

Formerly World Water & Environmental Engineering

# World Water

Volume 37 / Issue 2  
March / April 2014

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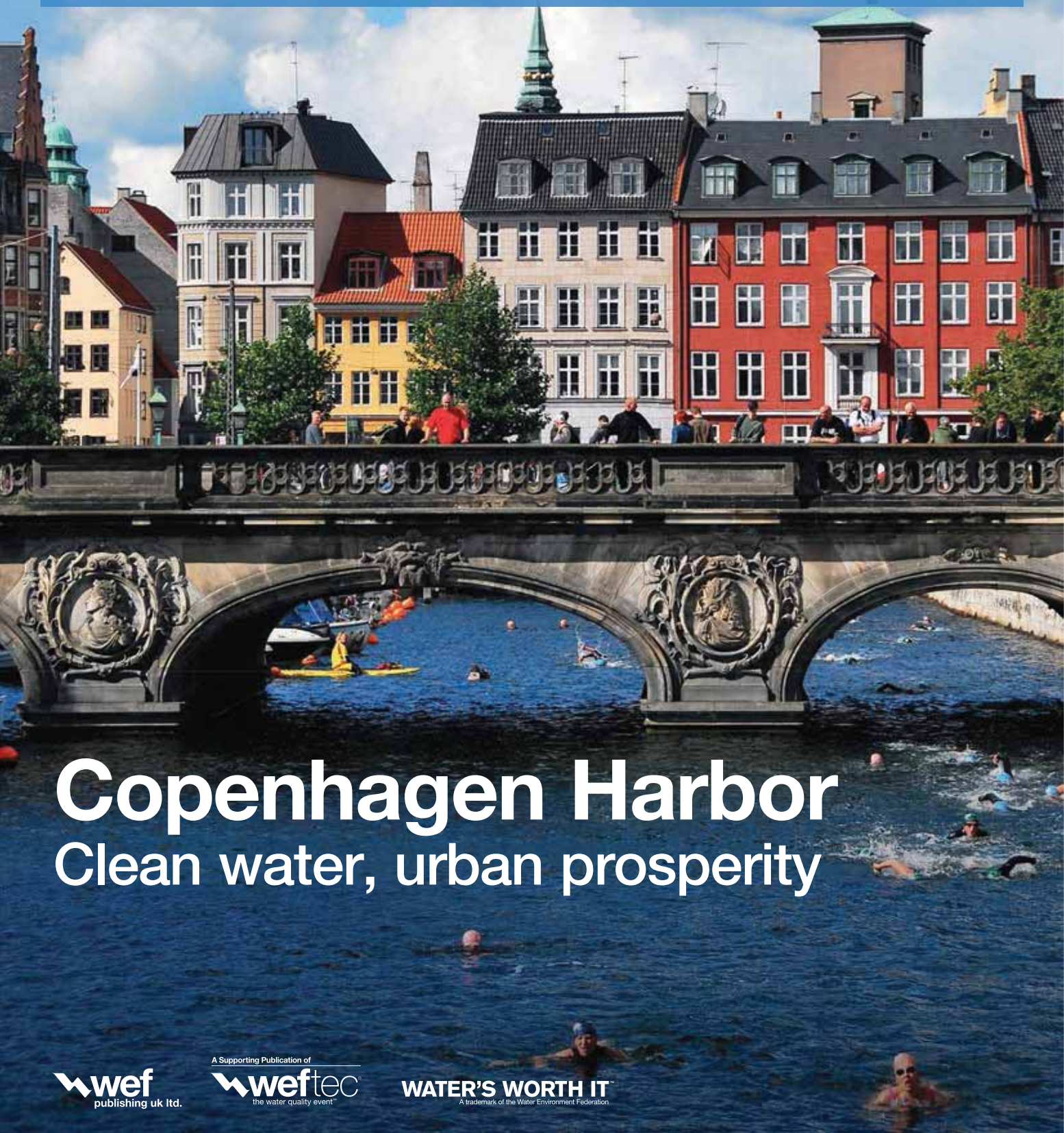
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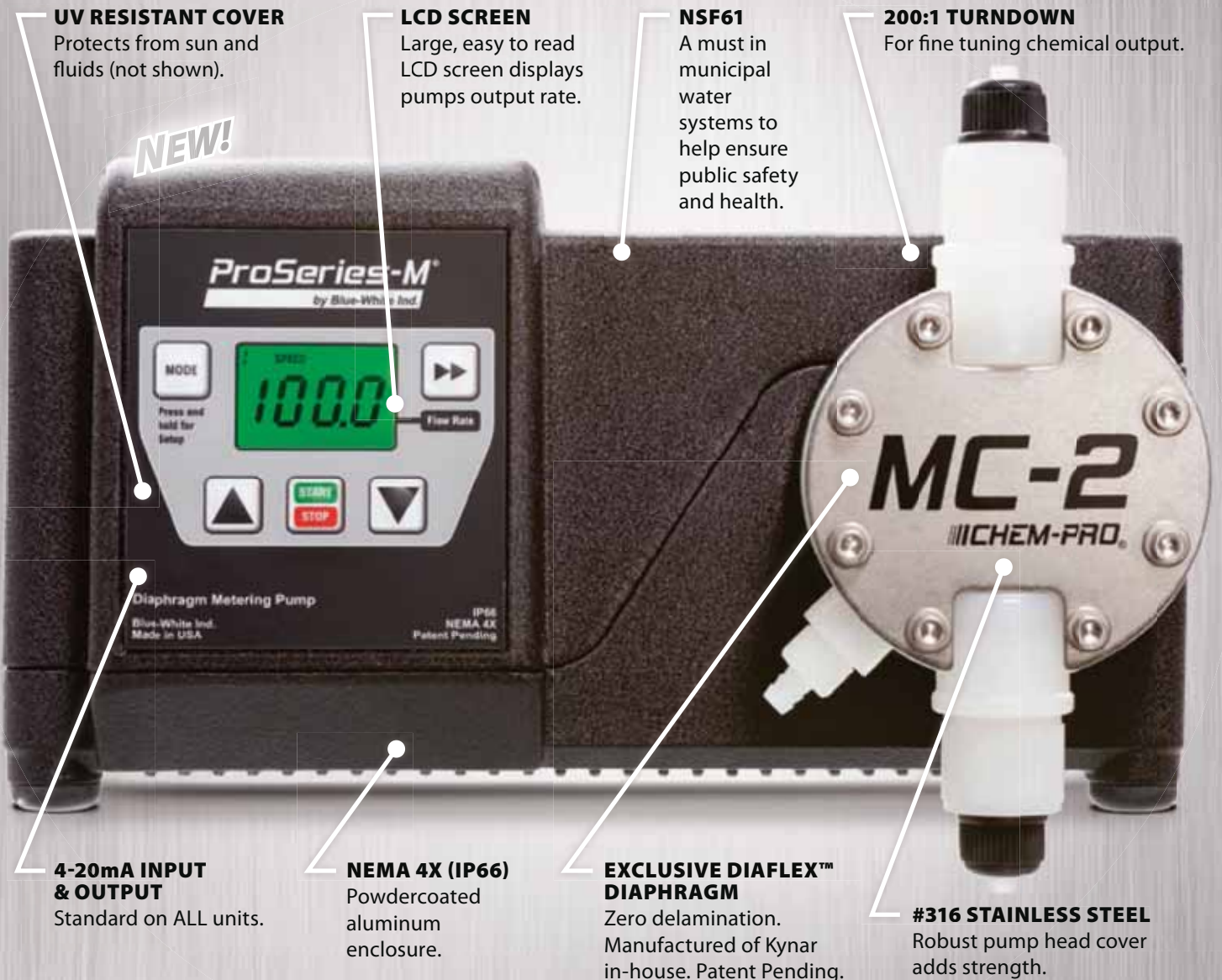
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*Cover image:* Safe for swimming, Copenhagen Harbor has become a recreational and tourist attraction following a major modernization of the city's sewer system.  
*Photo by:* Veolia Water Solutions & Technologies



**Pamela Wolfe**  
Editor-in-Chief

“In order to provide modern, affordable and environmentally sound energy and drinking water services for all, we need a sustainable approach to the management of both freshwater and energy resources”

**UN Secretary-General  
Bann Ki-moon**

# Cities invest in water-energy solutions for future growth

Swimming in urban waters – harbors, rivers, lakes – is a risky venture in most metropolitan areas. Murky, surface water contaminated with stormwater runoff, industrial wastewater discharges, and sewage limits swimming to public pools or coastal beaches and freshwater lakes in more pristine environments. Fortunately, pollution is no longer considered the inevitable price to pay for economic growth and prosperity, particularly in areas with limited freshwater resources. Political and industry leaders are starting to realize the far-reaching economic and quality-of-life benefits of clean urban water resources.

In this issue's cover story, “Reclaiming waters to revive city life,” William Mengebier illustrates this growing trend. The Danish city of Copenhagen transformed its waterfront into a vibrant, trendy hub of recreation and tourism by modernizing its sewerage system and installing real-time control technology to make the harbor water safe for public swimming. Investing in sustainable solutions and infrastructure to improve water resource management was key to the area's economic revival.

Water shortages and tight budgets are driving governments to implement sustainable practices and adopt technological solutions, including water recycling, water reuse, and stormwater management, to meet growing demands for water supplies. Examples in China, France, Portugal, Spain, and United Arab Emirates, the author provides, show how some cities are conserving water, reducing carbon footprint by producing biogas from sludge, and purifying effluent to augment and optimize their scarce water resources.

## 2014 UN Report on water-energy nexus

The world's limited freshwater resources are under increasing risk due to increasing demands, population growth, climate change, pollution, and rising energy consumption. Yet global water demand is projected to increase by 55 percent by 2050, while energy demand is forecast to grow by one-third by 2035, according to the fifth edition of the *United Nations World Water Development Report*, released on March 21, 2014. Energy production is water-intensive, responsible for an estimated 15 percent of water use worldwide, according to the International Energy Agency.

In the preface of the report, UN Secretary-General Bann Ki-moon writes, “Water and energy can drive economic growth and improvements in human health. They are enablers for poverty reduction, job creation, women's empowerment and human well-being in general... In order to provide modern, affordable and environmentally sound energy and drinking water services for all, we need a sustainable approach to the management of both freshwater and energy resources. This calls, in turn, for far greater coordination.”

The sustainability of both water and energy resources has become a major global concern, the report notes, which has led many countries to recognize the need to decouple water use from energy generation. More simply put, more countries worldwide are trying to find ways to generate power using less water. And more countries are

investing resources in water use efficiency and renewable energy. The UN report provides real-life examples of solutions and strategies in five global regions. Several of these are briefly mentioned to illustrate how government authorities can achieve sustainable goals.

In Vienna, Austria, renewable energy is produced in the city's drinking water conveyance pipelines and at Ebswien, the main water resource recovery facility that purifies 220 million cubic meters of sewage per year. Two long-distance pipelines convey mountain spring water by gravity to supply the city with drinking water. Turbines installed in 14 drinking water power plants located in the metropolitan area generate more than 65 million kilowatts per hour of electricity annually, enough to operate the system, and reduce water pressure to protect the city's water supply infrastructure.

Energy self-sufficient until 2020, the Ebswien facility also produces a surplus of energy, 15 gigawatt hours annually, by using a combination of renewable energy technologies, including hydropower, wind power, solar energy, and methane recovery during treatment.

In northern Mexico, the Los Alisos Wastewater Treatment Plant will be nearly energy independent upon completion in early 2014 of a US\$5-million solar panel farm, according to the National Water Commission of Mexico (CONAGUA), which has played a key role in the design and implementation of the project. The water resource recovery plant services 70,000 people in the Nogales area and discharges effluent for irrigation and aquifer recharge. It is the first project of its kind in Central and South America.

Following the March 11, 2011 Great East Japan Earthquake and tsunami that devastated coastal communities and damaged the Fukushima Daiichi Nuclear Power Plant, the Japanese government set a goal to tap the energy potential of municipal sewage sludge and worked quickly to locally produce energy for local consumption.

According to the Japan Sewage Works Association, the use of biogas and biochar-derived from municipal sewage since then has significantly reduced greenhouse gas emissions and the amount of sludge that needs to be disposed by the city. In Kobe, six water resource recovery plants generate 37,000 cubic meters of biogas, which is used to power plant operations, fuel vehicles, and augment the city gas supply. Kobe biogas needs further refining to use as auto fuel, so the city, in a research partnership with Kobelco Eco-Solutions Co., Ltd. and Osaka Gas Co., Ltd. built a municipal gas conversion facility. Also, the research group modified the process to improve the quality of Kobe biogas to the same level of city gas. City authorities are committed to using 100 percent of its city-produced biogas for local use.

Compared with the goals of safe drinking water and sanitation for all, swimming in city harbors may seem like a low priority to many. However, water and energy solutions integrated into city infrastructure can significantly improve the quality of air and water resources shared by all of us.



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# Singapore TechXchange – matching innovators with investors and partners

The Singapore TechXchange, a one-day conference on water technology innovation and commercialization, will take place on the first day of Singapore International Water Week, held from June 1-5, 2014. Singapore's Environment and Water Industry Program Office and the Public Utilities Board (PUB) will host the event.

TechXchange will showcase innovative technologies and business models, and provide a forum in which water-tech companies from Singapore and around the world can meet and network with potential partners – international companies, venture capitalists, and strategic investors – to accelerate the commercialization of advanced water-tech solutions.

PUB Chief Executive Chew Men Leong will deliver the keynote address “Singapore’s vision for innovation in water.” The plenary session establishes the main theme of the event – “Innovation to commercialization and internationalization.” Chaired by XPV Capital Managing Director David Henderson, speakers from leading water companies such as Xylem, USA; Veolia, France; Electroscan, USA; and Mekorot,



Israel will address the challenges in taking innovative solutions to market.

Following the plenary session, select water-tech companies in the field of next-generation membranes and advanced biotechnology will present brief snapshots of their technologies and solutions to a panel of investors. These include water-tech startups Cerahelix, USA; Lentikat, Czech Republic; Aquaporin Asia and Ceraflo of Singapore; and Baleen Filter, Australia.

Several roundtable discussions

hosted by leading industry experts will also be held on the topics of wastewater treatment and reuse; convergence in the oil and water industries; low-energy desalination; and the smart technology revolution.

BlueTech Research will present the Disrupt-o-meter Award to the company voted as the most innovative, disruptive technology, and the BlueTruffle Award to the company voted as to have the strongest go-to-market strategy. For more information, visit [www.techxchange.rethinkevents.com](http://www.techxchange.rethinkevents.com).

## Amiad wins Angolan filtration project

The Mitrelli Group awarded a US\$1.1-million contract to the Israeli company Amiad Water Systems to supply and install 50 containerized drinking water filtration systems, as part of Mitrelli's Water for All project in the Angolan province of Moxico. Based in Israel, Mitrelli designs, implements, and executes large-scale turnkey projects.

Amiad will commission the filtration systems, which will be central to the project solution that requires water to be pumped from the local river to supply clean water to the villages in Moxico and Kuanza Sul. Amiad CEO Arik Dayan reports that the project is expected to reduce water-borne diseases among the local population and enable water to be accessed at various points within the village rather than being collected, and physically carried, from a distant water source.

The solar-powered filtration system will use minimal chemicals and will require minimal maintenance. Each system includes deep bed media filters, chemicals dosing pumps and disinfection units. The Water for All initiative will provide full water infrastructure to villages in three Angolan provinces. Amiad will also supply, install, and commission 50 systems in two other provinces.

## Tokyo Waterworks starts up mini-hydro plant in pump station

In October 2013, the Tokyo Metropolitan Waterworks Bureau in Japan completed construction and started up a mini hydropower facility at the Kasai Pumping Station. The facility is the first owned by Tokyo Metropolitan Government to sell all generated electricity through Japan's renewable energy feed-in-tariff scheme.

The feed-in-tariff system requires electric utilities to buy electricity generated from renewable energy sources (such as solar, wind, and hydro) for a specific time period, at a minimum price determined by the national government.

Although conventional hydroelectric power systems

# Biogas upgrade facility under negotiations

Anaergia Inc. and Grannus LLC will enter negotiations with the Arizona's Pima County Regional Wastewater Reclamation Department to design, build, finance, own, and operate a large-scale, biogas-upgrading facility. The facility will produce clean, renewable biomethane.

The majority of biosolids generated from these operations are transferred to a centralized wastewater biosolids handling and treatment facility – located at

the Tres Rios Water Reclamation Facility. Anaerobic digesters process the biosolids, producing a continuous supply of digester gas, which is currently flared.

“Flaring the biogas is not the best use of this resource from an environmental or ratepayer perspective,” said Jackson Jenkins, director of the Pima County Regional Wastewater Reclamation Department. “This project will leverage innovative technologies and practices of the private sector to

help us accomplish the mandate set out in our System-Wide Biosolids and Biogas Utilization Master Plan.”

The project's primary goal is to use biogas to generate revenue and offset treatment costs. The department created a long-term partnership with Anaergia (Ontario, Canada) and Grannus (Arizona, United States) to deliver and operate the biogas upgrading facility, and market and sell the commercial biomethane product.



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use water pressure created by a difference in elevation to generate power, this hydropower plant uses pressure created when water is directed from the water treatment plant to the distribution reservoir. With a maximum 340-kilowatt output, the plant is expected to produce about 1.4-million kilowatt-hours of electricity annually – which is enough to power about 420 ordinary Japanese households. The Tokyo Metropolitan Government will sell the power to a new power producer and supplier, Summit Energy Corp, instead of an existing major power company. The project is expected to reduce carbon dioxide emissions by approximately 530 tons annually.

The government hopes to promote renewable energy based on a cost-effectiveness approach, which contributes to environmental-impact reduction and a stable energy supply.

### IDE opens Chilean office

IDE Technologies announced its expansion in the Latin American water industry with its new office in Chile, headed by Rodrigo Turra as the country sales director. Chile is the world's leading producer of copper, and with the expansion of new mines there is an increased need for water in areas with water scarcity. By increasing its presence in Chile, which has a strong economy and high external-investment rate, IDE plans to help meet this need through projects that desalinate seawater on the coast and pump the water to the mining operation.

Mr. Turra plans to increase awareness and sales throughout Latin America for IDE's small-to-large-scale membrane and thermal desalination solutions, and industrial water treatment solutions. Prior to joining IDE, Mr. Turra served as a business development manager for new business in Chile – generating more than twenty seawater desalination and water reuse project opportunities.

### ADB loans fund Nepal water projects

The Asian Development Bank (ADB) plans to provide an additional US\$25-million loan to the Government of Nepal to help complete the Melamchi tunnel and alleviate a severe water shortage in

Kathmandu Valley.

“Once completed, Melamchi tunnel will be a lifeline for the people of the Kathmandu Valley,” said Manoj Sharma, Senior Urban Development Specialist in ADB's South Asia Department. “The tunnel will not only bring the people of Kathmandu more clean water, but also support other downstream water supply and wastewater projects in the Kathmandu Valley.”

More than 2.5 million people in Kathmandu Valley have lived with inadequate and unreliable clean water supplies – resorting to bottled water, collecting rain-water, or drilling wells that lead to increased pollution and falling water in key aquifers.

In February 2008, the bank approved a restructured \$137-million loan for the then \$317-million Melamchi Water Supply Project, but the completion was delayed by political and economic uncertainties in Nepal, changes to the project design, and most recently, the need to find a new contractor to complete tunnel construction. The bank's additional funds – along with \$13.1 million from the Government of Nepal – mean the overall cost is an estimated \$355.4 million.

Cooperativa Muratori e Cementisti di Ravenna, an Italian construction firm, is contracted to complete the 27.5-kilometer Melamchi tunnel by the end of September 2016. The tunnel will take 170 million liters of water daily from the Melamchi River to Kathmandu. A water treatment plant to treat the Melamchi tunnel water flow, financed by the Japan International Cooperation Agency, is under construction on the outskirts of Kathmandu in Sundarjajal.

Improvements to the Kathmandu Valley water transmission and distribution network began as well – with a 2011 \$80-million ADB loan. The network will take water from the treatment plant to households, reducing water lost to leakages. In April 2013, the bank approved another \$80-million loan to expand and rehabilitate the sewerage network and build Kathmandu Valley wastewater treatment plants to deal with more than 90 million liters of wastewater per day.

## Field Notes



### Algeria

In July 2014, the UK-based Bewater will begin work on a new water resource recovery facility in Constantine, serving a population of more than 100,000. The treatment plant will incorporate pre-treatment, low speed aerators, clarifiers, and sludge dewatering by belt filters.

According to Bewater General Manager (Algiers) Mohammed Allouani, the company has similar wastewater treatment works in Zéralda, Ain-Oulmene, and Salah Bey in Algeria. In November 2013, Bewater was awarded a ductile iron pipe contract – supporting efforts to improve supplies of potable water to Setif City, which is located near Constantine.



### Brazil

Sulzer supplied aeration, mixing, and pumping equipment to a new water resource recovery plant in Campos do Jordão, Brazil. Inaugurated in March 2014, the wastewater treatment plant is the

first in the city – a popular tourist destination in Brazil, approximately 180 kilometers east of São Paulo.

The plant is one of the most comprehensive wastewater projects in which Sulzer supplied a total package to the treatment plant and connected lifting stations. Sabesp, the public water and wastewater utility in the State of São Paulo, and Araucária Saneamento SA, a consortium of private companies headed by GS Inima Brasil, formed a partnership to build the facility. The new plant uses biological treatment processes with activated sludge followed by ultrafiltration membranes.

The scope of supply comprises four Turbocompressors type ABS HST 9000, approximately 3,000 fine-bubble disc diffusers, eight submersible mixers type ABS RW, and 13 sewage submersible pumps type ABS XFP.

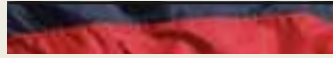


### China

Sembcorp Industries of Singapore will double industrial water capacity in Jiangsu province by expanding the capacity of the Nanjing Chemical Industrial Park (NCIP) water plant

from 120,000 to 240,000 cubic meters per day. Sembcorp NCIP Water, a 95-to-5 percent joint venture between Sembcorp and NCIP Utilities Co., will undertake the expansion project, scheduled for completion by mid-2015.

Present in the Nanjing Chemical Industrial Park since 2005, the Sembcorp Group will serve the fast-growing water needs of customers in the industrial park while limiting environmental impact, Sembcorp China CEO Alan Yau says.



### Germany

The GEA Westfalia Separator Group was awarded the TÜV certificate for energy-efficient production, according to DIN EN ISO 5001, a new standard for energy management systems. TÜV is an independent German technical inspection association that provides certification for international standards.

GEA reports that it complies with the government energy and environmental policies that seek to reduce the primary energy requirement in Germany 20 percent by 2020.

“In line with our holistic energy management system, we have plans to continuously boost efficiency by at least 1.5 percent every year and to reduce carbon emissions by at least 1.5 percent in relation to production volumes,” says GEA Plant Manager Ludger Reckmann in Oelde. He explained that the cost reductions, resulting from less energy consumption and a possible exemption from the EU levy, improve the company’s competitiveness. GEA invested in its own combined heat and power plant in combination with an absorption refrigeration system.



### Saudi Arabia

Toray Industries, Inc. and Abunayyan Holding launched Toray Membrane Middle East LLC – a joint venture that will manufacture and sell water treatment membranes and provide technical services. The new company plans to construct a production factory, located in Dammam 3rd Industrial City in the Kingdom of Saudi Arabia, and will begin production of reverse osmosis membrane elements in 2015.

## Milestones

The global consultancy CH2M HILL appointed **Gareth Heatley** as the managing director for water in Europe. In his new role, Gareth will lead the company’s water market on major projects in the European region – including the Thames Tideway Tunnel project and a diverse flood-risk management and water portfolio. With almost 25 years of experience in the water sector, Gareth started his career as a river and coastal engineer in 1990, worked as a Halcrow project engineer in 1995, and has taken lead roles in flood management programs. At CH2M Hill, Gareth also served in the European region as senior

projects director and as operations director for water in the UK and Europe.

The UK intelligent-pipeline monitoring company Syrinix appointed **Paul Norman** as business development manager. Norman has more than 17 years of experience in developing and providing technical solutions for a number of industries including the utility sector as well as fixed-line and satellite communications. He will be based at Syrinix’s headquarters at Hethel Engineering center, Norwich. According to Syrinix, its products focus on improving the risk management of water pipelines and to helping utilities move their

network management from reactive to active on a highly cost-effective basis.

Armstrong Fluid Technology promoted **Wayne Rose** to the position of global marketing manager of pumps. He is responsible for marketing the Armstrong portfolio of pumps, Suction Guides, and Flo-Trex valves on a worldwide basis – with an emphasis on the company’s Design Envelop pump models.

Since joining Armstrong 15 years ago, Rose has served in a number of roles – including product manager and marketing director (UK and EMEA), with responsibility for branding and communication.

Most recently, he headed manufacturing and technical services operations at Armstrong’s factory in Manchester, UK.

### Correction

The January/February 2014 issue of *World Water* incorrectly reported that **Stuart Widdowson**, who was appointed business development manager of the UK-based ARM Group Limited in December 2013, will be responsible for sourcing and delivering over 60 mine wastewater treatment systems in England, Scotland, and Wales. In fact, this responsibility was included in his previous position with the Coal Authority.



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Water quality solutions are helping cities around the world improve water resource management. Veolia Water Solutions & Technologies was recently interviewed on the company's technological solutions that have played a role in the current revitalization of urban areas. William Mengebier reports.

# Reclaiming waters to revive city life

Perched on a rock on the edge of Copenhagen's harbor, the Little Mermaid has gazed toward shore for more than 100 years. According to the fairytale on which this world-famous sculpture is based, she is drawn from the sea each day in hope of seeing her true love, the prince, once more. Until recently, another motivation might have been escaping from the filthy waters.

For many years, the harbor, contaminated with sewage and industrial wastewater discharges, had been considered a public health hazard and was closed to swimming. Now, following a major modernization of the city's sewer system and installation of state-of-the-art control systems, Copenhagen's waters are safe for humans. The harbor has become a tourism and recreation hub and its revitalized waterfront neighborhoods are vibrant and trendy.

Copenhagen is just one of an increasing number of examples of the technology and infrastructure investments being made by cities, as they confront the increasing pressure placed on water resources by skyrocketing urbanization.

### Booming cities, water worries

According to the United Nations Department of Economic and Social Affairs, urban populations worldwide are growing at a rate of two people per second. Within two decades, nearly 60 percent of the world's population will live in cities. In the developing world, urban areas gain an average of five million residents every month. Exploding population growth – in cities and in general – is placing unprecedented strain on resources. Especially ensuring adequate water and sanitation.

While urbanization brings opportunities to improve water resource management and increased access to drinking water and sanitation,

population growth is outpacing the ability to devise solutions, according to the United Nations. In the past decade, the number of urban dwellers who lack access to a water tap in their home or immediate vicinity has risen by an estimated 114 million – while the number of those who lack access to the most basic sanitation facilities has risen by 134 million. The resulting impacts can be measured in both human and economic terms, through increased disease and lost productivity of people too sick to work.

Cities in developing countries, while not faced with the same lack of basic human infrastructure, nonetheless face pressures to optimize their water resources. Strained public finances, water shortages, and wasted economic opportunity are all driving implementation of more sustainable practices – such as recycling and reusing water, finding solutions to prevent stormwater contamination, or maintaining public bathing and lake resources vital to quality of life and local economies.

### Keep swimming safe

Around the world, cities are looking to new technological solutions to improve water resource management. For example, Copenhagen's success in making its harbor safe again for public swimming was made possible through a multi-year investment in modernizing its sewage system and the installation of large storage tanks. Water resource recovery plants are now equipped with STAR® Control systems from Krüger, a subsidiary of the French water company, Veolia Water Solutions & Technologies. This real-time control system minimizes sewer overflow by controlling pumps and gates within the sewer system to reduce potential environmental impacts from combined sewage overflow. Consumption



of energy and chemicals is minimized while the quality of the outlet is maintained or even increased. In addition to improving health conditions and quality of life for Copenhagen's citizens, there are economic rewards from the investments as well, such as increasing harbor area property prices and spurring the opening of new shops and restaurants.

In the French Mediterranean city of Antibes, bathing water quality is maintained by a biological wastewater treatment and clarification system, managed for the municipality by Veolia. In addition, meteorological monitoring provides real-time warning of potential storm water overflows, allowing local authorities to control access to the community's beaches prior to any possible pollution events. The system keeps public beaches safe for recreation, which is also essential to the area's critical tourism industry.

### Stormwater overflow prevention

Stormwater solutions help cities protect water quality and manage sanitary sewer overflow treatment requirements prior to discharge. Veolia's BioACTIFLO® process combines biological treatment with the ACTIFLO® microsand ballasted high-rate clarification system, providing highly effective removal of suspended solids and biological oxygen demand.

In the northern French city of Lille, a new city-center treatment plant is meeting the growing needs of the population while contributing to sustainability. In addition to wastewater, the plant treats stormwater using the ACTIFLO process. The Veolia-built plant also generates a low carbon footprint and produces biogas from sludge.

In Copenhagen, the new eco-district of Orestad is built upon the concept of using its





**Top: Copenhagen's investments in modernizing its sewage system and installing large storage tanks have made its harbor safe for public swimming. Another benefit is the economic revitalization of the harbor area.**

**Above: Aerial view of the water resource recovery facility integrated into the city of Lille, France.**

Photos by Veolia

local water resources for aesthetic enjoyment. It incorporates an open water system design that uses the characteristic elements of the reclaimed marshland by integrating waterholes, ponds, and canals to create a distinct, unique identity. Veolia's ACTIFLO process is used to treat surface water from a local pumping canal. Within minutes, the ACTIFLO plant reduces suspended solids and phosphorus by up to 95 percent or more, to produce high-quality water. Its fully automatic operation typically requires the presence of personnel only a few hours a week.

In the Alcântara district of Eastern Lisbon, Portugal's newest and most modern wastewater treatment plant manages discharges from Lisbon as well as the neighboring municipalities

of Amadora and Oeiras. Two ACTIFLO clarification units treat stormwater, while other sections of the low carbon footprint, sustainable-design unit provide primary treatment, biological treatment, and sludge thickening.

The El Prat Water Reclamation Plant in Barcelona, Spain's second largest city, treats the secondary effluents from the metropolitan area wastewater treatment plant to optimize the use of scarce water resources. The facility meets Spanish chemical and biological quality standards for urban, agricultural, industrial, recreation, and environmental uses. The plant's processes include ACTIFLO tertiary clarification, followed by Hydrotech™ microscreen Discfilters, ultraviolet disinfection, and chemical disinfection. Then, a portion of the treated water is processed by an ultrafiltration and reverse osmosis unit so it can be re-injected into the aquifer and act as a barrier against saline intrusion.

Seventy miles south on the Mediterranean coast, Veolia's Camp de Tarragona Water Reclamation Project is also helping to relieve water scarcity. By efficiently treating municipal secondary effluent to meet local industry's process-water needs, freshwater can be used for municipal drinking water to meet the region's increasing demands. The plant reclaims water from treatment plants serving the Tarragona and Vila-Seca i Salou communities – applying tertiary treatment through reverse osmosis as its main process. Companies operating in Tarragona's Petrochemical Complex industrial zone use the reclaimed water primarily in cooling towers. To meet high water-quality criteria, municipal wastewater is treated with an ACTIFLO system, followed by Veolia's Hydrotech Discfilter microscreen filtration technology, and then a two-stage sand filtration. The pre-treatment

solution removes high concentrations of total suspended solids and organic compounds from secondary effluent, which prevents organic fouling and biofouling in the reverse osmosis stage. Such processes are making it possible to continue industrial growth in water-scarce regions through improved industrial sustainability.

In Sydney, Australia, a novel and sustainable design strategy has made the Darling Quarter office and leisure development a model for new inner-city development projects. In addition to designing, building, operating, and maintaining the buildings' recycled water plant, Veolia implemented a total water cycle management plan to achieve a range of social, economic, and environmental benefits. The plan included installing high-efficiency fixtures and fittings, as well as treating sewage to produce high-quality recycled water used for cooling towers, garden irrigation, and toilet flushing. In addition, rainwater collected from the building roofs is filtered, ultraviolet-treated, and distributed to the local community's public domain for landscape irrigation and other water-resource needs. Among the achievements is a 92-percent reduction in potable water consumption, saving the equivalent of 86 million bottles of water per year, and a 2,500-ton carbon dioxide reduction in the buildings' carbon footprint.

In the rapidly growing Chinese city of Shenzhen, the Xili treatment facility can recycle 50,000 cubic meters of water daily. As the city's first water resource recovery plant, it receives domestic wastewater and produces treated effluent that meets national discharge standards, supplementing water supplies drawn from the Shahe River. The plant is equipped with Veolia's Multiflo™ settler, Biostyr® biological filter, and ACTIFLO ultimate settler technologies.

In Dubai, Veolia maintains the artificial lake bordering the Burj Khalifa Tower – the world's tallest tower and part of an enormous residential, commercial, leisure, and entertainment complex. The company built the water treatment installation and manages plant operations for the 300,000-cubic meter lake. The lake is fed with previously treated stormwater, and topped up with freshwater to offset evaporation. The 62,400-cubic meters, per day treatment plant includes the stormwater treatment facility and recycling equipment. Installed Veolia technologies include four ACTIFLO modules, four Hydrotech Discfilters, an ACTIDYN® sludge treatment module, and two belt filter presses for sludge dewatering.

Likewise, one of Copenhagen's most popular recreational areas is the Inner Lakes. To protect the aquatic environment, the lakes are supplied with sufficient amounts of freshwater and the correct nutrient balance is maintained to reduce algae growth, improving water clarity and oxygen conditions, which preserves flora and fauna. An ACTIFLO plant at Lake Emdrup removes phosphorus and reduces chemical oxygen demand and suspended solids, playing an important role in maintaining the improved quality of the water that flows to the Inner Lakes.

Like the revitalized harbor district nearby, the lakes are drawing Copenhagen's tourists and residents to enjoy the cold, clear northern waters – illustrating how city water reclamation strategies can create an environment that even a mermaid can love.



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# Network-wide bioaugmentation delivers multiple benefits

Engineered collection system bioaugmentation provides municipalities with a way to reduce the operational costs of wastewater treatment, increase capacity, and improve effluent quality without capital expenditure. Jim Elliott of In-Pipe Technology Company explains.

The new, patented technology of collection system bioaugmentation, developed by In-Pipe Technology, Inc., enables municipalities to begin the treatment process in the sewer conveyance network before the influent reaches the treatment facility. In the US city of Huntington, New York, this strategy delivered enhanced nitrogen removal and overall cost efficiencies – which helped the city comply with discharge regulations at its wastewater treatment plant.

Many municipalities, similar to Huntington, face increasingly difficult and costly wastewater management challenges such as aging infrastructure, constraints on capital expenditures, increasing flows, more stringent regulations, and sanitary sewer overflows from fats, oil, and greases. By expanding biological treatment beyond the facility throughout the entire wastewater conveyance network, municipalities may be able to better address some of these issues – through reducing operational costs, expanding treatment capacity, and improving effluent quality without incurring additional capital expenses.

Biological treatment methods, devised in the early 20th century, form the basis by which wastewater plants function. In simple terms, naturally occurring bacteria remove organic carbon-based waste compounds by “eating” them. During this process, bacteria in the wastewater converts the organic compounds into water, carbon dioxide, nitrogen, and more bacterial cells – which are then separated from the clean effluent stream. This metabolism occurs primarily within the confines of the treatment plant, which has inherent limitations of size, retention time, and processing capacity.

In-Pipe’s technology augments the fundamental biological wastewater treatment process by adding a highly concentrated, carefully selected blend of beneficial bacteria at strategic locations

throughout the wastewater collection system. It enables the wastewater treatment process to begin outside the limited confines of the treatment plant making the entire wastewater conveyance and treatment system function more efficiently. The collection system bioaugmentation program is engineered to address the dynamic nature of the sewage by delivering bacteria into the sewer system constantly. The added bacteria must cause a beneficial change, and then maintain performance despite the continual addition of the indigenous unwanted bacteria in the wastewater.

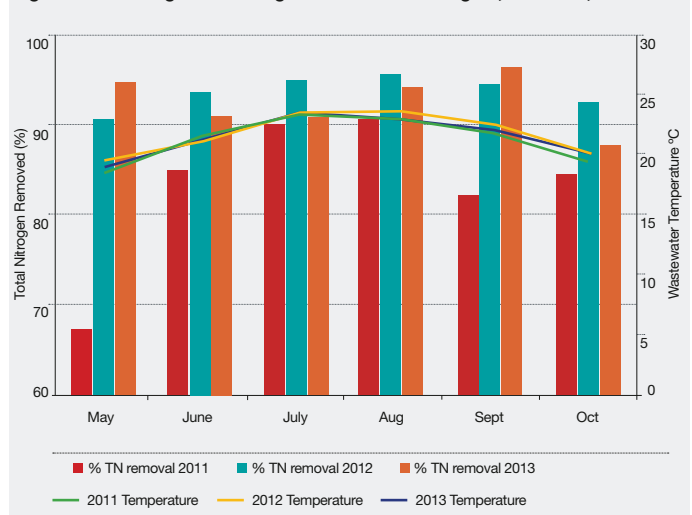
Similar to an intravenous drip, application of the bacteria is accomplished by installing numerous compact, self-contained, strategically placed dosing stations that dispense the microbial solution at varying strengths and rates into the sewer piping. This initiates biological treatment of the wastewater earlier in the process and allows it to accelerate by taking advantage of the retention time, surface area, and the biofilm in the miles of piping. The technology can reduce biosolids by applying it directly to aerobic digesters and aerobic and facultative lagoons.

## Benefits and performance

Primarily, the system reduces net operating cost and produces cleaner effluent water without additional capital expenditure. Other benefits include up to 60 percent reduction in biosolids production; up to 50 percent in power consumed for aeration; reduced pumping costs in collection system; fewer sanitary sewer overflows due to fats, oil, and greases; and up to 100 percent increase in treatment plant capacity.

Sewers can provide similar treatment capabilities as a trickling filter due to the vast expanses of attached sewer biofilm. In untreated conditions, the sewer biofilm is largely non-beneficial, consisting of mostly anaerobic bacteria that are slow growing and

Figure 1. Percentage Total Nitrogen Removed - Huntington, New York, USA



**Collection system bioaugmentation enables the wastewater treatment process to begin outside the limited confines of the treatment plant.**

may also contribute to hydrogen sulfide production. Strategically introducing facultative, spore-forming bacteria throughout the sewer collection system modifies the existing biofilm and transforms the collection system into a useful part of the treatment process.

The concept of bioaugmentation is a technique to improve the degradability of a specific area by introduction of competent microorganisms. Sewer biofilm is composed of Extracellular Polymeric Substance, which is a sticky organic matter produced by microbes and responsible for cells adhesion in biofilms. Three distinct layers of aerobic, anoxic, and anaerobic conditions exist within the sewer biofilm. Within each layer, separate conversion processes occur. Hydrolysis, fermentation, and oxidation of organics result in decomposition within the sewer to influence sewer biofilms and wastewater characteristics.

In-Pipe uses a formulation of bacteria from the genus *Bacillus*, which contains facultative anaerobes that grow under anoxic conditions (either with nitrate or nitrite as the electron acceptor), in aerobic conditions (by respiration with oxygen as the final electron

acceptor), and by fermentation (in anaerobic conditions). The *Bacillus* bacteria enhance the microbial community by increasing reactions in the sewer biofilm that contribute to increased metabolism of the sewer's wastewater compounds. The addition of *Bacillus* allows a gradual repopulation of the sewer biofilm by bacteria that are more efficient at degradation of organics than the bacteria that are present in natural, untreated conditions.

Microbiological treatment is carefully engineered and the program design is driven by factors such as organic load, distribution, collection system layout, and treatment objectives. The In-Pipe *Bacillus* formulation is added continuously to the outer reaches of the wastewater collection system. As a result, these beneficial bacteria grow throughout the surface of the sewer pipes and take advantage of the residence time in the sewer to reduce the organic load to the wastewater treatment plant.

Performance in the collection system provides additional capacity within the plant, forestalls costly upgrades, and extends the life of existing infrastructure – providing a sustainable solution without additional energy consumption or capital expense.

### Conclusions

Properly engineered and applied in the sewer collection system, bioaugmentation has multiple beneficial effects. Conversion of the indigenous sewer biofilm to one

## Performance in the collection system provides additional capacity within the plant.

dominated by *Bacillus* significantly reduces the influent load on the wastewater treatment plant by reducing influent organics, solids, and nitrogen loads as well as improving the removal efficiency, increasing capacity, and reducing operating costs. In addition, bioaugmentation is capable of reducing collection system problems by reducing hydrogen sulfide production and reducing the occurrence of sanitary sewer overflows caused by fats, oil, and greases in the collection system. Bioaugmentation leverages existing collection system infrastructure for utilities on a budget that face increasing loads and more stringent regulations, and can improve operating efficiencies without costly capital expenditure.

### Author's Note

*Jim Elliott is the vice president of sales at In-Pipe Technology Company, Inc., based in Wood Dale, Illinois, US. For more information and a complete list of article references, contact the author by email at [jelliott@in-pipe.com](mailto:jelliott@in-pipe.com).*

## Bioaugmentation improves nitrogen removal efficiency

In the US town of Huntington, New York, In-Pipe designed a treatment strategy using a collection system bioaugmentation program that improved nitrogen removal performance and the overall operating and cost efficiency of its wastewater treatment plant processes by reducing sludge production and energy consumption.

In-Pipe provided, installed, and maintains 42 dosing units for the collection system, which add a consortium of bacteria throughout the town's wastewater collection system. Bacteria form a biofilm inside the sewer pipes, which initiates treatment of the wastewater in the sewer system during conveyance to the treatment facility. The bacteria also inoculate the influent wastewater with heterotrophic, facultative bacteria that enable a greater degradation of organics and removal of nitrogen in the facility.

Following nine months of collection system bioaugmentation treatment, the plant managers observed the following changes:

- Effluent total nitrogen load decreased by 67 percent, including performance during the coldest time of the year.
- The plant is able to sustain a higher mixed liquor suspended solids during cold weather to improve nitrogen removal without incurring upsets due to filamentous bacterial growth (a former problem).
- Energy consumption per pound of nitrogen removed decreased 26 percent.
- Influent biochemical oxygen demand and total suspended solids load decreased 27 percent and 20 percent, respectively.



# Major renewal project calls for HDPE pipe

Severe cold in the United States resulted in major water main breaks in many cities. To prevent future pipe bursts, Springfield, Missouri, is replacing its old cast iron pipes with high-density polyethylene (HDPE) pipe. Susan Hylton of McElroy Manufacturing reports.

Atlantic Street in Springfield is notorious for water line breaks. It has been excavated too many times – to make repairs on a 1925 cast iron water main that is buried only one meter in depth.

Any kind of weather – heat waves, cold snaps, droughts, and downpours – can cause the ancient pipe to burst or rip at the joint under the patched street. A recent polar blast that lasted about a week resulted in more than a dozen water main breaks, and every one of them occurred in the area's oldest cast iron lines.

It's a situation that City Utilities of Springfield wants to remedy. It's also why the community-owned utility – serving 110,000 customers in Missouri's third-largest city of more than 162,000 residents – has started the slow process of replacing its crumbling infrastructure on a portion of Atlantic Street where some 126 water customers reside.

One of the critical decisions they made at the start of their first major renewal program was the type of pipe to use. It had to be durable, and it had to outperform cast iron pipe.

City Utilities Engineer Jeff Veteto said that high-density polyethylene

(HDPE) pipe was their top choice because of its leak-free system. Not only is it designed to prevent water breaks, it eliminates the environmental waste and costly loss of water from leaking pipes – an ongoing and common occurrence in older water lines. Veteto said some municipalities estimate they are losing a third of their water supply to leaks. He believes City Utilities' water loss is no more than 10 percent, but still significant and not acceptable.

"It's an extreme amount of money to waste on treating water that's just going into the ground," said Jobsite Superintendent James Medlin of Gillespie Excavating Co., the contractor for the project. "I believe HDPE is going to become more of a standard."

Brad Marshall, City Utilities' contract inspector, said that HDPE pipe is resistant to bursting during freezing and thawing conditions because of its flexibility. "It costs a lot of money whenever (the main) breaks. It's an initial cost for CU (City Utilities) to do this, but in the

**Above: Water and gas lines were buried in a joint trench between the curb and the sidewalk.**



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long run it will be a savings to have this polyethylene system in place,” Marshall said.

Gillespie, based in Strafford, Missouri, is midway through the project to replace more than a mile of the 20.3-centimeter cast iron pipe with the same size of HDPE pipe.

“When we do a test, there’s no leakage. It has to be 100 percent no water leakage or it doesn’t pass,” Medlin said.

Because the cast iron is being left in place under the street and the new HDPE line is being buried in a much deeper 1.83-meter trench between the curb and the sidewalk, they did not need to tear up the street.

They are using the same trench to install a 10-centimeter medium-density polyethylene pipe for gas service, which is being laid carefully 30.5 to 46 centimeters above the new water main.

Medlin said that the joint trench work requires diligence. When digging, they have to be careful not to hit telephone poles or damage phone lines and other utilities in the same trench.

An essential component of HDPE pipe’s leak-free system is the way it is joined together through the butt fusion process. City Utilities encouraged Gillespie to use McElroy’s fusion machines, which are engineered to apply the exact level of heat and pressure to seal the ends of thermoplastic pipe together. When cooled and complete, these welds are as strong as or even stronger than the pipe itself.

Gillespie used McElroy’s TracStar® 412 fusion machine to fuse the 12.2-meter lengths of 20.3-centimeter HDPE water line together. The track-mounted vehicle was self-contained and self-propelled so that it glided easily

from their box truck to the jobsite.

For the smaller 10-centimeter medium-density polyethylene gas line, Gillespie used the compact and lightweight Pit Bull® 14.

Veteto said that he prefers the butt-fusion method because beading can actually be seen forming on each end of the pipe during the melting cycle. When the melted ends are forced together, these beaded ends are one sign that the fusion was done properly.

Third-party industry research indicates that HDPE pipe and joints can have a lifespan of more than 100 years.

The water main and gas line renewals are being funded by a three-year increase in utility rates, which took effect in October 2013.

Most water mains in the United States were unlined cast iron until the 1940s. Though replaced by ductile iron in the 1970s and 1980s,

the US Environmental Protection Agency estimates that 40 percent of all water mains in the US are still cast iron, which is susceptible to corrosion, breaks, and leaks. Over the next 20 years, the Agency estimates the nationwide water infrastructure replacement needs at \$325 billion.

City Utilities is looking at an April 1 completion date and is very pleased with the progress Gillespie has made toward that goal. The Atlantic Street water main renewal project sets the standard for future projects. “I mean, from CU’s standpoint, all of our projects now are being designed with HDPE,” Marshall said.

#### Author’s Note

*Susan Hylton is a public relations specialist at McElroy Manufacturing, based in Tulsa, Oklahoma, United States.*

## Trenchless pipe installation breaks record – and thick ice

A Swedish drilling team demonstrated that trenchless installation of drinking water and sewage pipelines can be carried out successfully in temperatures well below the freezing point – at minus 27 degrees Celsius – and set a Scandinavian long-distance record.

Last winter, a team of drillers from BAB Rörtryckning AB struggled through centimeter-thick ice about 70 kilometers north of Stockholm to install two sewage and drinking water pipelines under the Länna Kyrksjö lake. The pipelines will service the nearby community of Norrtälje, which has grown significantly in recent years. The German company Herrenknecht supplied a horizontal directional drilling rig (HDD) type HK150C with a pulling force of 150 tons to help the team of the general contractor SVEAB to complete the core part of the project in three months.

The first drilling hole for the drinking water pipeline led from the shore to the lake bottom, where the pipeline was connected to a conventionally laid pipeline to create a link to the opposite shore. The 700-meter-long pilot was completed after two days of drilling at the lake bottom. Temperatures dropped 25 degrees, forming a decimeter-thick ice layer on the frozen lake.

“We fought against the ice for a total of two weeks, 24 hours a day. Day and night up to four boats were working on the lake as ice-breakers,” Magnus Tingstrand from BAB Rörtryckning AB recalls. The boats had to break through the ice to be able to lift the pilot head, change it for a reamer, and to

connect the pipe, which also was frozen into the ice. Tingstrand says the effort was worth it – the 710-millimeter pipeline was installed safely before Christmas.

BAB started installing the sewage ducts in January 2013. The plan was to install them in the form of a single “Double Pack” pipeline consisting of two polyethylene tubes (2x355 millimeters) that run parallel to the previously installed drinking water pipeline, which in turn, was to be produced in one step from shore to

shore deep under the seabed. In constant icy weather, “we first had to clear the jobsite of ice and snow, which took us one full day with temperatures of 27 degrees Celsius below zero,” Tingstrand says. Nevertheless, the team completed the pilot drill of the 1,385-meter-long crossing under the lake with a record of 457 meters per day – a record-breaking performance with an HDD rig in Scandinavia. Following the drilling, pipeline installation took just under 48 hours.







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# Water management strategy to minimize corporate risks

Climatic uncertainty threatens the reliability and quality of water supply, so management strategies that secure water supplies have become a high priority. **Rebecca Gale** of Waterscan Ltd. explains various approaches that have reduced water use and maximized available supplies.

Climate change has been a hot topic over the last decade, as extreme weather events have increased around the world. Temperatures have risen, glaciers have melted, ecosystems are out of sync, and weather events have become more frequent and more intense. In 2007 alone, monsoons caused floods in South Asia that displaced an estimated 20 million people, heavy rain in China killed 66 people in flooding and landslides, and floods in the United Kingdom (UK) cost the economy US\$5.3 billion, according to BBC News.

Climatic uncertainty threatens the reliability and quality of a

continuous water supply, which is imperative to industry. Before devising a water management plan, all risks – operational, reputational, regulatory, and financial – should be analyzed to ensure a robust strategy, with a collaborative approach to a shared problem.

Operational risk can be either a direct physical risk to a business, an indirect risk from an unsustainable supply chain, or both. Using flooding as an example, a flooded site's indirect risk is the potential loss of revenue if the site cannot operate, while the direct risk is associated with the expenditure required to repair flood damage.

**Recycling water creates a sustainable, dependable, and controllable source of supply, which is essential for business stability.**

In times of water scarcity, the operational risk to a business is that production will cease, stores won't open, and employees cannot work.

Reputational risk encompasses the customer experience and the public's view of the company's brand. It is more imperative now for a company to have a good corporate social responsibility policy. Consumers are becoming increasingly aware of the environmental implications of products they buy and seek to purchase goods from ethical companies. In 2004, protesters in Kerala, India, accused Coca Cola of depleting the groundwater and polluting the



Chinese soldiers use sandbags to protect fields from river flooding. Photo credit: chinahbzyg / Shutterstock.com



local environment, which led to the shutdown of their plant. Coca Cola denied these allegations, but the brand in this region was irrefutably damaged. Since then, the company has been carrying out one of the most sophisticated corporate social responsibility global water strategies in the beverage industry.

Regulatory risk encapsulates current and future local water regulations and legislation surrounding water supply and wastewater. Failing to meet these requirements can lead to the termination of the business's water supply or large fines for environmental degradation. In China, between 2008 and 2009, there were 8,179 legal disputes on water-related issues. In 2010, a mine belonging to the Zijin Mining Group leaked 9,100 cubic meters of contaminated wastewater from the plant into the Ting River. Thousands of fish were poisoned, drinking water was affected, and operations were suspended. The company was fined \$4.5 million and the five employees directly responsible were fined and imprisoned.

The financial risk to business is the accumulation of the operational, reputational, and

regulatory risks, and is often the driving force behind a business seeking to mitigate their water risk. Companies can be fined millions of dollars for non-compliance with regulations, and loss of revenue from operational and reputational risks can also be substantial amounts. The other financial risk a business can face is the potential increase in supply or wastewater company charges, plus abstraction and discharge licences. Compared to the financial implications of the other risks, the price of water does not currently reflect its true value. It is anticipated that water will be treated more like a commodity in the future, much like oil.

#### Water measurement

Good water management begins with measurement and transparency. Adapting to climate change, mitigating water risks, and effective water management is about knowing how much water is being used, where and when, and then setting priorities on where water reductions can occur – this is referred to as water footprinting.

A water footprint of a business is defined as “the total volume of freshwater that is used directly or indirectly to run and support the

business,” according to the Water Footprint Network (WFN). A water footprint is divided down into many subsections. For example operational, supply chain, product, and end-use water footprints are subsections, which are further broken down into blue, green, and grey waters. Blue water refers to the consumption of surface or groundwater. Green water refers to the consumption of rainwater that does not become runoff. Greywater is an indicator of pollution.

#### Operational water management

To optimize water resources within a business, initially it is better to look at operational water consumption as the company has a direct influence over reductions. The best way to monitor a business's water consumption is through automated meter reading. Irregular and estimated water company charging systems provide poor data if the site is billed at all. Data loggers monitor consumption from revenue and sub meters and provide remote meter readings up to every 15 minutes. Unusual patterns in water consumption and leakage can then be immediately identified and rectified.

The success of any water

management project can be evaluated using this accurate data. For Whitbread's Premier Inn hotel chain in the United Kingdom, the automated meter reading identified peaks in consumption at approximately 11 am that was caused by inefficient housekeeping practices, which led to a preventable wastage of water. Whitbread also saved \$665,700 identifying and stopping 11 major leaks.

#### Water-efficient technology

Successful water management is about identifying and prioritizing significant high-water consumption and reducing it to a best-practice benchmark. Full water audits of sites can show where technologies need maintenance, where processes and behaviors are inefficient, and where water reductions can be made. Automated meter readings can monitor savings to determine which technologies are the most effective in terms of water consumption savings and return on investment, before implementing the technology solutions across the whole portfolio. Changes to employee and customer behaviors are the most challenging, but often the cheapest way to save water. However, many technologies



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available in the market generate significant water savings with an impressive return on investment.

All water points should be considered for improvements. For example, hotels that install low-flow showerheads and taps, and dual-flush toilets, and encourage guests to wash towels only when necessary, can significantly reduce the water use per room. Premier Inn saved approximately 500,000 cubic meters (m<sup>3</sup>) of water per year by installing low-flow showerheads in 40,000 rooms throughout its hotels. In companies where there is a high level of domestic water use, such as offices, considerable savings can be made through urinal controls and generally the return on investment is evident within a few months. For Sainsbury's Supermarkets Limited in the UK, the annual water saving from urinal controls and new-build waterless urinals amounted to 50,310 m<sup>3</sup>.

#### *Rainwater harvesting and water recycling*

Recycling water creates a sustainable, dependable, and controllable source of supply, which is essential for business stability. It reduces the pressure on less renewable sources, such as groundwater and surface water, which is needed for

continued ecosystem functioning. Furthermore, potable water is not used for non-potable applications, which reduces the supply energy cost per cubic meter.

All rainwater harvesting systems work on the basis of using rainwater as their primary source of water, with mains water as a backup source. When accounting for rainwater-harvesting water use as part of the water footprint assessment, rainwater is considered blue water – simply because it would have eventually become run-off if it was not captured by the system. Even though blue water is less sustainable than green water, the use of rainwater is more sustainable than surface or groundwater, and is a useful means of reducing the demand on mains water. It can also act as a preventative measure of surface water flooding due to the improved management of surface water runoff. The supply of water is dependent on rainfall, so regions that are water stressed, due to a lack of rainfall, are not suited to this technology. Rainfall replenishes other sources of water, so by collecting the water it is no longer available for other users. Installations need to be analyzed on a case-by-case basis – for their effect on the local watershed,

the increased carbon cost, and the benefit to the site. Systems vary from the basic water butts for irrigation, which require no treatment, to systems for non-potable water use, and systems that filter the water to potable water standard.

Rainwater harvesting should not be a substitution for other water efficiency measures. All cost-effective technology should be implemented before alternative supplies are considered. Rainwater harvesting does not reduce water consumption, but water efficiencies will.

Unlike rainwater harvesting, greywater recycling saves mains water regardless of external environmental factors and reduces water consumption within a business more consistently. Greywater recycling reuses water used in baths, showers, and hand basins, for use in flushing toilets and irrigating gardens. Therefore, it is suited for installation in buildings, like hotels, that have the potential to meet a significant proportion of domestic demand for water. Greywater is generally installed in new-builds since retrofitting a system is costly and ineffective. Many greywater systems have an increased energy cost due to the ultraviolet disinfection used to

**Businesses cannot afford to ignore the potential risks that can occur from the lack of understanding of their water use, its effect on the local catchment, and of the importance of a strategy to reduce freshwater dependency.**

treat the water. Some systems are designed to use less energy, and instead of using ultraviolet they use an ultra-membrane filtration technology. A cost-benefit analysis should be carried out to see if the system will meet the demand, produce a shortfall, or would have water stagnant in the tank. Premier Inn installs greywater systems in all newly constructed properties, which can reduce water consumption in hotels by 40 percent.

#### *Bespoke recycling*

Operational water use can be reduced to almost zero in most industrial systems. Bespoke recycling systems, custom-designed for specific processes, can reuse significant volumes of water. Located in the UK, Walkers Crisps (PepsiCo) plans to stop water intake at all manufacturing sites in the next 10 years by capturing, treating, and reusing water extracted from potatoes during slicing and frying.

*Sustainable drainage systems (SuDS).* All new buildings in the UK have a mandatory requirement for sustainable drainage where feasible over conventional drainage. The reason is to retain surface water runoff on site and



## UK green grocer reduces water use 50 percent

Sainsbury's Supermarkets Limited achieved a relative reduction in their water use through an operational water management strategy that included installing automated meter reads, efficiency measures, rainwater harvesting and bespoke recycling.

Due to the company's commitment to sustainability and corporate social responsibility, a target of 50 percent relative reduction against sales area, compared to a 2005-2006 baseline, was set. This strategy has saved one billion liters of water compared to the baseline. Annual savings from some of the water-saving techniques implemented include: pre-rinse spray taps that saved 29,000 m<sup>3</sup>, remedial works that saved 119,064 m<sup>3</sup>, urinal controls that saved 50,310 m<sup>3</sup>, shared supply that saved 50,000 m<sup>3</sup>, account analysis that saved 147,000 m<sup>3</sup>, and rainwater harvesting at Sainsbury's Swansea saved 1,300 m<sup>3</sup>.

All new stores aim to be 50 percent more efficient than the baseline year, and install a suite of water-efficient technologies and rainwater harvesting systems as standard.

Sainsbury's aims to be the UK's greenest grocer, and has consequently opened two new stores that are water-neutral. The UK Environment Agency and government define water neutrality as no net increase in water use after a development in a pre-defined area, which encompasses the new development and surrounding area. The company reduced water consumption at the Leicester and Weymouth stores as much as possible before offsetting the remaining water used in the stores in the local community.

release it at a controlled rate. SuDS are designed to reduce the potential effect of new and existing developments on surface water drainage discharges. Urbanization has caused areas of vegetation to be replaced with impermeable surfaces that do not have the ability to absorb rainwater, which overloads the drains and causes flooding. These drainage systems aim to replicate natural systems to drain away dirty water run off through collection, storage, and cleaning, before slowly releasing it back to the environment. They should be easy to manage, require very little energy input, be resilient to use, and should be environmentally and aesthetically attractive. They should also use the following techniques: source control, permeable paving, water detention, infiltration, and evapotranspiration. This water can be recycled for use in buildings by using underground attenuation tanks for storage.

### Summary

Holistic water management maximizes available water resources on a large scale beyond one company's needs. Water management should focus on the allocation of water on an equitable basis to satisfy all demands in a

catchment area. Businesses share similar water issues, such as availability and quality, but each water management approach should be unique depending on its location and water-consuming processes employed. Water reduction and efficiency is the first step towards achieving water stewardship, and the influences and drivers can be varied for each regional area.

Historically, business' overuse of water had minimal effect on global water resources. However, businesses cannot afford to ignore the potential risks that can occur from the lack of understanding of their water use, its effect on the local catchment, and of the importance of a strategy to reduce freshwater dependency. Numerous water management strategies can be implemented to suit different businesses. Every saving made is a step closer to a more sustainable water environment, not just for the business, but also for the local community.

### Author's Note

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# Elevating water to the carbon level

The demand for water and the cost of treatment are increasing, making sustainability and efficiency essential for water companies, manufacturers, and business users alike, says **David Copeland** of Sustainability Live 2014 – IWEX. Water is the new frontier in the battle against climate change, so water management and energy should both be given high priority, he contends.

Water and energy are inextricably linked as a sustainability concern. Although there are differences between energy efficiency measures and water efficiency measures, they share many common attributes and are typically managed by the same person or function within an organization.

For many businesses that rely on water as part of their commercial processes, and for organizations whose business is water (such as utilities), the management of water, waste, and energy are already a strategic concern. For example, since the water and sewerage sectors were privatized two decades ago, they have made significant progress in addressing a neglected infrastructure and the polluted beaches and rivers that earned the United Kingdom (UK) the label: “dirty man of Europe.”

Today, the UK has a cleaner environment and high-quality drinking water. According to the UK regulatory authority Ofwat, services are safer, better, and more secure than ever before – with leakage down 35 percent since its peak in the mid-1990s. UK water companies have invested more than US\$118 billion in maintaining and improving assets and services, and some 90,000 kilometers of pipes and water mains have been replaced or improved.

## Regulatory reform

Despite significant progress, multiple challenges remain. The costs associated with implementing European Union (EU) legislation, for example, are considerable. The Water Framework Directive could cost between \$41-139 billion in England and Wales by 2027. However, the UK government’s ambitious Draft Water Bill is designed to slash red tape and drive increased competition, to ensure water companies have an incentive to implement cheaper, more sustainable solutions for sourcing water.

Meanwhile, the Department for Environment, Food and Rural Affairs (Defra) has embarked on a “Water for Life” program that includes plans for reform of the abstraction regime – ensuring a resilient infrastructure to meet future demand for water, and protecting rivers and other water bodies from over-abstraction and pollution. Defra is also working with the Environment Agency and Ofwat – to provide clear guidance to water companies on long-term planning

**FOR MANY BUSINESSES THAT RELY ON WATER AS PART OF THEIR COMMERCIAL PROCESSES, AND FOR ORGANIZATIONS WHOSE BUSINESS IS WATER (SUCH AS UTILITIES), THE MANAGEMENT OF WATER, WASTE, AND ENERGY ARE ALREADY A STRATEGIC CONCERN.**

and managing demand. Ofwat also launched a refreshed “Delivering sustainable water” strategy in 2010, as well as numerous other projects.

The energy-intensive water and sewerage sectors have a large amount of carbon embedded in their production processes. Therefore, companies will be affected by the implementation of the CRC Energy Efficiency Scheme, which is a mandatory carbon emissions reporting and pricing scheme that came into effect in October 2013. The scheme covers all organizations in the UK (excluding state-funded schools in England) using more than 6,000 megawatts per hour, per year of electricity.

Organizations that meet the qualification threshold are required to monitor their energy use and report their energy supplies annually. They must also purchase and surrender allowances to offset their emissions. Failure to comply will result in financial and other penalties.

## Technological evolution

With EU countries obligated to cut greenhouse gas emissions at least 40 percent of 1990 levels by 2030, water companies will need to invest and innovate in new technologies, processes, and approaches that reduce carbon impact while also improving services and the local environment.

One area of focus is the use of smarter leakage

and pressure management techniques. UK water companies lose up to 27 percent of treated water due to the water network’s poor condition, and could save resources using smarter leakage and pressure management technologies. However, water utility companies have been slow to adopt new technology. A smart water network is defined as an integrated set of products, solutions, and systems that enable utilities to remotely and continuously monitor and diagnose problems, set priorities, manage maintenance issues, and use data to optimize all aspects of the water distribution network.

According to research commissioned by the US company Sensus, smart water networks could save utilities globally up to US\$12.5 billion a year. The findings, available in the White Paper “Water 20/20: Bringing smart water networks into focus,” provide insight from more than 180 utilities worldwide. They suggest improvements in system performance (such as leakage and pressure management), network operations, and water quality monitoring, with informed decision making about the allocation of capital expenditures, which can stimulate dramatic savings when driven by smart water network’s real-time data. Sensus specializes in utility management systems that provide advanced measurement, data collection, analysis, and control capabilities.

## Utilities get smarter

Last year, Thames Water announced it was to become the first UK company to install smart water meters at all the properties it serves – enabling customers to monitor their usage online. With less than a third of its customers currently on meters, the company aims to have all its connections metered by 2030. Numerous other water companies throughout the country are also piloting smart water meters and advanced metering infrastructure, as well as other technologies such as smart pressure management solutions.

Thames Water is also pioneering a new technology at its Slough Sewage Treatment Works to recover phosphorus and ammonia from its wastewater stream and transform them into a premium-quality commercial fertilizer. The fertilizer, called Crystal Green, is sold in North America, but has also received the go-ahead for



sale in the UK from the Environment Agency and Trading Standards Service.

Dubbed Europe's first "nutrient recovery reactor" (or "poo power" by some), the project at Thames Water is a public and private partnership, with Ostara Nutrient Recovery Technologies (Vancouver, British Columbia, Canada) delivering the plant. Thames Water expects to make more than \$278,000 a year from the combination of selling 150 tons of its fertilizer to farmers and gardeners, and not having to spend as much money on chemicals to unblock pipes. Thames Water's Head of Commercial Projects, Graham Southall, will deliver a presentation on this groundbreaking project at IWEX, an annual forum for the water and wastewater industry. IWEX, part of Sustainability Live 2014, will be held in Birmingham, England, on April 1 to 3.

#### Retailer takes up water stewardship challenge

Water efficiency and sustainability are also becoming a growing concern for commercial organizations. Water stewardship is one part of Sainsbury's 20x20 Sustainability Plan, which is the cornerstone of its business strategy. At the end of 2013, the retailer announced a reduction in operational water consumption across its entire estate by 50 percent, compared to May 2006.

Sainsbury's achieved its water reduction target in a number of ways, such as eradicating underground leaks that saved hundreds of thousands of pounds, as well as fitting equipment

## UK WATER COMPANIES LOSE UP TO 27 PERCENT OF TREATED WATER DUE TO THE WATER NETWORK'S POOR CONDITION, AND COULD SAVE RESOURCES USING SMARTER LEAKAGE AND PRESSURE MANAGEMENT TECHNOLOGIES.

such as pre-rinse spray taps and low-flush toilets across all of its stores. It also invested in rainwater harvesting for all new stores as standard, as well as retrofitting these units in existing stores. Sainsbury's became one of the first organizations to achieve the Carbon Trust Water Standard, which certifies organizations that measure, manage, and reduce water use year after year. Tuval Rockman, the environmental resources manager at Sainsbury's, will serve as the chair for the IWEX session on water efficiency for business.

Politicians' focus has shifted to achieving carbon emission targets, so the threat posed by water shortages in the UK is now a lower priority. However, the UK organization, Carbon Trust, believes water is the new frontier in the battle against climate change. Carbon Trust helps businesses, government, and the public sector to reduce carbon-based fuel use, save energy, and commercialize low-carbon technologies. The Organization of Economic Co-operation and Development (OECD) in Paris, France, echoes this view, and has identified a number of concerning trends for water demand, water

quality, and water supply and sanitation. According to the international economic organization, water demand will grow by 55 percent globally between 2000 and 2050, with the increase being driven primarily by manufacturing, electricity, and domestic use. Over the same period, the number of people at risk from floods is projected to rise from 1.2 billion to 1.6 billion in 2050 (nearly 20 percent of the world's population), placing \$45 trillion of assets at risk. This has prompted the OECD to call for urgent and strategic policy responses – with a warning that governments and authorities in charge of water management must do more to make the water outlook manageable.

#### Author's Note

David Copeland is the marketing director of Sustainability Live 2014. Organized by Faversham House as part of this event, IWEX showcases water technology innovations and offers a complimentary keynote and seminar program. Energy Recovery is also part of Sustainability Live at the NEC Birmingham, which will be held on April 1 to 3, 2014.

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# Awaiting IMO ratification: Questions emerge on treatment system selection

Questions of the effectiveness of ballast water treatment systems emerge as the shipping industry awaits ratification of the International Maritime Organization's (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM). **Adrienne Fazio** of Hyde Marine, Inc. reports.

Ten years after the IMO adopted the 2004 International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM), ship owners, environmentalists, marine companies, and regulators still wonder when ballast water management will become a reality. Even the IMO Secretary General Koji Sekimizu proclaimed the 2014 World Maritime Day (September 25th) theme as "IMO conventions: effective implementation" with the hopes that there would be progress towards effective and global implementation of all IMO conventions.

In 1991, IMO's Marine Environment Protection Committee began the process of creating the framework of regulations, which would later become the BWM Convention. The guidelines were established six years later, in 1997. Yet, because the Convention's 38-states signatory does not meet the minimum combined 35 percent of world merchant shipping tonnage, the BWM Convention remains unratified. Experts believe ratification will happen in 2014, just as they did in previous years, but many find this year's possibility more realistic given recent revisions, as well as the adoption of a resolution that will make the implementation schedule more manageable.

During its 65th session in May 2013, the IMO Marine Environment Protection Committee introduced a proposal to meet ship-owner concerns about ballast water management system implementation. Instead

of tying installation dates to the 2.5-year dry-docking interval, ship owners now have a five-year window, which is tied to the ship's marine pollution (MARPOL) certificate. It was also recommended that enforcement of the discharge standard be suspended until 2016 for sampling. These revisions passed by committee were then reviewed and approved by the IMO General Assembly during the December 2013 meeting. Enforcement of the Convention will take place one year from ratification.

While the industry waits to hear news of IMO ratification, the United States Coast Guard has declared its own regulation that requires vessels with ballast capacities between 1,500 and 5,000 cubic meters, at the time of their first dry-docking after January 2014, to comply and implement a solution. Additionally, new vessels built after December 1, 2013, with plans to call on the United States must comply with the regulations upon arrival.

In the United States, ballast water is regulated by two entities: the Environmental Protection Agency under the Clean Water Act and the US Coast Guard under a memorandum of understanding with the Environmental Protection Agency. The US Coast Guard's Final Rule became law in June 2012. Because no ballast water management system has received US Coast Guard Type Approval, the US Coast Guard will grant extensions to those ship owners who request an extension one year in advance of their compliance date.

Concurrently, the Environmental Protection Agency Vessel General Permit became effective December 17, 2013. This new, proposed regulation includes more stringent rules on ballast water. The agency has no mechanism for granting extensions and ships need to apply for an individual permit. Additionally, the permit requires vessels operating in US waters to periodically sample – however, under the signed memorandum of understanding, the US Coast Guard enforces the permit.

## System selection

While speculation continues on the IMO ratification date, ship owners still have concern over the effectiveness of ballast water treatment systems and the ability of these system manufacturers to be able meet the upcoming surge in demand. Currently there are no ballast water treatment systems with US Coast Guard Type Approval, but there are more than 30 systems that have IMO Type Approval. Selecting an appropriate technology based on vessel type, and then choosing a reputable manufacturer can be a challenge – especially with so many options presented. In some cases, ship owners essentially place multi-million-dollar bets on the system they finally select. Some questions before making a costly decision should include:

- Does the system have IMO Type approval?
- Will the vessel travel to any US ports?
- What is the likelihood that the system selected will receive US Coast Guard approval?



**Ship owners still have concern over the effectiveness of ballast water treatment systems and the ability of these system manufacturers to be able to meet the upcoming surge in demand.**



- How many years of operating experience does the ballast water manufacturer have?
- What type of installation and retrofit experience does the company have?
- Will the system fit into the existing vessel?
- Did the manufacture conduct reliable and comprehensive testing of its system?
- How confident is the manufacturer about compliance when it comes to real-world testing?
- Does the company understand the dynamics of the industry and communicate potential challenges?
- Will the company still exist when there are future service needs?

With more than 60 companies in the ballast water treatment system business, owners and engineers must first determine what type of treatment technology is best – considering the type of ship, trade routes, space available, power requirements, and price. The first consideration is the method in which the system filters out sediment and larger organisms. This can be done with screen filtration, flocculation, a hydrocyclone, or in some cases, no filtration at all.

Following filtration, ballast water is then treated by chemical or physical means. Chemical processes require additional IMO approval and often include chlorination, electro-chlorination and electrolysis, advanced oxidation process or ozone. Chemical treatment can provide effective disinfection, especially for high-flow systems.

**IMO Ballast Water Management Implementation Timeline**

Ballast Capacity	Constructed before 2009	Constructed in or after 2009 but before 2012	Constructed in or after 2012
<1500 m <sup>3</sup>	EIF before 2016: by 1st IOPP renewal survey after the anniversary of the delivery of the ship in 2016 EIF after 2016: by 1st IOPP renewal survey	By 1st IOPP renewal survey after EIF	
1500 - 5000 m <sup>3</sup>	EIF before 2014: by 1st IOPP renewal survey after the anniversary of the delivery of the ship in 2014 EIF after 2014: by 1st IOPP renewal survey		
>5000 m <sup>3</sup>	EIF before 2016: by 1st IOPP renewal survey after the anniversary of the delivery of the ship in 2016 EIF after 2016: by 1st IOPP renewal survey		By 1st IOPP renewal survey after EIF

EIF – entry into force of the BWM Convention  
IOPP – International Oil Pollution Prevention certificate  
IOPP renewal survey – renewal survey with IOPP certificate (MARPOL I)

Ships constructed after the entry into force are required to comply on delivery  
Regulations apply to vessels greater than 400 GT

**Table 1. Specific timeline dates depending on ballast tank capacity and construction date**

Also, in some cases, it can offer relatively easy installation for retrofit tanker vessels if no equipment needs to be installed in the pump room. Yet, there is always the risk and cost of carrying chemicals on board, long hold times for the treatment to be effective, the need to neutralize discharge with additional chemical agents, and potential ballast tank corrosion.

Physical disinfection often comes in the form of ultraviolet treatment, deoxygenation, ultrasound, or cavitation. The most common

ballast water treatment technology is ultraviolet disinfection. It is often easy to use, safe, and not affected by water salinity, temperature, or hold times. Organisms cannot build resistance against ultraviolet disinfection, it does not cause tank corrosion, and there are no harmful toxic byproducts. However, there could be the need for frequent cleaning of lamp sleeves in the presence of iron and suspended solids, and electrical

*Continued on page 49*



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# Reliable green energy for food, brewery plants

Advanced anaerobic treatment offers clean effluent, less fossil fuel pollution, and a reliable source of renewable energy. **Marc Eeckhaut** of Global Water Engineering reports on several anaerobic Latin American plants that generate energy and additional profits in the food and beverage processing facilities.

Latin American companies are discovering that wastewater streams, normally a business cost, can be a source of green energy and extra profit. New anaerobic wastewater treatment plants simultaneously clean effluent to high discharge standards while producing methane biogas – generating green electricity or fueling boilers and other factory plant fuel consumers.

Advanced anaerobic technology plants can typically pay back their costs within two years or less – and then go on working continuously. Owners can choose to use the energy for their own purposes or – where government policies permit – deploy gas-fired generators to sell electricity back to the grid.

“Not only does this system offer profound environmental benefits in terms of clean effluent discharge and less fossil fuel pollution of the air, but also it provides reliable base load power,” says Global Water Engineering Project Manager Rodrigo Cruz, referencing recent anaerobic plants installed in Latin America.

“Most industries have not realized the potential of this green energy cash cow,” says Global Water Engineering President and CEO Jean Pierre Ombregt, based in Belgium. “They have mainly been focusing on treating their effluent to meet local discharge standards at the lowest possible investment costs. By doing so, wastewater treatment installations have only generated additional operating costs and have never been seen as revenue generators.”

Early Latin American adopters of anaerobic technology are already reaping millions of dollars a year in benefits, and are planning further extensions to expand the concept. Companies from Mexico, Ecuador, and Nicaragua have used this technology to turn a problem into a profit.

## Sabormex – Mexico

A global exporter of diversified food and beverage products, Sabormex is capitalizing on the benefits of its existing high-efficiency wastewater treatment plant by installing a Global Water Engineering complete biogas-reuse system to replace fossil fuels with green energy.

Founded in 1964 in the city of Puebla, Sabormex (which is translated as “Mexican flavor”) produces a large number of Mexican brands including Clemente Jacques (sauces and dressings), La Sierra (canned foods) or Tazza, Garat and Familiar (coffee). These brands are exported to more than 20 countries. Such diversified production results in very fast and significant changes in the composition and flows of the company’s wastewater, which, before



**Left:** Global Water Engineering’s anaerobic treatment plant is carefully integrated into the scenic landscape of Cumbaya, a suburb of Quito, Ecuador. **Right:** Carbon dioxide system installed at Compañía Cervecería de Nicaragua.

treatment, often contains high concentrations of fat, oil, and grease, and high levels of total suspended solids and chemical oxygen demand.

In order to deal with the variable characteristics of the wastewater, Global Water Engineering created and installed an ANUBIX™-B anaerobic reactor, designed for 24 tons of chemical oxygen demand per day. This reactor, operating since 2011, has shown consistently high removals and stable performances, Mr. Cruz reports.

Global Water Engineering’s Mexican partner, ICR Ambiental, built the treatment plant. ICR specializes in the engineering and construction of water and wastewater treatment, solids digestion, and power generation plants, and has partnered with the company by engineering and building wastewater treatment plants in Latin America for years.

All suspended solids and fats sent to the wastewater treatment plant are first separated in a dissolved-air flotation installation, which generates up to 100 cubic meters of primary sludge daily. In order to digest this organic-rich, primary sludge, Global Water Engineering installed an ANAMIX™-T reactor. This thermophilic, continuous, stirred-tank reactor achieves high removals of pollutants – even while fed with a difficult stream containing high concentrations of fat and solids. Up to 10 tons of chemical oxygen demand are fed to this reactor per day, with the system achieving high removal efficiencies of more than 80 percent.

Startup of this reactor took only a few weeks, with the help of a special seed-sludge collected from another GWE ANAMIX™-T, which had been operating in Belgium for several years. This innovative method preserves bacterial activity to enable seed sludge to be shipped overseas in regular containers.

In addition, Sabormex has subsequently ordered from Global Water Engineering a complete biogas use system to burn the biogas generated by the two anaerobic reactors. This will generate 6,000 normal cubic meters per day of biogas – allowing savings equivalent to up to 8,000 kilograms of fuel oil daily.

The quantity of biogas produced by Sabormex is equal to approximately 2,650 tons of the fossil fuel equivalent per year, worth more than US\$2 million in the first year.

## Cervecería Nacional – Ecuador

Ecuador’s leading brewery, Cervecería Nacional, is introducing a second waste-to-biogas plant that is expected to increase the company’s savings by more than \$25 million worth of green energy over the next decade. The company – a subsidiary of the SAB Miller Group – was founded in 1887 in Guayaquil, where its largest plant is still located today. It was under the name Pilsner, registered in 1913, that the company produced the first Ecuadorian beer – which 100 years later is still the country’s top seller.

The new Global Water Engineering installation commissioned by the company expands on the



success of its first plant in Guayaquil, which already produces the equivalent of more than 6,000 kilograms of fossil fuel a day, by extracting biogas from the wastewater stream.

The latest installation, producing the equivalent of 3,000 kilograms of fossil fuel a day, is at Cerveceria Nacional's Quito plant, where the Global Water Engineering wastewater treatment plant was integrated in the relatively small area of the brewery. This design decision preserves the surrounding scenic landscape of Cumbaya, one of the most beautiful suburbs of Quito. A brand new anaerobic reactor was integrated into the installation, which incorporated pre-existing tanks reconverted into new equalization and aerobic treatments.

Mr. Cruz explained, "After the huge savings observed in the first installation at the Guayaquil plant, and in line with the high level of respect for the environment that CN stands for, GWE was awarded a second biogas reuse system project, which was successfully started up this year. This system, drawing on a 3,000-cubic-meter-per-day wastewater treatment plant, is producing biogas for the main boiler of the brewery, which is a brand new boiler producing 20 tons of steam per hour and generating savings of up to 3,000 kilograms of fuel oil per day."

The combined fossil fuel saving generated by the two plants will quickly repay the cost of the installation, generating the equivalent of more than \$2.5 million a year in savings. This estimate assumes the plant runs 330 days every year at full capacity, with a heavy fuel oil price of \$0.83 per liter.

#### Compañía Cervecera – Nicaragua

Nicaragua's largest brewery, Compañía Cervecera de Nicaragua, is also embarking on a wastewater-to-energy initiative with a brand new Global Water Engineering wastewater treatment and biogas-reuse plant at its brewery in Managua. Global Water Engineering designed and installed an anaerobic reactor incorporating ANUBIX™-B technology for 13 tons of chemical oxygen demand throughput per day, as well as a biogas-use system installed at one of the company's boilers, which saves up to 3,000 kilograms of fuel oil per day. A revamp of the plant's aerobic and complete sludge dewatering systems has also been included in the current project.

The one-kilometer distance between the wastewater treatment plant and the boiler room created an additional challenge, which Global Water Engineering resolved by using its drying system GASODRIX™. This allowed Compañía Cervecera to use an existing pipeline at the plant without intermediate draining points. The plant is currently being commissioned for service.

The famous Flor de Caña rum distillery operates another wastewater-to-energy enterprise in Nicaragua. Global Water Engineering installed two large ANAMIX™-M digesters, which feed on wastewater from the cane molasses-based distillery.

#### Anaerobic process advantages

Modern anaerobic processes concentrate the methods in closed reactors – operated in ideal temperatures and under process control

to optimize waste degradation in order to generate large quantities of methane from the wastewater's organic materials.

Mr. Ombregt says, "The quantities of methane produced can diminish or even completely replace the use of fossil fuels in the production process. One ton of COD (chemical oxygen demand), digested anaerobically, generates 350 normal cubic meters of methane – equivalent to approximately 312 liters of fuel oil – or generates about 1,400 kilowatts per hour of green electricity."

The United Nations Development Program recognizes anaerobic digestion technology as one of the most useful decentralized sources of energy supply because it is energy-efficient and less capital-intensive than large power plants. It can also benefit local communities by providing local energy supplies and eliminate the need for large anaerobic lagoons with unpleasant odors.

"Anaerobic wastewater treatment sheds a whole different light on the cost structure of wastewater treatment infrastructure," Mr. Ombregt says. "It can generate significant income for many factories and food, beverage, and other primary product processing plants throughout the world."

#### Author's Note

Marc Eeckhaut is the executive vice president of marketing and technology for Global Water Engineering, who can be reached at [mail@globalwue.com](mailto:mail@globalwue.com). Visit [www.globalwaterengineering.com](http://www.globalwaterengineering.com) for more information.

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Once again IFAT 2014, the world's leading trade fair for water, sewage, waste and raw materials management, is set to break its own record.

# IFAT highlights water and energy solutions

Some 3,000 exhibitors in the environmental technology sector from more than 50 countries will showcase their solutions and services in the fields of water and wastewater treatment, energy recovery, sewer rehabilitation, and more – in more than 230,000 square meters of floor space. IFAT 2014 will be held from May 5-9 in Munich, Germany.

In addition, event organizer Messe München put together an extensive events program that includes panel discussions, seminars, exhibitor presentations, and programs that focus on country and regional markets. Spotlights this year will be the challenges and solutions for expanding markets in India, China, Mexico, Central America, and Turkey.

Canada's oil and gas sector is the focus of a special event "Future of water and energy management," organized in cooperation with the Canadian government and provincial governments of Quebec, Ontario, Alberta, and British Columbia; Bavarian Research Alliance; and the Bavarian State Ministry of the Environment and Consumer Protection. This event promises to be well attended given the pressures of growing demands for water and energy throughout the world. For the first time at IFAT, the United Nations is presenting a seminar on water and energy issues, reflecting its 2014 World Water Day theme, which recognizes the need to address the need to secure energy security and sustainable water use.

A significant number of IFAT exhibitors and joint exhibitor stands – 56 in total, from 13 countries – will exhibit innovations that provide solutions to global energy and water challenges. For example, the German company, Siemens, which specializes on automation, control, and drive systems for industry and municipal water authorities, will be presenting its modular water management software, Siwa. This product helps network operators optimize complex water and wastewater networks. Its leak module identifies and localizes leaks in water transport systems, according to Siemens. Also on display is Alfa-Laval's new Iso-Disc, a disc filter developed based on technology from its 2012 acquisition of the US company Ashbrook Simon-Hartley, which reduces energy use in tertiary filtration.

The Water Environment Federation's (WEF) International Pavilion, including more than 20 WEF members as exhibitors, will also present products and services that address challenges in water supply, decentralized wastewater treatment, energy efficiency, stormwater management, and other related issues. The WEF International Pavilion will be located in IFAT Hall A4.

In this preview section, ADI Systems, Aeration Industries, Bio-Microbics, E. H. Wachs, Hamilton Kent, Mazzei Injector Company, Sekisui SPR Group, Sipos Aktorik GmbH, Permastore, Flexim, Hydro International, and other IFAT exhibitors, report on technologies that will be on display at IFAT 2014.

## HOBAS displays GRP pipe systems at IFAT

HOBAS Engineering GmbH will display its centrifugally cast GRP pipe systems for water, wastewater, and industrial applications at IFAT 2014 in Hall B6, east entry. The exhibit will present HOBAS' Pressure Pipe OD 3270 with flush FW-coupling, a two-in-one trenchless solution designed to withstand external as well as internal working pressure.

Also on display is HOBAS' modular combined sewer overflow tank that serves as an ordinary sewer in dry weather. It prevents overflows in wet periods by separating solids and conveying the clarified water into the storage tank or discharge system. The image above shows HOBAS' pressure jacking pipe OD 1720, PN 6, installed in Venice, Italy.





## Lifespan System® prevents manhole inflow problems

Extraneous water inflow and sewer surcharge can be eliminated in wastewater collection systems by installing the Lifespan® System, the world's first rubber manhole solution, according to Toronto-based Hamilton Kent.

The system features a corrosion-proof, durable rubber frame and matching rubber adjustment risers, and a mechanically sealed cover. Lifespan was designed to eliminate unwanted inflow at the cover and chimney area of a manhole. The locking cover, made of cast iron or a lightweight composite material, provides a watertight seal at the top of the manhole.

The system has undergone rigorous field-testing in challenging city road and off-road environments. From extreme high to extreme cold temperatures, as well as environments with many freeze-thaw cycles every season, these roads are exposed to significant weather changes, corrosive road salts, snowplows, and heavy traffic. Hamilton Kent reports that Lifespan reduces road maintenance because it is engineered to retain the structural integrity of the surrounding pavement and underlying concrete structure.



The system weighs 25 kilograms, compared to traditional manhole frames that weigh between 113 and 136 kilograms. This offers advantages in installation and rehabilitation projects in easements and areas where it is challenging to use heavy equipment. The 60-centimeter composite cover weighs only 30 kilograms.

Further simplifying installation, the Lifespan System offers tapered adjustment risers, 1.27 centimeters on one side and 3.81 centimeters on the other – allowing installation crews to easily match the grade of the surface surrounding the manhole. Currently Lifespan is

available in sizes of 60, 68.6, and 76 centimeters. All three sizes come with the SHURE-LOK design, ensuring the cover will be placed into the frame with the proper orientation for the locking cams to engage in the pockets on the inside of the frame.

After a one-in-50-years rain event – in which 15 to 20 centimeters of rain descended in one hour – the Canadian Township of North Glengarry, Ontario, decided to rehabilitate eight leaky manholes with the Lifespan System. The first four units were installed in on-road locations. The others were designated for off-road use near an active creek – which was critical for controlling unwanted inflow.

The Township has reported impressive results and “zero issues,” and has since ordered more Lifespan units.

IFAT Hall A4, Stand 309A

## FLEXIM ultrasonic flow meter detects leaks

Many developed countries with aging infrastructure need to contain and repair water leaks in drinking water distribution networks. FLEXIM's ultrasonic clamp-on flow FLUXUS® ADM 7407 provides a measurement solution that helps localize leaks, while avoiding problems experienced with conventional in-line flow meters, according to FLEXIM GmbH, based in Berlin, Germany.

As the sensors are mounted on the pipe wall outside, the installation of the system does not interrupt the supply. Moreover, due to the permanent coupling on the pipe, the rugged, stainless steel mounting fixture VARIOFIX as well as the IP68

protected sensors, guarantee safe and long-term stable measurements – even when buried sub-surface.

The ultrasonic flow meter FLUXUS® detects the smallest volume streams with the highest precision, the company claims. This precision is achieved by means of matched and paired sensor pairs in addition to measurement algorithms for an accurate and reliable signal processing. Leaks that affect distribution system efficiency can be localized using GSM by building network of a multitude of flow measurement points.

IFAT Hall B3, Stand 141C



VARIOFIX C with IP68 transducers in subsurface mounting. Photo by FLEXIM GmbH

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# Fine grit removal reduces energy costs

Sewage treatment operators are allowing more harmful grit to pass through their inlet works than they realize, leading to costly equipment wear, higher energy use, and increased maintenance costs. Hydro International Business Director **Clive Evans** explains why international experts infine grit removal are coming to IFAT 2014.

IFAT Hall A1, Stand 213

Operators should rethink their assumptions about wastewater grit particles that could be the unknown cause of huge operating inefficiencies. It is time to change minds about grit removal – the result could be huge savings in operating costs.

The latest scientific research into the true nature of wastewater grit is overturning conventional thinking. Particle size, shape, specific gravity, and composition all influence settling velocities and affect removal efficiencies. Removing finer grit particles than has been accepted practice could result in better plant performance and energy efficiency.

Ideally, 90 to 95 percent of all grits, sands, and fine particles should be removed at the inlet to the wastewater treatment plant. Wind-blown grit, dust, and sand in a wide range of particle sizes are typical of climates in Europe, the Middle East, and around the world. The particles lodge in open drainage systems such as ponds, channels, and highway drainage and are washed to the treatment works.

Grits and sands cause extensive and costly problems to mechanical equipment. Grit abrasion of metal surfaces causes premature wear in pumps, bearings, and valves. Grit settles in low flow pipes and tanks, causing blockages and plant downtime. The build-up of heavy inorganic sediments disrupts sludge settlement and digestion processes.

Fine grit removal could be considered an essential part of a plant's energy consumption reduction plan. Energy costs can account for 50 percent of a plant's operating costs and removing the amount of sediment that has to be pulled unnecessarily around the plant can reduce power costs substantially.



## Grit removal advice

International grit removal experts will be available at the Hydro International stand at IFAT 2014 to demonstrate ways to save energy and offer practical guidance on how to approach the issue. The five following points provide sound advice:

- Access the best technologies. Grit is a worldwide problem.

Technology, combined with best practice experience, has delivered proven projects in countries across the globe. Better techniques could dramatically improve the amount of grit removed and recycled for some water companies.

- Do the science. Grit separation and removal requires a rigorous scientific approach and starts

## Vortex power

Hydro International's technologies for fine grit removal in wastewater treatment plants are based on proven vortex separation techniques. They can be teamed with classifiers, washers, and dewaterers for grit handling, organics removal, and treatment.

New to Europe but already proven in North America, the space-efficient HeadCell® modular, multiple-tray settleable solids concentrator requires no power, has no moving parts, and targets grit as small as 75 microns.

The Hydro Grit King® is an advanced hydrodynamic vortex separator that augments gravitational forces to separate grit from water with minimal headloss. Its free-standing vessel or constructed chamber design uses no power and has no moving parts, achieving low operating and maintenance costs.

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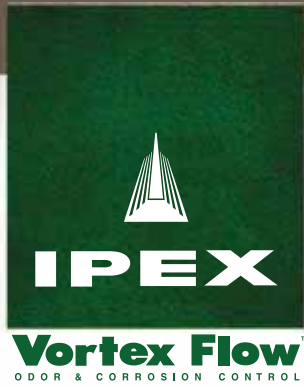
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Using the wastewater's own flow energy to suppress turbulence, aerate the sewage and oxidize dissolved hydrogen sulfides (H<sub>2</sub>S), the Vortex Flow's patented spiral design sucks odorous gases downward towards the bottom of the structure where they are entrained back into the sewage flow. Visit [www.abettersewer.com](http://www.abettersewer.com) to request your FREE conceptual design and learn about this one-time investment, custom designed to suit your specific sewer drop needs.



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with an understanding of grit characteristics and behavior. Wastewater grit is not clean sand, yet many grit removal systems are designed as if it were. Failing to accurately account for the settling velocity of organic- and grease-covered grit consistently leads to systems that fail to perform.

- Challenge your paradigms. Check your assumptions of the behavior of grit and you may be surprised by what you learn; particle size, shape and specific gravity influence settling velocities and affect removal efficiencies. There is some excellent academic research available on the topic. Hydro would be pleased to share this with you.
- Question conventional assumptions. Consider removing finer grit particles than has been accepted practice. Our findings suggest that the outcome may result in considerably better plant performance and energy efficiency.
- Approach grit removal as a through-life capital cost, rather than as an annual maintenance burden. In this way, good practice can be shown to benefit whole plant performance.

## Anaerobic MBR treats wastewater, produces energy

ADl Systems' Anaerobic Membrane Reactor (ADI-AnMBR) for food processors treats wastewater with minimal membrane fouling and less waste sludge production, while also producing renewable energy. Combining anaerobic digestion and membrane filtration in one process, ADl Systems says that its anaerobic MBRs treat high-strength wastewaters under higher volumetric loading rates and longer solids retention times than traditional anaerobic treatment processes. A food processing application of ADl Systems illustrates its benefits.

Ken's Foods produces salad dressing and barbeque sauce at its US facility in Marlborough, Massachusetts. The company upgraded its wastewater treatment system by installing an ADl-AnMBR system. According to ADl Systems, the system can treat 475 cubic meters per day of raw wastewater and has been reliably treating Ken's Foods' wastewater since 2008. Biogas is used to scour

membranes, significantly reducing the rate of membrane fouling. None of the submerged Kubota flat-plate membrane cartridges have needed replacing – even after more than five years of operation.

Effluent from the AnMBR system meets all discharge limits and is discharged directly to the local publicly owned treatment works. Total suspended solids removal is 99.9 percent (less than 2 milligrams per liter), and chemical oxygen demand removal averages 99.3 percent (190 milligrams per liter).

The system produces 5,800 cubic meters per day of biogas, which is stored under a floating, insulated geomembrane cover. Biogas is used in a boiler to heat the wastewater treatment system to mesophilic temperatures (35 degrees Celsius), as well as provide building heat. Excess biogas is flared.



This plant upgrade reduced sludge dewatering and disposal costs and made the existing system less dependent on macronutrients, polymer, and chlorine. In addition, the ADl-AnMBR reduced sequencing batch reactor power and aeration requirements by 85 percent, reduced operations and maintenance costs by 50 percent, and increased operating capacity by 60 percent.

IFAT Hall A4, Stand 402B

## Mazzei patented injectors at IFAT

The US-based Mazzei Injector Company will present their broad line of patented injectors at the IFAT Trade Fair in Munich, Germany. Mazzei manufactures a range of chemical feed, mixing, aeration, flotation and ozone mass transfer component and system technologies for a variety of markets – including agriculture, beverage, chemical process, food processing, high purity water, potable water, wastewater, and reuse.

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patented, high efficiency Venturi differential pressure injectors with internal mixing vanes that transfer or mix liquid or gas additives into solution. The injectors produce energy efficient aspiration of chemicals, powders and gases, and are used in industrial and municipal water and wastewater oxidation and disinfection applications. When a sufficient pressure difference exists between the inlet and outlet sides of the injector, a vacuum is created inside the injector body, which initiates suction of a liquid or gas through the suction port. Mazzei Injectors operate over a wide range of pressures and require only a minimal pressure differential between the inlet and outlet sides to initiate a vacuum at the suction port.

Mazzei injectors can be used alone, or paired with Mazzei mixing nozzles, entrained gas separators, and flash mixers to provide complete chemical and gas addition systems such as in the Mazzei patented GDT™ ozone contacting system, which is used in municipal water, wastewater, and industrial applications. The benefits of the GDT process include: small footprint, low capital and operating costs, consistent performance, ease of maintenance, broad turn-down/control range, highest mass transfer and mixing efficiency.



Six Mazzei model 12050 stainless steel injectors provide aeration for activated sludge digesters at the City of Atwater, California, Regional Wastewater Treatment Plant with a capacity of 42.4 million liters per day. Photo by Mazzei

IFAT Hall A4, Stand 309B

## Decentralized systems for small communities, large operations

Demand for water in many communities – small and medium – have reached critical levels around

the world. Decentralized treatment systems are gaining in popularity for returning treated water to the local environment.

Bio-Microbics' MyFAST® High Strength Sewage Treatment Plants (HS STP™), offering versatility in design and flow rates, are used as an alternative to expanding existing centralized plants. The self contained MyFAST HS STP provides reliable, affordable water supplies, and infrastructure that sustains community growth, according to the US-based company in Shawnee, Kansas.

Builders and developers searching for reasonable wastewater treatment options for projects with land constraints, opportunities for direct discharge, groundwater recharge, and water reuse opportunities are requesting advanced onsite treatment systems. FAST® technology is fitting for clustered communities and commercial outlets. Large decentralized systems with flows up to 600 cubic meters per day benefit with Bio-Microbics quick and easy installation and cost advantages of MyFAST high performance, low maintenance and sludge management in one tank.

Decentralized systems, installed as an alternative to sewers, should address considerations such as operation and maintenance, as well as sludge management. Bio-Microbics does this by providing sludge management zones: BioSolids Management Systems (BMS) and Aeration Management Systems (AMS) on sewage treatment plants reducing costs for communities and individuals.

Bio-Microbics Fixed Integrated Treatment Technology (FITT®) process approach of the MyFAST system uses pre-aeration (AMS Zone), mixing, and degrading sewage before it enters the treatment zone. The MyFAST system enables simultaneous aeration, mixing and self-cleaning of the attached growth inside the tank. This eliminates the need for pumping primary to settle before the treatment zone. Complete with effective, pre-engineered air delivery system to aid in robust circulation of wastewater, pre-aerated wastewater flows to the treatment tank where bacteria and higher life forms flow through the media's channeled path and become "fixed" to the media inside the MyFAST unit. This treatment process achieves higher percentage nitrogen removal rates. MyFAST copes with surges and provides higher removal rates for organic material. Growth on the media thickens and sloughs off



during the aeration process, settling to the bottom of the treatment zone for removal. Effluent is more than 95 percent removed of solids and waste. Treated water is then available to replenish groundwater and aquifers, or made available for greywater reuse.

IFAT Hall A4, Stand 303A

## SEKISUI presents trenchless method

The SEKISUI SPR Group will demonstrate its Spiral-Wound method SPR™ at its booth at IFAT. With the slogan "Underneath the City," the company will present its holistic approach to the management of pipe systems with services and technologies used in the fields of inspection, design, installation, and maintenance. The focus will be on a broad technology portfolio for trenchless rehabilitation of potable water and sewage pipelines, including Spiral-Wound, Cured-in-Place, and Fold-and-Form processes. In the Spiral-Wound process, PVC profile strip is fed from a spool above ground into a machine stationed directly in the



sewer and formed into a watertight pipe inside the old pipe.

IFAT Hall B5, Stand 121

## Actuator solution for eel bypass

SIPOS Aktorik GmbH presents its latest electric actuation advances in valve control at IFAT 2014. Its initiatives include variable speed capability to protect against water hammer, and a gearbox synchronization solution that addresses automation challenges that arise

when valve stems are set apart.

The company's latest advance is an eel bypass system, developed in response to a German government requirement for turbine intake screens to provide clearances that guarantee fish can pass parallel to hydroelectric plants. SIPOS pioneered a synchronized actuator solution that was piloted at an RWE hydroelectric power plant at Unkelmühle near Bonn, Germany. SIPOS Aktorik is part of the AUMA Group of Germany.

IFAT Hall A4, Stand 326

## Diamond Wire pipe saw cold cuts

The Diamond Wire Guillotine pipe saw from E.H. Wachs safely cold cuts steel, ductile and cast iron pipe and bar from 4 to 16 inches (10.16 cm to 40.64 cm) in diameter, as well as PVC, clay and other materials. A single nylon strap secures the tool to the pipe, restricting tool motion and eliminating operator fatigue. The saw features a quick-change, continuous loop diamond wire cutting element that is shielded for safety. "Operator safety is first and

foremost," states Jeff Swiatowy, General Vice President for E.H. Wachs.

Designed for one-person operation, the saw is controlled by a simple manual feed control knob. "An experienced operator will be able to cut based on the audio tone the wire makes," states Swiatowy. "But for the beginner operator, the gauge assists in determining the correct amount of pressure to apply during cutting."

Similar to a band saw, the pipe-cutting tool uses a pre-tensioned, twisted, diamond-bead media that is fed across pulleys. As the wire runs through the machine, it corkscrews, which allows complete use of the diamond beads cutting 360 degrees. One hundred percent of input power makes it to the cutting media because the wire is supported on bearing-mounted wheels – compared to chain saws that scrub power between the chain and the backer bar. This is why there are more cuts per wire (typically 30 or more) and cut faster using just a Class II hydraulic circuit – such as a skid-steer or other equipment capable of producing 8 gpm at 2,000 psi.

IFAT Hall A4, Stand 406B

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### Tanks withstand extreme weather

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PERMASTORE® modular tanks receive independently audited product testing and more than 300,000 structures have been exported to over 110 countries. Each one can withstand local environmental extremes from the arctic cold to the desert heat. The modular tank system allows rapid installation. Permastore offers a complete range of diameter and height options with storage capacity solutions exceeding 50,000 cubic meters.

IFAT Hall A3, Stand 211

### Aire-O<sub>2</sub> Triton® reduces energy use 28 percent at UK creamery

In July 2013, the largest cheddar cheese manufacturer in the United Kingdom, Dairy Crest Davidstow Creamery in Camelford, installed two 48.5-kilowatt Aire-O<sub>2</sub> Triton® process aerator and mixers to provide efficient mixing and fine-bubble aeration at its 24-hour, upgraded effluent treatment plant. Aeration Industries' UK representative, KEE Process Limited, installed the Tritons without de-commissioning the reactor during the treatment process – eliminating the need to empty the reactor contents and find a temporary effluent disposal solution.

The Triton is a surface-mounted aerator that operates below the water surface, eliminating atomization and aerosoling of wastewater. The blower supplying low-pressure air is a high-efficiency regenerative unit and is quiet in operation. The Triton injects a plume of fine air bubbles into the water, ensuring that air reaches deep (up to 10 meters) into the tank. The air-water mixture forms a cone-shaped plume, which increases in depth in its zone of influence to ensure

all tank contents are completely mixed. Because the Triton uses low-pressure air, the mixed liquor temperature is not elevated, minimizing energy use.

The blower can be controlled using a dissolved oxygen probe and programmable logic controller to facilitate effective dissolved oxygen in the mixed liquor. During low-load conditions the blower switches off, but the Triton continues to provide efficient mixing to the reactor contents. A well-mixed activated sludge reactor ensures the entire installed volume of the reactor participates in the treatment process.

KEE Process provided the necessary process engineering input to the creamery and re-evaluated the reactor design for treating 850 cubic meters per day of creamery effluent. The company concluded that the process required between two and three 48.5-kilowatts of Tritons for oxygen requirements, but only two for mixing. It was decided that two Tritons would provide the necessary mixing of the mixed liquor and almost 85 percent of the oxygen demand. The balance of the oxygen would be provided by the retained existing helixor aeration system. In effect, the Tritons took over as the primary aeration system and provided the critical mixing vital to any activated sludge process.

Since commissioning the Aire-O<sub>2</sub> Triton process aerator and mixers, the power consumption is 28.3 percent less than that of the previous aeration system.

IFAT Hall A4, Stand 406A

### Flow Pulse monitors pumps

By installing a Flow Pulse non-invasive flow monitor, manufactured by Pulsar Process Measurement, at one of their wastewater pumping stations, the UK water company Thames Water avoided extensive groundwork, disruption to local traffic or neighboring properties, and the need to transport sewage from the station.

In this two-pump station, Thames Water planned to monitor pump station performance and check the individual condition and efficiency of each pump. Instead of installing a magflow-type meter for direct flow monitoring to obtain this information, the utility installed a Pulsar Flow Pulse unit. This was

Continued on page 48





## Milan Expo Israeli Pavilion – advances in water technology

The Israeli Pavilion at Expo Milano 2015 in Italy will highlight the nation's achievements in efficient water and agriculture technologies, according to Shimon Tal, the chief executive officer of RTS Water Ways. Focusing on the theme "Feed the world, energy for life," the Expo will be held for six months beginning May 2015.

Israeli advances in conservation, irrigation, smart water systems, and efficient agriculture have contributed significantly to securing water and food supplies in water-stressed regions, Mr. Tal says. The pavilion will promote these innovations such as drip irrigation and other advanced water and agricultural technologies and management approaches.

Expo visitors will be able to visit demonstration farms, outside the Expo playground, to see Israeli water and agricultural technologies at work. Eran Eizik (Oryan), Tzuki Deutsch, and Shimon Tal are organizing the demonstration side event in coordination with the Italian research organization Parco Tecnologico Padano (PTP). The model of the demo farm project will consist of four or more sites in commercial and running farms (greenhouses, field crops, and irrigation, animals) and the water infrastructure of Milano. The demo farms will allow Israel to present comprehensive advanced approaches to food production and water management. Special tours for visitors will be organized to the demo farms. Academic

activities, conferences, and workshops will be part of the activity. "We see the Expo as a good opportunity to launch a much wider cooperation between companies and organizations from Italy and Israel also after the Expo," Mr. Tal says.

Israeli companies will be able to present their technologies at the demo farms. In the Israeli Pavilion, efforts will be made to facilitate meetings between Italian companies and research institutes with Israeli companies to promote mutual interests in Italy, Europe, and throughout the world.



**"Israeli advances in conservation, irrigation, smart water systems, and efficient agriculture have contributed significantly to securing water and food supplies in water-stressed regions."**  
**Shimon Tal, RTS Water Ways**

## Real-time sewer leak detection

The real-time sewer exfiltration detector technology, *Vigi-Leak™*, developed by R.Z.E.E. of Israel, detects leaks early in sewer pipes and measures the volume of wastewater loss.

Leaking sewers is a worldwide problem – persistent pollutants, including Carbamazepine and other synthetic molecules such as artificial sweeteners, are found in groundwater, providing strong evidence of a chronic linkage between leaking sewers and groundwater deterioration. In Germany, nearly US\$100 billion is needed to replace malfunctioning old sewers, according to Frost & Sullivan, a global market research firm. An Israeli governmental water authority, which set up an investigative team in 2009 led by Professor Ophira Ayalon from Haifa University, estimated that 100 million m<sup>3</sup> of wastewater are lost every year in Israel. This loss is a tremendous waste of a valuable resource for an arid nation that reclaims approximately 75 percent of its treated wastewater for irrigation.

R.Z.E.E. staff was involved in determining the extent of Israel's most severe sewage leakage event – the Western Galilee incident from 2003 to 2011. Company experts detected a main sewage collector leak of an estimated 500 m<sup>3</sup> per day, and an estimated total volume of 1,400,000-m<sup>3</sup> raw wastewater loss, polluting nearly 100 million m<sup>3</sup> of natural groundwater resources. This loss resulted in US\$50 million worth of damage to the Israeli water economy.

R.Z.E.E. Chief Executive Officer Roberto Zimmerman explains that the *Vigi-Leak* technology is based on the company's experience with the Western Galilee incident. A minor investment in real-time sewer leakage detection technology, such as *Vigi-Leak*, he says, could avoid major groundwater contamination from sewage leakage, and enable sewer operators to provide their flow data instead of remaining dependent on flow data delivery service providers.

*Vigi-Leak* technology is based on the following principles:

1. Flowrate is continuously measured through the Any-Geometry-Flume™ method at pre-selected segments of the sewer following a catchment area.
2. Performance of a quantitative correlation between the integration of one or more lateral discharges upstream and the discharge measured downstream of the main collector. This correlation is performed through a self-training algorithm, which uses historic data to yield real-time alerts when a noticeable discrepancy occurs between the two values.

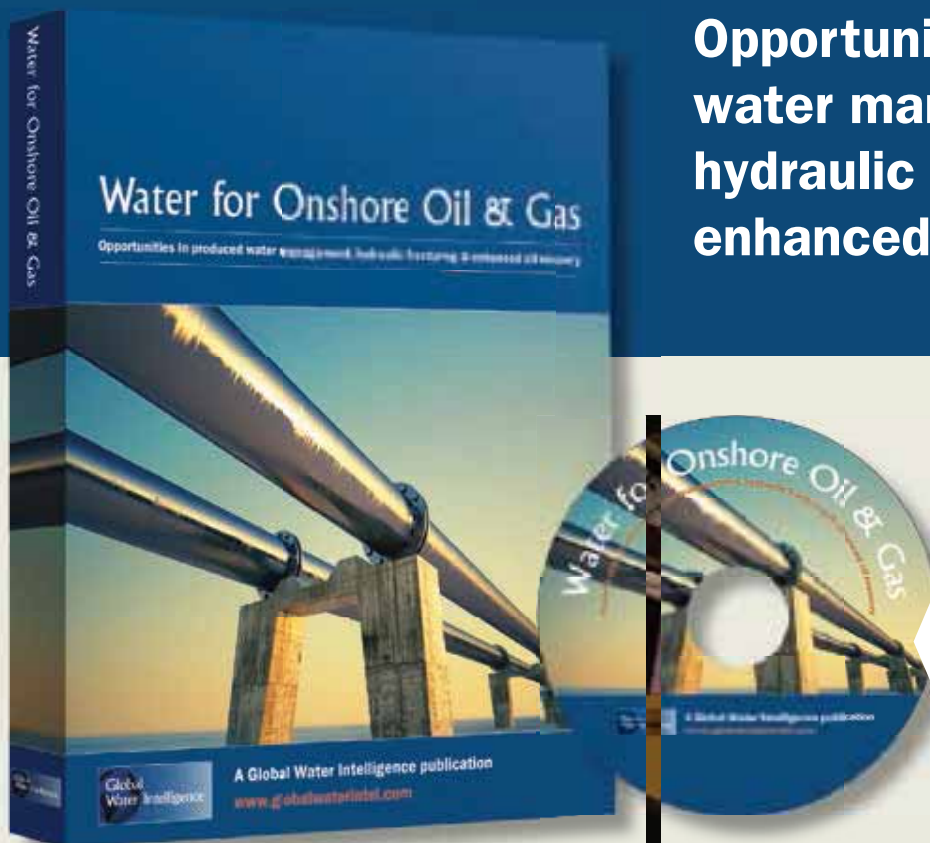
Data from measuring stations is transmitted using internet interface to sewerage system operators and sewer malfunction alerts are sent in real time to cellular devices.

*Visit IFAT Hall A4, Stand 308 (Israel Export Institute) for more information on Vigi-Leak and other advanced water technologies.*

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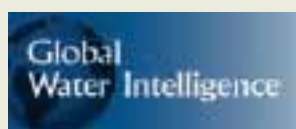
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By 2035, the IEA predicts that global oil production will increase to 97 million barrels per day to meet growing demand. Global gas production is projected to reach 5 trillion cubic metres per year by 2035. Managing the increased volumes of produced water associated with this production – and sourcing water for operations – is becoming more challenging. Scarce water resources have pushed operators to reuse produced water for water floods and fracturing fluids. Tighter environmental regulations are restricting the usual methods for disposing of produced water, encouraging operators to look at new approaches.

There are huge long-term opportunities for oilfield service companies and water technology providers offering solutions to manage these challenges. This new report showcases the potential of this growing market.

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# Continuous backwash filter – new approach to multimedia filtration

The continuous backwash mechanism in multimedia filtration (MMF) proves advantageous in large-scale desalination plants, according to IDE Technologies' Dr. Boris Liberman, CTO Membrane Technologies, who explains how it simplifies the design of the pretreatment facilities.

Although conventional MMF-based pretreatment for large-scale desalination plants has proven reliable and efficient, IDE's new continuous backwash mechanism avoids some of the drawbacks inherent in conventional treatment – such as the large backwash system.

Conventional pretreatment uses several filters, which must be backwashed in sequence. During this process, additional filters are required to compensate for those being backwashed, in turn requiring more backwash channels and concrete walls. The water- and air- backwash systems require large-diameter pipes and valves, as well as measurement instruments. A large volume of backwash water has to be stored, treated, and then discharged to the sea.

Due to the design of the standard MMF underdrain, during the backwash procedure it has to convey five times larger flow than during normal filtration. Air scouring makes the underdrain more complicated.

Media expands during backwash – and for this reason, in conventional gravity filters a minimum quantity of water is kept above the media. To meet all the requirements, the height of standard gravity filters is adjusted accordingly.

Recognizing the drawbacks of backwash mechanisms, IDE developed the Continuous Backwash Filter that uses standard media – sand and anthracite – and a common filtration area with continuous filtration and a continuous backwash system. The new system uses spot cleaners that provide continuous automatic backwash across the entire filtration area.

The Continuous Backwash Filter is constructed of precast concrete elements, and includes underdrain media support, filtration media, and a channel that collects filtrated water.

The spot cleaner consists of a compartment installed on a gantry that moves in an X-Y coordinate across the entire filtration area. It is equipped with an air blower and an air pipe with an air distribution nozzle. It penetrates and rises in the media, using an actuator-operated screw jack equipped with a positioner.

The underdrain comprises a porous plate resting on a fiberglass-reinforced plastic support structure, which provides a free flow of filtrated water to collectors. The media on the porous plate prevents the sand from leaking. A self-priming pump installed in the spot cleaner

compartment powers the backwash. The main features of the spot cleaner are:

- Coverage of each point of the filter media every 24 hours
- Each cleaning cycle cleans an area of approximately one square meter
- The source of the backwash is filtrated water
- The backwash is executed by blowing air and pumping water through the section of media in the spot cleaner range
- The underdrain plate is backwashed together with the media

The spot cleaner moves across the entire filtration area in X-Y horizontal coordinates, and descends in the Z vertical coordinate, cutting through the media. The media expands by 40 percent during the backwash process, due to fluidization of the media by the up-flow of filtrated water. The height of the spot cleaner above the media allows it to expand, and includes a buffer space to avoid media carry-over from the spot cleaner to the backwash water channel.

The spot cleaner takes water for the backwash directly from the underdrain, thus eliminating the need to construct storage tanks for use before and after backwash, and the related pumps and pipes. A relatively small air blower system is required. Backwash flow is small and continuous.

Flow control is not necessary because the filter is in constant operation with steady-state fouling conditions. The filtrated water pumps take the necessary flow for the reverse osmosis plant at any time, thus there is no need to install instruments to measure and control the filtrated water flow.

A full cleaning cycle lasts approximately 10 minutes. During a 24-hour period, one spot cleaner can cover approximately 140 square meters of media. Although it can cover the entire filter area in 24 hours, the actual backwash frequency is between 70 and 90 hours. Several spot cleaners can be installed to work in parallel on the same bridge, and several bridges can serve a large filtration area. In a pilot test conducted in the Hadera desalination plant's MMF, the silt density index was measured hourly in the exact location where the spot cleaner finished backwash activity. The silt density index in the cleaned spot improved more quickly than that of the standard MMF.

## Achieving flow efficiency with valves

Energy-saving practices in the long-term sustainability of water and wastewater infrastructure can reduce operational costs and increase profits. The use of an integrated approach using A.R.I. products – air valves, check valves, and the ARIavCAD analysis software – helps utilities substantially reduce energy and operational costs and protect the environment, A.R.I. Global Marketing and Sales Manager Moshe Aylon says.

The US Environmental Protection Agency estimates that three percent of US energy consumption is used for drinking water and wastewater services. The cost amounts to US\$4 billion annually to run water and wastewater utilities. Pump energy costs can account for as much as 50 percent of a utility budget, so focusing on pumping challenges can reap significant benefits.

Pumps on pressure pipelines are not designed to move air. Any air in the pipe creates additional friction and pump head losses, which result in longer run times and greater maintenance costs from pumps that must work harder to maintain liquid flow. When one or more pumps are not operating efficiently, it takes more energy than necessary for the pump to perform as designed.

Research and field experience of the effects of air pockets on flow efficiency and energy consumption have led to the conclusion that air pockets have a very significant impact – especially in wastewater force mains. Air and gases in pressure pipe systems contribute to energy losses at pumps.

Moshe Aylon explains that modern and innovative air valves have proven reliable and are a cost-efficient device that prevents the accumulation of air pockets and prevents energy losses. An innovative synthesis of bladder tanks and air valves from A.R.I. – when properly selected, sized, and placed on the pipeline using the A.R.I. ARIavCAD software program – can improve the system's flow efficiency. They reduce pump workloads and lower head losses, which result in large energy savings.



The A.R.I. air flow lab tests all types of air valves, including those with diameters from 1.2 to 30.48 cm (1/2 to 12 in).

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# Modeling tool helps meet tight deadline for Zarqa water project

WaterCAD's TRex elevation tools reduce water distribution model building time by 10 to 15 percent. Perrine Parrod of Bentley Systems explains how the hydraulic modeling tool helped Dar Al-Omran design engineers of Amman, Jordan, meet a fast-track project deadline.

Bentley Systems' WaterCAD hydraulic modeling software helped Dar Al-Omran design engineers meet a fast-track schedule for a major water distribution project in Jordan's Zarqa Governorate. Its interoperability with AutoCAD and ArcGIS, in addition to its TRex functionality, proved instrumental in developing cost-efficient solutions for a large water supply system.

Located northeast of Amman in the Central Region, the 4,761-square kilometer area is projected to increase rapidly from its current population of 871,600 to 1,690,000 by 2030. To meet the growing population's needs and address the current water network limitation, the Millennium Challenge Corporation, a US foreign aid organization, is funding a major restructuring of the network – including the development of water supply areas, distribution areas, and district metering areas, with a transition away from direct pumping into supply. The project will install and replace approximately 35 kilometers of primary and secondary trunk mains and approximately 550 kilometers of tertiary distribution mains.

Three consultant firms – Hazen & Sawyer, Jordan-based Dar Al-Omran, and Nicholas O'Dwyer Ltd from the United Kingdom – were commissioned for the works' detailed design, using Bentley's WaterCAD for all hydraulic modeling works.

## Water supply problems

The existing water supply scheme – with approximately 3,500 kilometers of water mains, pumping stations, and reservoirs – has a variety of major shortcomings. Because of inadequate water resources and high levels of leakage, supply is intermittent, available approximately 37 hours per week on average, or 22 percent of the time, with high levels of water leakage mainly in the tertiary pipe network.

Most of the network is supplied by direct pumping from low-level sources and pumping stations rather than by gravity from elevated reservoirs, which is a more efficient system. The distribution network's serious deficiencies include pipes that are laid over the ground and corrosion in steel piping. Also throughout the system are hydraulic capacity inadequacies as well as supply and water pressure imbalances – with some excessively high-pressure areas while higher elevations have low pressure and minimal supply.

This restructuring and rehabilitation project will improve the hydraulic efficiency and performance of the water supply network – including reducing water loss. For the water supply network, the project will reduce operation and maintenance costs and increase revenue due to improved availability of supplied water. For impoverished populations, this plan will provide greater access to clean, potable water – improving hygiene and overall health.

## Meeting design deadlines

“WaterCAD was instrumental in ensuring that extremely tight deadlines and project milestones were

met by the project team and facilitated the development of cost-efficient solutions for a very complex water supply system,” explained Emran Hammoudeh, head of Dar Al-Omran's water and wastewater design department.

In this fast-track project strategy, which enables the completion of all construction and commissioning works before the December 2016 client deadline, the team developed one WaterCAD model for the primary and secondary networks and 32 models for the tertiary network. WaterCAD helped Dar Al-Omran meet the project design deadline in a number of ways:

- During the model-building phase, WaterCAD's interoperability with AutoCAD and ArcGIS allowed efficient existing GIS and network data transfers.
- WaterCAD's TRex functionality efficiently integrated survey data and allocated elevations to specified nodes – based on data from a digital elevation model that was developed from site survey work. The combined use of the digital elevation model and TRex ensured that no discrepancy occurred between the individual sub-models being progressed by the modeling teams. The extensive use of the TRex functionality in the model-building process resulted in an estimated 10 to 15 percent savings in time and resources.
- The Thiessen Polygon Creator in WaterCAD's LoadBuilder module helped efficiently allocate demands across all models' nodes.
- Extended period simulations of over 24 hours were required for both the continuous and intermittent supply arrangements, as well as average-day demand and average-day, peak-week demands. Four scenarios, with two additional child scenarios, were developed to ensure robust hydraulic design of the works. Using WaterCAD's Scenario and Alternative tools, the team efficiently developed, managed, updated, and recalled these scenarios within the same overall model framework.

## Streamlined tender drawing

Because the project involved approximately 600 kilometers of new and replaced pipeline, detailed design and tender drawings were a major challenge. For example, the preparation of tender documents for five network contracts required 1,371 drawings and five sets of specifications. WaterCAD facilitated the migration of designs from the models to the detailed design and tender drawings. WaterCAD's interoperability with AutoCAD saved time and minimized the possibility of data-transfer related issues.

“In overall terms,” Hammoudeh concluded, “WaterCAD is a key factor in the achievement of the project and program goals, which will result in a sustainable improvement in the Zarqa water supply scheme for the benefit of the local community.”

## Author's Note

*Perrine Parrod is senior manager at Bentley Systems' Applications Advantage, Water Department.*



**WaterCAD was instrumental in ensuring that extremely tight deadlines and project milestones were met by the project team.**

**EMRAN HAMMOUDEH,  
HEAD OF WATER AND  
WASTEWATER DESIGN,  
DAR AL-OMRAN**



Water models of Zarqa and Russaifah water networks are displayed in Google Earth.

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## Caprari pump delivers Antarctic deep drilling

For 16 years, a British Antarctic Survey (BAS) research team has been involved in an ambitious mission to explore subglacial Ellsworth Lake beneath the West Antarctic ice sheet for signs of primeval life. The project calls for deep drilling to acquire cores, each containing 100 milliliters of water, dating back to one million years ago. BAS is part of the UK Natural Environment Research Council.

Last winter the first borehole was drilled to a depth of 300 meters. Stainless steel submersible pumps, supplied by the Italian manufacturer Caprari, were used to pump about 210 liters of water heated to 90°C into the borehole at a pressure of up to 138 bar. The effort was a race against time because the bore channel, measuring 360 millimeters, froze at a rate of 0.6 centimeters per hour despite the hot water pumped into it. To equalize the pressure of the water, a cavity the size of a ship cargo container had to be created at the ends of the two bore channels drilled.

A 1.5-megawatt industrial boiler produced 90,000 liters of hot water, which was gradually pumped in through three basins, with power supplied by several generators. Approximately 100 tons of equipment was flown to the research site, some from 16,000 kilometers away and most required sterilization. This equipment included the Caprari pumps, which Project Manager Martin Siegert reported worked very well despite extremely adverse operating conditions.



The borehole electric pump was coupled to a Caprari-designed motor. With 22-kilowatts output at 400 volts, the pump produced approximately 300 liters per minute flow rate at the depth reached in the project. Its overall diameter was 146 millimeters, 2.5 meters in length, and 111 kilograms in weight. The unit was assembled on the hot-water drilling head, which alone weighed 200 kilograms and was 1.4-meters long. A compact, one-piece, 3,200-meter feed pipe was made to operate the unit. The on-going project has cost US\$13 million.

## University researchers look for farm chemical runoff solution

University of Missouri researchers join a national, nine-year research effort with the Mississippi River Basin Healthy Watershed initiative funded by the United States Department of Agriculture's Natural Resources Conservation Service. The project will analyze chemical runoff from a dozen Missouri farms – to determine the long-term effects of these chemicals on the environment, and to find solutions. Nearly 40 percent of the world's corn and soybeans are produced on Mississippi River Basin farms.

“Our goal is to determine what kinds of materials are going into the state's streams and into the Mississippi River and the Gulf of Mexico,” said Ranjith Udawatta, an associate professor of agroforestry in the MU College of Agriculture, Food and Natural Resources. “After we collect our data, we can work with farmers to create better ways to mitigate runoff, sediment and nutrient losses.”

Phosphorus and nitrogen, used

in Midwestern agriculture, drain into rivers and create a hypoxic zone, or “dead zone,” in Gulf of Mexico waters. These nutrients create substantial algae blooms that later die and sink to the seabed, consuming oxygen as they decompose. The resulting low oxygen levels significantly affect fish and other aquatic life. Udawatta believes the farmers will also benefit from any positive strategies, allowing them to create greater crop yields by retaining topsoil, nutrients, and fertilizers in their farms by slowing or even reducing runoff.

Udawatta and his research team will use 40-foot wooden berms that channel the chemical runoff into metal collection tunnels where a meter will measure the flow rate and volume of runoff water. After a rainstorm, the researchers will take water samples from the collection tunnels and analyze them for sediment, nitrogen, and phosphorus concentrations to determine what nutrients are running off each test field.

According to Udawatta, the first three years will determine baseline data while the team also works with participating farmers to test mitigating strategies – including strategically planting grasses and trees or terracing the land. Any collected data from Udawatta's



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## Blue-White Industries awarded patent

Blue-White Industries was awarded a US patent on its new component control system that ensures that two or more positive displacement pumps, operating in a system together, will run only if all pumps in the system are running. The system can reduce costs by eliminating the need for separate pump controllers for each unit. This feature will be particularly important when failure of one pump to meter chemical could have a damaging effect on the

entire process.

One example is when pumping two or more chemicals into a system using multiple pumps, when two or more chemicals rely on one another to achieve desired results such as a chemical reaction. This new patented feature is available on Blue-White's Flex-Pro® A3 and A4 Metering Pumps; and Proseries-M® models M-3 and M-4 Metering Pumps. The company is based in Huntington Beach, California, United States.

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team will be compared to others involved the national project. Udawatta also explained that runoff collection should be tested in different geographic areas since no mitigation solution is universal.

## Xylem reduces energy costs 65 percent at Lake Como facility

Xylem reports that it has reduced the energy consumption of a water resource recovery plant in northern Italy by 65 percent. According to a comparison study conducted by the plant operator, Comopedur, Xylem's Flygt 4530 submersible mixers saved US\$69,000 in annual operational costs at the facility.

Located in the scenic Lake Como region, the plant treats 16 million cubic meters of wastewater annually, serving a population of approximately 200,000. Treated water from the plant is discharged into Lake Como. Plant reliability and the need for consistently high quality treated effluent are of crucial importance. The plant is located in a heavily populated area of the city, which makes access to heavy

machinery challenging.

Comodepur commissioned Xylem to ascertain if operational costs could be reduced at the plant. Five mixers had been in operation for ten years in the pre-denitrification tank, which, due to the particular shape of the 5,800-cubic meters tank, required a high level of energy to operate. This relatively large number of mixers was necessary because of the tank shape; "dead spots," and the tank depth and irregular slopes made consistent mixing very challenging. The five mixers had delivered consistent and reliable mixing at the plant throughout the past decade.

Using simulation software, Xylem examined the situation and advised that the existing mixers be replaced with the new, mid-size energy-efficient Flygt 4530 model. A submersible mixer featuring a high-efficiency propeller of 1.2 meters in diameter, the Flygt 4530 is designed for biological wastewater treatment applications.

According to Luigi Cece, director of the Comodepur plant, the new Flygt mixers paid for themselves within just 13 months. The new mixers consume 175,000 kWh of energy annually, a 65 percent reduction on the 500,000 kWh the old mixers required to operate.

Given these savings, Comodepur ordered an additional three Flygt 4530 mixers to replace mixers in another equalization tank the company operates.

## Selwood Pumps exhibits at IFAT

Selwood has designed, manufactured, hired, and sold mobile contractors pumps for more than 60 years and is the leading pump supplier in the United Kingdom, selling a full range of pumps for all applications. These include solids handling, high volume drainers, high head, hydraulic submersible, chopper, and positive displacement pumps. More than 75 percent of Selwood's pump units are exported from the UK and sold through a worldwide distributor network.

Selwood will be exhibiting a selection of pumps at IFAT 2014 for applications in the water and wastewater industry. On exhibit will be its popular S150 Seltorque Super Silent vortex flow pump, which features 100-millimeter solids handling

making it suitable for pumping raw sewage, sludges, and slurries. The solids handling and dry running capabilities offer ease of use and cost-effective operations.

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## Events 2014

### May

#### 4-7 Denver, Colorado, USA

2014 NGWA Groundwater Summit: Ten Years of Moving Research to Solutions, Organized by National Ground Water Association  
www.groundwatersummit.org

#### 5-9 Munich, Germany

IFAT 2014 Trade Fair for Water, Sewage, Waste, and Raw Materials Management  
www.ifat.de

#### 5-9 Chapel Hill, North Carolina, USA

2014 Water Microbiology Conference: Microbial Contaminants from Watersheds to Human Exposure  
www.watermicroconference.web.unc.edu

#### 11-14 Limassol, Cyprus

EDS Conference on Desalination for the Environment: Clean Water and Energy, Organized by European Desalination Society  
www.desline.com

### May

#### 18-21 Austin, Texas, USA

Residuals and Biosolids 2014 – Sustainability Made Simple: Facilitating Resource Recovery, Organized by Water Environment Federation  
www.wef.org

#### 21-23 Mexico City, Mexico

IWA Water, Energy and Climate Conference 2014: Solutions for Future Water Security  
www.wecmexico2014.org

#### 31-June 3 Miami, Florida, USA

Odors and Air Pollutants 2014, Organized by Water Environment Federation  
www.wef.org

### June

#### 1-5 Singapore

6th Singapore International Water Week  
www.siww.com.sg

#### 3-6 Moscow, Russia

ECWATECH 2014 International Water Forum: Water, Ecology and Technology  
www.ecwatech.com

### June

#### 5-7 Delft, The Netherlands

Water Integrity Forum: Extend the Base, Increase the Pace  
Organized by Water Integrity Network (WIN), the UNESCO-IHE Institute for Water and Education and the Water Governance Centre  
www.waterintegrityforum.org

#### 28 to July 2 Istanbul, Turkey

5th World Congress of Environmental and Resource Economists  
www.wcere2014.org

#### 30- July 2 Reno, Nevada, USA

2014 AWRA Conference "Integrated Water Resources Management: From Theory to Application"  
www.awra.org

### July

#### 8-10 Sydney, Australia

Peri-Urban'14, International Conference on Peri-Urban Landscapes: Water, Food, and Environmental Security  
Organized by Australian Water Association  
www.awa.asn.au

### July

#### 30 – August 1 São Paulo, Brazil FENASAN Brazil 2014

25th National Exhibition on Sanitation and Environment Services, and AESabesp Congress  
www.fenasan.com.br

## Upcoming WEF Webcasts COMPLIMENTARY

**April 23** Utility Management – Asset Management State of the Practice: A Focus on Strengths

**April 29** Joint WEF/ WERF Event – Algae Bioreactors as a Cost-Effective Approach for Enhanced Nutrient Removal

**May 7** Odor Control 101: Successful Strategies, Innovations, and Technologies

**May 14** Wastewater Treatment Modeling 101

**May 28** Water Innovation Showcase Partners, Part 2: Innovation Lifecycle and International Perspectives

**For more information, email**  
webcasts@wef.org

*Continued from page 27*

consumption could be higher in high-capacity systems.

With an estimated 30,000 to 60,000 ships requiring ballast water treatment equipment, ship owners or operators with older vessels are hesitant to make a large financial investment until it is an absolute requirement. Currently, the delay in ratification of the IMO Ballast Water Management Convention and change in compliance deadlines further postpones the large order boom, and lessens the immediate burden of capacity concerns.

As some suppliers continue to innovate, install systems, and gain additional knowledge from real-world use of ballast water treatment systems, owners should gain more confidence in these systems, the testing conducted, supply capabilities, and the robustness of certain approvals from these reliable companies that are transparent about their experiences. With increased confidence comes the acceptance of positive change. The hope is that all stakeholders are comfortable and prepared for the reality of ballast water management in 2014.

#### Author's Note

Adrienne Fazio is the marketing manager for Hyde Marine, Inc., based in Coraopolis, Pennsylvania, United States.

## Hyde Marine launches IMO-Type Approved system

One company attempting to address ship owner concerns over regulations, compliance, and reliability is Hyde Marine, Inc. – a subsidiary of Calgon Carbon Corporation – which anticipates a major increase in orders for ballast water treatment systems over the next few years, as the industry moves to comply with new and pending regulations.

Hyde Marine specializes in diverse ballast water treatment solutions, ultraviolet treatment technology, and ballast water research. In 1995, the company noticed the ballast water in ships carried thousands of species of aquatic animals and plants. Early experiments and further shipboard and land-based testing of many different types of ballast water treatment system configurations led directly to the development of the Hyde GUARDIAN® BWTS, which combines filtration and ultraviolet disinfection. Initial success in the Great Lakes and early testing at the Royal Netherlands Institute for Sea Research, which has one of the most challenging operating conditions, facilitated IMO Type Approval for Hyde Marine in 2009 and AMS approval in 2013. Additionally it has approvals from ABS, Russia Maritime Register of Shipping, and Det Norske Veritas.

The US Coast Guard recognizes the Det Norske Veritas as an independent lab that evaluates and tests technologies designed to treat ballast water on ships.

Hyde GUARDIAN systems have operated continually on ships for over 10 years. In 2003, one of these systems was installed on Coral Princess – the first ship accepted into the US Coast Guard Shipboard Technology Evaluation Program.

In December 2013, Hyde Marine launched its IMO Type Approved Hyde GUARDIAN Gold™ Ballast Water Treatment System in response to ship owners' requests for a system that fits in limited, tight spaces – especially for retrofit vessels. The company says it has the smallest footprint on the market, due to the compact screen filtration and medium pressure ultraviolet reactor. The new filters were tested in challenging water that combined low salt content (less than one practical salinity unit) and was 1,000-times more productive than the IMO-required organic particle loading count. The screen filtration enables the system to reduce power and energy use by 30 percent during backwashing.

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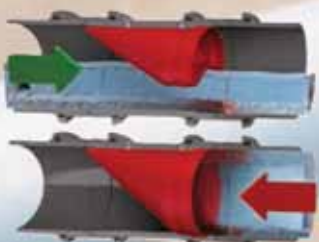
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