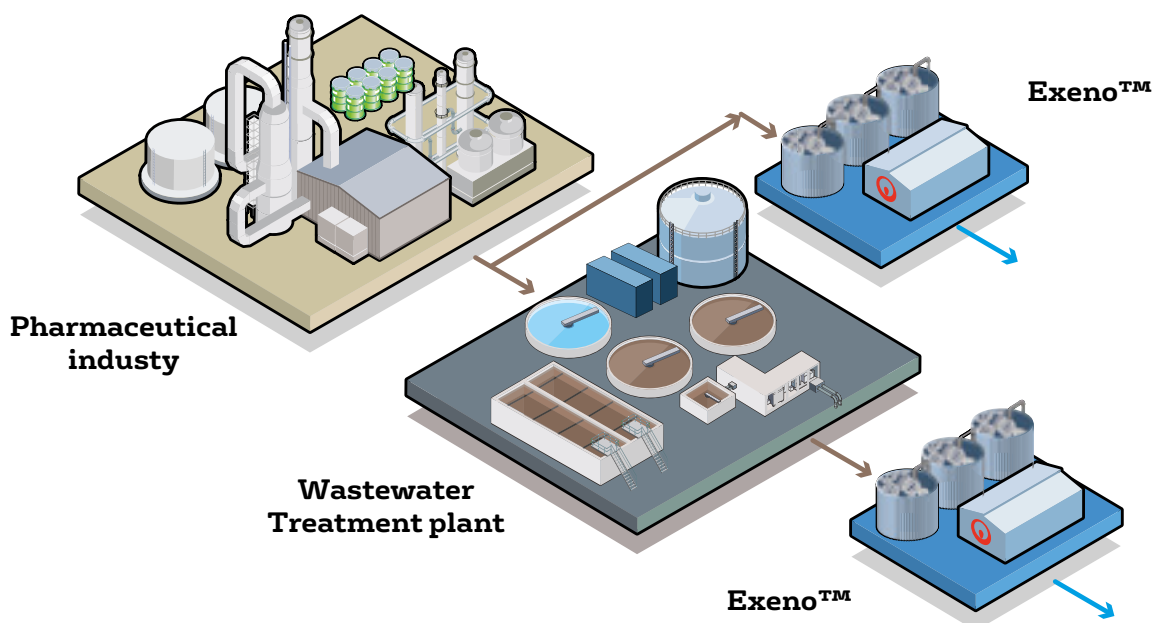
#### **AstraZeneca, Sweden**

AstraZeneca approached AnoxKaldnes in order to obtain a state-of-the-art solution for a new treatment plant. The wastewater from the pharmaceutical production was highly toxic and in addition contained many difficult-to-degrade organic compounds. The recipient was the very sensitive Lake Mälaren, which surrounds several cities including the capital, Stockholm. Since the beginning, the treatment results are excellent. In addition, the built-in tolerance to peak loads and toxicity in the MBBR process has provided a very stable operation that could not have been obtained with conventional treatment processes. The treated wastewater is totally detoxified by the action of the microfungi. The bacterial communities remove additional organic substances: the overall TOC removal is 97%. Approximately 80% of incoming nitrogen is removed. Phosphorous removal is 99%.



## An effective and economic friendly biological removal of drug residues in wastewater

Numerous pollutants such as pharmaceuticals and other drug residues are continuously released into wastewater treatment plant (WWTP) due to (i) human consumption (in hospital and in households), (ii) manufacturing (e.g., pharmaceuticals industry) and (iii) veterinary and agricultural use (e.g., of antibiotics and pesticides/herbicides). Due their complex chemical formula and limitation of conventional WWTP, when discharged into receiving water bodies, can possibly cause acute and chronic toxic effects on aquatic organisms even at very low concentrations.



# EXENO™

## *an effective, economic and environmental friendly solution from Veolia Water Technologies*

Exeno™ is the Veolia Water Technologies solution for an effective and economic friendly biological removal of drug residues in wastewater. Exeno™ is based on AnoxKaldnes™ MBBR (Moving Bed Biofilm Reactor) and relies on microorganisms growing as biofilm on plastic carriers. By using multiple reactors in series, MBBR technology will select for specific microorganisms specialized in removing difficult biodegradable compounds like pharmaceuticals. Exeno™ can be designed for complete treatment of wastewater (for example from pharmaceuticals industry where multiple MBBR in series are used to remove pharmaceuticals) and post-treatment of municipal WWTP after existing activated sludge plant. In this case, three reactors are used in cyclic mode and a short retention time is sufficient to remove residual drugs in wastewater. As an innovative biological solution, Exeno™ is:

- **Effective:** resulting in high removal of hardly degradable pharmaceuticals (e.g. diclofenac)
- **Economical advantageous:** using more bacteria and less ozone and/or activated carbon, the cost of energy and chemical usage is reduced
- **Environmental friendly,** avoiding the release of by-products typical of advanced treatment

### References

#### **Astrazeneca, Sweden**

A tailor-made MBBR process in six stages for treatment of wastewater from production to the quality required for discharge to the lake serving as drinking water resource for greater Stockholm. The plant was designed for removal of TOC, N and P (capacity 1,800 m<sup>3</sup>/d, TOC 440 kg/d).

#### **JCS Grindes, Latvia**

A five stage MBBR process for degradation of hardly degradable organic compounds from pharmaceutical production, including phenols and high concentrations of organically bound nitrogen compounds. Plant capacity 500 m<sup>3</sup>/d.

#### **Mermis, Denmark**

A development project partly funded by Danish EPA with focus on MBBR for removal of pharmaceuticals primarily from hospital wastewater. Project partners from universities, institutes, water companies.

#### **Mereff, Denmark**

A follow up development project on findings in Mermis with focus on post-treatment with MBBR of effluents from conventional activated sludge system (project partly funded by Danish EPA). The process utilizes a rotation principle providing unique treatment results. Process patented.



## BIOSEP MBR™

### *An aerobic biological treatment for wastewater treatment and water reclaim*

An innovative solution developed by Veolia Water Technologies, Biosep™ combines two proven technologies:

- Biological treatment using activated sludge
- Membrane filtration

Biosep™ produces very high quality water, fully compliant with the highest standards for water reuse for irrigation, industrial and municipal applications.

With more than 120 references worldwide, Biosep™ is recommended for:

- Significant reduction of carbon, nitrogen and phosphorus pollution
- High and simultaneous removal of bacteria depending on the treated water, completed by downstream disinfection.

**Biosep™** is sold under the **Neosep™** trademark in Japan, the United States, Australia and New Zealand.

**Biosep™ Pack** - new standard membrane filtration units

- > Flow rates from 4 to 110 m<sup>3</sup>/hr
- > Flexible and modular solutions, manufacturing in-house in the Veolia workshops
- > Guaranteed performances identical to those of the conventional Biosep™ process

*Biosep™ Pack is added to a biological aeration tank. The membrane bioreactor replaces the traditional settling system and separates perfectly the purifying biomass from the treated effluent through microfiltration.*

*The microfiltered water is of excellent bacteriological quality and removal of TSS is guaranteed at any time. Flow rates from 4 to 110 m<sup>3</sup>/hr.*

#### **Applications**

- > Small or medium sized industrial effluent treatment plants (800 to 10,000 PE)
- > Temporary solutions during refurbishment or upgrade work



# EVALED®

## *Evaporation technologies for wastewater treatment*

### APPLICATIONS

- Effective solutions for the treatment of industrial wastewater, concentrating and removing salts, heavy metals and a variety of hazardous components.

### PERFORMANCES

- ZLD
- Water reuse
- Valuable matter recovery
- Up to 95% distillate yield
- Sizes from 0.1 to 200 m<sup>3</sup>/day of distillate produced

### BENEFITS

- Waste disposal costs reduction
- Low energy consumption
- Fully automatic, minimum labor
- Remotely controllable (Industry 4.0 compliant)
- Standard & Package design
- Small footprint, Plug & Play
- High quality of distillate

Evaled is now boosted by our digital services offer AQUAVISTA™

### REFERENCES

#### **Chemical, wastewater from washdown of factory areas, cleaning of processing and batch tanks, spillages, etc., South Africa**

- Water reuse for tanks cleaning
- Water recovery: ~ 96%
- Concentration factor: ~ 25 times

#### **Printing, Inks production, Mexico**

- ZLD, water reuse for products manufacturing
- Wastewater reduction: ~ 98%
- Concentration factor: ~ 50 times

#### **Chemical & Detergents, healthcare products, Italy**

- Reduction of sludge from biological plant, disposal cost reduction
- Water recovery: ~96%
- Concentration factor: ~25 times

#### **Glue and adhesive products, Germany**

- ZLD, disposal cost reduction, concentrate recovery as by-product to resell
- Water recovery: ~90%
- Concentration factor: ~10 times



## IDRAFLOT®

### *Flotation technology*

Flotation is a physical process where water is separated from the suspended solids to be reused. Flotation consists of separating solids from the water phase by attaching the solids to fine air bubbles to decrease the density of the particles which float instead of sinking. The rising solids are called the “float” and are skimmed off the surface and further processed in the sludge train.

Chemicals can be added to improve the separation: first for coagulation and then for flocculation.

The type of flotation used by IDRAFLOT® is the Dissolved Air Flotation (DAF), in which the suspension is saturated with air at high pressure. Bubbles are released to the water and will attach to the suspended solids.

The bubbles from a DAF system are much smaller than in other types of flotation systems and better adhere to the solids. This makes IDRAFLOT® DAFs one of the most efficient flotation options of wastewater treatment.

#### Applications

Effective for biological treatment and thickening of activated sludge from biological plants.

- Wastewater treatment process - pre-treatment

- Wastewater treatment process - tertiary treatment (P removal)
- Wastewater treatment process - sludge thickening
- MBBR post treatment sludge separation
- Rain water, floor cleaning
- Pure water and wastewater
- Filter back wash treatment

#### Benefits

- A unique mobile and modular stainless steel design for faster delivery, easier implementation and reduced costs;
- An enhanced thickening and clarification performance. This creates an increased removal of insoluble COD, suspended solids, and FOG (fats, oils, and grease).
- The IDRAFLOT®’s three patents are intended to assure a perfect mixing of the waste with saturated water and a uniform distribution of the water flow along the entire surface of the unit.
- Treatment capacities from 5 to 480 m<sup>3</sup>/h.
- Reduce chemical additive dosing
- Reduce the saturated water flow rate (up to 50% less compared to the conventional models)
- Avoid hydraulic short circuits
- Reduce the unit’s operational costs



An ideal solution that not only effectively treats high TDS wastewater, but also manages the subsequent mixed salts.

# MBD™

## Modular Brine Crystallization System

### Thermal, Modular, Wastewater Treatment System

#### System Description

The system is based on HPD® Forced Circulation Crystallization technology to treat a variety of waste streams followed by management of waste brines for disposal (as a concentrated or solid waste brine). This “Bulldozer” system is supplied as a modular, skidded system and designed to treat feed from RO reject, ponds, or untreated brines without complex pretreatment:

- Capacity: 13.5 m<sup>3</sup>/h (70 gpm)
- High-efficiency, Mechanical Vapor Recompression (MVR) driven
- Process designed to resist scaling
- Materials of construction minimizes corrosion
- Used for volume reduction or Zero Liquid Discharge (ZLD)

#### Benefits & Features

##### Environmental Performance:

- Water recovery up to 99%
- High-purity recovered water suitable for reuse, discharge, or aquifer reinjection
- Produces solid salt cake suitable for landfill disposal (ZLD option)
- Minimal chemical consumption

##### Modular Design:

- Rapid deployment to site
- Supplied as (3) skids; can be redeployed
- Shippable by standard, over-the-road transport
- Small footprint

##### Mixed Salt Management (ZLD option):

- Centrifuge or filter press
- Supplied as skidded package

##### Applications

- Pond Volume reduction
- Evaporator blowdown treatment
- Pilot well testing
- Zero Liquid Waste (ZLW) requirements

##### Reference

###### OSUM Oil Sands Corp., Canada

MBD™ crystallizer will reduce the disposal costs and increase the amount of recovered water as the new system will reduce wastewater disposal by up to 80%, remove 6 trucks per day from the road on average, and recycle up to an additional 90,000m<sup>3</sup> of water annually for reuse to generate steam at the Orion oil field.

# Follow the Electron

## *Veolia's Capabilities for lithium, nickel and cobalt producers*

### Process Development Expertise

Veolia Water Technologies has a long history of supplying systems for purification, recovery, and drying of inorganic chemicals utilizing its HPD® Evaporation and Crystallization Technologies.

State-of-the-art research and development capabilities allow investigation into the behavior of complex multi-component aqueous systems and subsequent optimization of the process design to most efficiently achieve the desired product quality and reduce performance risk. Unlike typical for hire hydrometallurgical laboratories, Veolia also designs and supplies commercial equipment. Veolia understands how learnings at the lab or pilot scale translate to commercial performance and will take responsibility for the processes that are developed in our facility. We can typically scale up from the laboratory scale directly to offer commercial systems on a design build basis with complete process, mechanical, and schedule guarantees.

Precursor materials for lithium ion battery production must be provided at extremely high purity levels. Nickel and cobalt compounds are particularly sensitive to contamination during the crystallization process. Through our crystallization expertise supplemented with specific testing, Veolia is able to identify the appropriate crystallization processes required to achieve desired purity levels from unique sources with differing contaminant levels.

### Lithium Processing Experience

Veolia has supplied several process systems to leading lithium suppliers worldwide as well as having performed analytical, bench and pilot scale testing.

- Lithium brine concentration
- Lithium salts crystallization
- Lithium salts purification by re-crystallization
- By products recovery from lithium processing
- Impurity removal (precipitation, ion exchange, etc.)
- Solid/liquid separation systems and solids handling

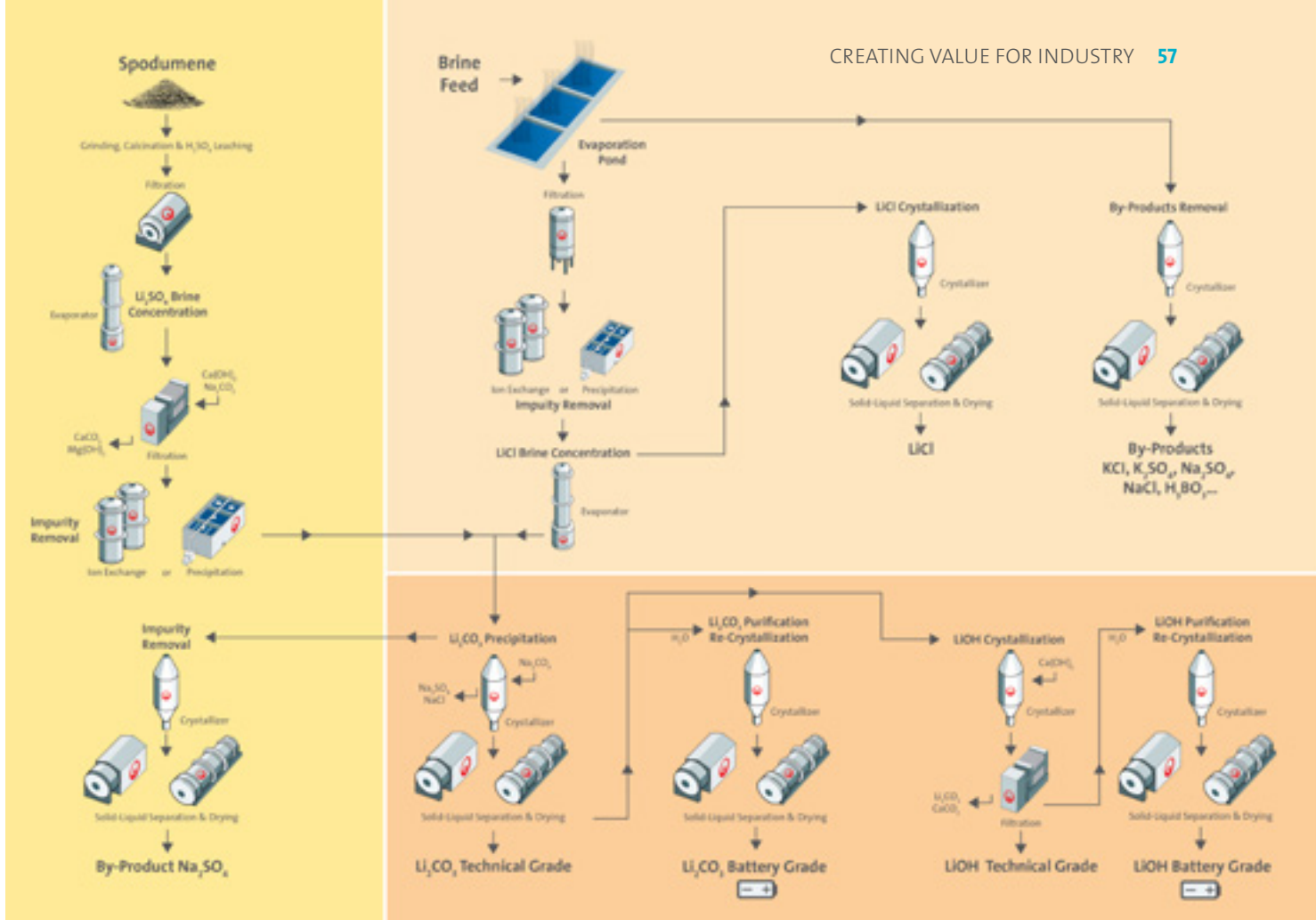
Lithium salts crystallization

- Lithium Chloride (LiCl)
- Lithium Carbonate (Li<sub>2</sub>CO<sub>3</sub>)
- Lithium Hydroxide anhydrous and monohydrate (LiOH)
- Lithium Sulfate anhydrous and monohydrate (Li<sub>2</sub>SO<sub>4</sub>)
- Lithium Bromide (LiBr)
- Lithium Phosphate (Li<sub>3</sub>PO<sub>4</sub>)

By-product recovery from lithium processing:

- Potassium Chloride (KCl)
- Sodium Sulfate (Na<sub>2</sub>SO<sub>4</sub>)
- Sodium Chloride (NaCl)
- Potassium Sulfate (K<sub>2</sub>SO<sub>4</sub>)
- Boric Acid (H<sub>3</sub>BO<sub>3</sub>)





## Research & Development

Veolia's 5,000 m<sup>2</sup> Research and Development Center is crucial for development of challenging process designs for HPD® Evaporation and Crystallization technologies.

The facility is home to a wide variety of tools used for investigation of new process designs, testing to support customer projects, and development of new technologies. It is the foundation for design evaluation, feasibility, and process validation as well as improvement and economizing overall system designs.

The analytical, bench-scale, and pilot-scale testing capabilities, with an extensive catalog of data, allows advancement of first-of-a-kind innovations.

This is especially important to design processes for achieving the purity requirements in evolving lithium, nickel and cobalt applications and purity requirements.

Rigorous testing provides the confidence that the commercial system will perform as designed.



# Mobile Water Services

***Delivering water anywhere, 24/7. Ideal for planned hire, emergencies and disaster***

**Our Mobile Water Services** provide pure water anytime, anywhere, 24 hours a day, 7 days a week. With flow rates from 200 litres/hr to >150 m<sup>3</sup>/hr, our Mobile Water Services are ideal for planned hire, emergency call-outs and disaster recovery. Safeguarding the production of your water treatment plant, our Mobile Water Services provide flexible water services, while reducing your wastewater discharge volume and identifying reuse opportunities.

## EMERGENCY MOBILE WATER SERVICES

This high-value service has been developed to protect and provide your business with 'treated water security' in the event of an unplanned circumstance where you require a temporary water treatment plant. We can deploy equipment and engineers within four hours of your call 24/7, and can deliver any quality and quantity of treated water for an unlimited time period, in a safe and responsible way.

## PLANNED MOBILE WATER SERVICES

This 'customer choice' planned service provides customised, flexible and adaptable solutions for your foreseen requirements for temporary water treatment. This service provides capabilities, technologies and engineers who deliver treated water of any quality and quantity in the most cost-effective way, during open-ended usage periods and meeting the highest service standards.

## MULTI-YEAR MOBILE WATER SERVICES

Our multi-year service provides reliable, cost-effective and adaptable solutions to meet and exceed your long-term requirements for treated water. This service provides tried and tested standard equipment, capabilities, technologies and engineers who deliver treated water to industry standards, meeting and exceeding quality and quantity requirements in a secure, responsible and sustainable way.

Multi-year services are available over defined time periods, typically between one and ten years, to match your needs.

## REFERENCE

### James Paget Hospital, UK

The renal ward at James Paget Hospital operates 16 hours each day, and accommodates up to 18 patients at any one time for three hour sessions. To support this critical activity, James Paget needed to upgrade their existing water treatment system.

Veolia Water Technologies's carbon analysis team assessed the carbon footprint of the existing system and compared various options for the new system. The recommended solution comprised of a Modula SXL hygienic reverse osmosis unit and a nephro SAFE heat sanitisable ultrafiltration unit. The project has provided James Paget Hospital with a new renal water system to meet its current and planned needs, and a reduced carbon footprint. ●

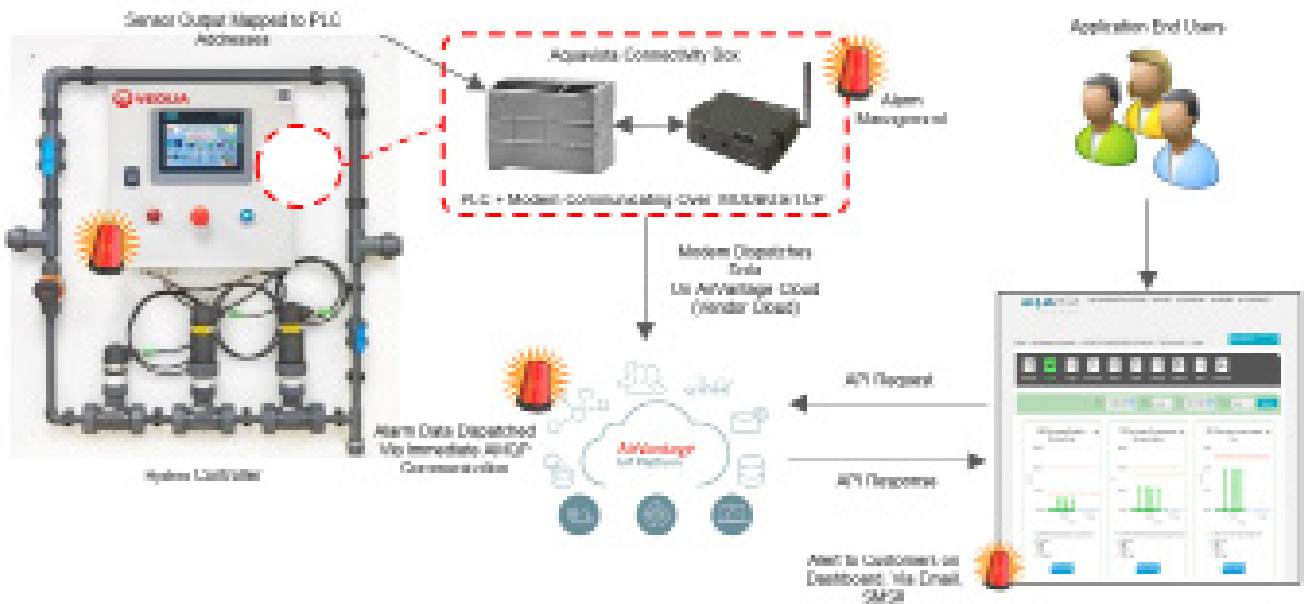




## Did you know that HYDREX™ covers all your water treatment chemical needs?

Veolia Water Technologies provides a **full range of water treatment additives but also associated services** (technical assistance and audit onsite + support of Hydrex experts' team) and **equipment** such as dosing systems and tanks. You can also take advantage of our **AQUAVISTA™ monitoring** / digital tools and on-line scanners to ensure better performance of the treatment. If you need water treatment chemical assistance, Hydrex™ has the solution!

Boiler Water Treatment Products	➤	HYDREX 1000 SERIES
Cooling Water Treatment Products	➤	HYDREX 2000 SERIES
Drinking Water Treatment Products	➤	HYDREX 3000 SERIES
Membrane Treatment Products	➤	HYDREX 4000 SERIES
Maintenance and Cleaning Products	➤	HYDREX 5000 SERIES
Wastewater Treatment Products	➤	HYDREX 6000 SERIES
Biocides Products	➤	HYDREX 7000 SERIES
Industrial Application Products	➤	HYDREX 8000 SERIES
Thermal Desalination, bulk chemicals & Others	➤	HYDREX 9000 SERIES



# AQUA service plant audit

**Decades of experience in the building** and operation of water treatment plants is the basis for the development of our plant audit.

You are the expert when it comes to your technologies, products and services. You modify your processes based on the customers' requirements. But what about your water treatment? How much does the purification and disposal of your wastewater cost? Is the water quality sustainable? How high is the energy and chemicals consumption? How can risks be minimised and health protection be optimised? How often is maintenance required? Can you run your plant more efficiently? What would the budget be for necessary investments?

## AIMS OF THE PLANT AUDIT

- Long-term operational safety
- Lowering operating costs
- Increasing the plant output
- Legal certainty
- Resource-minimizing operation



## EFFICIENCY IN FOUR STEPS

### 1 Initial discussion

- Definition of the requirements, first plant inspection
- Review of the documents
- Detailed offer for AQUA service plant audit

### 2 Kick-off

- Inventory of performance data and plant design
- Recording of measurement and operating data, water analysis

### 3 Report

- Plant status with operational recommendations
- Economic perspective of ways to optimize the plant
- Legal/technical limitations and risk analysis

### 4 Summary

- Evaluation of the findings
- Recommendation of options for optimisation

## BENEFITS

- Long-term operational safety
- Lowering operating costs
- Increasing the plant output
- Legal certainty
- Resource-minimising operation

# Veolia Industries Global Solutions

*integrated solutions for the industry*

Veolia Industries Global Solutions is part of the Veolia group, the global leader in optimized resource management. For companies with multiple facilities located across different countries or regions Veolia Industries Global Solutions provides tailored outsourcing support to manage Facilities Services, Utilities, Energy, Water and Waste.

Established for more than twenty years Veolia Industries Global Solutions brings a wealth of experience in managing and operating on site services for local and international industrial clients. With key expertise in Integrated Utilities Management and Integrated Facilities Management, backed by the global presence of Veolia and with a high degree of self-delivery we are well placed to match the evolving demands of our industrial clients.



### Integrated Utilities Management

Operation and maintenance of equipment dedicated to the production and distribution of utilities

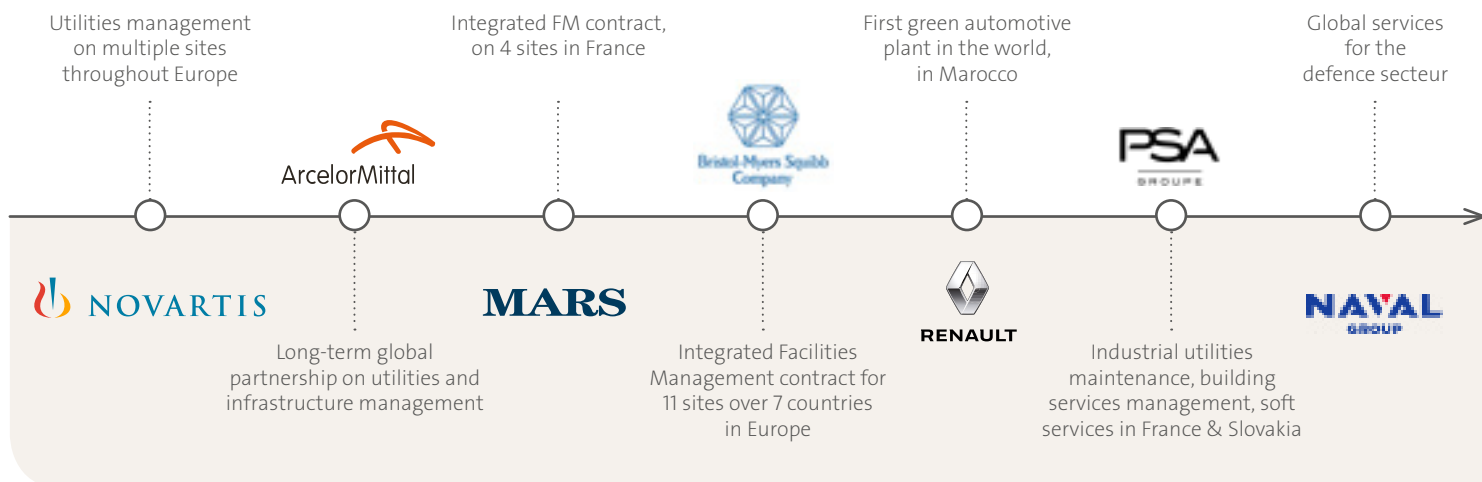


### Integrated Facilities Management

- Utilities infrastructure maintenance
- Support to production
- Occupant services



## Our key clients believe in us



### Novartis

Since 2001, Veolia has been supporting Novartis in its operational, economic and environmental excellence performance on its Basel industrial platform - a global showcase for the pharmaceutical giant. Veolia ensures and optimizes the supply and management of water (drinking, ultra-pure, industrial, and demineralized water) and energy fluids (electricity, steam, superheated water, compressed air, cooling water) from Basel sites, and the collection and treatment of waste, including the recovery of special waste. In 2014, all production support services for its European sites, including water, energy and waste management, as well as facilities and occupant services, became part of the partnership.

### Bristol-Myers Squibb

In 2010 Veolia assumed sole responsibility for an array of technical and support services on behalf of the pharmaceutical giant BMS, at its sites throughout Europe. The scope of services included in Veolia's contract with Bristol Myers Squibb is exceptionally broad a true IFM: utilities and water cycle management,

multitechnical maintenance, janitorial services, grounds management, laboratory support activities and an array of services for building occupants, including cleaning, reception and dining services.

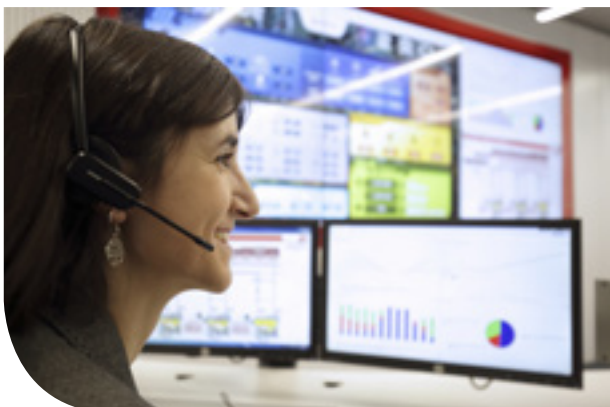
The contract encompasses 11 production, research and administrative sites: three in the UK; two in Ireland; two in Italy; and one each in Germany, Belgium, Spain and France. Veolia has demonstrated its ability to draw on its full range of expertise in utilities – the water cycle, hazardous and non-hazardous waste management, recycling of solvents and more – to produce a single, integrated solution.

Veolia's ISO 9001-certified Business Manual System, with its incorporation of ISO 14001 and OHSAS 18001 standards for managing environmental impact and safety-related risks, ensures that uniform, standardized procedures are in place at each of BMS's sites. Moreover, Veolia has proposed a number of solutions to improve energy efficiency, reduce their water consumption and recover waste at BMS facilities. Veolia have actively supported BMS in the acquisition of ISO50001 certification at a number of facilities.

# Hupgrade:

*our digital solution to serenely manage your facilities services, utilities, energy, water and waste*

- Typology of sites connected to Hupgrade:
  - tertiary buildings
  - industrial process
- Sensor metering through Building Management System, API and 4G secure routing
- More than 20 million data available for analysis by the end of 2018
- Economic target goals: min. **10%** reduction on annual consumption
- Number of energy performance actions identified and launched: **70**
- Close proximity to the Call Center
  - Monitoring of ongoing intervention requests
  - Management of urgent calls
  - Incident management
  - Management of meeting rooms











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# Resourcing the world