

wave

Insights from Veolia Water Technologies



Keeping industry flowing Mobile Water Services

WATER TECHNOLOGIES

BUSINESS CONTINUITY

Planning for the unexpected

DIGITAL

Boosting mobile water services

WATER SCARCITY

Securing water production

PLANT MANAGEMENT

Minimizing risk for aging assets

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

Resourcing the world



INSIGHTS

A fast moving and highly responsive service to meet today's industrial demands for treated water

Industrial needs in the water treatment market are constantly evolving based upon the external environment and the demands they face on a daily basis. On top of traditional operational, technical and economic constraints, more and more companies are moved by a desire to optimize their use of natural resources and to consume these in an environmentally responsible way.

Veolia Water Technologies creates technologies and services for water resource efficiency and sustainability. Our Mobile Water Services are highly flexible and available through operational expenditure with minimal capital. In today's world there is a growing demand for more performance-based services and we believe we are responding to and exceeding our customers' demands.

Flexible performance-based solutions

Our ambition is to improve the resilience and sustainability of our customer's manufacturing and operations through these performance-based services. We offer flexibility, both in terms of length of service and range of diverse applications, within most global geographies. Our focus is to recycle and reuse equipment, sharing them across a large customer base which optimizes the resources and provides cost-effective solutions.

We have evolved the business capability from primarily being a service provider treating drinking water to now having the capability to process natural alternatives and used water sources, increasing our partnership with customers to address water scarcity and extreme weather conditions.

Keeping industry flowing

Our mission is to ensure treated water is always available to industrial users — keeping industry flowing. We will meet this challenge by combining our service experience with existing and new technologies. The addition of remote monitoring and being digitally enabled will allow us to respond to challenges demanding greater performance while providing additional transparency.

This edition of Wave Magazine will give you an insight into this business, customer drivers and applications, and the growth journey we are on. It is a showcase of our commitment to our customers' needs, combined with the teamwork required to deliver this exceptional service.



Mark Dyson

Vice President, Veolia Mobile Water Business

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Keeping industry flowing

In 2020, Veolia launched its Impact 2023 program with the ambition of being the reference company for ecological transformation. For Veolia, ecological transformation means working to radically change patterns of production and consumption by placing ecology at the heart of every process and every assessment. We provide meaningful solutions to major problems, with and for our stakeholders: local authorities, manufacturers, civil society, employees and more. Providing quality mobile water services is at the heart of this strategy.

As a global organization providing mobile water services, Veolia Water Technologies combines technical know-how and industry-leading resources with the service standards required to exceed customers' expectations. With a large, flexible fleet and a network of service centers and depots throughout the world, we provide a reliable and secure source of treated water 24/7, 365 days a year — for as long as it is needed, with rapid response and easy set-up, every time, for complete peace of mind.

Our mobile water assets are designed, produced and built by our expert technology business units, capitalizing on decades of experience and expertise in water treatment. We manage the full life cycle of the assets and rely on a strong in-house service team to operate and maintain them.

One trusted provider, three flexible services

- Emergency
- Planned
- Multi-year

Pre-packaged on a trailer, skid or container for maximum mobility and responsiveness, treating process water and reuse water.

Why go mobile?

● Plant failure

Emergency response, a solution in the event of unforeseen circumstances.

● Aging plant

A short or medium-term replacement when the existing plant is unreliable or costly to maintain.

● Additional capacity

Increase water treatment capacity to enable production flexibility or expansion.

● Enhanced quality

Implement a new sustainable solution on-site. Environmental compliance: Reuse process water to meet environmental standards.

● Planned maintenance and commissioning

Ensure continuity of production cycle during planned maintenance and commissioning and minimize any potential downtime.

Benefits of working with our mobile water services team:

- ✔ Reliable and secure supply of treated water.
- ✔ Peace of mind with business continuity ensured.
- ✔ Inclusive maintenance.
- ✔ Minimal CAPEX.
- ✔ All costs are defined and fixed for the service period.
- ✔ Cost-effective options for open-ended usage periods.
- ✔ Minimal to no chemical inventory on site.
- ✔ Flexible rental periods.
- ✔ Rental / lease / pay-as-you-go services.
- ✔ Bundled service offering.
- ✔ Environmental solution.

Fleet of over 700 assets strategically located around the world.

Our mobile water treatment technologies include:

 REVERSE OSMOSIS	 ULTRAFILTRATION	 DEIONIZATION	 FILTRATION
 SOFTENING	 CLARIFICATION	 DEGASSING	 SEAWATER DESALINATION

Flow rates from 5 to 1,000 m³/h under pay-as-you-go agreements.

Bundled services:

- ✔ Full water cycle audit
- ✔ Chemical refills
- ✔ Membrane cleaning or replacement
- ✔ Resin regeneration and recycling
- ✔ Full technical support with commissioning, start-up and maintenance engineers available 24/7
- ✔ Transportation logistics
- ✔ Commissioning and startup
- ✔ Maintenance and spare parts

Industries served:

- ✔ Automotive
- ✔ Chemical
- ✔ Engineering houses (EPCs)
- ✔ Food and beverage
- ✔ Metals and mining
- ✔ Oil and gas
- ✔ Petrochemical
- ✔ Pharmaceutical
- ✔ Power
- ✔ Pulp and paper





Minimizing risk for aging assets



Aging water treatment equipment can present a significant problem for heavy industries such as power generation, mining, chemicals, petrochemical and refining. Failure can mean the difference between production and a full stop on revenue. With capital constraints affecting every industry, temporary mobile water treatment plants are an attractive solution to improve reliability and ensure continued operations.

Mobile water treatment systems have a key role to play in addressing aging assets across many heavy industries. Mechanisms associated with aging such as corrosion, erosion and fatigue affect many kinds of industrial equipment and installations, including water treatment. In addition to safety concerns, aging water treatment plants can potentially have a major impact on operations given that water is vital to many industrial processes. A failure in water supply equipment, changes in the quality of process water or any restriction on availability could disrupt production, resulting in costly downtime for operating sites.

At the same time, many businesses are facing capital constraints, making investment in new facilities extremely challenging if not impossible. For example, fluctuations in commodity prices, such as oil, can make capital investment proposals difficult. Any capital investment that is available is likely to be allocated to the core business to deliver higher returns through production improvements or to enhance safety, rather than water treatment.

As a result, many industrial sites will try to extend the operational lifespan of existing treatment facilities, grandfathering assets well beyond their normal life expectancy.

Turning to portable water treatment plants

Given an aging asset base, preventive maintenance and refurbishment of permanent water treatment plants must be carried out more frequently in order to allow operations to continue. Such maintenance programs must be executed without interrupting plant operations and the production schedule. With operators looking for alternatives to the costly emergency maintenance that may be required, they are increasingly turning to mobile water services providers. Temporary solutions can help to maintain water supplies during maintenance

Improving reliability, ensuring production.



or refurbishment operations or can assist during capital projects with temporary treated water supplies.

Temporary mobile water systems may also be deployed to improve water quality; for instance floods or periods of water scarcity could mean high levels of suspended solids that may cause operational difficulties to existing plants. Other kinds of plant failure like boiler or condenser leaks may require more water and could also necessitate a temporary treated water supply. Assets may also present changing operational needs, for example in peaking power plants which are only operated on a seasonal basis, or where a new gas turbine has been added to an existing power plant but no additional water treatment capacity has been included to meet additional demand.

Intermittent or environmental constraints requiring mobile water services.

Alongside process water, mobile water treatment may be deployed to support aging assets in relation to plant discharges too. Regulatory requirements are becoming far more stringent, for example through the introduction of tougher requirements for maximum total suspended solids (TSS), pH balance or removal of contaminants such as ammonia or heavy metals.

Pressure to meet environmental constraints can make a case for mobile water treatment by addressing ash pond remediation in coal-fired plants or mine tailing ponds, for example.

Indeed, the drive to improve sustainability is also prompting an integrated approach to water by coupling wastewater and process water. Operators can potentially use mobile water treatment to support reuse of spent water, minimizing the environmental impact.

Flexibility, quantity and quality of supply

Operators within heavy industries like power, chemical, petrochemical and refining are facing an increasing challenge from their aging assets, including their on-site water treatment plants. Inevitably, these water treatment plants may fail and flexible temporary water treatment solutions can be used to improve reliability and security of treated water supply.

Temporary mobile water treatment systems may be deployed to either provide full or a part of the need for various water treatment processes, and not just as an emergency service. Mobile water treatment is a cost-effective approach as a planned or long-term solution such as to extend the life of the plant. In any event, mobile water treatment is flexible and adaptable technologies can be added or removed depending on changing requirements with open-ended rental time periods. Quality and quantity of treated water is produced with guaranteed performance.

However, perhaps the key benefit of mobile water treatment plants is their ability to maintain business, anytime anywhere. For many industries, no water means production disruption. A power plant that is not running can lose up to \$1 million per day, making the relative cost of water security insignificant. Even more troubling, contractual obligations could significantly increase the costs of failure by exposing businesses to penalties.

By deploying proven mobile water treatment technologies that are supported by experienced engineers, heavy industries give themselves an opportunity to focus on their core business and allow service providers to give confidence in the availability and quality of water supplies. It reduces the risks of production disruption and, ultimately, ensures that water is never a threat to business continuity. ●



A network at your service

Mobile water services are at the heart of Veolia's ambitious Impact 2023 program which aims at being the reference company for ecological transformation. Having a strong, flexible and well-located network of regeneration, recycling and service centers as well as numerous mobile assets featuring a wide range of water treatment processes is essential to address the needs of customers in a timely and efficient manner.

Veolia Water Technologies has been expanding and investing in the development and construction of new ion exchange regeneration and recycling facilities around the world to provide our customers with access to these high-value services. These facilities allow us to further innovate our mobile water services offer and provide service consistency on a worldwide and local basis.

In addition to the unique regeneration capability, the facilities are equipped to maintain, service and store all mobile water assets, warehouse spare parts and consumables. A team of engineers dedicated

to this service organizes, delivers, regenerates and supports our mobilizations.

The responsiveness and availability of mobile water services ensure that a secure and reliable source of treated water is available 24 hours per day, every single day, in the event of unforeseen operational issues or for continuous, longer-term services. A strategic location is key to enable these valuable differentiating services to reach customers faster and more efficiently, ensuring business continuity with no interruptions in production.

Going mobile provides both an economic and environmental solution for our customers as the sharing of these assets optimizes resources and their use. ●

***Rapid
responsiveness
with full service
capability.***



USA

Dayton, Ohio — We adapted our regeneration and recycling facility to optimize equipment storage for easy dispatch from this location as well as to manage the recycling and regeneration of ion exchange resins. Located in the Midwest, this central facility gives us great reach throughout this region as well as the Gulf Coast and New England.

A world map with a light gray background. Several blue location pins with white checkmarks are placed on the map, indicating service centers. Pins are located in North America (USA, Canada), South America (Brazil), and Europe (UK, France, Germany, Italy, Spain).

**Regeneration
and service
centers around
the world**



Recent investments in these facilities will lead to an improvement in the responsiveness and availability of our mobile water services teams, ensuring a secure and reliable source of treated water is always available. Their locations enable us to reach our customers faster and more efficiently, providing a resilient offering and ensuring business continuity with no interruptions in production.

Mark Dyson, Vice President Veolia Mobile Water Business

MIDDLE EAST

Dammam, Saudi Arabia — Established in September 2021 as an equipment depot combined with an ion exchange regeneration and recycling facility. This installation, unique in the Middle East, has good reach into Qatar, Kuwait, UAE and Egypt as well.



ASIA PACIFIC

Penang, Malaysia — Acting as a base for our South East Asia fleet, the expansion of this site, to be completed at the end of 2021, will allow the full mobile ion exchange asset portfolio to be offered. The site also services Thailand, Singapore, Indonesia and Vietnam.

Australia — Consolidation of our depots and facilities to be able to respond quickly to our local customers across this vast country.

EUROPE

Veolia Water Technologies has three main regeneration and service centers in Europe, all of which have recently benefited from major investments.

Heinsberg, Germany — A brand new, state-of-the-art facility opened in May 2021 in the industrial heart of mainland Europe. It is strategically located to provide easy access to Germany, the Netherlands, Belgium and Northern France.

Wissous, France — The expansion of this facility located just south of Paris was completed in 2020. It can now propose a more comprehensive and diverse offering to both the French and southern European markets of Italy and Spain.

Stoke, United Kingdom — Refurbishment to fully upgrade and modernize this regeneration and recycling station was completed in June 2021. This facility is now able to support customers in the UK and Ireland in a more efficient and effective way.

These facilities also offer customers the opportunity to further engage with Veolia Water Technologies through training days, Show and Tells, technology education and asset and services awareness. With its mobile water services offering, the company brings security and reliability around the provision of treated water in both a highly responsive and responsible way.



Planning for the unexpected

It might never happen but if it did would you be prepared? In the case of a business emergency could you respond to minimize loss of production and potential financial and reputational consequences?

You need to have a plan — not only to ensure the business doesn't suffer, but also to give you and your customers peace of mind and reassurance that all steps have been taken to mitigate any disruption. The unexpected does happen: power failures, severe weather disruption, break downs, fires — even global pandemics. Although your risk planning may be thorough there are some events that cannot be avoided — but they can be planned for.

Business continuity management has become increasingly important as organizations understand the impact of disruptive events upon business processes. The ISO 22301 standard which covers *Security and resilience: Business continuity management systems*, was updated in 2019. It specifies requirements to plan, establish, implement, operate, monitor, review, maintain and continually improve a documented management system to protect against, reduce the likelihood of occurrence, prepare for, respond to, and recover from disruptive incidents when they arise. Obtaining such a standard enables you

to ensure that your company can continue to operate, “business as usual”, during unforeseen circumstances.

What does this mean for water treatment?

Ask yourself how long your customers would be willing to wait if your business was facing an emergency or disruption that impacts your production. The answer is, probably not that long!

Having a business continuity plan in place for your water treatment facility makes you more resilient to disruptions and able to respond within a timeframe customers will find acceptable. This reassurance is a differentiator in the market and one that can be straightforward to achieve.

Your business must understand its desired level of service and what the minimum acceptable level is — the essential service it has to provide to avoid losing customers and to fulfill your primary contractual obligations. Your business continuity plan should help you return to the desired level of service in the shortest time possible.

Making a start

The first step to putting a business continuity management plan in place is to assess the likely impact on your business of significant

Business continuity planning for resilience.

events, and to plan a response in advance. Next, you should test the effectiveness of the plan and continuously invest time and thought into managing the risk.

Working through these stages is best done with an informed team from a number of departments to identify as many events that could lead to business disruptions and involve people who are able to develop the best methods to respond.

There are a number of consultancies who offer disaster management and for catastrophic incidents in high-risk or high-cost activities, these are a valuable option. However businesses can take on the process themselves and partner with key suppliers to manage the risks and ensure action plans are in place for certain events.

The World Economic Forum's Global Risk Report highlights water scarcity and extreme weather events as common risks likely to have a big impact on businesses. A reliable and consistent water supply is vital to many industrial sectors including manufacturing, power and petrochemical, to name a few.

A treated water security plan

Veolia Water Technologies has been providing mobile water services and supporting our customers for many years with mobile water treatment assets, fulfilling their needs for short term process water or wastewater treatment.

The company's REACT Treated Water Security plan has been in place in Europe for over ten years and provides customers with a free assessment of their water treatment requirements, identifies potential risks and prepares a response plan to minimize any disruption to their water supply. The plan includes a full business continuity audit, which in the event of an emergency will speed up the process, ensure peace of mind and avoid costly downtime.

Emergency response in practice

A waste incineration plant customer was able to benefit from 365, 24/7 access to the Veolia team of expert engineers and mobile

water treatment assets, providing service quality and support at the moment they needed it. As a registered customer, they received priority service and were able to mitigate lost production downtime.

Following a fire, their water treatment plant had been damaged and they were critically close to not being able to fulfill their water production. Our mobile water services experts were able to rapidly deploy the reverse osmosis and deionization assets required to maintain water supply. Being a REACT-registered customer ensured preferential service and mitigated the risk of water supply loss and possible reputational damage.

The unique REACT contingency plan for treated water security has been developed to protect businesses and their facilities, 24 hours per day, 7 days per week, in the event of a breakdown or failure with an installed water treatment plant. It provides peace of mind in the event of an unforeseen event while fulfilling the requirements under ISO 22301:2019 Business Continuity Management Standard.

Business continuity planning should be regarded as a priority for any business; with good planning you can take steps to minimize the potential impact of a disaster and ensure the resilience of your company. •

An energy recovery facility in the UK handles 210,000 metric tons per year of municipal solid and street cleansing waste. This waste is incinerated to fuel two 50-bar water tube boilers which produce steam to drive a turbine generating 19 megawatts of electricity. The high-pressure boilers operate at 40 m³/h of steam flow and require the water treatment plant to have an operational capability of up to 4 m³/h of high-purity water.

Demineralized water is produced on site by an ion exchange plant but during a two-day control system modification, the plant was unable to meet normal output quantity and quality. Within four hours of contact, Veolia's Mobile Water Services experts had dispatched units capable of delivering a continuous supply of the required quantity of high purity water to the site. The mobile solution enabled the turbine to continue running at full capacity while the modifications were carried out.

Easy steps to responsive service – a customer journey

Our ambition is to be the customers' choice for the provision of mobile water services by rental agreements, ensuring treated water is always available.

Four simple steps for outstanding service:

1 YOUR PROJECT – TREATED WATER QUALITY AND QUANTITY

Our service is flexible with agreements to meet the customer's needs — from days to weeks to months and years. Our experienced sales managers work with the customer to understand their requirements. This includes pre-project feasibility studies. Where required our operations team will conduct a full analytical testing of feed water supply and then agree on the process selection and design.



2 LOCATION AND FOOTPRINT FOR EQUIPMENT ON SITE

Our team works with the customer to understand their on-site survey and will provide assets and ancillary equipment to meet site-specific requirements anytime and anywhere, 365/24/7. The team will also comply with all site health and safety requirements for mobile water treatment assets, engineers and logistics partners. A site-specific service proposal is developed, in partnership with the customer, to meet their specific needs. Full technical operating guidelines and procedures will be available.



3 MOBILIZATIONS AND SERVICE

Once on site, our commissioning team will work with the customer to position and commission the mobile water treatment assets in complete compliance with the site's health and safety requirements. Plug-and-play technology allows fast start-up with experienced on-site service and operational coverage up to 24 hours a day; process monitoring and optimization are other benefits of working with the Mobile Water Services team. When the customer's project finishes, we decommission and demobilize the equipment.

4 CARE PROGRAM

Customer service is extremely important to us. To make sure our customers receive the best service possible we have created the CARE program. Our service team will schedule review meetings with you to suit your schedule. During these meetings you will be able to discuss the performance of our assets, identify any development areas and ensure plans are in place to respond to additional requirements. Through regular updates and transparent service, we strive to achieve the highest levels of satisfaction.



Emergency and REACT service

Our emergency mobile water treatment services can minimize downtime and production losses, ensuring business continuity in all unexpected situations. Offering short-term, immediate cover with a rapid response to emergency needs 24 hours a day, 7 days a week, 365 days a year.

Whenever you require emergency water treatment services you can simply pick up the phone and call us and we will rapidly respond to your needs. In addition we offer a REACT Service. REACT is a “Treated Water Security” plan that delivers peace of mind for companies with business-critical water treatment systems. By registering with this service, businesses can ensure that water treatment plant failure does not lead to total production plant failure. The Mobile Water Services team will ensure the right temporary water treatment resources are in place in the shortest possible time to ensure minimal disruption and ongoing continuity of supply.

- ✓ Free treated water security plan for business continuity.
- ✓ 24/7 protection for your facility against water treatment plant downtime.
- ✓ Priority access to ready-to-go mobile water services.

Our REACT ‘Treated Water Security Plan’ offers:



A free pre-audit to establish the mobile assets and services needed on-site



A priority access to ready-to-go Mobile Water Services' assets 24/7



Business continuity planning assistance for ISO 22301 registered companies



Mobile Water Services help deliver EPC projects on time

Timely performance, cost saving, quality and safety are essential to all parties involved in a construction project. The construction process is however subject to many variables and unpredictable factors that could impact the successful delivery of a project. Mobile water services are a great option for EPC companies to ensure meeting their client's water requirements safely and within the specified cost and timeframe.

Ensuring contract deadlines without delays.

The key success indicators of a construction project include its completion within the planned budget and schedule, and within the required quality, safety, and environmental limits. However, a project slipping over its planned schedule is a common problem for engineering, procurement and construction (EPC) companies. To the owner, any delay means loss of revenue through non availability of production facilities. Delays can also cause higher overhead costs to the contractor due to a longer work period and additional workforce, as well as higher material costs.

When project costs or schedules exceed their planned targets, client satisfaction is impacted which can have effects on contractors and consultants in terms of relationships, mistrust, litigation, arbitration, cash-flow problems, and diminished support

of the company's stakeholders. Completing projects on time is not only an indicator of efficiency, but is also essential to a company's financial health and reputation.

The construction process is subject to many variables and unpredictable factors, which come from many sources. EPC companies notably face a number of challenges for the supply of treated water for the commissioning and start-up of new facilities or even the continuous operation of existing assets during planned maintenance, and the late life management and decommissioning of a plant. These challenges range from water system flushing, condenser cleaning, pipework and tank hydro testing, and steam blows through to cold start-up of assets, risk mitigation on the late delivery and start-up of a permanent water treatment plant, and

Supporting smooth start-ups and testing.

minimization of potential downtime during maintenance.

Engineering companies can benefit from the rental of mobile assets to ensure contract deadlines are achieved safely without delay. This gives them confidence during handover that the quality and quantity of treated water provided by this type of service meets the clients specifications.

Commissioning on time and within budget

Provision of temporary water treatment is well established and Veolia Water Technologies' Mobile Water Services are well placed to meet the requirements of EPC companies. Mobile water solutions are commonly used during the start-up phase of a new power facility for instance. They can support an increased demand for purified water for applications such as boiler cleans, pipework flushes and steam blowing — which remove construction debris, sand, mill scale, etc. — from critical systems, including air-cooled condensers or steam turbine lines. This ensures optimal equipment cleanliness, enabling efficient plant operation for daily power generation. Mobile water solutions can be brought on site to purify the water for this process and then removed when the water demand resumes to normal operating levels following the commissioning activities.

A mobile water treatment plant can also be used if there is a delay in the delivery and start-up of the permanent water treatment plant, which could hold up the project and incur financial penalties. The mobile water treatment plant can be provided to treat the raw water available and produce the desired quality and quantity for any commissioning needs. The mobile plant could also substitute the permanent one to allow the project to go into full-scale operations. This may mitigate any delays in meeting the client's requirements.



ASSET START-UP

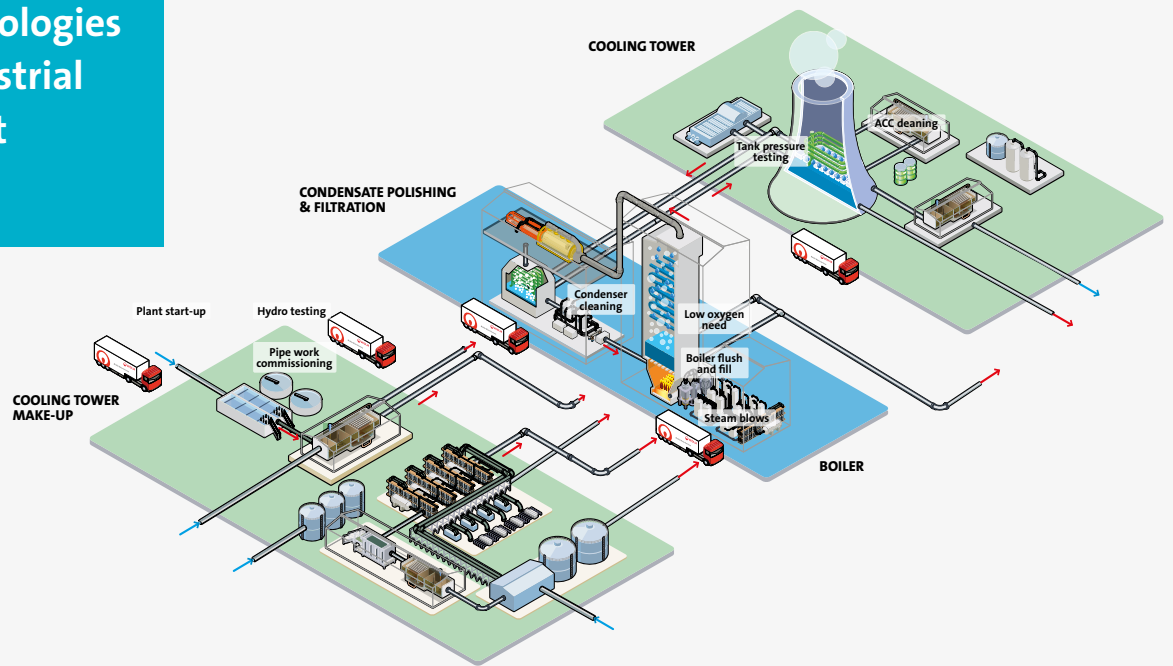
A global leading engineering company in the field of thermal power and environmental technologies was one of the main actor in the construction and commissioning of one of the biggest power plants in Poland, a high-efficiency 500 MW brown coal-fired power unit at a mining and energy complex.

Our Mobile Water Services team was contracted to support the power plant start-up with 100 m³/h of demineralized water. During a power plant cold start-up, additional volumes of makeup water may be required in excess of the capability of the installed plant. This short term requirement, if assisted by the use of a mobile plant, will speed up the start-up phase and take the client to full scale operation quickly, saving lost hours of production.

Our adaptable solution fulfilled the client's treated water requirements and contractual delivery date.



The latest technologies to cover all industrial water treatment applications.



Planned maintenance and turnarounds

EPC companies also need to plan for maintenance of their clients' existing water systems. Mobile water services can be brought in to cover equipment servicing, ensuring that production or business processes can continue and avoiding costly downtime.

Scheduled turnarounds may involve a total suspension of operational activities. A turnaround that exceeds its timeline or budget can have serious financial consequences, so it is essential that an efficient, reliable water supply is available as needed. In these instances, mobile water services can be brought in to support all maintenance and cleaning activities. They can also bridge a gap for operators with a problematic plant until it can be replaced or repaired, or even to bridge a time period if there are variations in feed water supply or quality, as demonstrated by the experience of the service company of one of the world's leading chemical groups.

The client provides production facilities and utilities for its customers in a chemical park. The individual plants in the park, usually supplied with demineralized water by the client, encountered problems with the raw water filtration which led to considerable

operational issues. Our team of mobile water services quickly mobilized assets to produce 200 to 250 m³/h of treated demineralized water in accordance with VGB standards — a German guideline for feed water, boiler water and steam quality for power and industrial plants — in order to meet the treated water demands required for the chemical park's customers without interruption for a period of three months. This short-term intervention offered a reliable and secure, 24/7 supply of deionized water in continuous operation.

Preventative maintenance and refurbishment of a permanent water treatment plant needs to be carried out more frequently without interrupting the production schedule. A temporary water treatment system may be deployed to either provide the full replacement or partial part of the various processes during this interim need. Typical applications include resin replacement, pressure vessel maintenance, control upgrades, reverse osmosis membrane cleaning or replacement, maintenance on chemical dosing equipment and work on waste treatment plants.

Temporary and flexible water supply during decommissioning activities

There are numerous processes and stages to be completed during a decommissioning project while the water treatment plant is

Flexible applications to support start-ups, maintenance and decommissioning projects.

required to continue to provide treated water throughout the project, as all the stages are completed. The quantity of water required by the site may reduce; the feedwater may change due to other decommissioning activity, causing uncertainty for the process. On-site water treatment plants that have been designed for a certain throughput may not be able to effectively manage the varying flow rates or feed water changes and may also be expensive to maintain.

For planned decommissioning activity, Mobile Water Services provide a reliable, secure and flexible supply of treated water to support the project. It is also possible to use these systems in the case of unforeseen events.

A nuclear power station was being decommissioned in the UK, generation ceased, and the plant had to be defuelled. Originally, during nuclear power generation, the site consumed some 900 m³/d of demineralized water for steam raising and cooling but, once generation ceased, this reduced to about 26 m³/d. This meant that the on-site demineralization plant was larger than required and costly to maintain; our client wanted to decommission and de-man it but they still needed a supply of demineralized water.

We provided the demineralized water requirement at the site using a trailer-mounted mobile demineralization plant which provided ion exchange demineralization using similar technology to the station's on-site plant but at a much reduced flow. Instead of in-situ regeneration, when the ion exchange resins became exhausted, the trailer was simply returned to our central regeneration and recycling service center. This meant that there was no requirement for chemicals or for effluent disposal which could have created health and safety issues and interfered with the defuelling work.

TANK FILLING AND LOW OXYGEN NEED

An engineering company received an order for the planning, construction and filling of a district heating storage facility from a German utility company. A 40,000 cubic meter water storage tank was an important part of the overall concept for future district heating in the region. In conjunction with the boiler that had already been put into operation, excess electricity from the network can be used to heat water in the boiler and temporarily store it in the heat store. The water is heated to 115°C and stored in the storage tank before being released with a time delay. With the hot water stored in the heat store, depending on the outside temperature, the supply of over 70,000 district heating customers in the area can be guaranteed for up to eight hours.

However, even at maximum output, the engineering company was not able to completely fill the heat store within the required 6 week period. The engineering company contracted our Mobile Water Services team to perform the first filling of the storage tank with the required capacity. We provided a mobile reverse osmosis asset in double pass to reduce the salinity of the city water by approximately 97%. A mobile degassing unit was added to reduce the undissolved oxygen from the permeate to <20 ppb O₂ along with a mobile pump for additional pressure to pump the treated water into the district heat storage.

The continuous operation of the mobile water treatment units for a period of about six weeks provided the quantity and quality of water required and ensured the completion of the project on time and within the targeted cost framework.



Our teams remotely monitored the trailer, which was changed every month. Our client calculated that this reduced the costs by 50% compared with operating the on-site plant and also allowed early removal of the redundant demineralization plant.

Awareness is key

Mobile water services can bring numerous benefits to EPC companies. It is important that



this thinking is factored into commissioning, maintenance, and decommissioning plants, as it is not uncommon for these processes to demand more water than originally anticipated. As awareness grows, we can expect to see mobile water services being implemented more frequently, supporting planning and helping EPC companies to deliver projects on time and on budget while maintaining resilient and effective water treatment plants in the process. •

STEAM BLOW AND CONDENSER CLEANING

One of the world's leading engineering houses built a 44 MW biomass power generation plant on behalf of a major British energy company. Prior to the commissioning of the plant, we received a request for the cleaning of their steam lines using the process of steam blowing and for a closed-loop filtration and polishing system for the flushing of the air cooled condensers (ACC), which had become contaminated with debris during fabrication.

When commissioning a power plant it is essential that the steam lines are free from particulate matter to avoid damage to the steam turbines. This is achieved by conducting steam blows — where steam generated in the boilers is allowed to escape to the atmosphere at high flow rates and velocities — blowing the particulate out of the steam lines. This loss of steam is usually beyond the capabilities of the installed deionizing plant to makeup, so it is common practice to use mobile deionizing units.

The customer also uses ACCs which condense the steam exiting the steam turbines. Due to their delicate structure these needed to be flushed for 24 hours at a high flow rate. To minimize water and energy waste, Veolia proposed a scheme of mobile skid pumps and a filtration unit along with standby units to accommodate swap-outs as required, which would have to be carried out without interrupting the flow through the system.

Using a mobile solution ensured our client a continuous supply of 140 m³/h, the compliance with stringent health and safety standards under extreme operating conditions, as well as a minimum wastage of water and a significant reduction in cost.



Supply continuity for Michelin

A compact technology with plug-and-play connections delivering water of a predetermined quality and quantity: these are the core features of Veolia Water Technologies' mobile water treatment solution, a flexible temporary alternative that allows industrial customers to maintain process continuity under all circumstances.

The Michelin factory at Bassens, near Bordeaux in France, is one of three in the world that produces synthetic rubber for tires. Two on-site demineralization units provide the constant supply of demineralized steam the production process requires. *"We run two units because demineralization also involves time spent regenerating resins in the ion exchangers that are needed to produce demineralized water in sufficient volume",* explains Victorine Chailan, an energy and fluids engineer with Michelin. *"As soon as one unit starts its regeneration cycle, the other one takes over production."*

In September 2020, Michelin needed to carry out maintenance on one of the units, so it ordered a mobile water treatment solution rather than cutting back its steam production. With an hourly capacity of 100 cubic meters of demineralized water, the on-site fleet of Veolia trucks quickly delivered the 600 cubic meters needed at the plant every day. François Shamber, energy progress coordinator at the Michelin Bassens plant, talks about his experience: *"Thanks to Veolia's mobile water solution, we had all the steam we needed and maintenance went ahead without a hitch. We'd absolutely use this kind of solution again."* •

Article initially published in Planet Magazine, April 2021.

Digital to boost mobile water services

More than any other component, water is essential in countless industries and business sectors. By combining digitally enabled solutions and operational data with our unique mobile water treatment expertise, we support our customers in becoming more sustainable, more performant and more resilient.

Over the past ten years, mobile water services have evolved to incorporate more and more digital solutions, providing the ability to improve asset management as well as customer relationships, operations and logistics. The digitalization of our assets has led to better reliability and even greater transparency of output performance for customers regarding actual use and deployment.

When mobile goes digital

We are focused on delivering the best possible customer experience and journey to our growing customer base. Moving to digitally enabled assets and equipment, using Veolia's Hubgrade remote monitoring solutions and VAMS asset management software, allows us to improve service delivery.

Available in 2021 for our global asset fleet, VAMS is based on INFOR — a leading software platform for complete lifecycle management of assets including scheduling and deployment. The software enables best-in-class management capability to track

assets, record maintenance and attached costs, and improve the overall understanding of our assets and their operation.

This greater awareness is shared across regional teams, improving best practices around the world which translates into stronger field-based reliance and better insight into the operation and life cycle of remote equipment. Proactive and reactive maintenance are optimized, improving our asset-ready capability and allowing us to respond to customer needs in a shorter time period. Having assets that are serviced to the correct levels and standards also enables us to manage compliance and regulatory requirements in a more defined and structured way.

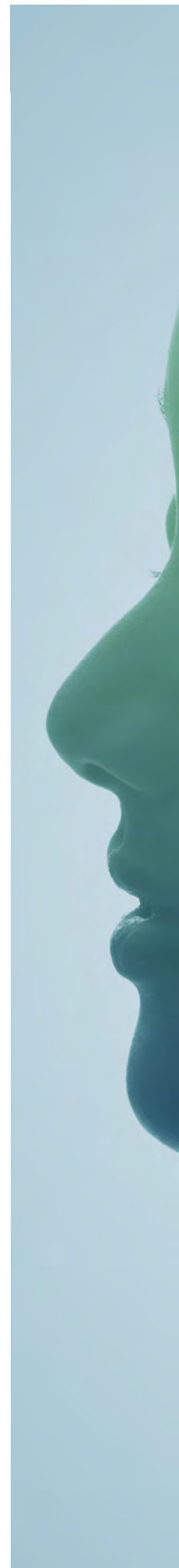
Performance-based data to deliver on our promise

Knowing where our assets and technicians are located allows us to optimize our deployment strategy — identifying the nearest and readily available — to minimize transportation and logistics as well as reduce our environmental impact.

Connected tracking tools allow us and our customers to track the asset(s) in real time, showing when to expect their arrival onsite. All the necessary information about deployment and assets is available on smart devices for our field technicians, ensuring they are prepared to receive them and start-up the plant upon arrival. Technicians are deployed based on skills and abilities to manage the field-based assets.

For assets returning to depots following mobilizations with customers, maintenance can be planned and predicted in advance to ensure assets are maintained quickly with the necessary spare parts and consumables.

Our standard stock inventory management tool enables us to manage the ongoing supply of consumables and spare parts to both our field-based and in-maintenance assets. The tool is optimized for just-in-time management of spares and consumables, minimizing costs and improving asset reliability for our customers.



Hubgrade for remote asset management

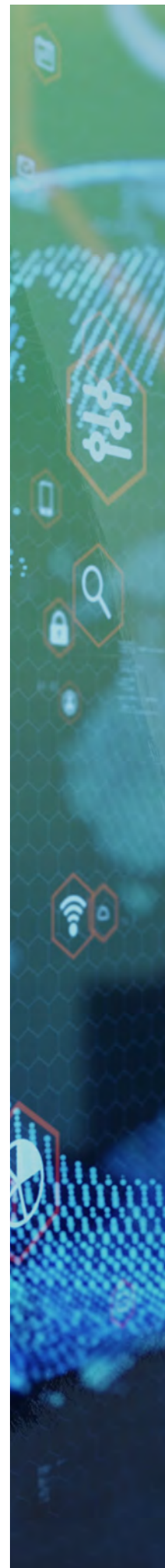
Hubgrade brings together all of Veolia Group's digital offerings for data collection, management and analysis. It takes us even further into the world of connected environmental expertise "delivered as a service" to our customers.

Our remote digital platform monitors field-based performance of critical processes and electromechanical operational parameters to enable us to increase equipment up time. We are able to respond to operational concerns before they may affect the productivity of the equipment, providing the customer a more secure and reliable water treatment system.

Thanks to augmented reality offered through Hubgrade, we are able to remotely troubleshoot any potential problems to reduce technician on-site time and potentially out-of-hours travel and site-visit time which increase health and safety risks. The digital platform also records lifetime operation and performance of key components, allowing efficient and timely replacement based upon predictive lifetime data. The optimized reporting improves transparency around customer reporting and asset performance.

These digital tools enable us to manage our assets and services in a more structured way, complementing our standardization approach for reliability. They are instrumental in us achieving our goal of reaching optimum performance and delivering service excellence to our customers.

As our fleet grows to meet the ever-increasing challenges faced by our customers, digitalization will support the further diversification of our assets and technologies. Going forward, we will build upon these tools and capabilities to set the benchmark in the industry for the provision of mobile water services. ●



Securing water production in a water-scarce world



“The risks that drought poses to communities, ecosystems and economies are much larger and more profound than can be measured.” — United Nations Special Report on Drought 2021.

It is a common misconception that water scarcity only affects the planet’s drier regions. Drought is now widespread, and by the end of the century all but a handful of countries will experience it in some form.

The European Commission has estimated that at least 11% of Europe’s population and 17% of its territory have been affected by water scarcity to date. According to a special report on drought published in June 2021 by the UN Office for Disaster Risk Reduction, at least 1.5 billion people have been directly affected by drought this century, and the economic cost has been estimated at \$124 billion.

A Swiss study predicts that like other parts of the world, Europe will be drastically different by 2050. London’s climate may be more like Barcelona today. Madrid will be more like Marrakech. On the other side of the Atlantic, just two years after California celebrated the end of its last devastating drought, the state is now facing another one. Nearly half of the US — from the Pacific coast to the Great Plains and upper Midwest — is experiencing moderate to exceptional drought conditions. 2021 could be one of the driest years in a millennium, and there’s no relief in sight.

As well as causing humanitarian crises, the growing scarcity of freshwater due to rising water demands and a changing climate presents a major risk to manufacturing businesses. The World Bank predicts that global GDP growth rates will fall 6% by the middle of the century as a result of increased competition for water. And this would result in costs of \$2.5 billion for companies at the mercy of increased water scarcity.

Water issues are becoming highly material factors affecting the growth and profitability of companies. They create material, physical, regulatory, and reputational risks.

The main challenges faced by the industry with respect to water are those of securing adequate supply for what is a water-intensive process and ensuring that, if a body of water is contaminated, the pollution is addressed where it occurred and in a timely manner. Where the water resource has diminished, a worsening of water quality has normally followed because there is less water to dilute pollutants. In addition, salt water increasingly intrudes into coastal aquifers.



Climate change will almost certainly exacerbate these adverse impacts in the future, with more frequent and severe droughts expected all over the world. To circumvent any water related problems, companies are implementing water conservation strategies, examining water reclaim and reuse opportunities, re-engineering their water-using processes, and investigating alternative water sources.

All around the world, operators across several industries have already worked with temporary water treatment services providers to implement a flexible solution to issues arising from water scarcity and feedwater changes. Typical applications include treatment of high chloride and high conductivity, suspended solids, high microbiological, high organics, and alternative feed supplies.

***Options
for water
conservation
strategies.***



SPEEDY SOLUTION SAVES THE TOURIST SEASON

A small coastal municipality in Spain which sees its population of 1,000 multiplied by 10 in the summer suffered in 2018 the worst drought of the last 20 years. The lack of rainfall resulted in an increase in chloride concentration at a level of 700 mg/L. This was due to saltwater intrusion into the freshwater aquifer, which under normal conditions supplies the municipality with drinking water. Had the concentration of chloride reached 800 mg/L, the water would no longer have been suitable for consumption, and the municipality would have had to contact the Health Department.

Forced to take emergency measures, the municipality contracted Veolia Water Technologies in July for the provision of a mobile plant equipped with reverse osmosis technology to treat the aquifer. The mobile unit was supplied and installed in record time. At the beginning of August, the unit — equipped with four reverse osmosis modules with a total production capacity of 100 m³/h — began treating the aquifer to reduce conductivity by up to 40%, achieving chloride concentrations between 400 and 500 mg/L.

By using a temporary mobile water system, the municipality ensured regulatory compliance and mitigated economical and reputational risks during the tourist season.



Emergency provision of temporary water treatment is well established and mobile water services are well placed to meet these urgent requirements. A temporary water treatment system is a perfect solution in an emergency, and can sustain a continuous supply of treated water for all unanticipated scenarios, such as coping with short-term seasonal or unexpected changes to a facility's raw water supply. Mobile water services can be brought in to ensure that production or business processes can continue and avoid costly downtime.

SWEET SAVINGS

A confectionary company wanted to reduce and recover the amount of sugar discharged to the drain. Their goal was to reuse and recycle it and to produce treated water to prevent sugar crystallization of their conveyor systems as part of their manufacturing process.

Our Mobile Water Services team offered a tank and pump to collect the sugary solution along with a reverse osmosis system. The sugar solution was concentrated in the conventional reject line and recirculated back for process use. The permeate was recovered and used to rinse the conveyor belts, preventing the build up of sugar and operational issues.

In addition to reducing the amount of sugar discharged to drain, the customer benefited from energy savings in warming the sugar solution and the costs associated with fresh sugar makeup and fresh makeup water. Maintenance frequency of the production process was also extended, allowing the customer to reduce production downtime.

Longer term asset rental is also now an attractive alternative to high upfront investment in permanent water treatment technology across many sectors. Tightening CAPEX budgets, an emphasis on business continuity and a desire for flexible, affordable water management, have all generated a demand for mobile water services, which offer a cost-effective, alternative solution providing emergency relief and fulfilling temporary water requirements.

Sustainable water sources

The recycling and reuse of so-called waste or spent water is a growing and evolving opportunity as more and more industries are challenging the economic and environmental feasibility of being more efficient and sustainable.

Well-published statistics clearly show that the amount of spent water being reused is minimal compared to the overall volume produced. This valuable resource can no longer be wasted. As the demand for fresh makeup water grows and the resource becomes scarcer, the need to develop a reliable and secure source of recycled water is ever more important, whether for continuous or intermittent use.

Mobile water services can be an integral part of a more circular economy by offering short term or multi-year rental solutions that can be used for proof of concept; such solutions can achieve fast results without the need for long studies and evaluations, usually synonymous with significant investments. This flexibility allows industrial facilities to learn while using and benefit while trialing different water reuse technologies and innovations on a full-scale scope, be it for intermittent or more permanent challenges.

Mobile water services can substitute the need for fresh makeup water and help recover valuable resources — such as

energy or trace resources — within spent water. The amount of wastewater produced can be drastically reduced, improving the operation's water footprint and helping with environmental compliance.

Mobile water services are a strong ally to utilities and industrial manufacturers facing the challenge of water scarcity. A distinct shift in outlook is necessary to help companies to transition from being vulnerable to a shortfall of water, to being fully prepared in the face of this pressing issue. •

MODULAR SOLUTIONS MITIGATE DROUGHT IMPACTS

A multinational oil and gas company faced a shortfall of water that could impact their production. Due to a persistent drought, the local water utility company had to limit the water supply to the company in order to secure the drinking water supply for the local population.

As a result, additional raw water volumes from other sources were required so that the company's power plant and processes could be adequately supplied. Given the variations in their quality, the different sources had to be treated accordingly.

Veolia Water Technologies provided one mobile filtration unit as sand filter, two mobile filtration units with active carbon, and a mobile reverse osmosis unit. For the oxidation of various ingredients as well as disinfection, a mobile dosing station with chlorine was used. Combining various mobile water systems guaranteed the company's water supply and met the required water specifications.

Downstream oil and gas industry

To buy or not to buy



Capital capacity and operating costs must be balanced with production requirements and sustainability goals.

Asset rental is an attractive alternative to high upfront investment in water treatment technology across many sectors, including the downstream oil and gas industry. Tightening CAPEX budgets, an emphasis on business continuity and a desire for flexible, affordable water management, have all generated a demand for mobile water services, which offer a cost-effective, alternative solution to procuring new installations for upgrading existing infrastructure, as well as providing emergency relief and fulfilling temporary water requirements.

In everyday life, we are familiar with rental or subscription-based models, whether leasing a car, streaming music or hiring equipment. However, choosing an alternative to ownership is not simply limited to the B2C market, and the mobile water services rental model has been growing over the past 15 years. It has quickly become a more cost-effective and flexible alternative to a fixed water treatment plant in a wide range of industrial situations, and the downstream oil and gas industry has much to gain from its adoption.

CAPEX considerations

The downstream oil and gas industry faces several challenges. Emissions and environmental targets, changes in supply and quality of feedstock and volatility in costing, pricing and product demand have all made it more difficult to make a strong case for capital investment. The fallout of this has been a reluctance to invest in projects where the lifetime and return on investment are uncertain. In light of this, one of the attractions of mobile water services is their flexibility, as the rental payments can be covered by the operational budget, removing the need to raise capital. Mobile water service suppliers are often willing to enter into pay-as-you-go, multiyear contracts, which help to improve financial planning thanks to predictable, regular payments.

A common misconception is that renting mobile water services is more expensive in the long run, yet this is rarely the case. A number of organizations are choosing long-term hire in instances where the

capital investment in a permanent plant would not pay back over the lifetime of the project. A net present value financial calculation comparing the costs of building and maintaining a new plant versus renting mobile water services over a multi-year period is revealing. While the build may appear to be cheaper, the service, asset maintenance and parts replacement offered by many mobile water service suppliers relieve the facility of these inevitable costs associated with owning a plant, not to mention asset depreciation.

In many instances, several leading downstream oil and gas companies have struggled to raise the necessary CAPEX to design and build a new water treatment plant, due to uncertainty over meeting return on investment KPIs. Partnering with Veolia Water Technologies and its Mobile Water Services team, each business opted for long-term rental of a containerized plant, which offered a more cost-effective solution and was readily approved by the management.

Emergency provision

Companies that do not need to upgrade or replace their water treatment systems can still benefit from mobile water services, particularly in the event of emergencies. Once a disaster hits, the clock is ticking and it is imperative that a facility gets back to business as usual as quickly as possible, maintaining its reputation and credibility.

Unplanned downtime results in loss of revenue and puts further pressure on the

Providing treated water as a service inclusive of all hidden costs.



plant to meet production quotas once it becomes operational. Typical emergency water treatment plant disruptions include defective equipment or controls, failure of the permanent water treatment plant, changes to the raw water supply and downstream equipment failures or issues.

Emergency services as a quick and effective solution.

A temporary water treatment system is a perfect solution in an emergency and can sustain a continuous supply of treated water for all unanticipated scenarios, such as coping with short-term demands. Having a robust plan in times of disaster is critical, and mobile water services are helping companies to develop these plans so that they can respond quickly and effectively when a water-related emergency does arise.

A perfect example of this was demonstrated when a leading international oil and gas company was experiencing trouble at one of its refineries — a contaminated condensate return was having a negative

impact on the steam cooling process. The next planned shutdown was not scheduled for another four years, so the company required a multi-year temporary solution for condensate polishing. Thankfully, a framework agreement for rapid and flexible asset deployment had been developed with our Mobile Water Services team, and it was able to step in and provide a trailer-based solution delivering up to 70 m³/h of treated water with a conductivity of <0.1 μS/cm. This intervention avoided costly downtime, and the refinery now benefits from 100% reuse of its condensate.

Planned maintenance and turnarounds

Many downstream oil and gas facilities will also need to plan for maintenance of existing water systems, and mobile water services can be brought in to cover equipment servicing, ensuring that production or business processes can continue and avoiding costly

downtime. In some instances, a facility may need to cope with seasonal or unexpected changes to its raw water supply. For example, bacterial and algal growth, or increased levels of suspended solids during a period of high rainfall, can lead to reduced throughput and long-term damage to existing equipment.

Refineries will often schedule turnarounds on a four-year cycle, which involve a total suspension of operational activities. A turnaround that exceeds its timeline or budget can be financially disastrous so it is essential that an efficient, reliable water supply is available as needed. In these instances, mobile water services can be brought in to support all maintenance and cleaning activities, as demonstrated by the experience of another multinational oil and gas company. A turnaround had been scheduled and, during the subsequent start-up phase, the refinery needed an extra supply of demineralized water — 100 m³/h in operation and the same in standby — running in parallel to its own demineralized water plant. We provided a four-trailer configuration to guarantee the water supply and meet the water specifications, including a conductivity of <0.1 μS/cm and <10 ppm of SiO₂. This short-term intervention offered a reliable and secure backup and, as a plan and agreement were already in place, the company was able to offer fast deployment and commissioning.

Renting through a reliable supplier means access to their expertise, allowing refineries to focus on their core activity. They may just find that long-term rental agreements can be a very cost-effective, permanent solution to their water treatment needs. ●



When a refinery in Mexico was looking to reduce downtime for maintenance and ensure continuity of its operations during the procedure, Veolia supplied one mobile asset for ultrafiltration, one for multimedia filtration using zeolites, and five reverse osmosis units. A team of engineers were required to support the plant operations for 24 hours a day, seven days per week for three months. Within two weeks, the customer was equipped with the 210 m³/h of demineralized water they needed, with a quality and quantity warranty to maintain the integrity of the boilers.



Always safe

An interview with Health & Safety Manager Lyndsey Wicks

At Veolia Water Technologies, health and safety excellence is a key part of how we operate every day. We speak to Lyndsey Ellen Wicks, health and safety manager and chair of the global safety committee for Mobile Water Services, who explains how we are committed to the highest standards of health and safety around the world and how our strong safety culture plays a fundamental role in why we are able to forge such long term relationships with our customers.

How does Veolia approach health and safety for its mobile water services?

Health and safety is our number one priority to ensure we protect our employees, subcontractors and customers as well as anyone involved with or impacted by our work. We take a proactive approach to safety at all times and operate an open-door policy. Our Always Safe rules are a set of guidelines that every employee commits to adhering to at all times. We want to instil these rules in our employees and empower them to stop work and report an issue if they feel it is not safe.

Training is a core part of our approach. To ensure consistency around the world we have introduced the internationally accredited e-learning platform IHASCO for health and safety training. We pride ourselves on ensuring that our colleagues and subcontractors are trained to high health and safety standards, giving them the ability to assess the risks, introduce the necessary controls and work safely at all times.

All of our mobile service engineers are trained in risk assessment, manual handling, chemical handling, working at height, asbestos awareness and basic electrical safety and banksman awareness training.

Ensuring a safe working environment: Five preventive approaches reinforced in our daily work

- Risk assessment and awareness in the working environment.
- Behavior and vigilance: observing and caring for ourselves and others.
- Near misses and dangerous situations reporting, sharing lessons learned.
- Safety in project design.
- Apply the requirements of the Veolia High-risk management standards (confined spaces, work at heights, hazardous materials, etc.) which supplement the local regulations and also apply to our sub-contractors.

In addition, our entire team is trained to carry out Point of Work Risk Assessments. These are site-specific assessments that highlight all hazards and risks in the environment to ensure suitable and sufficient controls are in place to allow work to be carried out in a safe manner.

How does this set us apart in our sector?

Safety is an essential part of the operation of any site and customers need to be assured that anyone visiting their premises will comply with all safety guidelines. We clearly communicate our commitment to safety with each mobilization we undertake. We also work collaboratively with clients and other contractors to continuously improve our approach.

A complete commitment to health and safety best practice has long been part of our offering to customers. A testament to our success is the long-term relationships we have been able to build, based on excellent customer service, unrivalled technical knowledge of water and wastewater treatment and a positive approach to the safety of everyone involved.

adapted and introduced new measures and procedures. This included new COVID-19 risk assessments and controls to ensure we maintained the highest levels of safety.

However, our underlying principles have not changed. Every employee is expected to consider the risks and if at any point they feel it is unsafe to commence or continue work, they are empowered to stop and alert the relevant people. Our success during these difficult times has been, in part, a result of having the right culture in place already. Our teams have not had to adopt an entirely new approach but simply apply their training to a new potential risk.

What does this mean for our customers?

Peace of mind. Our customers can be assured that the substantial investment we make in training is evidence of the importance we place on good health & safety practice at Veolia.

We have over 15 years of experience working with industrial plant managers to safely provide temporary mobile water treatment services. We work with all stakeholders to develop and implement best practices.



Health and safety is at the core of what we do, from the design and construction of new water technology assets to regular maintenance checks. We are proud of what we have achieved, as demonstrated by our strong customer relationships. It is the building of a robust and positive health and safety culture that has helped us meet the challenges that recent months have presented.

How is our approach evolving in 2021?

Our strong health and safety culture has provided us with the ideal foundations to meet the challenges of working in a world coping with COVID-19. Our dedicated service teams have worked extremely hard to meet client demands through these difficult times. To keep our engineers on the road while ensuring complete safety of our people, customers' teams and the public, we have

Safety is everyone's business. We have a moral and legal obligation to keep our people and those affected by our undertakings safe. We do this by taking a positive, proactive approach to safety involving our workforce, sub-contractors and our clients in the decisions we make when implementing health & safety standards. ●



Climate conditions vary greatly from region to region and continent to continent. Everywhere, cities and industries are faced with conditions — permanent, recurring, or sudden and unforeseen — that can make guaranteeing a safe and constant water supply challenging. Oftentimes, mobile water solutions prove to be a reliable option to face these extreme conditions.

Managing the risks of extreme weather events

According to the United Nations, water is the primary medium through which we feel the effects of climate change. As the planet warms, these effects are exacerbated: higher temperatures and more extreme, less predictable, weather conditions are projected to affect the availability and distribution of rainfall, snowmelt, river flows and groundwater, and further deteriorate water quality.

In many instances, mobile water services can quickly and efficiently be deployed to maintain water supply with the conditions required to ensure the safety and comfort of populations, and the continuity of businesses.

Restoring drinking water production after a hurricane

In an emergency, the priority is to restore

essential services, of which drinking water production and distribution are at the top of the list. In 2017, Hurricane Irma caused widespread destruction across its path particularly in the northeastern Caribbean and the Florida Keys. The day after the category 5 — the maximum on the hurricane wind scale — hurricane hit, Saint-Martin and Saint-Barts had transformed into a desolate landscape: boats and cars were embedded in buildings, heaps of debris were topped with fragments of roofs, windows and pieces of walls, airports could not be used for several days and so on.

The considerable material damage extended to the three seawater desalination units supplying the islands with drinking water — 5,000 m³/d in Saint-Martin and twice 2,000 m³/d in Saint-Barts. It would take several months to fully restart them,

meaning that a temporary solution had to quickly be implemented.

A Veolia mobile desalination unit was flown in from Spain. The modular mobile container-based seawater reverse osmosis asset was able to treat the highly salted feed waters. The temporary unit was on site for 6 months until repairs could be completed to the water treatment plants.

Severe winter storms wreak havoc in Texas

In February 2021, the state of Texas suffered a major power crisis, the result of three severe winter storms sweeping across the United States. A massive electricity generation failure ensued, resulting in shortages of water, food and heat. Millions of homes and businesses were left without power, some for several days.

One of our clients was in need of water treatment to keep their plant operational during this catastrophic weather event. They had to carry out quick maintenance and replace the reverse osmosis membranes of their aging existing plant. The client needed to maintain production during the refurbishment and required a supply of low-conductivity demineralized water, which was vastly complicated by the unforeseen weather conditions affecting the region.

A mobile filtration unit and reverse osmosis asset were supplied in record time, ensuring treated water of up to 100 m³/h and below 10 µS/cm. The reliable solution allowed the client to continue production without any disruption.

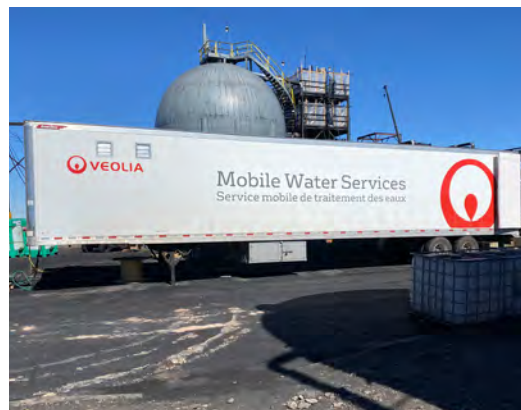
Absence of rain introduces water stress ahead of ski season

In 2018, La Clusaz, a municipality located in the French Alps, was suffering from a lack of raw water for drinking water production following a summer of drought. A decision was made to use water from a lake usually reserved for the production of artificial snow intended for the ski resort.

A 100 m³/h mobile ultrafiltration unit was quickly brought onsite to treat water from the lake. Its plug-and-play container was easy to install even in the notoriously mountainous area and procured the municipality a reliable source of drinking water.

Challenges of water treatment on remote mining sites

Brucejack, owned and exploited by Pretium, is an underground gold mine located in northwestern British Columbia, Canada, in a largely unexplored area. This location brings its own set of challenges when it comes to water treatment: with the mine situated near a glacier, the treated water criteria are very stringent and, with no road or air access, the site is only accessible by using a Husky-tracked vehicle to cross the glacier.



Veolia started working with Pretium in spring 2014 when the company needed to dewater Brucejack's underground workings during its exploration phase. A temporary water treatment plant relying on mobile assets was used for the exploration and construction phases, removing metals, suspended solids and toxicity from the water. The compactness, modularity and ease of installation and operation of the mobile units were instrumental in the success of this operation, which was in place for two years before a permanent water treatment plant was built. ●

**Rapid response
in the face
of extreme
weather
conditions.**

Membranes on the move for chemical-free degassing

The range of mobile water treatment services available to power plants has steadily widened over the years to include membrane degassing units, which avoid the need to use chemicals (such as hydrazine) on site.

**Low oxygen
water
without
chemicals.**

Much has changed since mobile water services were first introduced into the market. Originally, they were simply ion exchange resins mounted inside trailers, which could be transported to a site to provide a temporary supply of high purity water. However, needs have diversified, generating demand for a broader range of available physical and chemical technologies including degasification, pretreatment by clarification and filtration, reverse osmosis, absorption and ultrafiltration — with modularization allowing processes to be combined in a variety of configurations.



No chemicals needed

Veolia Water Technologies offers mobile membrane degassing units, called REMOX, which can reduce oxygen and carbon dioxide from process water — taking oxygen down to <10 ppb and carbon dioxide down to <1 ppm — in a flexible, fast and efficient way, without the use of chemicals.

The containerized membrane system is compact, efficient and maintenance free, and the portability of the REMOX assets enables them to be positioned to make the best use of the available space, eliminating or

reducing the need for building infrastructure to house the equipment.

Any number of assets can be operated in parallel or in series to provide the required flow rate. In addition, these modular units can easily be exchanged over time for the latest, updated technology, ensuring that a facility's water treatment systems remain at the cutting edge.

REMOX employs membrane contactors which are a microporous hollow fiber membrane to remove gases from water. The hollow fiber is knitted into an array and wrapped around a center tube in a housing.

The water to be treated flows over the outside of the hollow fiber array while a vacuum and sweep gas (nitrogen) is applied to the inside of the fibers. The membrane is hydrophobic, allowing direct contact between gas and water without dispersion.

A higher pressure is applied to the water stream than the gas stream, creating a driving force for the dissolved gas in the water to pass through the membrane pores. The gas is then carried away by the vacuum pump and the nitrogen sweep gas.

The REMOX unit, which can treat up to 100 cubic meters per hour, includes onboard services such as nitrogen generation, vacuum and compressed air. Allowable inlet pressures range from 0.8 to 2 bar, while the allowable temperature range is 5 to 25°C. •



RECENT APPLICATIONS

One recent application of REMOX was provision of temporary water treatment for a power company in the Netherlands, supplying water to three district heating networks. Temporary water treatment services were required when it became necessary to carry out long term maintenance on the existing water treatment plant.

Maintaining continuity of water treatment is of particular importance for district heating systems and avoidance of corrosion in the pipework.

A REMOX 50C system with a capacity to treat 50 cubic meters per hour was used to fill the district heating system's heat buffer storage tank. Special measures were required to ensure that oxygen did not get into the water post-treatment, including use of special pumps and fixed piping instead of hoses.

Another recent example of REMOX employed in a heat buffer storage tank project was in Germany, where Veolia worked with an EPC

contractor responsible for building a new circa 40,000 m³ hot water storage tank at a power plant site. The heat buffer storage tank, which can provide up to about 70 hours of district heating hot water supply, allows the power plant to run more flexibly and economically — enabling it to operate at low power or even shut down, depending on electricity demand. The heat buffer, which employs >100°C water, needed to be filled with deoxygenated water.

For this mobilization, Veolia Water Technologies' mobile water services experts provided a reverse osmosis system running in double pass configuration feeding a REMOX 100C to produce 45 m³/h, 24/7 deoxygenated demineralized water. The conductivity required was <40 μS/cm and O₂ <50 ppb. Additional supply of a feed water buffer and two pump skids assured constant filling of the heat buffer storage tank. An important benefit here was the chemical-free production of deoxygenated water.



Moving mining with mob

Exceeding the environmental and regulatory challenges.

For mining operations, effective water treatment is about more than meeting regulatory requirements and maintaining a social license to operate: choosing the right approach to water treatment can have a profound impact on a mine business. One increasingly attractive option for mining companies is the deployment of mobile water treatment technologies.

Often considered as a temporary or emergency solution where an existing plant has failed, mobile assets are also ideally suited to use during planned commissioning, refurbishment or maintenance projects and even for longer-term water treatment requirements, such as during decommissioning and site remediation.

A wide range of treatment options are available with processes including

clarification, filtration, deionization, demineralization/softening and metals removal all possible from a mobile platform. For the mining sector, removal of metals and other materials that are toxic to aquatic life down to parts per billion levels are typically required as part of the regulatory process.

Cutting capital costs

For the junior mining sector in particular, one of the perennial challenges is the provision of capital. The nature of such a business means that when raising capital in the marketplace there is a strong focus on securing funding for revenue-generating equipment used in ore processing within the mill. With the focus of major capital purchases centered on the mill, securing capital expenditure for water treatment is more challenging.

Mobile water treatment assets can provide important baseline data to support accelerated permitting.

Mobile water treatment makes an attractive solution as it can be more easily financed through the operational expenditure budget on a month-by-month basis during the construction and development phases. Once operations are successfully generating income, investment in permanent water treatment facilities is more manageable.

Another key benefit of mobile water treatment is found in the regulatory approvals process: mobile water treatment assets can provide important baseline data to support accelerated permitting. Operators are able to execute both mobile and permanent assets in parallel; getting assets in place allows them to prove that the process is effective while mining operations are underway.

each application. This in turn supports the development of permanent onsite water treatment facilities.

The plug-and-play capabilities of mobile water solutions also offer potential benefits, for instance at existing operational sites where conditions or requirements may potentially vary over time: changes to a mine water balance can occur, there may be seasonal variations such as spring melt or where a tailings compound reaches a level where there is a risk of a breach.

In 2020, a Vancouver-based mining company selected mobile technologies for a new wastewater treatment plant in order to meet strict regulations for discharges to the environment in Ontario's Red Lake Mining

Mobile water treatment

Junior mines can focus resources on mining.

Regulatory requirements related to mine water discharge are also becoming far more stringent. Tougher requirements for maximum total suspended solids (TSS), pH balance or the need to remove certain constituents such as ammonia, arsenic or other heavy metals means that water treatment technologies have also had to evolve and develop. As increasingly hard-to-treat wastewater demands have emerged, mobile technologies allow operators to establish and understand the process and the specific challenges associated with

district. Mobile assets for metals removal supplemented a permanent moving bed biofilm reactor (MBBR) system for toxicity removal.

Supplementing an existing system with mobile assets can also help draw down tailings water levels to give more free board in an impoundment area. As a result, temporary mobile solutions may yield previously inaccessible resources. For example, dewatering a large pit may take several years. By installing high-volume temporary equipment, this process can be significantly accelerated.

Flexible deployment

The modular system also gives more scope to quickly scale treatment capacity as required in response to market changes. A wastewater treatment facility installed and based on an





anticipated range of production scenarios could be insufficient if production at a site is significantly increased in response to changing commodity prices, for example.

Mobile assets are able to supplement an existing system and help take up extra capacity as needed. They also provide operators the opportunity to assess the

groundwater. However, this site was not only environmentally sensitive but also presented a significant challenge for access with only the narrow and congested railbed space available.

Removal of TSS and metals such as copper, zinc and others saw the deployment of a complete turnkey mobile treatment system for several years, featuring Actiflo®

Managing water levels in your tailings pond.



specific circumstances and determine the requirements or necessity for a long-term solution depending on their strategy. Indeed, the often volatile nature of commodities markets means that particular mining developments may only have a lifespan of a decade or less, making permanent water treatment assets an unwieldy investment.

Where a permanent plant may be considered a stranded investment — at a mine which is in the process of being decommissioned for instance — a mobile solution may be the best option. This also applies to the need for remediation at closed mine sites or elsewhere.

For example, a derailment that led to an ore spillage at a site in Canada's northern Ontario saw metals begin to leach into the

clarification units — which have a footprint up to 20 times smaller than conventional systems — for TSS removal as well as Hydrotech™ discfilters for polishing with a flow rate of 5,455 m³/d.

Remote access and speed of deployment

One of the characteristics of mine sites is that they are frequently located in remote, hard to access areas. The physical challenges of such locations make developing permanent assets difficult and time consuming. Mobile assets are more easily transported to even the most remote locations and allow for more flexibility to deal with weather-related constraints in regions such as the Canadian North, for instance, where a relatively narrow weather window makes these capabilities

advantageous.

Being able to treat large volumes of water with unique technologies that offer a small footprint is another big driver for mobile assets. For example, Pretium Resources awarded Veolia Water Technologies a contract for the Brucejack gold mine located in northern British Columbia. Initially deployed to dewater the mine during

treatment technologies are also evolving. With physical and chemical separation for suspended solids, turbidity, hardness and metals removal, membrane separation and demineralization for total dissolved solids, specialty ion exchange and heavy metals removal, there are a host of existing mobile technologies available with new ones emerging as well.



Each mine site poses its own challenges. Miners want to tackle issues regarding effluent management from the early stages of the development of their mines, as a way to not only protect the environment as much as possible but also to respond to demands from the local communities. Using quickly deployed mobile assets to test and adjust treatment processes early on ensures the best solution according to the specific conditions of the mine site is selected.

the exploration phase, Pretium chose the mobile Actiflo® system in response to the site's remote location 275 km northwest of Smithers, only accessible via a 12-km glacier.

Minimizing TSS and heavy metals from their gold mine effluent while using as little land as possible, the system allowed construction operations to be developed during the almost two years needed to obtain all necessary environmental federal and provincial regulatory permits.

Discrete containerized units mean that different modules can be up and running in a relatively short period. A mobile treatment plant can be mobilized and operational in just weeks, whereas construction of permanent infrastructure typically requires a minimum of a year and in many cases much longer than that.

Making mobile water treatment the solution of choice

In response to changing demands from regulators and operators, mobile water

Certainly, effective water treatment is critical to mining operations and without it an extractive business can't generate any revenue. But considering the business case for mobile water treatment assets, it is clear that there is far more scope than emergency short-term deployment.

Indeed, mobile treatment is going from the crisis option to instead becoming the solution of choice from the start. With flexibility, speed of deployment and cutting-edge technologies, mobile water treatment is a key part of the mining portfolio during exploration, development, operational and decommissioning phases of mine life. ●

Pharmaceutical industry

When renting is the best option

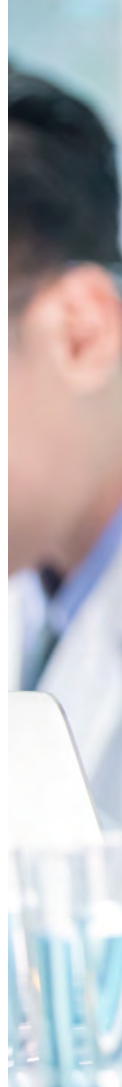
Capital expenditure and investment in water infrastructure are critical to maintaining an ongoing high quality supply... but when might it be better to rent equipment instead of purchasing it?

The pharmaceutical sector is a major water consumer and relies on treatment processes to ensure a safe and secure supply of purified water that meets and exceeds stringent quality and quantity demands. The industry is highly regulated by supervisory bodies such as the United States and European Pharmacopoeia, and every manufacturing facility has a User Requirement Specification (URS) defining feed-water quality, volume of water and necessary purification steps. Purified water is used in a variety of applications, from production to cleaning reactor vessels and facilities require a continuous, reliable supply that mitigates the risk of microbial growth and the deterioration of water quality.

The US and European Pharmacopoeia highlight three key measurable variables in water treatment: conductivity, Total Organic Carbon (TOC) and bacteria levels. Water purification for pharmaceutical

manufacturing is a multistage process, with reverse osmosis (RO) and continuous electrodeionization (CEDI) forming the two core processes to reduce conductivity and TOC. Invariably, pretreatment is required for most raw water to protect the RO and CEDI units. This usually includes softening and some form of free chlorine removal. Some customers may choose to install an additional post-treatment process, such as ultrafiltration (UF) steps to remove endotoxins from the water or an ultraviolet disinfection unit as an extra precaution to kill any prevailing bacteria that may have passed through the system.

Further pretreatment purifications steps may also be necessary, depending on the hardness of the raw water supply. For example, water from Suffolk and Norfolk in the UK has a very high conductivity — around 1,000 μS compared with 80–120 μS in Scotland. The US Pharmacopoeia calls for water





conductivity to be less than $1.3 \mu\text{S}$ at 25°C , requiring significant pretreatment of the raw water supply prior to RO and CEDI.

Finally, preventing dead legs and ensuring that water is kept moving, as well as using hot sanitizable equipment, are key steps to ensuring that the quality of water is maintained and bacterial growth is minimized. Once a plant has been installed, the U.S. Food and Drug Administration, European Medicines Agency or other equivalent region-specific agency audits the facility to see that drug production complies with regulations, and that companies are meeting the day-to-day monitoring and sanitization procedures.

It is essential that a facility can rely on the quality of water from its purification system, as a single product batch voided by impure water can represent a loss in revenue in the region of one million euros. The potential disruption and financial impact caused by out-of-specification water quality means that planned equipment maintenance is

extremely important. The arrival on the market of rentable, skid-mounted mobile water systems can offset this disruption and provide a source of pharmaceutical-grade water during planned maintenance or a facility upgrade to support continued production.

Plants for hire

During the last decade, an increasing number of companies have created a demand for long-term equipment rental, particularly in cases when the return on capital investment will not be met during the lifetime of the project, and especially if it is a period of less than five years. A multi-year “pay-as-you-go” scheme may be the most suitable option, providing a more cost-effective approach to water purification, and enabling the water system to be covered by the operations budget, leaving the capital available for core investments.

In cases when capital investment is the most sensible route, a mobile system can still meet the additional requirements in the



The Orion™ system is the result of Veolia Water Technologies' long experience in the production of purified water and cold water for injection through membrane technology, being the most advanced system on the market and the most demanded by the pharmaceutical and cosmetic industries for the production of water as an ingredient. Orion combines the technologies of reverse osmosis, continuous electrodeionization, ultrafiltration and a system for thermal sanitization at 85°C that ensures the microbiological quality of the treated water. In addition, the equipment is enabled with Hubgrade Essential for on-line monitoring of the main system parameters.



interim period between increased demand and a permanent solution being installed. A complete turnkey project can take up to 10 months from initial installation to completion, followed by validation, including performance qualification steps that can take up to six months depending on the size of the system. Mobile water systems are already fully validated and can be introduced into the main water purification supply in a two to three-week timeframe.

A final benefit afforded by the rental market is the opportunity for companies to conduct production trials as they monitor the effect of water quality on their manufacturing processes. Temporary treatment plants provide a cost-effective means of finding out whether making a substantial capital investment is worthwhile.

In practice

In one instance, a client needed to increase production in response to market demand, and its existing water infrastructure could not meet the water requirements and necessary validation. In another example,

a supplier of pharmaceutical-grade plastic foam needed to improve water quality and validation in response to the demands of a multinational client.

Flexible hire periods and a pay-as-you-go system, combined with full service and maintenance support, provided an ideal solution in both situations.

New way of thinking

The rental model may be new to the water technology market, but there is a solid business case for many pharma companies to opt in, whether to cover planned maintenance, deal with an increase in production or simply as a more cost-effective solution during shorter-term projects.

Increased options and flexibility in the water technology market can only help to provide the reassurance pharmaceutical companies need that their supply of pharma-grade water is safe, secure and can reliably support continuous production as recognized by the International Society for Pharmacoepidemiology (ISPE). ●



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Design: Veolia Water Technologies Graphic Design Team

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09/2021 (210193)



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