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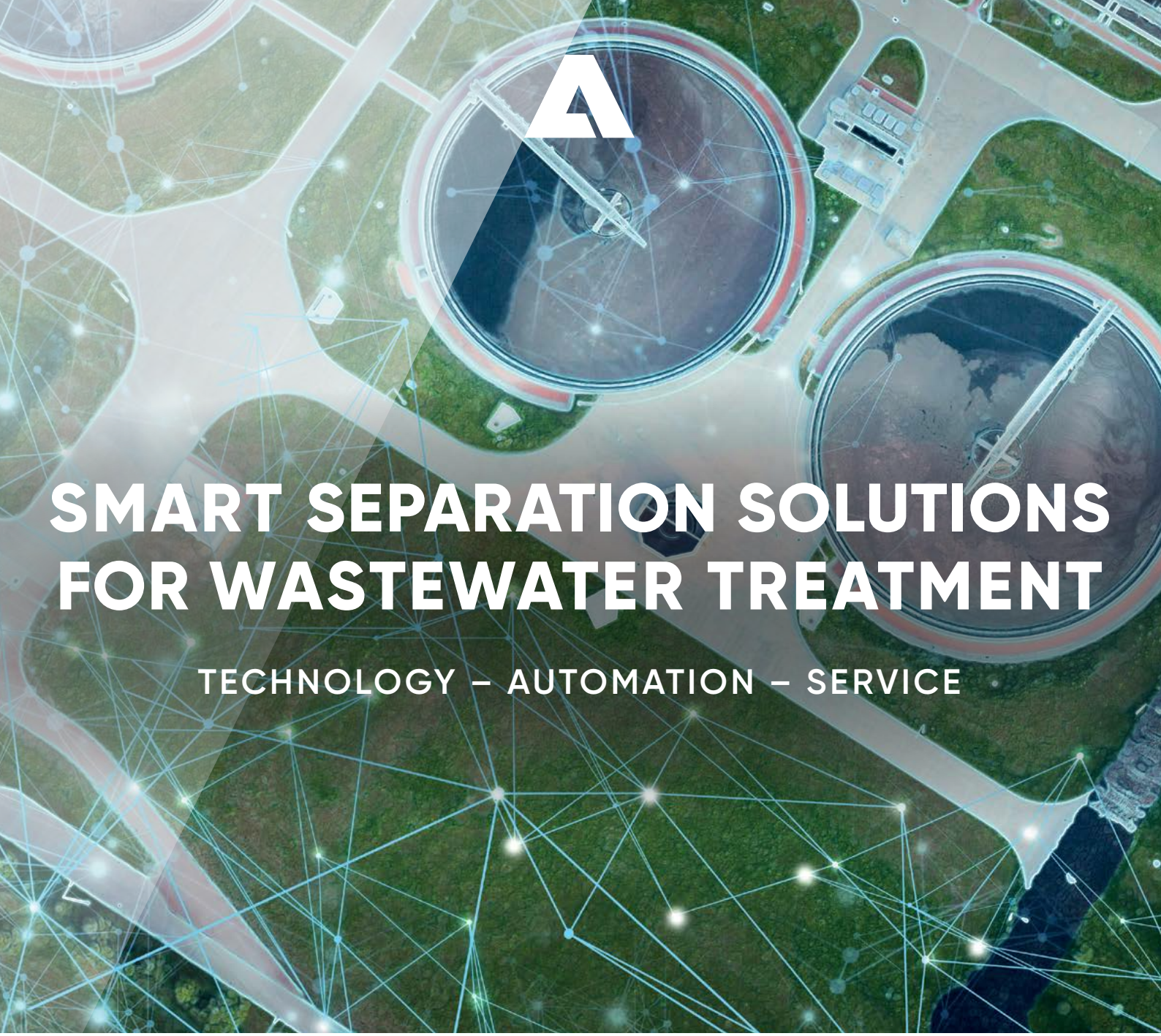

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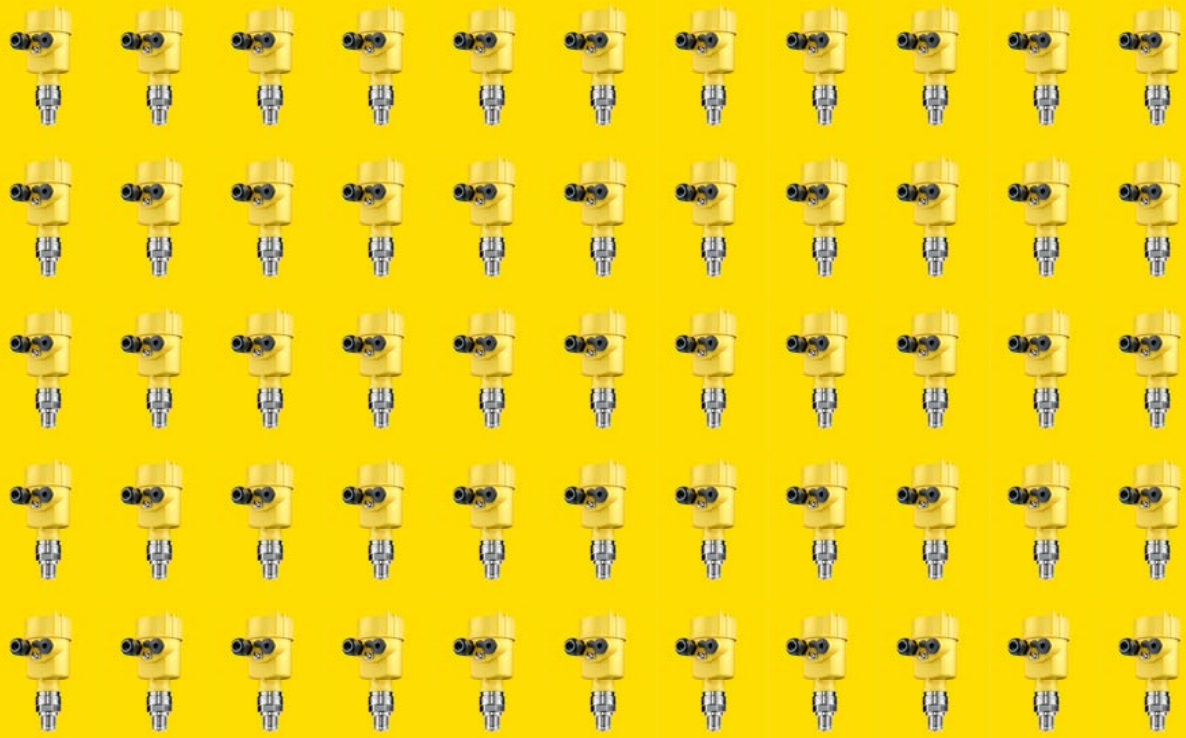

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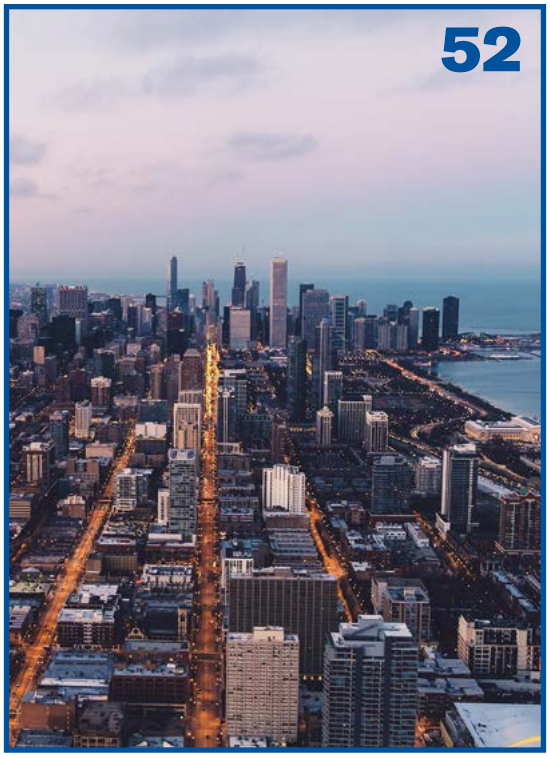

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WORLD WATER DAY

World Water Day is celebrated on 22 March of each year, and this year, the United Nations (UN) is commemorating this occasion with a particular focus on groundwater with the theme "Groundwater: Making the invisible visible".

Groundwater is one of the world's most important natural resources and is a vital water supply for humanity. More specifically, The Groundwater Project revealed that 2.5 billion people worldwide depend solely on groundwater resources to satisfy their basic daily water needs. That said, groundwater is depleting due to an increase in human activity which then leads to pollution, degrading the quality of groundwater and posing a threat to human and ecological health. It is then critical to then not to overexploit but to preserve and use groundwater more sustainably.

Echoing support to this year's World Water Day theme is De Nora. On page 16 of this issue, Dr Mirka Wilderer, CEO of De Nora Water Technologies, provided an overview of today's groundwater situation and the impact of the exploitation of groundwater. She said: "More than 30% of the earth's freshwater resources are made up of groundwater. As such, protecting the supply and safety of our groundwater is key to ensuring a sustainable future for all moving forward."

Besides issues on depleting groundwater, the world is still very much under the loom of the COVID-19 pandemic, particularly when the Omicron is now found to be more infectious than its predecessor Delta. For the US Centers for Diseases Control and Prevention (CDC), the agency has been carrying out the national wastewater testing programme since the outbreak of the pandemic. A partner the CDC has been working with on this programme is LuminUltra Technologies, which was tasked to gate data from up to 500 wastewater treatment plants across the US to test for SARS-CoV-2 in wastewater. To find out more, flip to page 36.

And more countries have now embraced the concept of Living with Covid by completely scrapping all COVID-19 restrictions like in the UK and Denmark. In Singapore, although the government adopts a more conservative approach to transitioning out of the pandemic, the city-state has been taking further steps to extend the vaccinated travel lane to its citizens and vaccinated travellers to enter the country quarantine-free. This will open the doors to more visitors attending the Singapore International Water Week (SIWW) 2022, which will be taking place from 17-21 Apr 2022 at the Marina Bay Sands. Flip to page 53 for more highlights of the event.

We have also curated a SIWW2022 Special on page 55 of this issue which showcases some of the solutions and technologies that will be demonstrated on the exhibition floor during the event.

All in all, happy World Water Day and may water be used more sustainably.

Cheers,
Josephine Tan

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ABB LAUNCHES DIGITAL SOLUTION TO REDUCE ENERGY USE AND OPTIMISE OPERATIONS IN WASTEWATER PLANTS

ABB Ability Smart Solution for Wastewater is the first in a family of digital solutions designed to optimise operations and reduce energy consumption in the water sector

ABB has launched ABB Ability Smart Solution for Wastewater, a digital solution that addresses the unprecedented challenge faced by wastewater treatment plant operators to achieve both the lowest energy use and the highest operational standards. The new wastewater technology enables continuous monitoring, coupled with automation, to achieve energy savings of up to 25% during aeration and pumping and up to 10% reduction in chemical usage, ABB claimed.

The solution is composed of two main pillars, advanced process control (APC) and digital twin and simulation technology to forecast future operational needs. It will help wastewater treatment plants reach optimal operating conditions through continuous monitoring and automation. This enables constant, incremental operational adjustments and gains, reducing energy consumption and chemical usage, alongside increasing profitability.

Developed with the hydraulic modelling intelligence from the Danish water environment specialists, DHI Group, the ABB Ability Smart Solution for Wastewater creates a treatment process by predicting wastewater inflow together with environmental factors such as weather patterns, reducing the risk of overflow and fines. ABB Ability Smart Solution for Wastewater will be the first in a family of smart solutions for the water industry. Building on the experience and performances of ABB's Optimax and APC, this offering is designed to make wastewater treatment plants safer, smarter and more sustainable.

According to the International Energy Agency, global electricity consumption in wastewater treatment reached 222Twh in 2020, with electricity usage across the sector predicted to increase 80% by 2040. This is in part due to the increasing demand for treated wastewater, which is now considered a valuable potential resource.

Marco Achilea, global segment manager, water and infrastructure, ABB Energy Industries, said: "With the demand for treated wastewater rapidly growing around the world, our goal is to continue to develop sustainable solutions that reduce energy use whilst improving water quality and operational efficiency."

DEWA IMPLEMENTS SMART BALL LEAK DETECTION TECHNOLOGY IN WATER TREATMENT NETWORKS

Saeed Mohammed Al Tayer, managing director and CEO of DEWA, highlighted the agency leverages the latest technologies and solutions to enhance water resources and conserve consumption

Dubai Electricity and Water Authority (DEWA) has adopted the smart ball leak detection to detect invisible water leakages in water transmission pipelines that are hard to detect or reach. This is part of DEWA's ongoing efforts to reduce water losses.

The smart ball system consists of a small diameter sphere that is inserted into the water network where it travels freely, driven by the water flow. Sounds generated by a leak, gas pocket or anomalies have distinctive characteristics. The system captures the sounds of these from inside the pipeline with the software then able to detect the location of the leak. DEWA further revealed that the technology has saved 68.45 million gallons and AED2.74 million (US$745,963) since its implementation in April last year.

DEWA has been adopting the latest technologies in the generation, transmission and distribution of electricity and water networks. According to Saeed Mohammed Al Tayer, managing director and CEO of DEWA, the agency has been able to reduce electricity losses to 3.3% compared to 6-7% in Europe and the US in 2020, and reduce water network losses to 5.1% compared to 15% in North America. DEWA's total installed capacity is 13,417MW of electricity and 490 MIGD of water.

"In Dubai, we have a comprehensive vision to ensure the sustainability of resources as part of the integrated strategy of managing water resources in the country which focuses on enhancing water resources, conserving consumption and using the latest technologies as well as innovative solutions. This includes operational technology," he said. "In 2014, DEWA commissioned the SCADA system at its sustainable building in Al Quoz, enabling DEWA to monitor the water transmission network in Dubai remotely, collect data round the clock in addition to water transmission pipelines, pumping stations and storage that extend over 2,300km with over 8,500 smart devices in the field."

ANDRITZ TO MODERNISE SECOND GENERATING UNIT AT THE JEBBA HYDROPOWER PLANT IN NIGERIA

Jebba hydroelectric power plant on the Niger River
(Photo credit: Mainstream Energy Solutions Limited)

Andritz has received an order from Mainstream Energy Solutions Limited for the modernisation of another generating unit at the Jebba hydroelectric power plant on the Niger River. This contract follows an order received in January last year to modernise the first unit 2G6.

The Andritz scope of supply and services comprises the entire electro-mechanical and hydro-mechanical equipment for unit 2G5, including a 96.4MW turbine, a 103MVA generator and accessory equipment, as well as the intake gas.

Originally commissioned in 1985, the Jebba hydroelectric power plant is located in the North Central zone of Nigeria, about 100km downstream of the Kainji Hydroelectric Power Plant. It is equipped with six 96.4MW turbines and has a total generating capacity of 578.4MW.

The objectives of the general rehabilitation programme are to extend the equipment service life for the next four decades, improve reliability and ensure compliance of the frequency and voltage control with the national grid code. The new equipment will repower the plant, improve the energy production of Nigeria and provide much-needed energy to the people of the country.

The commissioning of the second generating unit has been scheduled for the beginning of 2024.

ENERGY RECOVERY CLINCHES TWO CONTRACTS IN ASIA

Energy Recovery has been awarded two contracts to supply its PX Pressure Exchanger (PX) energy recovery devices and an array of pumps to support industrial wastewater treatment operations at a battery-grade lithium carbonate manufacturing facility in Tibet, China; and a textile wastewater treatment facility in Rajasthan, India. Both projects will utilise Energy Recovery's PX in the seawater reverse osmosis (SWRO) desalination portion of their industrial wastewater treatment operations.

The textile wastewater treatment facility in India will utilise a combination of Energy Recovery's PXs, turbochargers and boosters to maximise efficiency. The operation in China is at one of the largest salt lakes in the world and will produce lithium carbonate, a crucial ingredient in lithium-ion batteries that power electric vehicles. The PXs will help make treating industrial wastewater associated with lithium mining operations more energy efficient.

Robert Mao, president and CEO of Energy Recovery, said: "Our products continue to bring affordable, drinkable water to communities around the world. Today, by making wastewater treatment more energy-efficient, our products are also making industrial operations like textile manufacturing and lithium mining into cleaner, greener processes."

More regions have prioritised sustainable wastewater treatment as the world faces dwindling freshwater resources, and regulatory pressure to reduce pollution from industrial operations increases. Energy Recovery highlighted the opportunity for industrial wastewater is vast, and pointed out more than 16% of global freshwater withdrawals end up as industrial wastewater, flowing back into the world's aquatic ecosystems without being treated.

"The need to efficiently and sustainably treat wastewater is truly a global issue," Rodney Clemente, senior vice-president of water at Energy Recovery, emphasised. "Particularly in fast-developing countries that have embraced industry and manufacturing – like much of South Asia – wastewater treatment will no longer be a nice-to-have, but a must-have. With Energy Recovery's technology, wastewater treatment can also be energy efficient, economical and more environmentally friendly process."

Energy Recovery's PX pressure exchanger

The emissions and cost savings of the PX will enable industrial producers to better align with the United Nations Sustainable Development Goals, which include targets that seek to improve water quality by reducing pollution and halving the proportion of untreated wastewater globally. The company described reducing the energy usage and emissions associated with wastewater treatment will be an essential step for a more sustainable future – according to estimates by the International Energy Agency, total energy consumption for the water treatment industry is expected to increase by 130% through 2040.

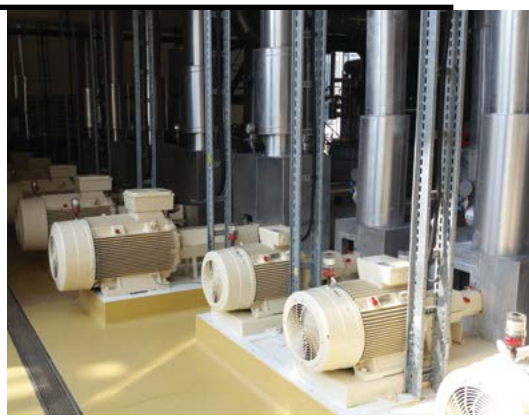
SUEZ CLINCHES VINYTHAI CONTRACT TO REDUCE WATER FOOTPRINT AND OPERATIONAL COSTS

SUEZ – Water Technology & Solutions has been awarded a contract to design and build water treatment, wastewater recycling and waste recovery systems for VinyThai, a Thai manufacturer of plastics and chemical products. The technologies and services will provide VinyThai with a compact solution for resource recovery, enable it to meet discharge limits, and reduce its water footprint, operational costs and risks.

The package will consist of SUEZ's Poseidon dissolved air floatation system, PROFlex brackish water reverse osmosis system, ZeeWeed 500D membrane bioreactor and filter press for biological waste and polyvinyl chloride (PVC) waste. SUEZ will also provide chemical supplies, as well as plant operation and maintenance services for the next five years.

Thomas Buer, senior vice-president of ES technologies and systems at SUEZ – Water Technologies & Solutions, said: "VinyThai share the same passion for the environment, high standards for safety and health, and a commitment to innovation and operational excellence as SUEZ, making them an excellent partner."

SOUTH KOREAN TYRE MANUFACTURER ACHIEVES ENERGY COST SAVINGS WITH RIVENTA PUMP SYSTEM



Riventa's pump system optimisation reduces South Korean tyre manufacturer's energy costs by 13%

In the port city of Yeosu in South Korea, a global tyre manufacturer has been able to achieve an annual energy reduction of 13% at its water pumping plant following the installation of a Riventa pump system.

For a pressurised system that circulates cooling water for synthetic rubber processing, Riventa utilised its FREEFLOW technology and Green Pump Index (GPX) benchmarking system to simultaneously monitor five pumps. For 150 hours, system pressure was measured, together with flow rate and head combinations to pinpoint how effectively the pumps could meet the varying demands of the system.

Included in the tyre manufacturer's objectives was the need to address pressure objectives for the system, which were operating at 4.5kg/cm^2, compared to the contractual minimum supply pressure of 3.8kg/cm^2. Although the five pumps had the same casing, Riventa found that by trimming the diameter of three pumps by 3.5%, an 11% reduction in pressure would be achieved.

By understanding the operation of the system and how the pumps interact with it, Riventa was also able to calculate optimum performance and make potential GPX recommendations. For instance, the GPX index was improved from 54 to 64 after Riventa's modifications. So, for example, of the 100% of electrical power consumed by the motor, just 54% of that power was being successfully converted into net hydraulic output power.

WATER FILTERS MARKET SET FOR GROWTH: RESEARCHANDMARKETS.COM

The water filters market by revenue is expected to grow at a CAGR of over 6% during the period 2022-2027, ResearchAndMarkets.com revealed in its new report.

Entitled *Water Filters Market – Global Outlook & Forecast 2022-2027*, the report pointed out the presence of major players – such as SUEZ, Pall Corporation, Pentair, Veolia and DuPont – is expected to boost the sales of water filters that generally utilise the activated carbon and ion exchange filters with enrichment vitamins E and C. However, the governmental policies, rising waterborne diseases, awareness among the millennial population and rise in the environmental impact of bottled water are expected to propel the market for water treatment systems.

Improving the taste and odour of tap water for drinking has been another objective of players in the market that makes drinking a dominant end-use in the resident segment. Particularly, filter cartridges are used in numerous industrial applications to trap contaminations and solid waste. In addition, cartridges filters eliminate submicron particulate matter. With that, the report revealed that the revenue for the cartridge segment is expected to reach US$5.38 billion by 2027, growing at a CAGR of 6.66% during the forecast period.

The report further identified Germany as the largest market for water filters in the European region, followed by the UK. While Italy and Spain are regarded as other potential markets, the scope for filters is "comparatively low" in Scandinavian countries, owing to the high quality and safe tap water boost investors' confidence in the market.

And Asia-Pacific, the region is the fast-growing market for water filters with China being the market leader in 2021, according to the report. The growth is mainly supported by the economic development and hike in middle-class consumers in India and China. Asia-Pacific, which is expected to account for over 70% of the middle-class population by 2030, thus possesses a "huge positive influence" on the market growth with driving demand for the water filters market.

The need to improve the taste and odour of tap water for drinking is a factor driving the demand for filter cartridges in the resident segment (Photo credit: Pixabay)

CENTRISYS SECURES MAINTENANCE CONTRACT FOR NYC WASTEWATER TREATMENT PLANTS

Centrisys Corporation has secured a contract with the New York City (NYC) Department of Environmental Protection to provide maintenance and repairs for 83 existing decanter centrifuges located in eight NYC wastewater treatment facility locations. Centrisys' contract was bid in partnership with Jett Industries, a general contractor focused on constructing and modifying water and wastewater treatment facilities.

Kevin Miedreich, project manager with Jett Industries, commented: "Aligning with Centrisys in the contract bidding process to support NYC's wastewater treatment facilities allowed us to bring all of our collaborative strengths to the table to ensure we provided recommendations that offer facility efficiencies and an innovative problem-solving approach. The cooperative arrangement allows our team to lean on our in-depth knowledge of facility processes and expedite lead times."

NYC manages 14 wastewater resources recovery facilities that treat 1.3 billion gallons of wastewater daily. The treatment system consists of over 6,000 miles of sewer pipes, 135,000 sewer catch basins, over 495 permitted outfalls for the discharge of combined sewer overflows, and 95 wastewater pumping stations that transport to the wastewater resource recovery facilities located throughout the five boroughs. NYC's sludge is digested and transformed into biogas. After digestion, the leftover solids are then dewatered.

The contract covers maintenance and repairs for 83 existing decanter centrifuges in eight NYC wastewater treatment facility locations

Michael Kopper, president and CEO of Centrisys, concluded: "In 2020, we announced the installation of 32 American-made CS26-4 Centrisys decanter centrifuges at NYC's largest wastewater treatment plants. We appreciate their trust in our team and look forward to further supporting NYC with our maintenance and repair expertise in the years ahead."

GLOBAL WATER SUMMIT 2022 RELEASES WATER-POSITIVE ZERO CARBON AGENDA

Returning after two years, the 2022 Global Water Summit, organised by Global Water Intelligence (GWI), is scheduled to take place in Madrid from 16-18 May 2022. The conference will unpack the developments, issues and opportunities across the global water sector within the theme Water-Positive Zero Carbon.

The 2022 Global Water Summit will explore the ways that climate change is changing water. The synergies between emissions and water security, together with the global political commitment for climate action, create the potential for transformational change.

The conference will assemble business leaders and decision-makers from across the international water sector to discuss major trends. The three-day agenda will include a variety of sessions within six strands, including Defining Water Positive, The Smart Way to Zero, a two-part workshop The SGD 6 Challenge, Accelerating New Models for Desal, Supersizing Potable Water Reuse, Next Generation Water Technologies for Industry, Leading to Race to Zero, and much more.

The 2022 Global Water Summit offers an opportunity for the global water industry to come together. It is an essential opportunity to disseminate information and drive the global conversation around water positivity and the zero-carbon movement while giving a complete business-focused global overview to the leaders of the water sector.

In recognition of the environmental impact of international conferences, the Global Water Summit has also announced a carbon pledge. Investing to reduce water industry carbon emissions by 500tCO2e, more than double that generated by travel to the event, this carbon offset pledge demonstrates the commitment to the objectives of the conference.

The 2022 Global Water Summit will take place from 16-18 May 2022 in Madrid, Spain

FLOW CYTOMETRY: THE IDEAL TOOL FOR TREATMENT PROCESS MONITORING

Clean and safely managed water is often described as the first line of defence for public health. However, waterborne microbial contaminants pose threat to human wellbeing and remains a challenge for utilities and wastewater plants to eliminate in order to provide potable water for the wider community.

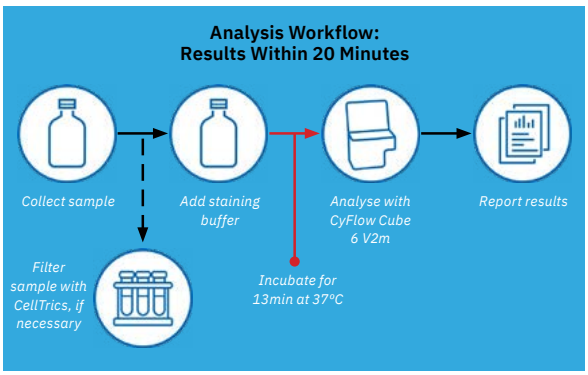
CyStain BacCount assays utilising CyFlow Cube 6 V2m flow cytometry is the state-of-the-art method for water quality analysis.

A typical treatment process involves multiple steps. These include coagulation and flocculation, sedimentation, dissolved air floatation, ozonation, sand filtration, membrane filtration, and chlorine- or ultraviolet (UV)-based disinfection. That said, disruption in treatment or lapse in distribution may arise, resulting in conditions for microbial growth.

For over 100 years, the heterotrophic plate count (HPC) method has been a steadfast reference measure for general microbiological quality. The term "heterotrophic bacteria" denotes all bacteria use organic nutrients for growth; however, many remain unculturable under laboratory conditions[1].

CyStain BacCount assays utilising CyFlow Cube 6 V2m flow cytometry have proven to be a fast and effective method that can be easily standardised and automated. Moreover, flow cytometry has become a vital and relevant alternative to classic HPC testing. Switzerland is the first country to have adopted this advanced method to quantify microbial cells in water[2].

Table 1 shows an overview of the applications of flow cytometry used in water quality analysis in Europe.



Process/Unit	Subprocess	Parameters	Reason for use
Source/raw water		TCC, HNA, LNA	Determination of assimilable organic carbon (AOC) and impact on the treatment process
Treatment	Pre-coagulation	TCC, VCC	Inter-stage sampling using FCM to inform process control
	Post-coagulation		
	Dissolved air floatation (DAF)	TCC	Understanding bacteria growth and abundance
	Membrane	TCC	Assess efficiency and integrity of membrane filtration
	Disinfection	TCC, VCC	Evaluation of disinfection efficacy
	Final water	TCC, VCC	Evaluation of treatment process
Distribution/ Network		TCC, VCC	Evaluate regrowth, reinstatement of the network following maintenance

Table 1: Application for flow cytometry in water quality analysis[3]
**Total Cell Count (TCC), Viable Cell Count (VCC), High Nucleic Acid (HNA), Low Nucleic Acid (LNA)*

CASE STUDY #1: EVALUATION OF THE CYSTAIN BACCOUNT ASSAYS WITH FLOW CYTOMETRY

An evaluation of CyStain BacCount assays were compared against the plate count method. Samples of rinse washout collected daily over seven days from a single manufacturing site in Singapore (Figure 1).

The CyStain BacCount assays contain fluorescent dyes that specifically bind DNA. CyFlow Cube 6 V2m flow cytometer analyses and simplifies the entire workflow with automated reporting of cell count in 20 minutes.

The BacCount Total assay contains a green fluorescent dye that unspecifically stains all bacteria in water samples. It stains

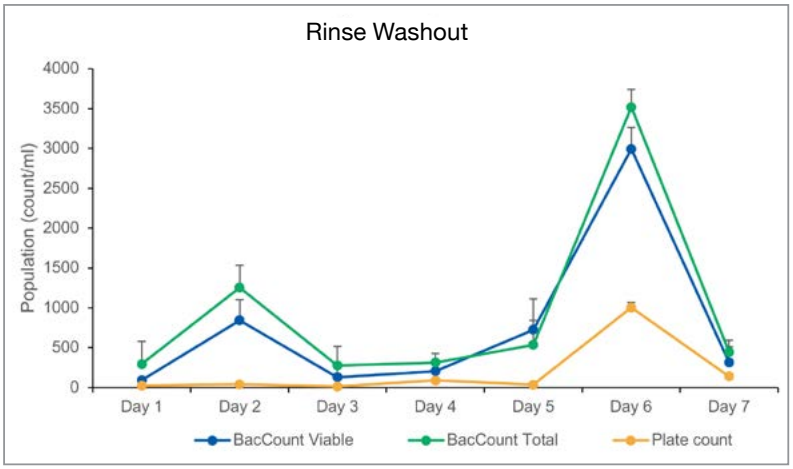
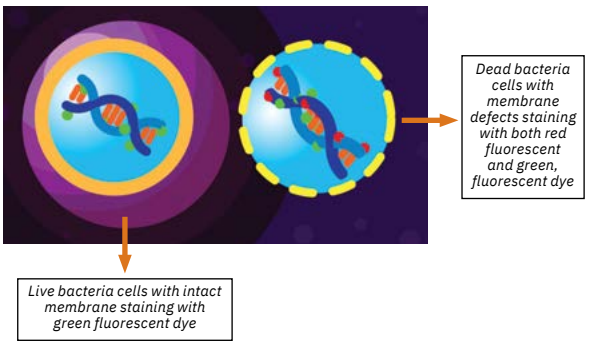


Figure 1: Measured microbial population of rinse water over seven days using BacCount Total and BacCount Viable compared to the plate count method. Rinse washout here refers to the samplings of a machinery washout solution collected from a single manufacturing site in Singapore. Measurements were performed with technical triplicates over a period of seven days.



both dead and live bacterial cells. The assay reports the total cell count (TCC) in a sample.

The BacCount Viable assay contains an additional red fluorescent dye that stains DNA and is used as an indicator of dead cells. The combination of both dyes in this assay allows the discrimination between the live and dead cells, thus provide the enumeration of viable cell count (VCC) in a sample.

Figure 1 demonstrates that the flow cytometry method provides greater sensitivity compared to the plate count method. The higher BacCount Total and Viable cell counts indicated more bacterial cells were detected with flow cytometry. The discrepancy in flow cytometry vs plate count can be attributed to "viable but nonculturable (VBNC)" bacteria that are physiologically active but cannot be cultured under laboratory conditions.

CASE STUDY #2: ESTABLISH THE BACTERIA FINGERPRINT OF A WATER SOURCE WITH CYSTAIN BACCOUNT VIABLE

Using the immense resolution of a flow cytometer, detectable bacteria can be further differentiated into low nucleic acid (LNA) and high nucleic acid (HNA) bacteria populations. LNA and HNA ratios can differ across water sources, presenting a signature "fingerprint" of the water source.

HNA bacteria are thought to be larger and more active organisms, whereas the LNA bacteria primarily consist of relatively small, less active bacteria in environmental water samples. However, growing evidence suggest that LNA bacteria are just as active and represent a different physiological state of bacterial cells[3].

A deep well water source in Germany presents similar bacterial fingerprint to that of river water (Table 2). At a waterworks facility in Germany, the same deep well water source undergoes chlorination as part of the water treatment process. Post treatment analysis showed a shift in its LNA-to-HNA ratio[4].

CONCLUSION

Flow cytometric analyses facilitate expedient monitoring of the quality of water treatment processes and allow intervention within a timely manner. Furthermore, the establishment of "fingerprints" may increase efficiency of treatment process and for automated 24/7 process monitoring.

Scan QR code to find out more from Sysmex Asia Pacific Pte Ltd.

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Types of water sample	Total Cell Count per mL	Total Viable Count per mL
River water	58,022	52,205
	LNA: 76%	LNA: 72%
	HNA: 24%	HNA: 28%
Deep well water	34,889	33,127
	LNA: 69%	LNA: 70%
	HNA: 31%	HNA: 30%
Chlorination	27,333	4,601
	LNA: 43%	LNA: 85%
	HNA: 57%	HNA: 15%

Table 2: Bacterial count of water samples from a waterworks facility in Germany[4]

Eagle.pt, the contactless water quality monitoring sensor

INNOVATING WATER QUALITY MONITORING SYSTEMS: *Contactless measurement method*

Today's water quality monitoring system involves the deployment of water qualities sensors or probes. However, they are continuously exposed to harsh environments and biofouling. **Choo Chun Keong**, director and founder of NexusBit Integral, discusses more on contactless water quality sensor and how it removes the issues of water-related biofouling and complex installations.

Monitoring the water qualities of water bodies like reservoirs and lakes is a critical process in water resources management and corrective actions. One of the key water quality indicators is the concentration of algae in the water system. Algae blooms put additional stress on water process plants, increase public health risk, endanger marine life and lead to further water quality abnormalities issues. Algae related issues have become more frequent with rapid urbanisation and global warmer climate.

Today, the most common method for real-time monitoring of water quality and algae trends is using conventional in-water probes, which are constantly exposed to biofouling. These in-water probes require regular on-site maintenance to prevent measurement drifts and sensor degradation from biofouling.

Maintenance puts a strain on manpower resources; increased on-site manpower and expertise are needed with more monitoring locations. Site maintenance typically forms the more significant part of the total cost of ownership for real-time water quality monitoring systems and is the key limitation for large scale deployment. This is also the bottleneck for real-time water quality monitoring to better leverage recent advances in the Internet of Things (IoT) and big data technologies.

THE NEW SOLUTION

NexusBit Integral has been working with PUB, Singapore's national water agency to develop an alternative method to simplify

real-time monitoring of the water quality. The company's solution is a contactless measurement sensor that measures water quality parameters, including turbidity, chlorophyll-a and colour dissolved organic matters – absorption (CDOM) above the water surface without any physical contact with the water. Therefore, it removes any water-related biofouling and complex site installations.

Contactless measurement also unfolds new methods of sensor deployments that were previously not possible with conventional in-water sensors, which required careful considerations in both environmental factors like water current flow, corrosion, and safety consideration for sensor retrieval. Using a contactless measurement sensor, this can be achieved by simply mounting it on an existing land structure that has a direct view over the water bodies.

This sensor system had been deployed on rooftops of buildings overseeing reservoirs for long-term monitoring. Measurement stations can be set up directly on flyovers and bridges. The sensor's compact size also enables it to be installed on drones for area spatial mapping of water quality.

HOW IT WORKS

The working principle is based on remote sensing, which derived water parameters from back-scatter ambient light that interact with the particulates in the water. The electro-optics system and algorithm are specially developed to cater for the deployment configurations and using full optical spectrum bandwidth enabled it to regress over water bodies of different characteristics and large ranges from low to very high Chl-a concentration.

The NexusBit Integral team intentionally named this contactless sensor the Eagle-point (Eagle.pt), like an eagle, it can see in fine detail from high above; a water quality sensor that takes an accurate measurement from above.

THE MEASUREMENT RESULTS

Working with an autonomous drone partner, the team fitted the Eagle.pt water quality sensors onto drones. These drones are equipped with Eagle.pt and have been used by PUB to regularly map the spatial spread of surface water quality over the reservoirs from 2021. Each survey mission covers the entire span of the reservoir with over 70 measurement points and typically only requires a few flights sorites of 30 minutes each, depending on the size of the survey. This is carried out over different reservoirs; from those with pristine water quality to reservoirs with catchments run-off from wetlands, light industries, and residential areas.

Initial measurement validation:
For every measurement point taken, the data is uploaded in-flight and published immediately to the end-user. During these survey missions, up to two corresponding water samples were taken and sent to the SAC-SINGLAS accredited laboratory for wet-lab analysis as verification points.

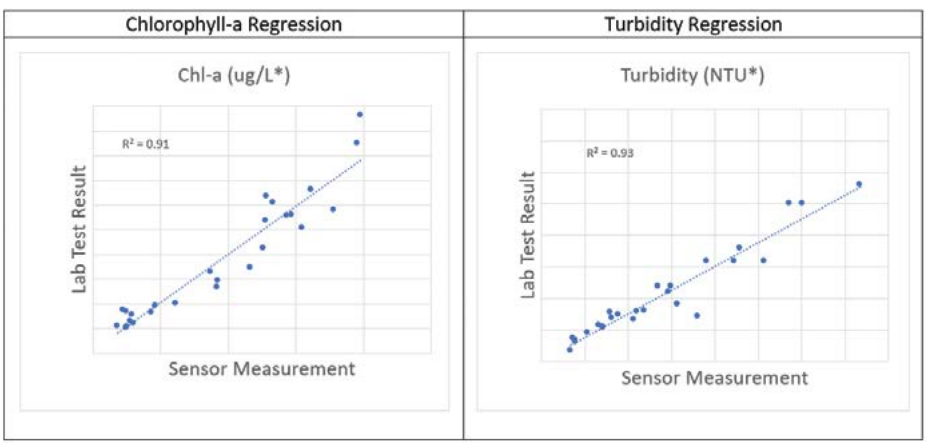
The graph shows the verification samples regression of real-time sensor data taken by Eagle.pt against the laboratory results over different reservoirs during the operational period of 2021. The regression shows a close correlation between Eagle.pt measurements and laboratory test results.

FROM MEASUREMENT TO PREDICTION

Today's advancement in IoT implementation, big data and machine learning technologies have changed the way the world processes information. With a massive quantity of IoT sensors deployed, scientists and engineers around the world have been learning more about the environment and discovering new solutions each day.

However, for water quality control and management, the bottleneck of mass deployment of sensors and maintenance has limited its potential to further leverage on recent advances in data technologies. Eagle.pt contactless measurement can simplify the sensor's deployment and maintenance requirement, typically reducing these costs by more than 50%.

By lowering the prerequisite in real-time water quality monitoring, we can increase the quantity of data points, at the same time enabling more organisations and the communities to collaborate in measurement and study the environment collectively and challenge the boundaries of prediction and corrective solutions. Simplify to expand the possibilities!



Regression of real-time contactless sensor measurement vs. lab test data

VISIBLE SOLUTIONS *make groundwater easy*

Groundwater is one of the earth's most important natural resources yet it is depleting at a very high rate due to climate change, overpopulation and pollution and contamination of resources. Echoing this year's World Water Day theme – Making the Invisible Visible – Dr Mirka Wilderer, CEO of De Nora Water Technologies, shares more with **Josephine Tan** on how the company is contributing to groundwater treatment.

Firstly, can you share with us an overview of today's global groundwater situation – why is groundwater becoming an issue, and how will you describe the role groundwater will play in the combat against climate change?
Dr Mirka Wilderer: The groundwater situation globally is precarious today, with the two biggest issues being scarcity and contamination of the groundwater we currently have.

Many people around the world rely solely on groundwater for daily life and agriculture. As demand for potable water increases to support the growing population and their daily needs, we are depleting our groundwater resources faster than they can be replenished. Climate change also causes more extreme temperatures and intense storms. Extreme heat and aridity are leading to higher evaporation of surface water, while the intensity of storms is affecting soil infiltration as well. This all results in faster depletion of our groundwater sources.

Additionally, our fast-depleting natural groundwater sources are getting tainted. While water moves through the ground, it picks up natural contaminants from the environment. With increased industrial activities globally and improper disposal of chemicals used, our groundwater resources are getting even more contaminated.

We all have a common human need for safe, clean drinking water but not everyone today has that access. More than 30% of the earth's freshwater resources are made up of groundwater. As such, protecting the supply and safety of our groundwater is key to ensuring a sustainable future for all moving forward.

While there is no one-size-fits-all solution, we believe that protecting the supply and safety of our groundwater resources go beyond managing extraction. Our solutions have to take into consideration the larger picture of water usage and issues, from water treatment to encouraging water reuse and recycling with technology.

At De Nora, it is our mission to provide solutions that enable the world to reuse and remediate precious water resources for a sustainable future. Any effort to conserve water resources through reuse, recycling and water treatment is going to help our world and the communities we live in immensely when it comes to the fight against climate change.

Capital Controls UV systems from De Nora treats groundwater, wastewater and drinking water featuring UV disinfection and Advanced Oxidation Process (AOP) solutions

Can you elaborate on the effects of the exploitation of groundwater, and why is groundwater increasingly being over-used?

Dr Wilderer: Groundwater resources are largely unregulated globally and are considered an "unseen" resource as compared to surface water sources. As demand for water exponentially increases to support the growing population, agricultural, irrigation and other industrial needs, our demands on groundwater far surpass nature's capability to refill them. Add on the effects of climate change including increased aridity and more intense storms that affect water infiltration into the ground – the demands on our groundwater supplies have truly become unsustainable.

A colleague of mine in Asia recently shared some concerning data about the situation in India. For example, the number of borewells in India has grown from 1 million to 20 million in the past 50 years, driven mainly by the increased agricultural output and industrial use. The Central Groundwater Board of India estimates that about 17% of groundwater blocks are overexploited. With 85% of India's rural population depending on groundwater for domestic water supply, and over 60% of irrigated agriculture using groundwater resources, I am deeply concerned about this situation and the potential impact on the communities there.

And this is true for many regions around the world. This unsustainable demand on our groundwater resources is everyone's issue around the world. This "unseen" resource provides 30% of our world's freshwater resources and we need a mindset shift to protect this precious resource. It goes back to careful consideration when we use water. Seek to understand, where does my water come from? What is in it? How much am I using daily and monthly, and what can I do to conserve? I often find in conversations that many people are not aware that improper disposal of chemicals, pharmaceuticals, even e-waste can contribute to environmental contamination and influence their groundwater sources.

The good news is – the technology to protect this precious resource through reuse, recycling and treatment of water is already available. We believe that water technology is truly one of the most important linchpins in combating groundwater overuse. At De Nora, we are committed to driving continued technology advancements and adoption so that we can further relieve the pressure on our precious groundwater resources.

More than 30% of the earth's freshwater resources are made up of groundwater. As such, protecting the supply and safety of our groundwater is key to ensuring a sustainable future for all moving forward.

Dr Mirka Wilderer
CEO of De Nora Water Technologies

De Nora SORB 33 tanks

What are the main pollutants in groundwater? More crucially, what processes and challenges are involved when addressing groundwater contamination?
Dr Wilderer: While water moves through the ground, it picks up both natural and artificial contaminants which affect water safety.

Some examples of natural contaminants are arsenic, iron and manganese nitrate while artificial contaminants are by-products of agricultural or industrial processes like pesticides, fertilisers, pharmaceuticals and solvents. Many times, these contaminants cannot be seen or tasted, yet they can cause serious harm to people and the environment.

The challenge is that once an aquifer is contaminated, it is very difficult to reserve the impact. Sometimes, the water can be cleaned with filtration systems, but in other cases, it may be rendered useless. Since much of the world's supply of drinking water comes from groundwater, this makes groundwater contamination a serious problem. Especially in a community that cannot afford to ship in clean sources of water, people may be forced to drink the contaminated groundwater as there is no alternative. This is truly heartbreaking.

De Nora supports millions of people every day with clean and safe drinking water, from treated groundwater sources. We want to create visible solutions to make groundwater easy, and we have developed a comprehensive kit of technical processes for filtration, oxidation, exchange and absorption solutions to remove contaminants from groundwater. Additionally, we have technologies deployed for water reuse to recycle wastewater and reduce our dependency on groundwater.

How will the transition to more sustainable use of groundwater resources make a business case for water utilities? Furthermore, what innovations and technologies have De Nora developed to improve the stewardship of groundwater?
Dr Wilderer: We have made this our mission at De Nora – to provide solutions that enable the world to reuse and remediate precious water resources for a sustainable future.

De Nora has a broad portfolio of technology for contaminant removal from groundwater as well as solutions for efficient water reuse in different processes and wastewater recycling to save groundwater and alleviate its increasing scarcity.

One of the examples is the De Nora SORB 33 arsenic removal system using a granular ferric oxide media for the absorption of dissolved arsenic in groundwater. Arsenic is difficult to remove from drinking water because it is soluble and dissolved in water. SORB 33 employs a simple "pump to treat" process that flows pressurised well or spring water through a fixed-bed pressure vessel containing the media where the arsenic removal occurs. It is simple and reliable. With SORB 33, we helped Aqua Pennsylvania Water Utility remove the arsenic level to less than 10ppb with minimised operation and maintenance.

Another example is we use UV technology for advanced oxidation with granular active carbon (GAC) to help Scottsdale Water Campus complete a major upgrade to its advanced water treatment plant. The UV Advanced Oxidation Process (AOP) technology can treat several groundwater contaminants such as 1,4-dioxane and N-Nitroso-dimethylamine (NDMA) that are not easily removed by other technologies. GAC can further eliminate the excess peroxide in the process and also remove other contaminants in source water, such as per- and polyfluoroalkyl substances (PFAS), another key issue for water systems. This solution allows Scottsdale Water Campus to ensure a reliable, long-term water supply.

We also offer solutions to address the problems further upstream such as in the oil and gas industry, where we provide applications to recycle waste brine systems and avoid using fresh groundwater for well stimulation. Our containerised ClorTec systems use electrolysis to generate sodium hypochlorite with a chlorine content of 0.8% as a safe oxidiser to kill bacteria, remove inorganic contaminants including heavy metals and hydrogen sulfide for produced water recycling for oil and gas customers. Also, we support seawater intake and desalination as alternate sources of water used for process and potable needs in water treatment applications.

At De Nora, we are passionate about making a difference in providing technologies today while developing solutions for the future that have a lasting impact on future generations. We continue to drive innovation when it comes to water and wastewater management so that we can protect these precious water resources for those who come after us.

VLT® AQUA Drive for a **Masterclass Performance**

30%

cost saving in the first year, compared to traditional drive systems

The VLT® AQUA Drive combines deep application know-how with powerful drives technology to make your water operation easier and more efficient than ever, while saving you considerable installation and running costs.

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Built to last and withstand even the harshest conditions, the VLT® AQUA Drive offers trouble-free operation of any type of water facility anywhere in the world.

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ENGINEERING **TOMORROW**

Danfoss

SHEDDING NEW POSSIBILITIES *into membrane filtration*

Founded in 2011, Aqua Membranes provides its 3D Printed Spacer Technology for spiral-wound membrane manufacturers who are looking to improve their product performance

To revolutionise membrane filtration, Aqua Membranes developed the 3D Printed Spacer Technology that reduces capital and operational costs by improving the efficiency of spiral-wound membranes and minimising fouling potential. CJ Kurth, CTO of Aqua Membranes, elaborates to ***Water & Wastewater Asia*** how the technology can optimise flow patterns and turbulence through the membrane element, leading to better cleaning and longer element life.

Being in the water industry for more than two decades, what are some of the key takeaways you have brought along to Aqua Membranes, and how will they help shape the strategies you have set out for the company?

CJ Kurth: Each customer's site is unique with its water chemistry, seasonality and financial drivers. They are part of a geography that faces collective water stresses, waste challenges and governmental requirements. Yet they all follow the same laws of nature. Solutions work best when the time is spent to understand this web of needs and priorities, and a solution is delivered to fit that specific context. As an abstract concept that easy, it takes time, effort and mental horsepower to put that into practice. That respect of each customer's requirements and the situation is common for large plants, particularly municipal desalination, but much more challenging with the vast number of smaller sites around the globe. Companies that thrive have found a way to operationalise the process of understanding and solving for a web of needs efficiently.

Likewise with start-ups, it is important to take a tailored approach; what is different in the technology, what are the expectations of the investors, who are onboard and what are their strengths. It can be tempting to apply a template from other businesses, past experiences or a case study but in my mind what's important is to sit with the specific situation and develop a plan for that case.

MEMBRANES: "THE CONTINUOUS PROGRESSION"

How will you describe the role membrane technology play within today's water sector, and what opportunities does membrane filtration offer in the areas of water sustainability?

Kurth: The biggest overarching trend of membrane's role in water has been the continuous progression of them becoming the defacto standard unit of operation for increasing the number of separations. Whether flatsheet or hollow fibre, membranes are an incredibly efficient way of processing a large amount of water through a small device with an advanced material structure.

With the pace of development in universities and industrial labs combined with interest from venture capital investors,

new membrane materials with improved separations capabilities and stability will continue the expansion of the separations with membranes as the key technology enabler.

In the face of climate change and where water is scarce, how will processes like desalination and water recycling support a circular economy? More crucially, what are the challenges involved and how is Aqua Membranes helping utilities to address them?
Kurth: There have been several interesting advancements in not only membranes but in operating paradigms for membranes to push water recovery to levels that would not have been considered possible a while back. Aquatech's HERO process and Desalitech's Closed Circuit RO were two of the early pioneers. More recent developments by IDE, Rotec, Gradiant and Water Surplus are continuing to improve the ability of systems to increase the amount of water being reused rather than disposed.

An example of how we are working to help with water recycling and minimising its effect on climate is our work with Micron. There is an enormous amount of water used in semiconductor manufacturing, and Micron is interested in how our printed spacer technology can reduce the energy used in their reuse and desalination systems.

3D PRINTING

Compared to traditional manufacturing, why did Aqua Membranes particularly select additive manufacturing like 3D printing technology for its production? Furthermore, how will you rate the adoption of 3D-printed solutions among water utilities, particularly in Asia-Pacific?
Kurth: A membrane can only function as well as the retained materials can be removed. For spiral-wound elements, this has traditionally been accomplished by flowing feedwater flowing through an extruded netting between adjacent membrane sheets. Other than changes in thickness, strand count and angle, this material is pretty limited in its design space. Further, the strands have a habitat of capturing retained solids leading to inefficiencies over time.

The spaces themselves are prepared by outside vendors, and since most changes to its design require new moulds, the timeline is normally months before a change can be evaluated. As a result, improvements have lagged drastically behind those seen with membrane layers.

By using additive manufacturing, Aqua Membranes can go from a computational fluid dynamics simulation to prototype elements in a day, and into production without needing an equipment change or development of a new supplier. It takes a component that is seen as critical and brings its design under the control of the element manufacturer. And from an end-user point, the only change is in performance, the spiral element dimensions are unchanged. As far as adoption, water utilities have a well-developed process of vetting new products; whether a product is made using additive manufacturing, new plastic or uses a novel membrane additive, the roadmap to adoption is already laid out.

What other trends in the water sector do you foresee taking place that will have a sustained impact in Asia-Pacific?
Kurth: Improvements to both membranes and system operations will see the use of challenging source waters becoming a more common occurrence; desalination, greywater, blackwater and produced water all are possible sources based on the needs of a given application. At the same time, systems are becoming more local. For recent history, water recycling was handled at a municipal level in developed regions with a central water and wastewater treatment. More industrial sites are now considering not just incoming water treatment needs, but also wastewater handling, treatment and reuse at their site.

PARLIAMENTARY REPORT CALLS FOR *better protection of rivers*

A look into the health of English rivers and efforts in monitoring pollution.

Meteor Communications has welcomed a report on river water quality, published by the UK Environmental Audit Committee (EAC). Following consultation with a wide variety of stakeholders, the report revealed evidence of river pollution in England.

However, Andrew Scott, technical director of Meteor Communications, who provided evidence to the committee, said: "Of course, it is good that this vitally important issue is being highlighted, and we are pleased to note that the report specifies a wide range of measures that should be undertaken to improve water quality; all of which should be underpinned by effective monitoring.

"The report also highlights the need for greater investment in infrastructure, which will be vital in the pursuit of the report's goals."

The data published by the Environment Agency, under obligations originally established by the European Union (EU) Water Framework Directive, showed that only 14% of English rivers met good ecological status and no river met good chemical status. The Environment Act 2021 empowers Ministers to set long-term statutory targets for the improvement of the natural environment and requires a long-term target for the improvement of water to be set not later than 31 Oct 2022.

Several witnesses criticised the use of 'spot sampling' suggesting that this method "dramatically reduces the likelihood of detecting pollution incidents". Witnesses also urged the introduction of continuous real-time monitoring of water quality. For example, Salmon and Trout Conservation observed that technological developments in monitoring meant that "continuous monitoring should now be both practical and affordable for the

Environment Agency to use widely, especially at potentially high-risk locations such as sewage treatment works."

The Centre of Hydrology and Ecology concurred: "The use of multi-probe Sondes with telemetry to detect ammonium, turbidity and dissolved oxygen concentrations in effluents at hourly frequencies, alongside flow gauging, could provide an accurate estimate of pollution loadings coming from sewage treatment works, an early warning system to detect sewage treatment works failures and provide the key data for researchers to evaluate the impact of combined sewer overflows on downstream river water quality and ecology."

The report provided further evidence in support of continuous monitoring. For example, it said continuous monitoring could provide a high level of certainty as to the condition of a river and the causes of pollution, thus alleviating the need to apply complex statistical processes to data analysis. The technique could be cost-effective if used in a targeted way. It was suggested that if there is a particular problem to investigate, the agency can find out more from continuous monitoring in two weeks than they would probably find in many, many years of random sampling.

Salmon and Trout Conservation also recommended the use of continuous monitoring, especially with the 'spikey' nature of discharges from such industries as watercress and trout farming. It said that the technology has progressed so markedly that continuous monitoring should now be both practical and affordable for the Environment Agency to use widely, especially for potentially high-risk polluters such as sewage treatment works. In addition, the report said that the Environment Agency, in its submission, had said that it would like to explore the use of continuous monitors for the quality of effluent that could "trigger early warning if effluents were starting to deteriorate" for regulatory purposes.

Meteor Communications' Environmental Sensor Network (ESNET)

During his presentation to the EAC, Scott explained that remote, continuous river water quality monitoring technology is already well-proven, and he elaborated: "Over 300 of our Environmental Sensor Network (ESNET) outstations are currently monitoring UK rivers, but many more will be necessary in the future because, for example, there are over 6,000 sewage treatment works in England alone.

"The current ESNET users are the Environment Agency, seven water companies, environmental consultancies and other water sector bodies. ESNET produces scientifically robust, legally enforceable evidence that truly reflects the dynamic nature of the surface water environment. It differentiates and identifies sources of pollutants from man-made activity such as sewage treatment works, combined sewer overflows and agriculture; outputting high-resolution data for the most important water quality parameters."

The ESNET systems typically monitor parameters such as dissolved oxygen, temperature, pH, conductivity, turbidity, ammonium, Blue Green Algae and chlorophyll. However, it is also possible to include other water quality parameters as well as remote cameras, water level and flow, or meteorological measurements. The addition of autosamplers enables the collection of samples for laboratory analysis, which enables the measurement of other pollutants such as pharmaceuticals and plastics. Autosamplers can collect at pre-set intervals or when initiated by specific alarm conditions. Meteor Communications stressed this is a particular advantage for water companies and regulators because it enables the immediate collection of samples in response to a pollution incident, which informs mitigation measures and helps to identify the source of contamination.

The ESNET systems were designed for the collection of real-time data from remote locations because they operate on low power and wirelessly connect with the MeteorCloud web portal providing secure access for viewing and downloading data.

Summarising, Scott said: "The EAC Report provides a detailed plan for improving water quality in our rivers, but as the report says, this will require a significant investment in infrastructure. A relatively small part of that investment, we believe, should be in a much higher number of remote continuous water quality monitoring systems. This will significantly improve our understanding of pollution, enable rapid response to pollution incidents, and allow source attribution when such events occur. It is therefore very pleasing to note that the report recommends that the Environment Agency should rapidly introduce cost-efficient and effective sensors at an increased number of locations."

CONDITION MONITORING
using the drive as a sensor

Variable speed drives have been used for over half a century, with the main advantage being the reduction of electrical energy use. With the advance of Industry 4.0, the role of the drive moves from that of a pure power processor to that of an intelligent element of the automation system. The ability of the drive to act as a smart sensor makes it a natural choice when implementing condition monitoring. This article further discusses how this can be used in water and wastewater applications.

NEW DRIVE CAPABILITIES FOR WATER AND WASTEWATER APPLICATIONS

Variable speed drives with power electronics converters have been used for more than half a century, and today, more than 20% of electric motors are driven by variable speed drives[1]. The main reason for using drives is the reduction of energy use. However, there are also other reasons for employing drives in water and wastewater applications, such as for process control, avoiding water hammers or optimised well exploitation.

Since the introduction of micro-processors to control the drives, additional functionality has been added to the original function – which is that of a powerful processor. For example, drives can perform pump de-ragging in wastewater applications, they can control several pumps in a cascade system in water pumping applications or can bypass certain frequencies to avoid resonances.

The advance of Industry 4.0 has given an additional boost to these additional functions. As Industry 4.0 deals with information and networking, Danfoss has started using the drives as smart and networked sensors.

INDUSTRY 4.0 IN MOTOR AND DRIVE SYSTEMS

Industry 4.0 is a generic term, suggesting a fourth industrial revolution that can be characterised by networking. Although the term is somewhat vague, a possible definition could be “Industry 4.0 describes the intelligent networking of people, things and systems by utilising all the possibilities of digitalisation across the entire value chain”.

The impact of this trend on motor systems is a migration from what is known as the “automation pyramid” to networked systems. This means that the various elements of the system, such as motors, drives, sensors and controls, get interconnected and also connected to a cloud – where data is stored, processed, analysed and decisions are made.

THE DRIVE AS A SENSOR

In variable speed drive applications, the availability of microprocessors in the drive and bus communication options, combined with current and voltage sensors, opens new opportunities. Moreover, additional

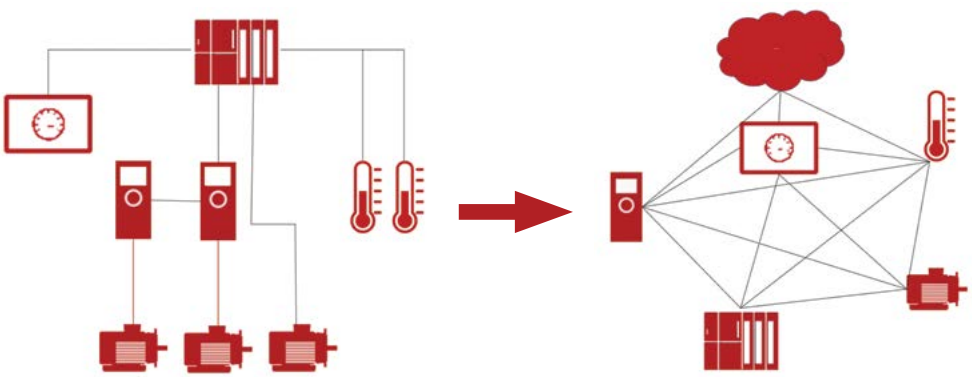
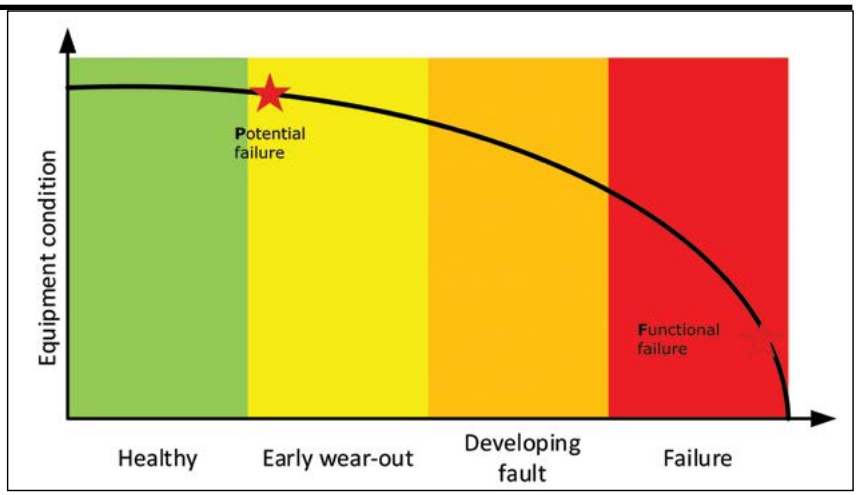


Fig. 1: Industry 4.0 refers to the transition from the automation pyramid to networked systems



From left:
Fig. 2: Drive as a sensor
Fig. 3: PF-curve representing the condition of a component until functional failure

sensors such as vibration and pressure sensors can be connected to the drive. This allows the drive to be used as a smart sensor for conditioning monitoring. The available information offers various use cases, like system optimisation, energy efficiency optimisation, and condition-based maintenance.

EMBEDDED CONDITION-BASED MONITORING

Condition monitoring is a technique to monitor the health of equipment in service. For this purpose, key parameters need to be selected as indicators for developing faults. The equipment condition typically degrades over time. Figure 3 shows a typical degradation pattern, also known as PF-curve. The point of functional failure is when the equipment fails to provide the intended function. The idea of condition-based maintenance is to detect the potential failure before the actual failure occurs. In this case, maintenance actions can be planned before functional failure, with advantages such as reduction of downtime, elimination of unexpected production stops, maintenance optimisation, reduction of spare parts, and others.

1. **Vibration level monitoring**
   Many mechanical failures, such as bearing wear-out, shaft misalignment and unbalances, create some kind of vibration. Thus, vibration monitoring has been established for monitoring rotating machines[2]. There are various methods ranging from basic simple monitoring up to highly sophisticated monitoring[3]. A widely used method is vibration velocity rotronic monitoring system (RMS) monitoring[2]. It is based on the RMS value of the vibration signal that is measured through a vibration sensor.

   Many mechanical faults have a significant impact on the RMS of the vibration, including unbalances, shaft misalignment, and looseness. However, the challenge in variable speed applications is the dependency of the vibration on the actual speed.

Mechanical resonances are typical examples. These are always present, and a monitoring system has to cope with them in some way. Often the fault detection levels are being set for worst-case to avoid false alarms. This reduces the detection accuracy in speed regions where no resonances are present.

Having a suitable vibration transmitter mounted and connected to the drive, the drive can offer advanced monitoring by correlating the transmitter signal with drive-internal signals like speed, or other signals that are relevant for the application. The drive can detect faults early and give traffic light information on the health state of the system to prevent functional failure. Maintenance can be prepared and scheduled in advance while the system can continue operating until the next possible maintenance break.

The vibration level in the normal and faulty condition is also dependent on the type, location and mounting of the sensor. Moreover, it varies with the actual application that is to be monitored. Thus, a learning period is required. This can be done in different ways. The first approach is learning the normal vibration levels during the initial period of operation. This means the application is running normally and the drive learns the vibration in parallel without affecting the operation. When enough data has been collected, the drive starts to monitor the vibration. Secondly, the drive can execute an identification run. Here, the drive controls the motor in a way that enough data is being collected. The possibility of using this second approach depends on the specific application. For example, in a water supply system, the pump may not be allowed to run at full speed at the time of commissioning.

A test set-up has been built to demonstrate the functionality. The fault in scope for this test is a misalignment of the motor shaft. Shaft misalignment adds mechanical load to the bearings and thus reduces bearing lifetime. Moreover, it creates vibrations that can lead to a secondary effect in the system. Early detection of misalignment and correction can extend the bearing lifetime and avoid downtime.

Figure 4 shows the test set-up with an induction motor driving a small pump. An angular misalignment can be created by slightly lifting the baseplate with the red handle. A vibration sensor has been installed on the baseplate of the motor to illustrate the concept. The analogue 4-20mA sensor signal has been connected to the analogue input of the drive.

Figure 5 shows an example of test results. The measured vibration in mm/s versus the motor speed in RMS is shown for two scenarios. In the first scenario, the system is in its healthy state. In this state, a baseline measurement is executed. The warning and alarm misalignment thresholds are derived based on the measured baseline. For the faulty scenario, a shaft misalignment is created by slightly lifting the motor baseplate through the red handle. The measured vibration in the faulty condition is shown in green.

In the above example, the drive can detect this fault. For other applications, the baseline data can be very different. Typically, even in a healthy state, the vibration is dependent on speed. There can even be resonance points that need to be taken into account while monitoring. Other types of faults such

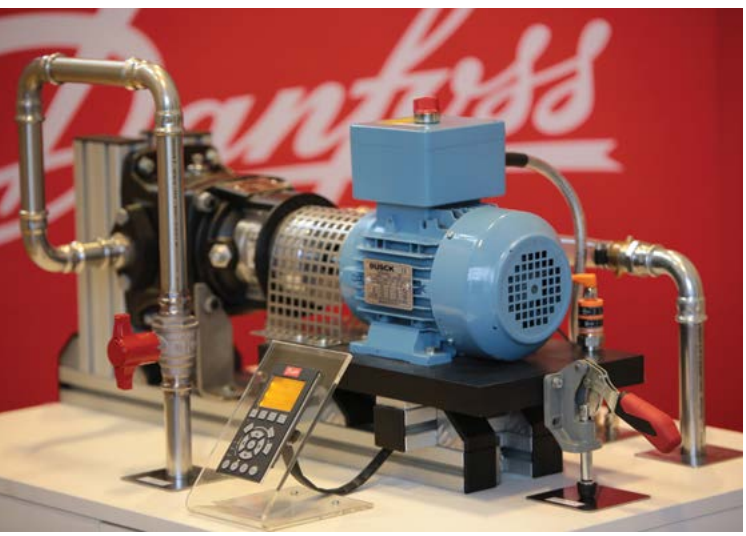


Fig. 4: Test set-up with a small pump driven by an induction motor. Vibration transmitter mounted on the baseplate next to a motor

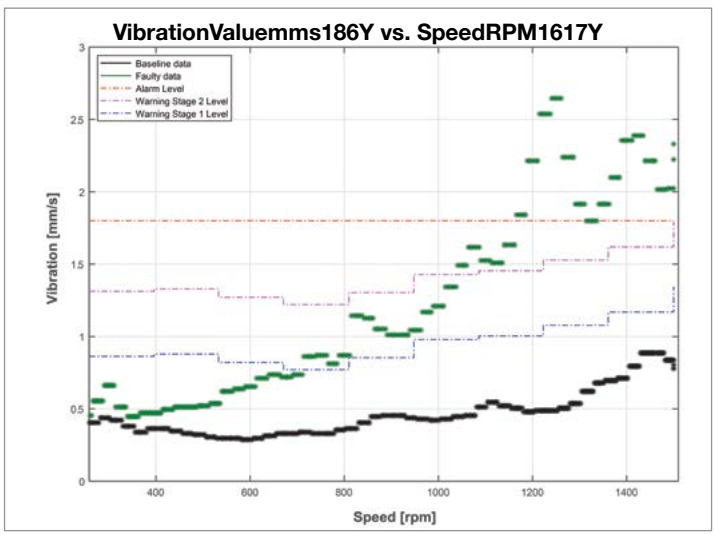


Fig. 5: Test data for two scenarios – fault free in black and fault in green

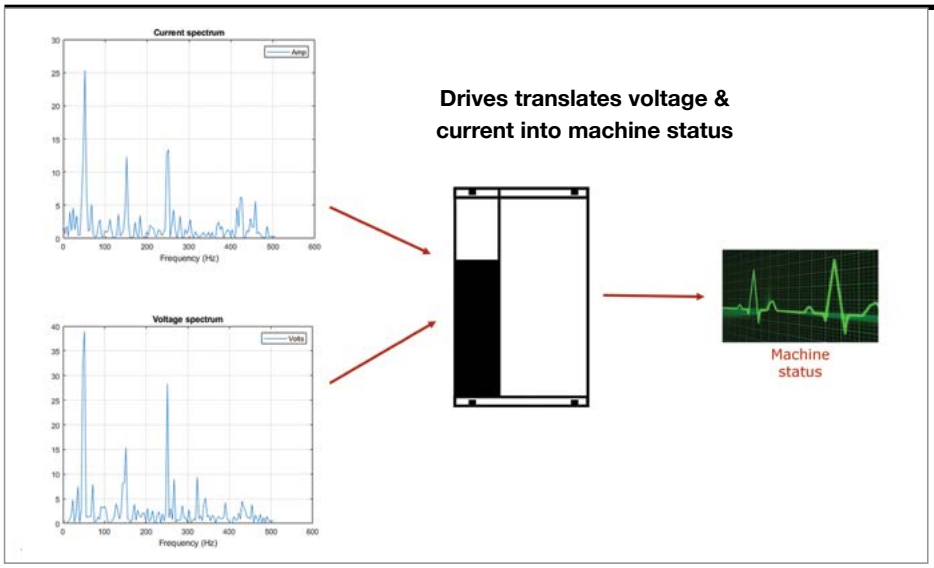


Fig. 6: Electrical signature analysis

as unbalances and looseness create different patterns.

2. Electrical signature analysis

The condition of the motor and application can also be monitored through electrical signature analysis. This technique has been under research for many years. The early studies have addressed direct online machines, and later variable speed drive applications have been investigated too[5,6,7]. With the available processing power and memory in today's drive, these techniques can be integrated into products as product features now.

Figure 6 illustrates the basic concept. Fault condition indicators can be extracted from the motor currents and voltage signals. Frequency components of currents and voltages can be related to motor or application faults like shaft misalignment or stator winding faults. The current and voltage sensors are essential components of drives anyway. They provide the necessary signals for controlling the motor.

These signals can be used for monitoring purposes. Thus, no extra sensor costs are added. Signal processing and analytical techniques play an important role in this context.

The drive, being the controller of the motor, can correlate the monitoring value such as specific current harmonics, with other available information inside the drive. Knowing the controller state, for instance, the drive knows when meaningful spectrum calculations can be performed. Like the vibration level monitoring, the correlation of monitored values with motor speed, load, and other relevant process data can be performed to get more accurate fault information.

3. Load monitoring in pumps

As shown in the previous section, drives are measuring motor current and voltage, and the primary purpose is to use these measurements for controlling the motor. The primary current and voltage measurement is used to calculate various parameters such as motor power, energy, actual motor speed or torque. And these values can be used for monitoring the motor load, for example, a pump.

In applications where the load depends on the motor speed, the torque estimation can be used for determining over-load and under-load deviations. During baseline, the drive "learns" the normal distribution of the load or the load envelope. As in the previous functions, there is a correlation with the motor speed. During monitoring the drive can detect over-load and under-load conditions, which can be caused in pump applications by faults such as fouling, sanding, broken impeller, wear out or others.

CONCLUSION

Condition monitoring can be used for implementing condition-based maintenance – which is an evolution from corrective and preventive maintenance. But conditioning monitoring relies on sensor data; and installing additional sensors can be expensive. However, if variable speed drives are already used in the application, they are a valuable source of data that can be used for condition monitoring, saving unnecessary expense.

This article is provided by Danfoss.

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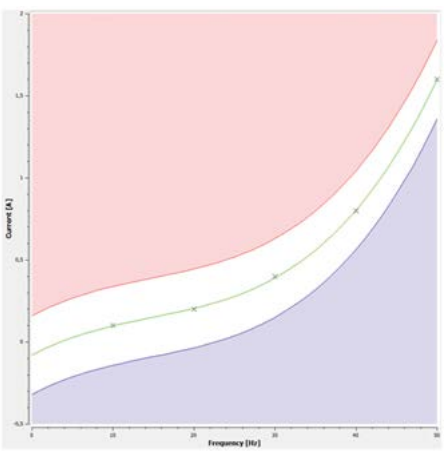

Fig. 7: Load envelope curve

SILENT SALTY *Invader*

The most appalling quality of water is its strength – Scottish poet Nan Shepherd.

By **Greg Weiss**

EXO2 multiparameter sonde from Xylem

In Thailand, more than 10% of its roughly 70 million citizens live in areas that are projected to be underwater by 2050. Based on the direst projections by the New Jersey-based Climate Central, in less than 30 years, Asian megacities such as Ho Chi Minh City, Shanghai, Mumbai and Bangkok could be completely inundated by rising sea levels; pushing hundreds of millions of citizens to migrate further inland away from the high tide line. These low-lying cities are already feeling the effects of rising sea levels, land subsidence (due to chronic groundwater extraction), and extreme climate-related weather and drought. Jakarta's situation has proven so alarming that their parliament has recently approved a US$32.5 billion bill to relocate the country's capital to a more climate benign location in Kalimantan, where it will be renamed Nusantara.

In other countries, these alarming projections are driving governments to accelerate their coastal resilience strategies in anticipation of this impending existential threat. Unfortunatey, the threat is already a reality for many around the world, as the sea advances inland and inundates surface and groundwater networks, otherwise known as saltwater intrusion (SI). Water managers worldwide consider SI to be the biggest untold water story around the globe; labelling it a "silent problem" because it has been easier to ignore politically, compared to other climate change issues, and has avoided, for the most part, the big media radar. On the other hand, for local farmers, burying their heads in the sand hasn't been an option, as their crops such as rice, durian, prawns have declined in yield due to the silent salty intruder.

THE KING OF FRUITS

Farmers in Thailand have been growing durain, known as the King of Fruits, for generations, and are the world's leading producer of this incredibly popular and lucrative fruit. What local durian farmers were hoping to be a bumper crop in 2019, turned out to be a bust, realising less than 15% of the projected harvest. Drought and SI were to blame. The saline waters are having a significant impact on the overall health of the durian trees, and its harvest-able fruit production. The intrusion was particularly bad that year and arrived surprisingly earlier than normal. It is becoming increasingly more complicated for farmers along the coast, where they face a double whammy intrusion as eroded coastlines easily give way to the rising sea. Efforts to protect the retreating coastline have had mixed results, but ultimately, have proven powerless during intense storm-induced wave activity and surge, which has been increasing steadily each year.

Rice farmers are also taking a disproportionate hit during droughts, as brackish water is often the only available water to irrigate their rice crops, which have a low tolerance to salt. This is of great concern not only locally, but worldwide, as Thailand and Vietnam are part of Asia's "rice bowl" that produce roughly 15% of the world's rice. The year 2015 was a particularly bad year for the rice growers in South East Asia. In Ben Tre, farmers lost 450,000 hectares of rice fields, which equates to about 1 million tonnes of rice, due to

seawater intrusion. And during the same year when the durian yields collapsed, the same was going on in the central provinces of Vietnam, which measured salinity values 12x the normal limit. Unfortunately, the bad luck continued for Ben Tre in 2020, as an environmental emergency was declared due to the "sudden and swift" increase in its river system's salinity, which includes the Co Chien, Ham Luong and Mekong rivers. Beyond its impacts on agriculture, these swift changes create acute problems for local residents. Often, freshwater needs to be trucked in or brought downstream on barges to help relieve the gap.

IT'S IN THE RIVERS

Originally considered a drinking and groundwater issue, SI is now becoming commonplace among the global surface water networks and particularly pronounced in the delta megacities of South East Asia. In a way, it is an early sign, and a perfect storm of human's impact from every angle, creating a cascade of feverish symptoms environmentally, agriculturally and economically. With the myriad challenges we face from a rapidly changing climate, none may be more potent than the impacts of SI.

Along South East Asia's massive delta plains, coastal water naturally ebbs and flows, regulated by monsoonal weather and sea. Wet season rainfall fuels coastal-bound rivers and dynamically interacts with the sea's opposing forces of wave and tides, creating some of the most highly productive ecosystems on the planet and a natural first line of defense against erosion.

The delta's rivers also push back against the sea, limiting its advance inland. But as sea levels rise and droughts become more commonplace, the sea's advance upstream is well, advancing. To exacerbate this shift, coastal habitat loss and the growth of upstream hydroelectric dams and sand mining have further weakened the land's ability to push back. The sea is winning; its saltier (and denser) water finding its way further and further upriver, and leaving a path of misery for both people and wildlife.

EYE ON THE SALT

The Chao Phraya River is an iconic symbol of Bangkok and is considered the artery of central Thailand. Travelling from the highlands of Thailand's north through Bangkok

1 Where seawater meets freshwater
2 An EXO water quality monitoring station

and finally emptying into the Gulf of Thailand, the Chao Phraya was the birth site of Bangkok, an area that would blossom into the "Venice of the East", attracting commerce and tourists worldwide.

With growing concern of SI in the Chao Phrya, the Office of the National Water Resources released a tender in 2017 for the installation of a series of continuous water quality monitoring stations along the river to collect and transmit data – particularly salinity – to key stakeholders helping to manage and mitigate the effects of SI. Green Banyan, a Xylem Analytics' partner in Thailand, was awarded the tender and began work in 2018, installing 16 monitoring stations along the Chao Phrya. Each site was equipped with a Xylem YSI EXO water quality sonde, along with power and communications to support the collection and transmission of water quality data to monitor the location and magnitude of saltwater mass intrusion. Each EXO was cabled to a logger system, where data was transmitted via modem to the customer's server.

TOOLS OF THE TRADE

For Green Banyan and its customers, the EXO is at the front lines in the battle to stay ahead of the salty silent invader. Its autonomous and multiparameter capabilities provide a means to continually monitor the location and magnitude of an encroaching saltwater mass. Although the signature parameter is salinity, the EXO also provides the flexibility to measure other parameters, to help fully characterise the intruding water mass, such as turbidity, dissolved oxygen, temperature and others. With its active biofouling protection in a central wiper, it can be deployed autonomously for weeks at a time without cleaning or calibrating, and more importantly, without interrupting the collection of data.

One of the key stakeholders of the SI-monitoring data programme were the upstream dam controllers along the Chao Phraya, who use the data to help decide when to release water to help push back the encroaching saltwater mass; a procedure known as the "water hammer method". If the reservoirs have the available capacity, the dams can release a volume of upstream freshwater to limit the intrusion. Unfortunately, as has happened in the past, if the reservoirs are well below capacity due to drought, front line defences are compromised, and the "hammer" option is limited. The decision-makers also face the difficult choice of reservoir water allocation and utilisation; a trade-off in reserving freshwater for "hammer ops" at the expense of farmer's crops. The farmers often get the short end of the stick. They rely on river and reservoir water to irrigate their crops but have often been deprioritised when a significant intrusion occurs, with any available volume being reserved for driving saltwater seawards.

WHERE DO WE GO FROM HERE?

This is an extremely complicated situation with a diverse and expansive stakeholder list and its concomitant conflicts of interests, both locally, nationally and internationally. But ultimately, something needs to change before these historically and vital fertile lands collapse. A variety of solutions have been proposed, from innovative integrated farming techniques to incentivising a reduction in upstream development like sand mining and dam building. But so far, the only tangible actions have been taken at the local and personal levels.

"Dead fish and dead shrimp, and if we don't have a solution soon, dead farmers too," explained a Mekong Delta-based shrimp farmer, who at 62 years old, has farmed the delta all her life but is now realising, among many others in the community, that their way of life may be coming to an end.

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ADDRESSING PRESSURE MANAGEMENT CONTROL VALVE APPLICATION *for City West Water*

Home to a population of 4.9 million people, Melbourne has a large urban footprint and is faced with the challenges of demand for infrastructure services while dealing with the depletion of the water supplies due to consistently high summer temperatures and drought conditions. These pressures have driven the government to increase awareness of water usage and to construct the country's largest desalination plant for A$3.2 billion (US$2.3 billion).

Water is supplied to the Melbourne metropolitan area by three water companies, one of which is City West Water (CWW), which provides around 100 billion litres of water every year to over one million residents and 40,000 businesses, including Melbourne's central business district. Supplying so many with safe drinking water is a challenge and every year CWW is required to prepare a Drought Preparedness Plan to manage any potential shortfalls in the water supply.

A part of this plan is to proactively reduce leakage across the reticulation networks. CWW has established a suite of actions to achieve this, including active leak detection, mains renewals, rapid response to bursts and leaks, intelligent network technologies and pressure management.

Several pressure reducing valves (PRVs) were installed across the CWW region which serves to reduce leakage and calm the network by stabilising pressures.

CWW installed several PRVs across the region

One such valve installation is the Gourlay Road Pressure Managed Area (PMA). This is a district metered area serving 1,200 properties in the Caroline Springs area of Melbourne. This zone previously experienced very high pressures at times of low demand up to around 100m. CWW determined that more could be done to more effectively manage

the pressures in this zone to reduce unnecessary stress on hot water services, taps and their network infrastructure.

The challenge was that the control valve had to provide data back to the company's SCADA system, and this would require power at the valve sites. It was determined that running power to this installation was not economical and therefore required a more specialised control valve solution. This valve was requested to be self-powered, continually monitor PRV outlet pressure, flow and also provide PRV stem position feedback to provide trends of any potential unusual valve behaviour.

CWW had previously worked with Challenger/Cla-Val on one of the pressure management projects and were satisfied with the product and services provided so when CWW designed the Gourlay Road PMA they approached Challenger/Cla-Val and asked for advice on whether a self-powered PRV is achievable and can also provide supplementary power for the battery-powered RTU logger. Challenger/Cla-Val provided an option of a PRV with a mini-hydro assembly which satisfied all the requirements.

The installed valve is a 150mm PRV complete with a motorised reducing pilot, a valve position transmitter, a valve controller, and an integral Hydro-Powered Turbine installed in the pilot system to power the valve. The turbine works by utilising the available differential pressure across the valve to convert the kinetic energy in the water into a charging electricity supply to a 12VDC 3.5Ahr rechargeable battery pack.

The motorised pilot on the valve allows the downstream pressure to be changed remotely using a 4-20mA signal from the SCADA system. This allows CWW to vary the pressure either on a set schedule or whenever they deem it necessary.

Legend

1 *PRV services to reduce leakage and calm the network by stabilising pressures*
2 *A self-powered PRV is able to provide supplementary power for the battery-powered RTU logger*
3 *The installation of PRV is complete with a motorised reducing pilot, a valve position transmitter, a valve controller, and an integral Hydro-Powered Turbine*

The pilot will revert to operating as a mechanical pressure reducing pilot if ever there is a loss of power.

Valve position is provided by a stem position transmitter providing a 0-100% analogue feedback signal to the provided valve controller. The controller enables CWW to leave the valve in an automated state of control. Using the programmable controller to provide a Flow versus Pressure control curve, outlet pressures are modulated according to changes in flow. All site information is relayed to their on-site RTU all of which is powered by the Hydro Powered Turbine.

The controller was also programmed with an Alarm Condition that in the event of an imminent power failure from the turbine, it will automatically drive the motorised pilot to its default high-pressure setting before power is lost. Once power is restored, the controller automatically reverts to the Pressure versus Flow control curve.

For remote monitoring the controller retransmits; flow, outlet pressure, motorised pilot command signal, feedback and valve percentage position out to the RTU and can be viewed live by CWW personnel. The controller also features a 'display time out' to conserve power when not in use.

The controller is user-friendly and was programmed to follow its control curve. By monitoring incoming flow, the outlet pressure is adjusted accordingly.

As flow demands vary throughout the day the PRV now provides the correct pressure into the network; overcoming friction losses at peak demand and lowering pressures in times of low demand, in turn, minimising background leakage and reducing stresses on the network pipe system.

The installation has now been operational for approximately 18 months.

The mini-hydro turbine assembled PRV provides a suitable solution for CWW to achieve the required outcome for this project. The flow modulation-controlled outlet pressure enabled a further reduction in pressure at low flow conditions. The hydro-turbine enabled the RTU rechargeable battery with extended life and provides communications to the SCADA monitoring.

Sophie Wang, NRW senior engineer with CWW, reported that the project was a success with estimates indicating that there has been a 34% reduction in background leakages – a saving of A$50,828 per year. A 43% reduction in bursts – another saving of A$86,000 per year for every 100 incidents and important, fewer customer complaints.

EVAPORATION TO MAKE *the digestate from anaerobic digestion reusable*

The reuse of digestate from anaerobic digestion as water for different purposes within a plant.

By **Cristina Del Piccolo**

A plant in Belgium feeds an anaerobic co-digestion plant with the organic fraction of municipal solid waste (OFMSW), kitchen waste, waste from supermarkets and floated sludge. The plant is composed of a pulper to pre-treat part of the waste and two anaerobic reactors that produce biogas in mesophilic conditions. The by-product of the reaction is wastewater composed of digestate after solid-liquid separation and a smaller stream from the pulper. The wastewater is highly polluted, with a high load of organic residues, suspended solids and salinity.

The plant wants to be virtuous and reduce tap water consumption, hence, it puts in place an approach aiming at increasing the recovery and reuse of water. There are several points in the plant where water is required. Furthermore, the quality for reused has to be the same and be at the maximum. He started from an analysis of the qualities of water he had available and at the beginning, when the plant was put in operation, they were two:

- A very raw one, that came just after a solid-liquid separation and that was considered suitable for the pulper,
- An intermediate one from the aerobic biological plant so with reduced pollution in terms of organics and ammonia which was considered suitable for the anaerobic reactors.

For the uses such as biofilters, scrubbers and polymer preparation, the operator, in the beginning, was using tap water from the municipality, since the two streams from reuse he had implemented till that time were considered good enough. To further reduce the income of tap water and increase the percentage of water reused inside the plant, the operator decided to add a treatment stage to polish the wastewater to a very high quality so that it could substitute the need for tap water and make the plant independent from an external source.

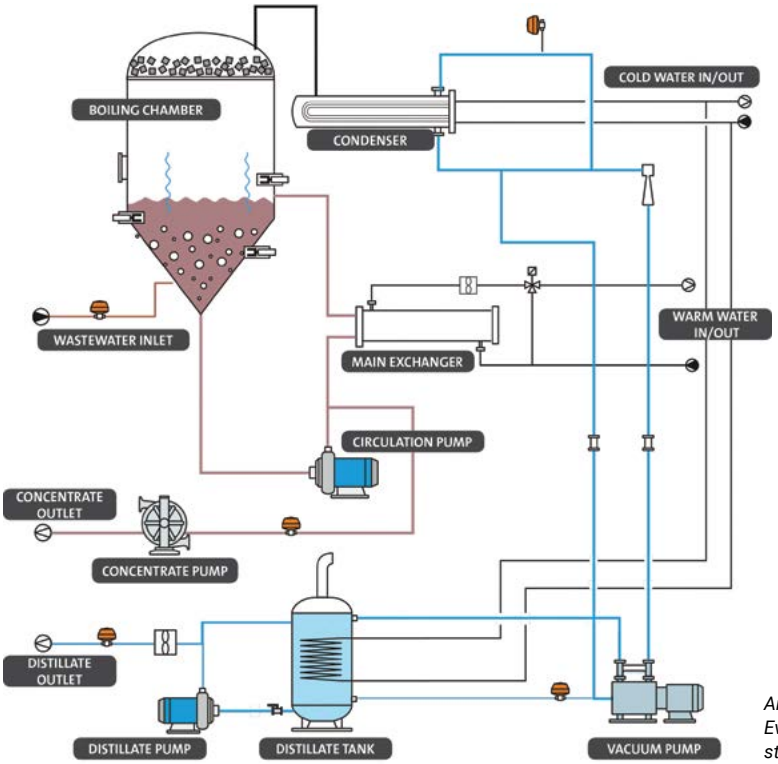
The treatment stage that was added to accomplish this task was an Evaporator from Evaled series AC F fed with hot water and working with forced circulation to manage highly concentrated and polluted streams. Evaporation technology is already part of the solution when highly charged effluents need to be treated. There are several examples of evaporation plants treating successfully landfill leachate which is wastewater quite similar to the liquid fraction of the digestate.

The evaporator was also successful in reducing the salinity that was circulating in the plant and that was increasing due to the closed-loop the operator was realising in the plant. The other advantage that the evaporator brought was to recover the thermal energy from the biogas cogeneration plant, otherwise lost, as thermal energy to sustain the evaporation process so that the Opex associated with the new stage is significantly reduced. In the evaporation process, the main contribution to the Opex is given by the energy consumption: If like in this case, it is possible to take advantage of an available free source otherwise lost, the advantage in terms of reduced Opex is immediately evident.

The Evaled evaporation stage is composed of:

- A pre-treatment which is essentially a pH adjustment and a degassing of the CO2 developed during the acidification phase. The main purpose is to reduce scaling by the elimination of alkalinity always present in such liquid.
- A main treatment which is based on evaporation technology with forced circulation.

The digestate is sucked inside the boiling chamber of the evaporator Evaled AC F 40 FF by the vacuum created inside it. The vacuum is created by the liquid ring pump coupled with the ejector that works with the Venturi principle using air as the motor fluid. A circulation pump sends the liquid from the bottom of the boiling chamber inside the shell and tube heat exchanger where it receives the necessary heat from the hot water stream that circulated inside the heat exchanger. Once heated, the liquid returns to the boiling chamber, and as a result of the vacuum, a portion of the liquid immediately boils. The vapour rises through the demister to dampen the droplets. Vapour is condensed against the U tubes of the heat exchanger. The steam condensation is then performed by an air cooler connected to the evaporator which provides and circulates the cold water for the condensation.



An overview of the Evaled evaporation stage

The vacuum system extracts the condensed distillate together with any non-condensable gases and sends them to a storage tank. The distillate and the concentrate are discharged through a pump. All operations are controlled by a PLC.

The heat exchange is effectively assured by the forced circulation principle, meaning that the liquid is transferred by a centrifugal pump which imposes a certain velocity so that scaling and fouling are prevented to happen on the surface of the tubes of the heat exchanger, thus assuring the possibility to get the highest recovery combined with the lowest maintenance possible. It is the preferred choice, especially in wastewater treatment and especially when the streams to treat are highly polluted, with high concentrations of organics and other compounds close to solubility which is reached later as long as concentration and recovery increase to assure smooth operation.

The experience in treating highly polluted wastewaters is also evident in the choice of the material of construction of the items in contact with the concentrate – the digestate is typically salty wastewater and so the material has to be corrosion resistant. For this reason, Evaled proposes super-duplex stainless steels which ensure high tolerance to anions such as chlorides, sulfates and more in high concentrations.

The hot water comes from the co-generation plant that transforms the biogas produced by the anaerobic co-digestion process upfront into electrical energy which is sold. The engine of the co-generation plant requires to be cooled down and this generates a hot water stream which is normally not recovered but that in this plant is considered a precious resource and sustains the evaporation process in the Evaled unit.

The Evaled AC F 40 FF unit works with a recovery of about 90%, being fed with about 38 tons/day of digestate, producing about 34-35 tons/day of distillate as pure water and about 3-4 tons/day of concentrate recovered as compost after composting.

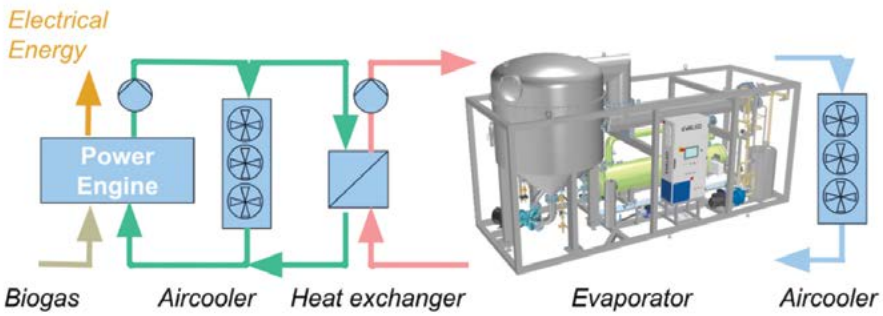
The distillate produced by the evaporator is reused internally in the plant that requires the highest quality. The concentrate is sent to the composting plant to be mixed with the solid fraction separated after the anaerobic stage and transformed into compost which is then sold as fertiliser to farmers, realising a completely closed and highly valuable circular approach.

The evaporation plant has been successfully in operation for almost 20 years and has been upgraded with a newer unit to increase the evaporation capacity and be aligned with the latest increase in treatment capacity of the overall waste treatment plant.

The inclusion of the evaporation stage in this complex waste treatment plant allowed the operator of the plant to achieve several goals, including:

- Zeroing of tap water need and income, making the waste treatment facility 100% autonomous and independent from an external water supply.
- Achievement of a closed-loop circuit and reduction of the environmental impact of the waste plant.
- Optimisation of the available sources and utilities through the recovery of thermal energy previously lost, to feed the evaporation process for free.

Cristina Del Piccolo is CTO of Veolia Water Technologies Italy.



The anaerobic co-digestion process

SARS-COV-2
and the future of wastewater-based epidemiology

Wastewater-based epidemiology is becoming more widely known as a tool in the fight against COVID-19, in part because of a project from the US Centers for Disease Control and Prevention (CDC). The CDC is continuing to build its National Wastewater Surveillance System, testing samples twice weekly from up to 500 wastewater facilities across the country.

By **Jordan Schmidt, PhD**

LuminUltra develops a rapid on-site SARS-CoV-2 testing solution

Testing wastewater to gather targeted public health information in a population has been around for decades, but it has perhaps never been more valuable than it is now. With the recent explosion of the Omicron variant, some jurisdictions have placed restrictions on quantitative polymerase chain reaction (qPCR) testing and moved to a voluntary self-reporting system of rapid antigen testing.

Wastewater testing is a non-invasive, cost-effective method to get an accurate picture of how prevalent the virus is at the community level.

This renewed focus on wastewater-based epidemiology has also resulted in the development of a new technology that enables people with limited training to perform a wastewater test and get results on-site in under two hours, rather than shipping samples off to a laboratory and waiting days or weeks for results.

The future of wastewater-based epidemiology is in localised testing with accessible technology, and it is already here.

WASTEWATER-BASED EPIDEMIOLOGY BEFORE THE PANDEMIC

The origin of wastewater-based epidemiology as a public health resource in the US goes back over 60 years.

Early in 1961, the city of Middletown, Connecticut, administered oral vaccinations against poliovirus, the virus that causes Polio, a life-threatening disease that can infect the spinal cord and lead to paralysis.

Researchers from Yale University's School of Medicine[1] conducted experiments to determine the efficacy of the vaccination campaign by testing wastewater at six sewage sampling sites in or near the city. Their work showed the prevalence of the virus in wastewater corresponded with the vaccination campaign, and they were able to track the presence of individual variants of the poliovirus in the community over a period of months.

The CDC relies on LuminUltra's existing network of physical and mobile laboratories across the US to ensure samples are collected and tested

More recently, wastewater-based epidemiology has been used to map community opioid exposure in the US. Researchers[2] conducted a pilot study of wastewater opioid monitoring in a North Carolina municipality for five months in 2018. The 24-hour aggregate samples were collected from 10 residential manholes throughout the pilot, and opioid metabolites were measured and quantified using liquid chromatography-mass spectrometry/mass spectrometry (LC-MS/MS).

The data were used to map opioid use in particular communities, highlighting opioids that were most prevalent and in which areas. Public health officials identified pharmacies as critical access points for outreach and prevention efforts because they fill opioid prescriptions and are the primary distributors of naloxone, a medication used to reduce the effects of opioids. Researchers stated the maps can "provide an evidentiary basis for the deployment of pharmacy-centred public health responses."

WASTEWATER TESTING FOR SARS-COV-2

A recent study[3] indicated the Omicron variant may be 105% more transmissible than the Delta variant, and by January 2022, the number of reported cases per day had more than doubled in the US compared to January 2021[4].

While some jurisdictions had already abandoned individual testing and reporting, many remaining jurisdictions have now followed suit, as limitations in available or anticipated resources have made it difficult for individual testing to keep pace with the spike in cases caused by the Omicron variant. In doing so, they have acknowledged it is no longer feasible to use centralised clinical testing to determine the true number of infections in a community or state at any given time.

Wastewater testing is emerging as the best tool to provide an accurate picture of total COVID-19 cases and variant cases in a community at this point in the pandemic. Pooled samples from a population, whether it is an entire city or an individual collection on individuals, while preserving the anonymity of those contributing to the wastewater sample.

CDC NATIONAL WASTEWATER SURVEILLANCE SYSTEM

In September 2020, the US Centers for Disease Control and Prevention (CDC) launched the National Wastewater Surveillance System (NWSS)[5]. This is the first national wastewater testing programme in the US, and its purpose is to measure the levels of SARS-CoV-2 in wastewater and track infection trends, both symptomatic and asymptomatic, at the community level.

The system coordinates wastewater surveillance programmes implemented by state, territorial and tribal health departments, to collect localised data that can then be analysed to determine local or national trends. Health departments use this information to adjust their pandemic response as necessary.

The CDC has been developing the NWSS by focusing on four areas: "1) offering technical assistance to implementing jurisdictions; 2) creating a data portal for centralised data submission and standardised data analysis visualisation; 3) coordinating communities of practice to share best practices among health departments, public health laboratories, and utilities; and 4) building epidemiology and laboratory capacity for wastewater surveillance at health departments."

Last December, with the transmission of the Omicron variant becoming more widespread, the CDC announced it was partnering with LuminUltra Technologies to gate data from up to 500 wastewater treatment plants across the country until March 2022 to test for SARS-CoV-2 in wastewater. The testing will identify not just the presence of the virus but also the genetic mutations associated with the Delta and Omicron variants.

LuminUltra has worked in the wastewater industry for over 26 years and has been at the forefront of SARS-CoV-2 wastewater testing throughout the pandemic, creating the world's first rapid on-site SARS-CoV-2 testing solution. The company was also one of the first in the country to use innovative technologies to identify individual variants of the virus.

The CDC relies on LuminUltra's existing network of physical and mobile laboratories across the US to ensure samples are collected and tested from each participating utility twice per week. LuminUltra tests the samples and uploads data to a CDC platform for analysis. The CDC reviews the data, and "to facilitate robust analysis, data comparability, and appropriate interpretation, the NWSS data platform receives SARS-CoV-2 RNA measurements and quality control data, performs automated data quality checks, adjusts SARS-CoV-2 concentrations for wastewater composition and method performance and performs regression analyses from serial measurements to classify SARS-CoV-2 wastewater trends."

LuminUltra's rapid, on-site wastewater solution is currently being used across a variety of sectors, including an international cruise ship line and an international airline

The data is then made available to public health departments through the CDC's online dashboard, and LuminUltra provides a weekly data report to each participating utility.

Because wastewater testing for SARS-CoV-2 can detect the virus up to seven days before symptoms become evident[6], the data collected shows emerging trends as well as current trends and therefore helps public health decision-makers in forecasting everything from hospitalisations and clinical resources needs to the required supply of personal protective equipment.

THE FUTURE OF WASTEWATER-BASED EPIDEMIOLOGY

Creating a national wastewater surveillance system has required much ongoing coordination. As the CDC has said, "Robust, sustainable implementation of wastewater surveillance requires public health capacity for wastewater testing, analysis, and interpretation. Partnerships between wastewater utilities and public health departments are needed to leverage wastewater surveillance data for the COVID-19 response for rapid assessment of emerging threats and preparedness for future pandemics."

Current wastewater testing is mainly the domain of skilled laboratories and technicians. The evolution of wastewater-based epidemiology will be driven by solutions that make wastewater testing more localised and accessible.

In 2021, LuminUltra developed the on-site SARS-CoV-2 testing solution which uses the company's portable GeneCount qPCR analyser to produce test results on-site in under two hours. The solution's portability and ease of use create reliable, laboratory-like results without the shipping time and wait for test results from a lab. This has been especially important during the pandemic when timely decisions about pandemic management can have an immediate impact on controlling the spread of the virus.

Localised testing is, therefore, more efficient and cost-effective than lab testing, and companies have been using on-site testing throughout the pandemic to ensure the safety of their customers and employees while avoiding or mitigating the impacts of prolonged or repeated shutdowns.

LuminUltra's rapid, on-site wastewater solution is currently being used across a variety of sectors. An international cruise ship line has established a wastewater testing programme with regular sample collection and on-site testing for SARS-CoV-2 on individual ships. Tests are performed and results are obtained onboard throughout the cruise. An international airline also uses a localised wastewater testing programme with sample collection and testing onboard the aircraft.

In another application, a major construction project with hundreds of workers at a remote Canadian mine site demonstrates the value in targeted sample collection. Construction workers at the remote work camp are housed in dormitories, which are each equipped with strategically located sampling devices.

When wastewater testing revealed the presence of SARS-CoV-2, the company shut down the individual wing of the affected dormitory and had the 11 workers in the wing isolate alone in their rooms. They then proceeded with individual testing and cleaning protocols. The infection was successfully contained to one worker, and the company successfully avoided a shutdown that would have cost millions of dollars.

CONCLUSION

Time and resources are essential in the success of any endeavour. Historic wastewater-based epidemiology has been done by sending samples, often by mail, to laboratories where testing was conducted by trained specialists. The future of wastewater-based epidemiology is localised and accessible. The lower cost and time savings of rapid on-site testing open the possibilities of wastewater-based epidemiology beyond the realm of public health, into the global market. And into the future.

Jordan Schmidt, PhD is director, product applications, at LuminUltra Technologies.

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SIWW2018 Key Statistics:

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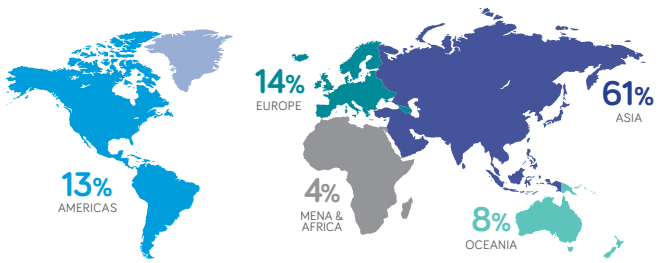
Over **24,000** Participants

From **110** Regions and Countries

S$23 Billon In Total Value for Business Announcements

Top Regions at SIWW 2018: (excluding Singapore)



Statistics reflected based on Singapore International Water Week 2018

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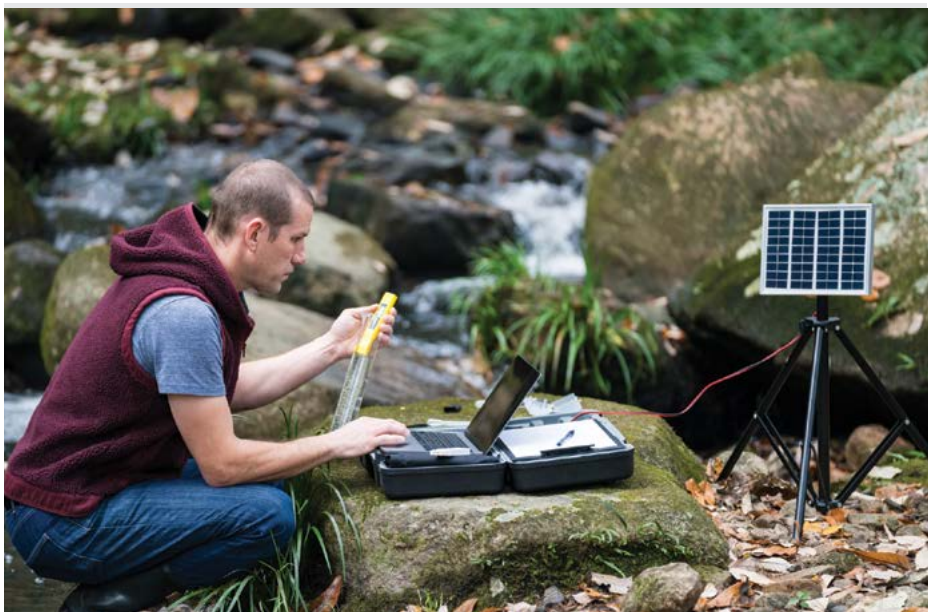
REACHING THE GOALS OF THE WATER ACTION DECADE *with modern data management*

Insights into managing water data.

By **Erik Larson**



Water samples can be entered into data systems in the field

We are three years into the United Nations Water Action Decade 2018-2028 and the water industry has already come a long way in transforming how we manage water, but the journey is far from over. Governments and water organisations recognise that they need a firm understanding of every part of the water ecosystem and water management lifecycle to affect real change. To do this, they are investing in all aspects of data, from collection to management, data quality to analytics, and transparency to accessibility. Data is being shared both internally and externally, with the public, and with global scientists.

Technological advancements have created an explosion in data; however, government agencies and water organisations are in various stages of maturity in collecting and analysing information from a variety of applications including:

- Source water: Using data from hydrological systems, organisations can properly account for and appropriately allocate water resources while minimising the impact on the environment.
- Drinking water: By bringing together data from all treatment facilities, lab testing results, and compliance regulations, organisations can ensure safe drinking water for everyone.
- Stormwater: Using data collected from reservoir levels, stream-flows, and rainfall, environmental organisations can take preventative action against flood dangers.
- Wastewater: Managing a highly regulated resource such as wastewater effectively requires accurate data, advanced record computation, and sophisticated analysis.
- Fats, oils and grease (FOG): Keeping track of activities and evaluating FOG programme compliance can provide data to help reduce risks and work with the community to remain proactive and mitigate violations.
- Backflow prevention: A centralised view of all testable backflow assemblies can provide cities with the visibility they need to ensure the continued preservation of water quality and protection of property.
- Pre-treatment: Industrial pre-treatment compliance can be better managed with the right data analysis and governance in place.

There are still two prevalent problems in water data management today:

1. **Siloed information**
   The data gathered from different water management applications or through manual or offline methods often live in silos across state and local government and industry organisations. Even within the same city or public works department, valuable, actionable information for water managers may not be readily available.

Aquatic Informatics portfolio of software solutions drive the efficient management of water information across the water cycle to protect human health and reduce environmental impact

For instance, a water utility that still relies on a paper-based system or spreadsheets to collect, track, and manage its sampling data, makes it almost impossible to share water quality insights with other organisations in the region. Even if there is a regional or provincially-run environmental monitoring agency that monitors the same watershed, the ability to integrate those insights or data is substantially hindered. A water quality issue in one region is often likely to have a cause or effect on a neighbouring region or department.

2. Lack of analytical tools

Other organisations have lots of data but lack the ability to glean insights from that data – they are 'data rich', but 'information poor'. Without proper tools that can organise, correlate, and compare data, in-depth analysis is not possible meaning water managers are missing out on information that could be critical. The very purpose of collecting data is so that you can act on it.

To make the most of data, we need to break down silos and use modern data management tools that use secure cloud-native infrastructure with rich data analysis. Below are four key components to optimising data.

CONSOLIDATE DATA

Many government agencies are entrenched in legacy systems which can make it hard, if not impossible, to examine data from sources alongside one another. Understanding the relationships between consolidated water data sources is powerful. It can unveil insights that would never be found otherwise and offer correlations that can be used to test new hypotheses about the cause and effect of different water activities. Alone, trends may not raise an alarm but when read together, they can indicate things like pollution from agricultural runoff or predict the risk of flooding with an approaching weather system.

Kootenay Watershed Science (KWS) is an example of a small community taking data consolidation into its own hands. In 2012, a tragic landslide led to the realisation that there was sparse data to understand the Kootenay watershed. KWS was formed to monitor snow, streamflow, and climate conditions in the Johnsons Landing area to better understand the hydrologic regime that contributed to the 2012 landslide and identify signals that may indicate an increased risk of slides in the future. Today, KWS uses a combination of professional hydrologists and volunteer citizen scientists to collect data and maintain a monitoring programme using modern data management software.

Paul Sasso, a hydrologist of KWS, said: "Once we began looking at all our data in the new data management programme, we were able

to see everything in such detail and it was easy to find errors and correct them. It drastically improved the quality of our data as well as our understanding of our hydrometric sites."

The software has a portfolio of capabilities for error detection, data cleansing and flagging, automatic bias corrections, and rating shift management. By automating quality assurance and quality control activities, KWS now has greater confidence in sharing this information with researchers, local governments, and education partners.

DIVE INTO DEEP ANALYSIS

Water utilities can struggle to get real value from the data at their disposal. IT teams, including business intelligence and data science teams, need to team up with managers across the organisation to identify what would be the most valuable analysis to have. Different departments will have different needs, for example:

- Water utilities may ask questions to ensure they have access to clean drinking water
- Water purveyors may ask questions to understand water loss within the system
- Environmental agencies may ask questions to find solutions in extreme weather scenarios

Good data creates demand for good information. In other words, once you know what you can know, you will want to know more.

The City of Ottawa has over 100,000 test results coming in from several different sources internally as well as external labs annually. In 2005, the city migrated to a new modern data management system to make it easier to acquire, access and process their data. With so much information, the opportunity for deep analysis is great and the city can make informed decisions and provide transparency across the organisation. Having historical data easily accessible and in a variety of different views makes it easier for the city to identify trends and better plan for the future. Having the data centralised also helps the city keep an eye on compliance. If there is an issue or missing data from a sensor, it is picked up quickly so the operators can bring the system back into check.

Good data creates demand for good information. In other words, once you know what you can know, you will want to know more.

Erik Larson
Digital Solution Expert for Aquatic Informatics

SHARE KNOWLEDGE ACROSS THE ORGANISATION

Sharing knowledge across the organisation is easier than it has ever been with online portals. Today, departments across the organisation can have real-time access to quality-assured data. Knowledge is power, whether the user is a front-line worker or the mayor, the user has a role to play in events like flooding, or water contamination. Online portals are designed to be user-friendly with modern graphical interfaces that allow for quick visualisation of water data through maps, data grids and charts. Stakeholders can overlay a series of data giving different users different levels of information. Online portals allow different departments to access data that would normally require an information request. For example, the person who needs to file the compliance report can easily extract and download the data they need to complete a filing.

The City of Kelowna in Canada was able to eliminate a legacy software programme by adding a feature to their existing modern data management portal. The new tool is a customised template that enables the generation of a monthly report for the Ministry of Environment. This changed a weekly task from hours to minutes and eliminated the need of training an employee for that task and the cost of running a legacy software programme. Having a centralised cloud-native platform enables the entry of data, and use, by whoever needs it within the organisation, whether it be for tracking, reporting or analysis.

SHARING KNOWLEDGE EXTERNALLY

Sharing data will help us identify the industries and communities that use water well, and those that do not. This knowledge sharing can go a long way to establishing best practices and forming helpful water regulations.

Water Survey Canada (WSC) operates over 2,800 hydrometric gauges and is one of the largest collectors of water data in Canada. Today, WSC uses modern cloud data management technology to interpret and disseminate information to provinces, territories and other agencies across the country. WSC is also part of global data sharing with organisations like UNESCO International Hydrological Programme, World Meteorological Organisation, the International Joint Commission, and others. Scientists know that the more data operators have from different sources, the better, but the quality and analysis of that data is where the true value lies. Due to a large number of agencies and people depending on WSC data, keeping it accessible and accurate in near real-time will always be a top priority.

Community outreach is an important component of any research discipline and much of data collection is effective research. Sharing real-time environmental conditions and their related consequences without politics, just the facts, brings a new level of transparency to climate change. Deepening the public understanding of how intricately the ecosystems are connected makes us all accountable when it comes to adapting our behaviour to sustain the planet.

Erik Larson is digital solution expert at Aquatic Informatics.

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With the rapid development of internationalization and globalization, China Lesso boasts more than 30 advanced production bases distributed in 18 provinces across China, and in some foreign countries. China Lesso remains committed to improving its strategic layout, broadening its sales network and expanding the market. This is how it provides products and services for customers in a timely and efficient way.

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ENSURING THE SECURITY *of water utilities*

The growing digitalisation of public utilities have led to a significant rise in cybercrimes and water solutions players are no exception. **Calvin Lai**, business manager, software and control Rockwell Automation, outlines the security gap between IT and operational technology (OT), and suggests the best practices in conducting a holistic enterprise-wide security assessment.

Rockwell Automation develops new products and technologies to deliver process control solutions to help maximise productivity while reducing costs

Increased systems interconnectivity and network accessibility have led to a rise in cybercrimes, threatening the security of both private and public sector assets. Last year, the Australia Cyber Security Centre (ACSC) reported a 15% increase in cyberattacks compared to the previous year. In February 2021, a water treatment plant in Florida was targeted by hackers who leaked a toxic chemical into their water systems[1].

Public utilities and critical infrastructure such as water treatment facilities are not exempt from security breaches, except those malicious actors can now more easily remotely access and interrupt operations, leading to potentially deadly outcomes. As more organisations across industries embrace technological innovation spurred by the disruptions caused by the pandemic, the speed of this transformation renders their physical information and intellectual property more vulnerable to cyberattacks.

As water solutions providers look to upgrade their systems and operations with the latest technologies, they must place equal importance on their cybersecurity investments.

THE CONVERGENCE OF IT AND OT

Most existing water facilities were built in the 1970s[2], with their brownfield operations in dire need of an upgrade after decades of service. Water industry players also face the challenge of integrating legacy systems with new innovations. The increasing convergence of IT and operational technology (OT) means there is no longer an "air gap" between business operations and the technology directly monitoring and controlling industrial equipment, assets, and processes.

A common oversight is under-protecting OT systems in network security planning, which makes these systems a convenient "backdoor" for hackers. Older machinery and computer systems built before the age of high-speed Internet can also pose a chink in the armour for ransomware attackers to penetrate. For example, while industrial control systems (ICS) that automate or remotely control processes grant workers more seamless access to an organisation's system, it also serves as a free pass to an open and unsegmented network for hackers once breached.

The process of aligning and modernising IT and OT priorities may be extensive, complex, and time-consuming. However, in the long run, this is an invaluable investment that not only neutralises potential threats but also protects the reputation and viability of a business charged with providing a service as critical as potable water.

A HOLISTIC APPROACH TO IT/OT SECURITY

There is no 'one size fits all' when it comes to risk tolerance and cybersecurity. Each part

of a system requires a tailored approach and solution to provide a truly robust safety net.

For starters, organisations should conduct an enterprise-wide security assessment encompassing:

- An inventory of authorised and unauthorised devices and software
- Detailed observation and documentation of system performance
- Identification of tolerance threshold, and risk and vulnerability indications
- Prioritisation of each vulnerability based on impact and exploitation potential
- Mitigation techniques require to bring an operation to an acceptable risk state

The process in aligning and modernising IT and OT priorities may be extensive, complex, and time-consuming. However, in the long run, this is an invaluable investment that not only neutralises potential threats but also protects the reputation and viability of a business charged with providing a service as critical as potable water.

Calvin Lai
Business Manager, Software and Control, Rockwell Automation

Equally important to note is no one single product, technology, or methodology can fully secure plant-wide architectures. Water solution players should adopt a comprehensive defence-in-depth security approach that addresses internal and external security threats.

Rockwell Automation has outlined four key areas that are aligned to industrial security standards, deploying multiple layers of defence – including administrative, technical, and physical – for threat detection and prevention:

1. Visibility

Gaining visibility of ICS assets and network devices is imperative to building a robust security system that applies to any form of industrial ecosystem. This is a continuous process of discovering and identifying all the different assets across the plant-wide network, allowing the IT/OT security team to logically group these assets based on their functionality. This aids in detecting suspicious activities. Knowing the infected device type helps to identify potential and silent vulnerability to remediate similar endpoints in the network.

2. Segmentation

Also known as zoning, segmentation is an important piece of network architecture required by the IT/OT network design team for improving security and performance by grouping and separating network assets. By creating access control lists (ACLs), IT/OT teams can help prevent the spread of the infection and limit it only to endpoints an infected host can reach, protecting the wider network.

3. Anomaly detection and mitigation

The possibility of asset-infection increases when there are little to no access control methods applied to plant-wide architecture. In the event of a breach, the IT/OT security team must move quickly to identify the infected device before deciding how to address the threat based on the level of risk. Industrial operations need a flexible and scalable method to detect anomalies, have the option to block threats, and identify compromised assets.

4. Intent-based security for OT

In many industrial operations, OT relies on IT to define, enable, and manage industrial security policies, architecture, and design. The fluidity of OT requirements means that the IT/OT security team should develop standardised processes that enable OT to express operational intent resulting in dynamic industrial security access policy changes – without having to depend on IT. For example, during a time of remote work, an automated self-service process can allow OT engineers to grant restricted access to industry partners so that can fix or service a plant asset, and then revoke it as soon as the work is complete – all without IT intervention.

FAIL TO PREPARE; PREPARE TO FAIL

Hyperconnectivity means that criminals are no longer encumbered by geography or physical measures of deterrence. Water solutions players are equally vulnerable to the type of ransomware or data-security breaches experienced by other sectors unless they take the necessary measures to secure their IT and OT systems.

Proactively identifying the risks and weaknesses in an enterprise network not only aids in anticipating potential challenges but also allows for greater visibility of operations that can help organisations optimise output and capture growth opportunities.

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INDUSTRIAL SITES MUST FULFIL *water protection obligations*

Installation of a modular WPL Hybrid-SAF

With public attention on corporate environmental activities, there is particular pressure on industrial companies to limit their impact on the local water environment, says **Adam Parmenter**, industrial sales manager for WPL. This means robust wastewater treatment has never been more vital.

Scrutiny of the water sector's environmental performance has intensified over the past two years, catalysed in part by a heightened public appreciation of nature and outdoor spaces. As such, there is mounting pressure on utilities to improve their wastewater treatment systems and meet progressively higher standards set by regulators.

An investigation into the management of wastewater treatment works in England was announced by the Environment Agency and Ofwat in November last year, at the same time as a new Environment Act became law. These measures remove any doubt that the expectations being placed on the sector are immense. Industrial and manufacturing businesses that treat their wastewater on-site and discharge it to a public sewer may find this trend is reflected in tighter trade effluent standards set by water companies.

Centralised treatment plants are already seeking to accommodate multiple challenges, including growing populations, climate change and new pollutants emerging in the environment, which could push utilities to place tighter restrictions on industrial discharges to the sewer network. Having the correct treatment process in place is essential if industrial sites are to operate within the conditions of their trade effluent permits, avoid high tinkering costs and minimise the risk of fines, penalties and prosecutions.

Precise water quality parameters vary from site to site, but all trade effluent permits include a set measurement for chemical oxygen demand (COD), an indicator of the amount of oxygen required to break down pollutants in water. COD determines the effect treated effluent will have on the receiving watercourse – and the number needs to be as low as possible.

Once companies have removed as much COD as possible using screening and solid removal processes, they may find they still need to reduce the levels of organic further to comply with regulations. This is where biological treatment comes into play.

Biological wastewater processing technologies such as WPL's Hybrid-SAF are designed to reduce COD to the levels set by water companies, however stringent. They can also meet environmental requirements on biological oxygen demand (BOD) and ammonia.

The modular on-site treatment units are built off-site in a controlled environment. Easily installed, they can also be retrofitted into existing plants. Additional stages can be added to the process train to remove pollutants such as phosphorous where required by a permit.

The option of hiring offers enhancement to on-site effluent treatment. This option allows businesses to then conduct operational trials, with sampling and lab testing of effluent, to build a case for capital funds and ensure the correct processes are installed, helping inform a permanent, customised solution. The option to hire and then trial the solution before purchasing also means compliance can be achieved.

WPL is a framework supplier to water utilities, partnering with them on their wastewater treatment projects. This gives the business an understanding of the pressures facing the whole sector. Maintaining compliance, even in the most challenging circumstances, is achievable, enabling companies to satisfy all stakeholders, and provide full protection to valued watercourses.

KSB OPENS NEW WORKSHOP *in Singapore*

Housed with a new unit for mechanical seals, the KSB Singapore workshop is now better equipped to address customers' refurbishment and repair needs.

Mechanical seals are among the pump components most susceptible to wear. One way in maintaining pumps for a more extended period is through the selection of the correct mechanical seal.

Furthermore, it is also essential to have the mechanical seal in the pumps inspected and refurbished and is part of the routine maintenance to reduce pump failure in operation.

With an aim to be the one-stop pumping equipment supplier of all the business needs to its customers, KSB Singapore decided to invest in a mechanical seal workshop in Singapore last year. The 430sqft workshop is equipped with new equipment and, the company has a team of professionals with several years of experience to provide service and support to its customers in this region.

KSB provides advice to customers who are looking to convert their pumps fitted with seals from any manufacturers to KSB's mechanical seals. The mechanical seal can be refurbished, repaired or replaced in the workshop, and the company has the necessary equipment and specialists to complete the job.

For KSB Singapore, customer-centric is one of its core values and keeping the business running is vital for the company's success. Hence, it is critical for the company to provide fast and accessible services to its customers in Singapore to get their mechanical seals refurbished, repaired, or replaced promptly. And today, KSB Singapore provides a complete solution to customers pumping equipment needs, in addition to the supply of pumps, valves, systems and control valves.

KSB Singapore is committed and dedicated to providing quality customer support services essential for a business, and customer satisfaction is its top priority.

SINGAPORE WATER ASSOCIATION

NEWSLETTER OF THE SINGAPORE WATER ASSOCIATION

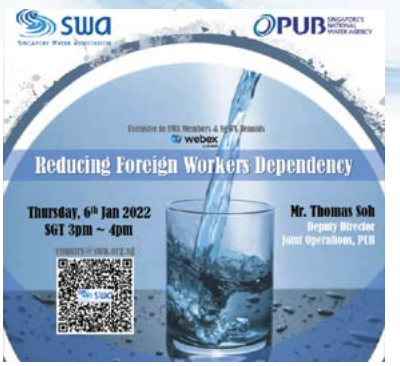
BRINGING
A NEW VIBRANCY
TO SINGAPORE'S
GROWING
WATER INDUSTRY

PUB Sharing: Reducing Foreign Workers Dependency

6 Jan 2022, exclusive for SWA members and SgWX tenants only, Webex

Singapore Water Association (SWA) curated a close-door sharing session exclusive for SWA members and PUB O&M contractors on 6 Jan 2022, marking SWA's first webinar in the new year.

PUB continues to provide a safe and reliable water supply to all households during the pandemic despite the disruption in the supply of foreign workers. Thomas Soh, deputy director of joint-operations at PUB, shared important updates and information in upcoming tender specifications and less reliance on foreign works in order not to disrupt the schedules and assist contractors in delivering their projects.



[Hybrid] Water-Food-Energy Nexus: Towards a Circular Business Economy

11 Jan 2022, complimentary

Another successful event was hosted at PUB Waterhub whereby 96 attendees, both on-site and online, joined us with Senior Minister of State, Dr Amy Khor as Guest-of-Honour. The event started with a welcome speech by Charles Quek, vice-president, general affairs, SWA; followed by a keynote message by Isabella Huang-Loh, chair of the Singapore Environmental Council (SEC).

Speaking to SWA and its members, Dr Khor graced the MoU signing ceremony between SWA and SEC and highlighted one of the notable achievements in circularity is in the water sector, while the water-energy-food nexus also has potential for the agriculture sector.

Other presenters at the event were Dr Augustine Quek from SEC, Kunal Shah from SWA, and Govindan Alagappan from Evoqua Water Technology.

SWA Water Utilities Series: Maynilad Water Operations – Enhancing Resilience in the face of Emerging Challenges

25 Jan 2022, complimentary, Webex

SWA organised its first Water Utilities Series in the Year 2022 with Maynilad Water Services Philippines and drew attendance from more than 100 members and partners. Maynilad is one of the largest water concessionaires in the Philippines.

Randolph T. Estrellado, COO of Maynilad Water Services, gave his welcome speech with an overview of Maynilad while Ronaldo C. Padua, vice-president and head of water supply operations division at Maynilad Water Services, provided insightful advice on how to enhance resilience amidst emerging challenges.

UPCOMING SWA ACTIVITIES

[e-Roadshow] Sharing session with Singaporean-German Trade Chamber and MMI Asia on IFAT 2022 Technology Mission @ Munich (30 May-3 Jun 2022)

24 Feb 2022

Webinar: Nitro – Shortcut Nitrogen Removal by Fluence Corp.

3 Mar 2022

ECO Water Series: Sharing Session by Singapore Environmental Council

11 Mar 2022

[Hybrid] SWA Industrial Water Series – Funding and Project Opportunities by World Bank

17 Mar 2022

Technical Site Visit: Takeda Pharmaceutical Plant @ Woodlands

25 Mar 2022

Singapore World Water Day: HIIT It Up!

27 Mar 2022

PUB Sharing – Coastal Protection

31 Mar 2022

2022 EVENTS CALENDAR

Last year is certainly not the best as we miss the essence of group missions and activities.

This year, it will be bustlingly filled with water shows, technology and business missions, networking events and webinars. We have an exciting and interesting line-up of the Water Series with PUB, Singapore's national water agency.

Download from https://www.swa.org.sg/2022-events-calendar/.

To stay connected on the latest updates on SWA, visit https://www.swa.org.sg, follow us on LinkedIn or Telegram.

SWA WELCOMES NEW MEMBERS

(joined from Jan-Feb 2022)

ASSOCIATE

1. Poly-line Pte. Ltd.
2. Yokogawa Engineering Asia Pte. Ltd.
3. Adzaan Consulting Pte. Ltd.
4. Purexygen Pte. Ltd.
5. Roxtec Singapore Pte. Ltd.

INDIVIDUAL

1. Vincent Ong Wen Xuan

YWP

1. Yeoh Ze Yong
2. Yeh Kuan Chun
3. Kieren Oh Yi Kuan

INTERESTED TO JOIN SWA?

We welcome all organisations who are actively involved and interested in the water and wastewater industry to join Singapore Water Association as either Ordinary, Associate or Institutional member. Sign up at https://www.swa.org.sg/membership/sign-up-online.

VEGA USHERS IN A NEW LEVEL ERA

with the radar sensor VEGAPULS 6X

The new radar level sensor VEGAPULS 6X is the result of 30 years of experience and over 1 million sensors used worldwide

Choosing an instrument can be a laborious process and often involve several questions and product research. VEGA attempted to simplify this process with the introduction of the new VEGAPULS 6X.

Florian Burgent, one of the product managers at VEGA who has been closely involved in the development from the beginning, said: "Ultimately, it's not the sensor that counts but what the users can achieve with it in their applications. Just knowing that they've chosen the best possible instrument solution and that they'll reach their goal faster with it, makes a big difference in their everyday operation."

VEGA now offers one sensor for all applications – VEGAPULS 6X. Selecting the right frequency or determining the DK value of the medium are no longer obstacles because choosing the right sensor specifications has now been simplified. The new configurator asks for the type of application and determines which sensor version is required. The entire procedure now consists of just a few clicks. And of course, an advisory discussion with a VEGA radar specialist is recommended. In any case, the result is simplicity for users and a measurement solution that delivers results independently of the media properties, process conditions, vessel shapes and internal installations.

FOUR-STAGE, ALL-ROUND PROTECTION

VEGAPULS 6X offers decisive technical innovations. It is equipped with a comprehensive safety concept. Functional safety is ensured as it conforms with the Safety Integrity Level (SIL) requirements. The certified sensor has SIL characteristics and provides the necessary operational safety to minimise risks in safety-related applications.

Another increasingly important focus is cybersecurity. In this regard, the VEGAPULS 6X conforms to IEC 61511, which fulfils the requirements for the security of system access and communication control. It thus ensures comprehensive process security, right through to the control system.

The third aspect of its extensive safety features is its self-diagnosis system. It continuously monitors the function of the sensor and recognises if it has been impaired in any way, thus contributing to higher plant availability and sensor performance.

Central to these features is a new, second-generation radar chip from VEGA, as Jürgen Skowaisa, product

manager at VEGA, elaborated: "The result pretty much consolidates our entire radar experience from three decades. In its scope and functionality, the chip is unique." It is especially characterised by its low energy consumption, high sensitivity, scalable architecture and universal applicability. The radar antenna system and the chip are connected directly to each other, without cables, for maximum performance.

NEW IN A DIFFERENT WAY: INNOVATION OF VALUES

Besides the technical highlights, the VEGA radar team addressed questions that, from the beginning, went beyond product design: What will be the long-term impact of this technology on the operators who adopts it? How can their work be simplified? What future goals of an industry can be realised with the new technology?

This new approach gave rise to the impulses that make VEGAPULS 6X different. By taking into consideration the users and process conditions of their applications, other points came into focus. These include the challenges in using measuring instruments, such as complicated adjustment procedures, the constant pressure to increase efficiency, and time constraints in general.

FOCUSING ON THE APPLICATION

The task of level sensors is to help users and make it easier for them to monitor their industrial processes. They often make processes more controllable and efficient, but even if they are easy to use, the process of selecting the right one for an application can still be difficult.

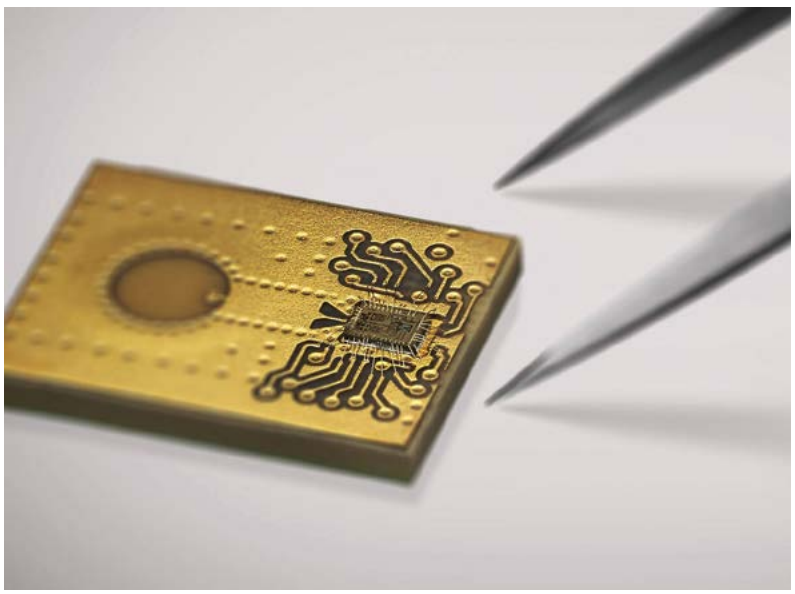
Skowaisa summarised the strategy VEGA is pursuing with VEGAPULS 6X in two words "Maximum simplification", and cited an example: "Until now, there were many different sensors that could be used for an application but today, with VEGAPULS 6X, there is one sensor for all applications." Even set-up and commissioning, he said, has been reduced to a minimum, requiring just a few clicks and the input of basic data.

"Our customers can even order a sensor that has been factory calibrated, customer-specific down to the latest detail, that only has to be installed and connected. It doesn't get any easier than that," he added.

RADAR MADE FOR PEOPLE

With VEGAPULS 6X, VEGA has rounded out its radar measurement technology with four innovations – more safety and self-diagnosis, new radar chip technology, new application possibilities, and simpler adjustment.

"Furthermore, our technology has reached such a high level today that reliable function is no longer the issue. The only risk is choosing the wrong sensor," Skowaisa said. With this new approach to VEGAPULS 6X, VEGA now provides the tools for the application in most cases while keeping experienced application engineers on standby to help with more difficult applications. "In the future, the user will longer have to worry about the technology, frequency or instrument version – the measurement will simply work," he concluded.



The inner value of VEGAPULS 6X – a second-gen radar chip developed in-house

OVER ONE MILLION INSTRUMENTS USED WORLDWIDE

The radar success story of VEGA in radar level measurement began 30 years ago. It includes milestones such as the two-wire radar instrument and the 80GHz radar sensor for liquids. In total, there are now over one million radar instruments from VEGA in use worldwide, in industries such as chemical, energy, food, oil and gas, and many others. With each new instrument generation, the company has set new standards and developed new features that have made the products even more reliable, accurate, robust, and flexible. And the focus is always on high sensor quality.

EUROPEAN €10M RESEARCH PROJECT *to design smart urban water systems*

Smart Water Futures: Designing the Next Generation of Urban Drinking Water Systems is a new European collaboration that explores how the design of urban drinking water systems can fit for the future. Linking the UK, the Netherlands, Germany, Greece and Cyprus, the six-year project will receive a total of €10 million (US$11.3 million) through the European Research Council's (ERC) Synergy Grant and will be led by a water-futures team that combines experience on water science, system and control theory, economics and decision science, and machine learning.

The research will seek to find out how the world can provide high-quality water in a future filled with uncertainty. High levels of urbanisation – 70% of the world's population is expected to live in urban areas by 2050 – coupled with the impacts of climate change will accelerate the increase in water demand.

Prof Dragan Savić, CEO of KWR Water Research Institute, the Netherlands and professor of hydroinformatics at the University of Exeter, UK, said: "Sustainable planning and management of water infrastructure are difficult to solve because of incomplete, contradictory, and changing requirements that are often difficult to recognise."

The research will link short-term decisions to make water utility operations more efficient together with longer-term thinking to create resilient infrastructure for unpredictable environments. An open-source toolbox will enable policymakers to better plan drinking water infrastructure.

"We need a unifying framework for short- and long-term decisions," continued Prof Phoebe Koundouri, professor of economics at the Athens University of Economics and Business, Greece. "This must integrate the correlation between time and uncertainty and be derived from a deeper understanding of the structure of human preferences."

As water networks become more advanced with the integration of digital technologies, more data will be generated leading to large-scale, complex cyber-physical systems. The project will contribute to the design and operation of the next generation of smart water systems.

Prof Barbara Hammer, machine learning group at Bielefeld University, Germany, concluded: "We will face problems that will become moving targets due to changes in the environments and demand. We need to devise robust methods to deal with these uncertainties under continuous changes."

Smart Water Futures will adopt a systems innovation approach to co-design future urban water systems by co-developing the necessary technological, policy and financial pathways.

SINGAPORE INTERNATIONAL WATER WEEK *returns in-person this April*

Gathering water leaders, experts and practitioners to share best practices, co-create innovative urban water solutions and generate new business opportunities around climate resilience, resource circularity and digital water.

The Singapore International Water Week (SIWW) 2022 is gathering water leaders, experts and practitioners to share best practices, co-create innovative urban water solutions and generate new business opportunities. With the resumption of international business travel, SIWW2022 is one of the first international water shows to be held in-person in Asia-Pacific since the COVID-19 pandemic.

The event, which is expected to attract over 15,000 physical and virtual on-demand attendees, is taking place from 17-21 Apr 2022 at the Marina Bay Sands in Singapore, alongside the CleanEnviro Summit Singapore. SIWW2022 also features an on-demand component that allows attendees to watch recordings of sessions delivered at the event via an online platform.

The United Nations (UN) World Water Development Report emphasised that water is the "climate connector" that allows for greater collaboration across the majority of global targets for climate response, sustainable development and disaster risk reduction. In conjunction, programmes delivered at SIWW2022 provides insights into business, innovation and policy intervention to address the world's pressing urban water challenges. With a focus on key thematic areas such as climate resilience, resource circularity, digital water and sustainability, SIWW2022 aims to spur collective action by the water sector to build resilience against climate impacts and create a sustainable water future.

Among the confirmed attendees are government officials and leaders from

Lee Kuan Yew Water Prize

Water Convention Keynote Plenary

utilities and international organisations such as Michèle Blom, Vice Minister, Ministry of Infrastructure and Water Management Netherlands; Long Naro, director-general of Phnom Penh Water Supply Authority; Jose Victor Emmanuel A. De Dios, president and CEO of Manila Water; YB Dato' Ramlee bin A Rahman, CEO of Permodalan Darul Ta'zim; Dr Soumya Swaminathan, chief scientist of World Health Organization; Paula Kehoe, director of water resources for San Francisco Public Utilities Commission; Dave Johnson, deputy general manager – operation of Las Vegas Valley Water District and Southern Nevada Authority; and Simon Parsons, director of strategic customer service planning of Scottish Water.

In addition, SIWW2022 welcomes long-standing partners, players and professionals in the global water industry such as Fiona Waller, head of water quality, Affinity Water UK; Dr Andrew Benedek, chairman and CEO of Anaergia; Booky Oren, chairman and CEO of Booky Oren Global Water Technologies; Joan Rose, Homer Nowlin Chair in Water Research at Michigan State University; Susan Moisio, global water market director at Jacobs; Menno M. Holterman, president and CEO of Nijhuis Saur Industries; Dr Alan Ryder, CEO and founder of RSK Group; Sabrina Soussan, CEO of SUEZ; and Patrick Decker, president and CEO of Xylem.

Flagship programmes and platforms at SIWW2022 comprise:

- The **Water Leaders Summit** which brings global water leaders together to share strategies policy insights and solutions to address urban water challenges. The summit focuses on climate impacts and looks to the future of global water megatrends.
- The **Water Convention**, a platform for professionals and technology providers from around the world to share their knowledge, practical experiences and novel technologies to address the current and emerging water challenges. Comprising six hot issues workshops, an opening keynote plenary, 49 oral sessions, one poster session and a closing plenary, the Water Convention will present over 300 papers spanning the six themes – Delivering Water from Source to Tap (Network), Delivering Water from Source to Tap (Treatment), Effective and Efficient Wastewater Management (Treatment and Conveyance), Cities of the Future, Water Quality, and Health and Nexus and Circularity.
- The **Lee Kuan Yew Water Prize** 2020 will be awarded at SIWW2022 to recognise the achievements of water professionals for their contributions in addressing the world's water problems.
- The **Water Expo** is a melting pot of products and services, featuring 350 international exhibitors with 14 dedicated country and regional pavilions, providing a one-stop marketplace for buyers looking for innovative urban water solutions.
- **Thematic and Business Forums** share critical information on emerging trends, business opportunities and challenges in today's water sector to improve delegates' understanding of the market and provide insights into specific project opportunities.
- **TechXchange**, a forum connecting innovators with investors, partners and buyers to share innovative technologies, promote interactive debate and generate networking opportunities.
- **Technical Site Visits** to some of Singapore's water facilities, exemplifying sustainable urban and water solutions.

Ryan Yuan, managing director of SIWW, said: "We are glad to be bringing back SIWW as an in-person event this April. This year's event carries great significance for a few reasons. First, it marks the resumption of face-to-face business meetings and interactions after a long hiatus. More importantly, building on the momentum from COP26 last November, SIWW2022 seeks to present solutions and innovation to build resilience against climate change and prepare the sector for a sustainable water world.

"Key thematic areas during SIWW2022 will revolve around climate mitigation and adaption efforts by the water utilities, cities and industries, in particular net zero, decarbonisation, nexus and circularity, and adaption to extreme weather events and droughts. We look forward to welcoming the international water community to the show."

Early bird registration for SIWW2022 closes on 14 Mar 2022. Visit www.siww.com.sg for more information.

Singapore International Water Week

The global platform to share and co-create innovative water solutions

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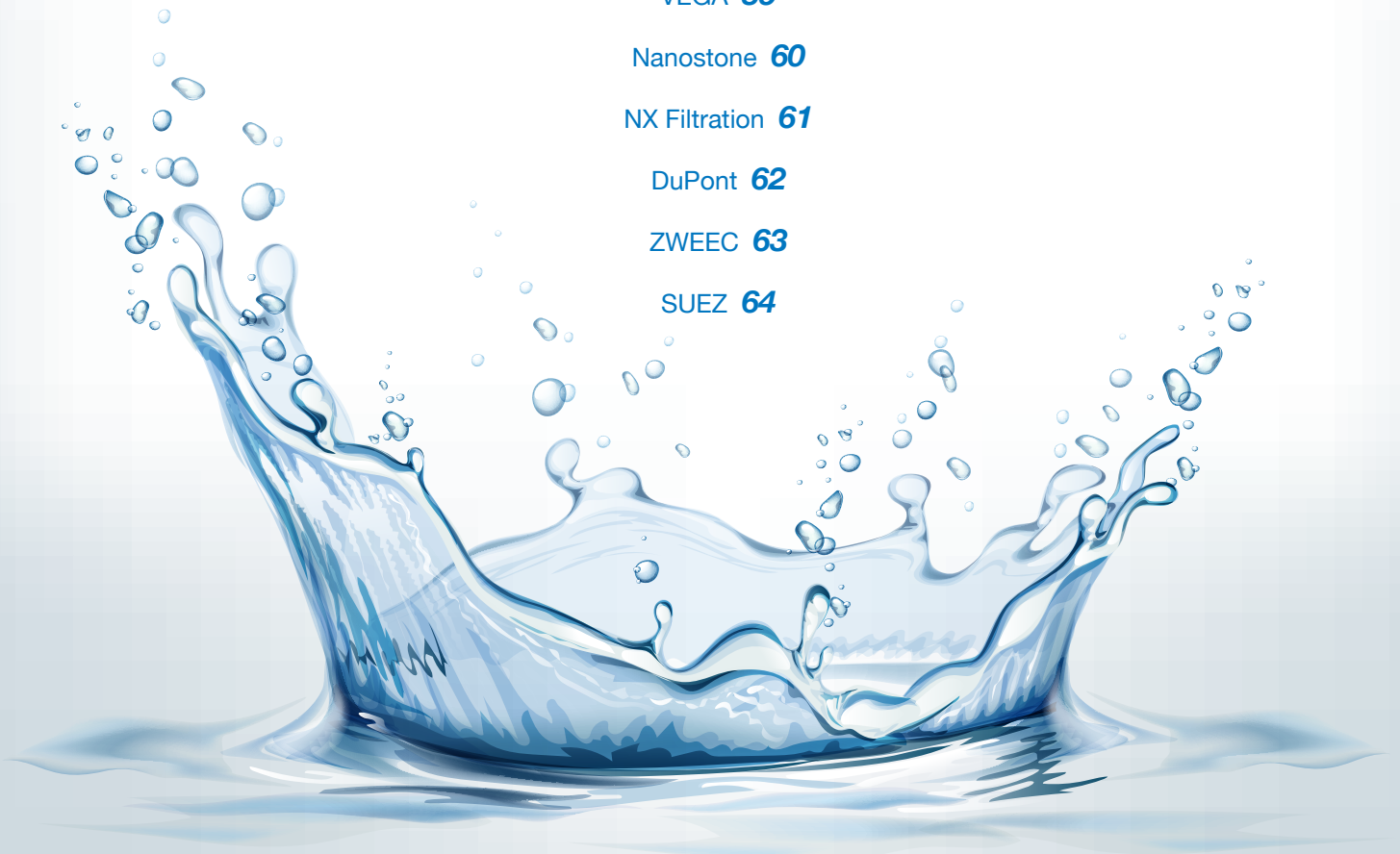

WATER SECURITY ANOTHER CASUALTY OF COVID-19 IN ASIA-PACIFIC

By **Bambang Susantono**

Children walking to a nearby river to get water in Laos (Photo credit: ADB)

The COVID-19 pandemic not only weakened economies and health systems, and resulted in human loss in the millions, but also widened existing gaps in realising development targets on water security.

The United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) Progress Assessment shows that Asia and the Pacific are off track on achieving all of the Sustainable Development Goals (SDGs) by 2030. Among those is SDG6, which targets the provision of universal access to safely and sustainably managed water and sanitation. Five of the six indicators for SDG6 that have credible estimates have barely reached the mid-point from the 2000 baseline.

The disease may not be water-borne, but proper handwashing is essential in preventing and controlling infection. COVID-19 has therefore also highlighted the importance of safe and adequate water services for hygiene, disinfection as well as for drinking.

VULNERABILITY IN ASIA AND THE PACIFIC

In Asia and the Pacific, the proportion of people without access to safe drinking water declined from 17.8% in 2000 to 6.3% in 2015. But water contamination and unequal access remain critical issues. During the same period, the proportion of people without access to safely managed sanitation declined from 48% to 35%, representing an additional 580 million people gaining access to safe sanitation. Regional disparities are still apparent with as many as 59% of people in South and South-West Asia still facing poor sanitation.

In a report by the Asian Development Bank, 22 out of the 49 developing member countries tracked for water security were found “insecure”, representing 2 billion people or about half of the region’s population.

The pandemic’s impact on the water sector has had significant gender implications. In many developing countries, women and girls are responsible for fetching water from communal sources or water vendors, potentially increasing their risk of COVID-19 exposure. Shared and poorly maintained sanitation facilities put women and girls at heightened risk of contracting COVID-19 as they manage their menstrual hygiene needs.

Asia and the Pacific is also the most disaster-affected region in the world, home to more than 40% of the globe’s calamities and 84% of the people they affect. This adds another dimension to the region’s water insecurity since many water utilities and resource managers in the region have been faced with dual challenges of dealing with COVID-19 and disasters, such as cyclones Amphan and Yaas that hit South Asia in 2020 and 2021.

UNCERTAINTIES FACING WATER SERVICE PROVIDERS

Many governments have intervened to ensure the continuity of critical water services during the pandemic, in some cases providing direct financial support to water service providers. In the absence of government relief, the financial losses from the pandemic are borne by water service providers. The revenue decline is the single biggest financial impact on water service providers. This is due to the sharp decrease in commercial and industrial water consumption that may not be fully offset by the increase in household consumption. Even with increased household consumption, some utilities have been unable to collect payments from residential customers in part due to customer relief efforts. Prolonged uncertainty over how service providers will be compensated for losses incurred due to the pandemic – either through government transfers or increased customer tariffs – may lead to reduced capital and maintenance spending, as well as significant changes to operating and maintenance planning, in the future.

As long as the pandemic persists, full financial recovery for many service providers may not be possible. The resumption of some economic activities has partially increased water demand and revenues for service providers, but many are still operating at a loss.

Asia and the Pacific is the most disaster-affected region in the world, home to more than 40% of the globe's calamities (Photo credit: ADB)

POST-PANDEMIC ERA

The post-pandemic recovery of the water sector will require a strong focus on preventing and responding to future health crises, and acceleration of universal access to water and sanitation.

In particular, governments and service providers must provide greater sanitation access. There are 369 million people in Asia and the Pacific without access to basic sanitation services, and the sanitation burden is borne disproportionately by the poor and vulnerable. Designing safe, inclusive, sustainable, culturally sensitive, and resilient sanitation service present an investment opportunity not only for governments but also for the private sector.

Conventional sewerage implemented by wastewater service providers is not only costly but also impractical in many instances. Citywide Inclusive Sanitation is an urban sanitation concept that ensures everyone has access to safely managed sanitation by embedding a range of services – both onsite and sewered, centralised or decentralised – tailored for the realities of the world's burgeoning cities.

The water sector after the pandemic must have a thorough understanding of the vulnerabilities and risks facing all of its stakeholders, systems, and resources. Service providers must identify and assess the risks faced by marginalised and vulnerable groups within their ambit of service, and the risks to their resources – physical and human. This will help them manage their resources and understand the possible ways for extending critical services to presently unserved groups or areas, to prepare for more effective and efficient crisis response and management.

Extension of water supply services to the entire population and sustainable management of water resources entail employing both established and innovative approaches, including decentralisation and digitalisation. Some technologies work more efficiently and are cheaper at low-scale applications. This is in contrast to the large economies of scale that water service providers and resources managers are typically configured for; in this way, decentralisation offers the potential for equitable service provision, provides redundancy in the systems, and helps speed up the implementation of suitable water supply and sanitation services and localised water resource management.

ACHIEVING RESILIENCE

Water services and resource management must be designed for sustainability and long-term resilience. Water is the primary medium through which we will feel the effects of climate change. The pronounced impacts of climate change on the water cycle also alter the operating parameters for many service providers and water resource managers in terms of supply and quality. Legacy systems are already at risk of failing to meet the demands of countries that experience rapid climate change such as Nepal and in the Pacific region. This does not bode well for developing countries that are intensifying investments in inflexible infrastructures, such as large multipurpose dams.

The pandemic also showed the need for water managers to be digitalised. Innovative technologies are available at affordable costs, that increase efficiency and bring resilience to both service providers and communities. Remote monitoring of quantity and quality of water, digitalised billing, and early warning systems to handle disasters, are a few examples. Adoption of technology has been slow in the water sector, despite evidence of its success across a wide range of applications. Demystifying the technology and demonstrating that users can choose the speed at which they implement it is key to its adoption.

TOWARDS A NEW NORMAL FOR WATER SECTOR

The post-pandemic "new normal" of the water sector will require a strong focus on preventing and responding to future health crises, accelerating access to water and sanitation, and adopting digital technologies.

The "new normal" of the water sector must include a thorough understanding of the risks faced by vulnerable groups in society. Service providers must identify and assess the risks faced by marginalised and vulnerable groups. This will help them understand the possible ways for extending critical services to presently unserved groups or areas, as well as prepare for more effective and efficient crisis response and management. Achieving this will not only help prepare for any new pandemic but will be key to tackling the bigger climate change challenge ahead.

Bambang Susantono is vice-president for knowledge management and sustainable development at the Asian Development Bank (ADB).

XYLEM HIGHLIGHTS DB600 DATA MONITORING BUOY

In this issue's accompanying article, Silent Salty Invader, it describes the Chao Phraya River water quality monitoring system, which was based on a network of "fixed", shore-based platform stations to help the Thai government alert key stakeholders affected by saltwater intrusion. Often, however, site conditions or project budgets are not conducive to a fixed station design, and so a buoy-based monitoring platform can be the ideal alternative. As do fixed platforms, these buoys provide continuous and autonomous monitoring of key water quality parameters, which are critical in the pursuit to protect Earth's most precious resource – water.

One such buoy-based platform, recently launched by Xylem, is the DB600 data monitoring buoy solution. The key features of this buoy are its size, user-friendly assembly and plug-and-play design. This buoy can be deployed by a single person, in water depths up to 20m and at current speeds of up to 4 knots. The DB600 package includes everything required to transmit real-time water quality data directly to the operator's device, with industrial field reliability. A global SIM card is provided with each buoy.

The buoy is custom built to be paired with the YSI EXO multiparameter sonde. The EXO sonde supports a suite of water quality sensors, including "The Big 5" parameters, algal chlorophyll and accessory pigments, nitrate, and others. The EXO's central wiper provides the biofouling protection necessary for longer-term deployments, particularly in tropical climates.

In addition, Xylem/Aanderaa's Direct Current Sensor (DCS) can also be fitted to the DB600, which is critical if the project requires simultaneous monitoring of surface water speed and direction. For example, monitoring turbidity during dredging operations gets a data-value boost when current velocity is combined, providing the user a means to assess the transport of suspended dredged material.

Real-time data can be easily viewed on any device using Xylem's HydroSphere data platform, or Eagle.io, which also provides geofencing to alert users if the buoy drifts off-site due to being unmoored or third-party theft, and also provides data alarms to alert the user via e-mail or SMS if a parameter's user-defined threshold has been exceeded.

In the Asia-Pacific region, the DB600 has already been deployed in a variety of diverse environments, from the Great Barrier Reef to a small bay off St. John's Island, Singapore. It has been employed for monitoring support in seaweed farming operations in Indonesia, as well as for municipal drinking water in southern Peninsular Malaysia.

Xylem is exhibiting at ***booth B2-Q09.***

Xylem's DB600 data buoy in various stages of deployment

Robust controller and display instrument for level sensors

RADAR IS THE BETTER ULTRASONIC

The degree of automation in the wastewater industry is steadily increasing. Many facilities now operate completely autonomously. For that reason, the associated measurement technology must be reliable and maintenance-free.

VEGA has extended the VEGAPULS family with a new instrument series for continuous level measurement in the wastewater industry. These compact radar sensors measure at a frequency of 80GHz and deliver accurate readings over many years, regardless of the ambient conditions. The new radar series is available in two versions – as a compact model with cable connection housings, and as a standard model with fixed cable connection.

This makes the new VEGAPULS ideal for, among other things, flow measurement in main sewers leading to sewage treatment plants, determination of the degree of contamination in mechanical screening or level measurement in rainwater overflow basins. With the high precision of the radar sensors, the impounded and discharged water quantities can be measured with just one sensor. Up until now, such measurements were mostly carried out with ultrasonic measurement technology, which was often influenced by environmental factors such as solar radiation, condensation, temperature fluctuations or build-up.

BUILD-UP IN CONTINUOUS LEVEL MEASUREMENT

Sensors are constantly faced with the issue of build-up at many level measuring sites. In the case of ultrasonic sensors, for example, contamination on the sensor face greatly affects the reliability of the measurement signal and enlarges the dead zone. The situation is different with radar technology. Optimised signal processing enables radar sensors to suppress interference caused by build-up on their antenna system. On top of that, radar technology is generally more immune to the effects of dirt and build-up and do not have to be cleaned.

NO DEAD ZONE

Another advantage is that the new sensors have no dead zone, and thus measure right up to the top of the container. Typical areas of application are therefore emergency power generators or storage and buffer tanks, among others. The new compact sensor delivers measuring results, even in small tanks and media with poor reflective properties. Furthermore, they can be installed in very confined spaces and small process fittings.

LEVEL VALUES OF PROCESS AND ENVIRONMENTAL INFLUENCES

Due to their physical measuring principle, ultrasonic sensors are easily affected by ambient conditions. For example, the transit time of sound changes with temperature, like warning by the sun or varying vapour and gas composition, which can all affect measurement accuracy. Strong wind or rain, or even fog, can dampen the emitted sound waves and restrict their measuring range. Radar sensors, however, are not affected by temperature or pressure fluctuations, vapours, gases or vacuum and deliver readings under all conditions.

VEGA is exhibiting at ***booth B2-D08.***

CERAMIC ULTRAFILTRATION MEMBRANE INNOVATIONS TO ADDRESS CHALLENGING WATER TREATMENT ISSUES

A TX drinking water plant installed with Nanostone ceramic membranes reached the daily capacity of 14.4 MGD

For decades, ceramic membranes have been successfully deployed on a range of water treatment applications – from seawater desalination pre-treatment, drinking water treatment to industrial water treatment – and provided a viable alternative for polymeric membranes. Ceramic-based membrane filters offer a robust membrane solution that does not exhibit integrity issues and capacity decline. Plus, ceramic membrane installations built more than 10 years ago are still in operation, allowing suppliers to offer warranties for up to 20 years.

Many drinking water plants with polymeric membranes have been converted to ceramic membranes. This growing adoption is due to a shift in economics that favours ceramics due to both product design features as well as more efficient manufacturing methods. Recent technology, such as Nanostone Water's CM-151, have enabled ceramic ultrafiltration (UF) to become a lower lifecycle cost alternative to polymeric microfiltration (MF) and UF membranes. In addition, designs are available to allow retrofitting of failing polymeric membrane plants.

When it comes to applications with complicated water sources, such as seawater desalination pre-treatment and industrial water treatment, the ceramic membrane also plays an important role as a barrier and protection to the whole process.

Many desalination plants around the world are unable to operate at the designed rate due to underperforming pre-treatment systems. Dissolved organics and suspended solids often bypass desalination pre-treatment systems and foul reverse osmosis (RO) polymeric membranes forcing curtailment of production and significantly increasing desalination costs. These shortcomings are related to seawater variances resulting from many factors including tidal effects, algal blooms, marine fuel oil and dissolved organic content. And this trend in water quality deterioration is anticipated to continue with climate change.

In the industrial world, industries find themselves competing with people for potable water and have been relying more on impaired water resources to sustain increasing industrial output. In particular, industrial operators have turned to unconventional sources like treated wastewater effluent from local municipalities as well as implementing tighter water management and reuse policies recycling water within plant operations. However, with many industries, the recovery of plant water can be challenging due to the aggressive nature of particulate material and suspended solids.

The development of new ceramic membrane filtration technology enables these challenging streams, either the seawater of an algal bloom or the wastewater from the industries, once complex to treat, to be processed reliably and economically.

Nanostone ceramic membrane technology has been redefining advanced water treatment with its ability to physically remove suspended solids and pathogens from even the most challenging waters with "reliable, simple and cost-effective" processes, and is a solution that will stand the test of time, the company claimed. Its single-step solution also eliminates multiple pre-treatment processes, reducing capital expense, land, and environmental footprints.

The company's core technology features an aluminium oxide ceramic core housed in a fibreglass vessel. The Nanostone design optimises water transfer via permeate conduit channels that run the length of the module. Water enters the bottom of the module, then enters the feed channels. The flat sheet segment design allows low-pressure flow, and the ceramic membrane coasting inside of the channel walls prevents the suspended solids, bacteria, and viruses from passing through the structure.

Visit Nanostone at ***booth B2-L35*** *to find out more.*

INNOVATIVE AND SUSTAINABLE NANOFILTRATION MEMBRANES ADDRESSING GLOBAL WATER CHALLENGES

Key global challenges around water scarcity and water quality are developing rapidly, driven by climate change, regulation and health awareness. Nevertheless, these challenges are still being addressed with technologies developed decades ago, including combined ultrafiltration (UF) and reverse osmosis (RO) schemes. With its direction nanofiltration (dNF) membranes, NX Filtration now seeks to disrupt this market, offering advantages in terms of selectivity, footprint and sustainability.

The hollow fibre dNF membranes can, in one single step, remove low molecular weight organics from polluted water, including micropollutants, colour, antibiotics, PFAS, but also bacteria and viruses from water. At the same time, they offer sustainability benefits in terms of low energy use and avoidance of pre-treatment chemicals. The low fouling and chlorine resistant characteristics have resulted in new and simple processes for the treatment of water, the reuse of wastewater and the production of potable water.

NX Filtration's fully automated Mexpert pilot unit

KEY APPLICATIONS

Over the past years, NX Filtration has developed commercial relationships based on dNF technology with a wide range of both municipal and industrial customers, including the likes of Veolia, Aqualia and PepsiCo.

For its municipal customers, NX Filtration's membranes are being applied to produce drinking water from surface water by removing, among others, micropollutants, bacteria, viruses and colour to treat wastewater streams to prevent discharge of polluting substances in the environment and to reuse wastewater for purposes that also include the production of drinking water.

NX Filtration's membranes are also serving various water consuming industries. Here, they treat surface or well water to optimise quality and characteristics for process water, prevent discharge of polluting wastewater and reuse wastewater for industrial processes and recover and recycle valuable raw materials from wastewater streams, such as indigo in the textile industry or cleaning chemicals in beer breweries.

To demonstrate the performance of dNF, NX Filtration offers a range of pilot equipment, varying from automated containerised pilot systems to table-top units for proof of concept. The fully automated Mexpert pilot installation allows for maximum flexibility in all piloting circumstances. It uses the largest dNF modules for full-scale testing results. Adapting running conditions, hydraulically cleaning the module, dosing cleaning agents, can all be controlled and monitored digitally. Datalogging allows for in-depth analysis of the test results.

To find out more about NX Filtration's solutions, visit ***booth B2-N15****.*

DIRECT TREATMENT OF SURFACE WATER WITH DNF FOR DUMAI CITY

The local government of Dumai City was looking for a solution to provide access to improved water sources by treating peat water from the local Masjid River. The river water has low acidity at pH 3-5 and turbidity <10 NTU levels, but a very high colour content of 1,000 TCU and more. Conventional water treatment technology – such as chemical dosing, clarification and sand filtration – were not capable of reducing the colour below 15 TCU, which is the drinking water standard set by the Indonesian Ministry of Health.

Based on extensive pilot testing, a dNF-based system for the city of Dumai was designed with a capacity of 50 litres/second, consisting of 120 dNF80 membrane modules. With this system, the local Masjid River is turned into a valuable source for the supply of drinking water to the city of Dumai, since colour and turbidity are non-detectable in the product water, while approximately 50% of the total dissolved solids (TDS) was removed within a step.

Treatment of surface water with dNF membranes for Dumai City, Indonesia

"STRENGTHENING OUR PARTNERS. SOLVING WATER CHALLENGES. SUSTAINING CLEAN-WATER FUTURE.": DUPONT WATER SOLUTIONS

DuPont Water Solutions is offering a broad portfolio of technologies and solutions that enable water reuse and recycling, desalination and groundwater access. These include reverse osmosis (RO) membranes, ion exchange resins (IEX), ultrafiltration (UF), electrodeionization (EDI), nanofiltration (NF), membrane bioreactor systems (MBR), membrane aerated biofilm reactors (MABR), membrane degasification, and closed-circuit reverse osmosis (CCRO) systems.

Under the overarching theme of "Strengthening our partners. Solving water challenges. Sustaining clean-water future.", DuPont Water Solutions has an exhibit at ***booth B2-N19***, showcasing the DWS technologies and products, all designed to address the most pressing challenges and needs.

DESALINATION

Upfront investment in high-quality and durable technology can simplify plant operations and avoid high operating costs over the plant lifetime. Frequent or premature seawater RO membrane replacement increases expenses mainly due to the cost of new membranes and manpower for installation, cessation in water production while installation is underway, disposal cost, and optimised operations during the start-up phase.

DuPont's experience in membrane chemistry positions it to offer durable RO technology that provides enhanced performance while extending membrane life and reducing the lifecycle costs of operations. Start saving now with FilmTec DRY SWRO and fouling resistant SW30XFR.

MUNICIPAL

Innovation plays a role in ensuring a clean, safe and affordable supply of water. DuPont offers expertise and advanced technologies that enable municipal water-treatment solutions such as wastewater treatment, drinking water production and trace contaminate removal.

Because water sources vary so greatly every area faces different challenges to their ability to produce potable water. The company assesses water quality and distribution systems to help find the right solution. Whether it's a relatively clean or complex water source, DuPont can help bring clean water to communities with treatments such as desalination, wastewater treatment and advanced filtration. When treating water for municipalities, the challenge goes beyond just producing the required quality and quantity. Growing population needs, variable water sources, increasing water source scarcity and regulatory pressures all combine to increase complexity. Municipal water treatment plants require water treatment technologies to produce high-quality water.

PRETREATMENT WITH UF

Compared with conventional pre-treatment, DuPont UF technologies have proven their performance in the removal of suspended solids, colloids and algae to better protect the downstream RO system with improved stability and productivity. Now, with the enhanced capacity of DuPont IntegraFlux, Inge and MEMCOR technologies, DuPont has a range of UF products from inside-out to outside-in, PES to PVDF, skid or MEV package, pressurised UF and submerged UF. It offers UF products with high stability, low energy, and less chemical consumption based on feed water quality and customer requirements.

INDUSTRIAL NEEDS

For years, DuPont has been meeting the needs of end-users, original equipment manufacturers (OEMs) and service companies around the world. The company's experience and range of solutions positions itself as a partner in the field of industrial water and wastewater to serve critical needs in microelectronics, power generation, oil and gas upstream, downstream chemical and petrochemical refinery, food and beverage, medical water, pharmaceutical, landfill leachate and more through UF, MBR, NF, RO, degasification membranes and IER technologies.

FilmTec Fortilife RO portfolio tackles the most challenging industrial wastewater and applications, with performance and support from DuPont. FilmTec Fortilife Elements can help reduce water costs, achieve sustainability goals, minimise fouling problems and move towards minimal liquid discharge (MLD).

DuPont Water Solutions is showcasing its technologies and products that are designed to address today's water challenges and needs

ZWEEC FOR SAFE WATER MANAGEMENT

1 ZWEEC Advance Dye Wastewater Reuse System (ADWRS), a robust treatment of difficult-to-treat wastewater
2 ZWEEC Bacpro is a rapid microbial sensor technology that detects bacteria in water and prevents microbial contamination

Being in the water sector since 2011, ZWEEC Analytics is all about developing relevant and smart water technologies to safeguard water resources. The capabilities are range from the source to the distribution, raw water to treated water, as well as the wastewater field, covering the entire water network while enabling water authorities to have an efficient and robust water infrastructure.

SMART BIOMONITORING

Biomonitoring allows a complete picture of water quality, including the unknown contaminant. ZWEEC has been known for its flagship Smart Biomonitoring System, AquaTEC, which in Singapore, has been implemented nationwide monitoring the drinking water quality. It performs 24/7 in real-time with remote monitoring capabilities, triggering alerts when abnormalities in water quality are detected.

This upgraded system named Aquapro is enhanced with artificial intelligence (AI). It is now capable to operate in high turbid water up to 200 NTU, making it suitable for raw water monitoring. The fish behaviour analysis has also been improved for more accurate early warning.

ALGAE RECOGNITION AND COUNTING

Harmful algal blooms (HABs) are one of the global water challenges that threaten public health and the economy. Therefore, regular algae monitoring is mandatory to ensure safe water.

ZWEEC's innovation, Algapro, is a breakthrough technology in algae monitoring. While the majority are still relying on human labour and is prone to error, ZWEEC's Algapro automates the algae recognition and counting process. The integration of deep learning algorithms, advanced automation systems and expert knowledge enables Algapro to operate accurately, consistently and at a large scale. Breaking the limitations of professional manpower resources, Algapro relieves operators from the labour-intensive manual microscopic examination.

MICROBIAL DETECTOR

Late detection of microbial contamination contributes to the severity of waterborne outbreaks that endanger public health. However, it normally takes more than 24 hours for the test cycle, not including the time it takes for transportation and testing.

ZWEEC's Bacpro is a portable device for rapid microbial detection on-site with high sensitivity. This innovation uses Advanced Light Spectrometry technology and can detect microbial contamination in less than six hours. Previously named BacSENSE, the upgraded version Bacpro has the capabilities to process up to six samples per cycle.

TREATMENT AND REUSE OF DYE WASTEWATER

While working with its partners and customers, there were requests for treatment and remediation of water before pumping into the water monitoring systems. As a result, ZWEEC has built competencies in water treatment system design, which has since become a specialised department within the organisation.

Wastewater generated from the textile industry is generally high in biochemical oxygen demand (BOD) and chemical oxygen demand (COD) as it comprises many compounds. Industrial wastewater accounts for 20% of global water pollution. ZWEEC has developed a robust treatment of difficult-to-treat wastewater, Advanced Dye Wastewater Reuse System (ADWRS). With this system, wastewater can be transformed into a useful resource, enabling water conservation and cost-saving.

*ZWEEC is exhibiting at **booth B2-K25.***

SUEZ PARTNERING CITIES & INDUSTRIES TOWARDS A SUSTAINABLE FUTURE

In securing and managing water resources, SUEZ has developed innovative and sustainable solutions that enable cities and industries to mitigate and adapt to climate impacts. These solutions will ultimately support their goals towards a low-carbon, climate-resilient future while embracing a circular economy.

Here are two success stories from Hengli Petrochemical, a Chinese producer of refiners and petrochemicals, and PUB, Singapore's national water agency, where both have implemented SUEZ's technologies to transform wastewater treatment and optimise water management systems.

CASE STUDY #1: AQUADVANCED URBAN DRAINAGE SUPPORTS THE OPERATIONS OF SINGAPORE'S DRAINAGE SYSTEM

Singapore is a highly urbanised city-state with a land size of 728km^2. Situated in South East Asia and near the equator, the island nation generally experiences hot and humid weather with an abundance of rainfall all year round. These attributes pose two major challenges for Singapore, which are managing limited storage capacity of freshwater sources to supply its residents and dealing with flash floods that can occur because of heavy rainfall. PUB, Singapore's national water agency, has a holistic approach to solving these challenges by adopting smart digital solutions.

The Mission

Dams have been built at major river mouths to mitigate flood risk and at the same time convert the rivers into rainwater storage facilities that can also be used by the city for water supply. The Marina Barrage, which commenced operations in 2008, is one of these dams.

In 2015, SUEZ and PUB began the collaboration to develop a digital platform, as part of the Smart PUB Roadmap to meet Singapore's future water needs and optimise its water resources management through digitalisation. The digital platform, known as the Catchment and Waterways Operations System (CWOS) is based on SUEZ's AQUADVANCED Urban Drainage. It is intended to serve as a decision support system for operators to manage the drainage system and tidal gates, monitor water quality, optimise reservoir operations and enhance PUB's response to flash floods. The platform was first piloted in the Marina Catchment and was well-received by its users for its insightful dashboards, intuitive interfaces and operational advisory for informed decision-making.

Following the successful pilot, the current phase of the project, which started in August 2019, endeavours to expand the CWOS to cover the other catchments.

The Solution: AQUADVANCED Urban Drainage

AQUADVANCED Urban Drainage is a real-time software solution developed by SUEZ as a digital tool for operators to monitor the drainage and sewerage system, flood management and protect the environment from pollution caused by combined sewer overflow (CSO). The solution addresses the problem at three levels – monitoring, anticipation and dynamic control.

In this collaboration with PUB, SUEZ helps the city-state to achieve its flood and efficient water resources management goals by applying its AQUADVANCED Urban Drainage solution for CWOS across the entire island. The system provides PUB operators with a real-time situational awareness using weather information and field sensor data in the network. By analysing these data, the system anticipates water levels and flows within the stormwater network and provides decision support to PUB.

SUEZ works with three user groups within PUB to help with day-to-day operations via AQUADVANCED Urban Drainage:

1. Drainage Operations
   - Monitoring of rain events by integration of various sensors and radars into one single platform to give a holistic view of the situation on the ground
   - Anticipation of flash floods using hydraulic models, data-driven models such as machine learning and deep learning, and more to optimise PUB's flood response
2. Reservoir Management
   - Monitoring of rain, water levels, transfers, gate operations, etc. to give a complete view of all relevant information in one dashboard

- Anticipation of floods using hydraulic models which provide operators with knowledge of the incoming flow to reservoirs and allow comparison with prevailing tidal conditions to optimise operations
- Dynamic control via real-time strategies proposal to operators advising on tidal gates and pump operation. Operators make the final decision on operations with decision support provided by CWOS

3. Water Quality
    - Monitoring of water quality sensors and lab data across Singapore through monitoring dashboard
    - Anticipation of water quality issues within reservoirs and waterways using water quality models, data-driven models like geospatial mapping, and mass balance model

The Result

- AQUADVANCED Urban Drainage system offers meaningful insights on flash floods and assists users in the optimisation of water storage within reservoirs.
- Continuous improvements to the system are being made based on user feedback and additional innovative features such as water quality forecasting will be incorporated.
- PUB has rolled out the CWOS, which is based on the AQUADVANCED Urban Drainage system, to enhance its water and flood management capabilities across Singapore.

8,000 km Drains, Rivers and Canals
17 Freshwater Reservoirs
2,200 mm Annual Rainfall

CASE STUDY #2: DALIAN HENGLI PETROCHEMICAL PROJECT

In 2015, Hengli Petrochemical commenced the construction of a 20 million tons per year integrated refining and petrochemical complex in Dalian Changxing Island, within the China Bohai economic circle.

SUEZ provides eco-friendly solutions that are designed to the needs of the petrochemical WWTP in China

The Bohai economic circle is a region whose environmental capacity is close to the threshold due to the high concentration of industrial enterprises and is one of the most water-deficient areas. Considering the strict environmental situation, SUEZ proposed the innovative concept of Embedded WWTP to fulfil the five development concepts of "innovative, harmony, greenness, openness and sharing" advocated by the Chinese government and to make substantial contributions to China's carbon emission reduction target. The core concept is that the design of a wastewater treatment plant (WWTP) becomes an environment-friendly resource integrator rather than the passive reception and terminal treatment.

By looking at upstream units and making comprehensive analysis on the sources, characteristics and generation process of pollutants produced thereby, the WWTP design is carried out in synergy with the design of upstream petrochemical units so that wastes produced in different steps can be utilised to treat wastewater.

In Hengli Petrochemical Dalian WWTP, the five embedded points – comprehensive utilisation of CO2 exhaust generated from the coal-to-hydrogen process, recycling of ethylene waste alkali liquor, comprehensive utilisation of ozone off-gas generated by wastewater tertiary treatment, utilisation of fusel, and treated water reuse – were developed and applied in a full-scale project, saving the operation cost for the enterprise, reducing the carbon footprint and decreasing the consumption of power and chemicals.

The Hengli Petrochemical Dalian WWTP has been running steadily since 2018. More than 80% of treated wastewater is reused for petrochemical production. Less than 20% treated concentrate from reverse osmosis system of high quality is discharged into the area, without any deterioration of seawater quality.

In this project, the embedded WWTP enables the enterprise to save direct operating costs of over RMB¥23 million/year, reduce CO2 emissions by 2,116 tons/year and chemical dosing by 9,596 tons/year, lower energy consumption air blowers by 7.01MkWh/year, reduce carbon source dosing by 1,460 tons/year, and reduce water resource consumption by 14Mt/day.

Since the successful completion of the Hengli Petrochemical Dalian project, SUEZ continuously extended the embedded WWTP concept to other industrial partners, such as Wanhua and Shenghong Group, the petrochemical companies in China.

In 2020, the Chinese government announced the target of "Carbon Peak and Carbon Neutrality". The concept of Embedded WWTP can be widely used in a variety of industrial wastewater treatment fields to reduce carbon emissions. Standing on such an advanced concept, integral process design can be realised from a high perspective, which will cover all the processes of production and wastewater treatment to turn waste into resource and transform from waste disposal to comprehensive utilisation.

The applications of Embedded WWTP facilitates the green development of the petrochemical sector and even the entire industry.

To find out more, visit SUEZ at ***booth B2-L19.***

EVENT CALENDAR 2022

APRIL

17 – 21 Apr
Singapore International Water Week 2022
Singapore

20 – 22 Apr
IE expo China
Shanghai, China

JUNE

8 – 10 Jun
Aquatech China
Shanghai, China

JULY

27 – 28 Jul
Trenchless Asia
Kuala Lumpur, Malaysia

AUGUST

4 – 6 Aug
LankaWater
Colombo, Sri Lanka

SEPTEMBER

6 – 8 Sep
CamWater 2022
Phnom Penh, Cambodia

8 – 10 Sep
DanangWater
Da Nang, Vietnam

14 – 16 Sep
ThaiWater
Bangkok, Thailand

14 – 16 Sep
Pumps & Valves Asia
Bangkok, Thailand

14 – 17 Sep
Water Indonesia
Jakarta, Indonesia

OCTOBER

5 – 7 Oct
Indo Water Expo and Forum
Jakarta, Indonesia

20 – 22 Oct
LaoWater
Vientiane, Laos

NOVEMBER

3 – 5 Nov
MyanWater 2022
Yangon, Myanmar

9 – 11 Nov
VietWater 2022
Ho Chi Minh, Vietnam

DECEMBER

7 – 9 Dec
Asia Water 2022
Kuala Lumpur, Malaysia

**Due to the COVID-19 pandemic which has resulted in closed borders and travel restrictions, please check the events' websites for the latest updates and changes.*

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