

SMART WATER & WASTE

WORLD

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INTERVIEW

YI WEI
GLOBAL WASH DIRECTOR, IDE

GROUND REPORT
WHEN COMMUNITIES LEAD THE WAY

PROJECT TRACKER
NAMAMI GANGE

WATER AROUND THE WORLD

TECH FOCUS:
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WATER AROUND THE WORLD

Smart Water & Waste World covers some of the cutting-edge water treatment technologies being applied around the world, while having an in-depth look at the most pressing issues concerning the water sector.

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Pipe Dreams to Dream Pipes

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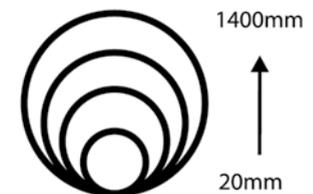


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“
*When the well is
 dry, we know the
 worth of water.*”
 - Benjamin Frankli

When the Well Runs Dry

This month, we have covered some of the cutting-edge water treatment technologies and best practices being applied around the world, while also having a look at some of the most pressing issues concerning the water sector.

It is said that we already have enough water in the world to meet everyone's needs. The problem is that this water is not distributed equally. This creates problems of water scarcity in many regions and countries.

Around 70% of the world's freshwater is used by agriculture. Due to ineffective or old irrigation methods, overuse of water is a huge problem in agriculture. Sometimes half of the water used may actually never reach the crops. The technologies like drip-irrigation are already there to solve this issue. But the willingness to adopt them is still missing.

We can understand the gravity of this situation from a recent study done by NASA scientists which says that the location of freshwater is continuously changing around the world. The NASA researchers used satellites and data on human activities to map locations where freshwater is changing around the globe. They found that several factors are involved in the shifts, including water management practices, climate change, and natural cycles. At least 40% of 34 hotspots studied around the world can be linked to human water management activities, such as excessive groundwater pumping for agriculture. These areas include northern India, the North China Plain and parts of Saudi Arabia.

As per UNESCO, more than 40% of the world's population will be living in areas of severe water stress by 2050. The UNCCD has predicted that as many as 700 million people will be forced to leave their homes by 2030 - due to the shortage of water.

The distribution of drinking water is even more uneven. As per WHO statistics, almost 800 million people in the world have no access to it at all. Since 1990, 2.6 billion people have gained access to an 'improved' drinking water source, one that is designed to protect against contamination. But in 2015, 663 million people (one in 10) still drank water from unprotected sources. In the developing countries, around 80% of illnesses are linked to poor water and sanitation situation.

Our coming generation will need to pay dearly for the lack of drinking water and sanitation facilities if we do not mend our ways now. While we can continue the debates, dialogues and discussions on these issues, following them with a timely action will decide the future of our water.

I am very excited to share the updates of the 2nd edition of our annual event - JAL SABHA 2019, Chennai. This is an exclusive forum for the heads of water supply and sewage departments of Municipal Corporations and Smart City CEOs. This -by invite only- forum provides a unique platform for the audience to come together to debate and discuss issues faced by corporations around water supply and sewage, 24x7 water supply, smart metering, STPs, among others. The event, with a gathering of 50 selective delegates from across India, is in line with our vision to create community-specific events.

Our next two magazine issues will be January (1st Annual Municipal Cases Studies Special Issue - on Water, Wastewater & Waste Management), and February (Water Purification & Treatment Business - Membranes, Housings, Vessels, and Pumps). I welcome editorial contributions on these and all other topics which you find significant for the water sector. Keep sharing your thoughts, inputs, and suggestions.

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LANXESS Plans to Invest up to Rs. 1250 Crores in India till 2023

The company's sales in India have more than doubled in the last ten years, and now it aims to strengthen the Indian production sites.



Left to Right) Dr. Hubert Fink, LANXESS AG Board of Management, Neelanjan Banerjee, Vice Chairman & MD, LANXESS India Pvt Ltd., and Dr. Rainier Van Roessel, LANXESS AG Board of Management

Mayur Sharma India

LANXESS IS STRENGTHENING its asset base in India. The company plans to invest up to Rs. 1250 crores till 2023. One of the focus areas of the investment will be the businesses for water treatment products. The company cur-

rently operates production facilities for five business units at its sites in Jhagadia and Nagda.

"The Indian economy is currently the world's fastest rising major economy, with the chemical industry as one of the fastest growing sectors. We aim to even better capitalize the huge potential of the

Indian chemical market and are therefore now launching a major investment package," said Hubert Fink, Member of the Board of Management of LANXESS AG.

In the last 10 years, LANXESS' sales in India have more than doubled from Rs. 1008 crores to Rs. 2608 crores. Its turnover in 2018 increased by 14% in the first 9 months compared to the same period last year.

"The demographic trend in India is leading to an increased demand in the areas of mobility, urbanization, nutrition and clean water. LANXESS can cater these demands with its wide portfolio of specialty chemicals," said Neelanjan Banerjee, Managing Director and Country Speaker of LANXESS in India.

WABAG Secures Order in Qatar Worth Rs. 555 Crores



SWWW Staff Qatar

VA TECH WABAG Limited has been awarded a first major EPC order worth Qatari Riyal 275 Million (Rs. 555 Crores) from Public Works Authority of Qatar (ASHGHAL).

For this Design & Build project, the scope includes rehabilitation of Doha South Sewage Treatment Works using lamella clarifier, disc filter and aerobic digester technology to treat the additional sewage generated by the foot-

ball stadium, which is under construction for the FIFA World Cup 2022. The project is scheduled to be delivered over a period of 24 months, while the existing plant is in operation.

Commenting on this order, Deep Raj Saxena, CEO Middle East & Africa said, "Pleased with the momentum we are gaining in the Middle East Region. This order will further consolidate our presence and will help us in building another significant reference in the region."

Thermax Completes Two Successful Projects in India

Mayur Sharma India

IKEA, THE SWEDISH furnishing major trusted Thermax as their partners for water treatment for their first store in India. The Thermax Water & Waste Solutions (WWS) division commissioned a WTP catering to both potable and non-potable water requirement of entire store. The scope of supply comprises a dual media filter (DMF), a softener and a reverse osmosis plant producing 2,000 liters/hour.

Thermax also installed a Zero Liquid Discharge plant with a recycling capacity of 3.6 million liters per day (MLD) at

Madhura Coats, Tamil Nadu. This system consists of an Effluent Treatment Plant (ETP), recycling plant & Multiple Effect Evaporators (MEE). The wastewater generated from manufacturing activities such as thread dyeing and bleaching are treated in ETP followed by recycling plant. The membrane filtration based processes help recover good quality water from this treated wastewater. While recovered water is used by manufacturing units, rejected water is sent to MEE. MEE reduces the volume of waste to be handled, thereby disposing off the brine generated; leaving zero discharge at the end of the treatment cycle.

Xylem Signs MoU with Government of Ethiopia to Explore Helping Country Solve Water Challenges

The MoU was signed at an event attended by Ethiopia's Minister of Water, Irrigation and Energy His Excellency Dr. Eng. Seleshi Bekele.

SWWW Staff Ethiopia

Xylem Inc. has signed a Memorandum of Understanding (MoU) with Ethiopia's Ministry of Water, Irrigation, and Energy (MoWIE) for future cooperation to help advance water security in Ethiopia.

The MoU was signed at an event in Ethiopia attended by Ethiopia's Minister of Water, Irrigation and Energy His Excellency Dr. Eng. Seleshi

Bekele; State Minister Water Supply and Sanitation Dr. Negash Wagesho; Xylem President and CEO Patrick Decker; and a representative of the U.S. Embassy in Ethiopia.

H.E. Dr. Eng Seleshi Bekele noted that the present MoU signed between Xylem and MoWIE creates an enabling platform to improve water supply and sanitation service delivery and ensure scheme sustainability. He also stressed that the Ethiopian water sup-

ply and sanitation sector benefit from the broad technical and technological solutions Xylem has been providing.

Xylem President and CEO Patrick Decker spoke about how honored the company is to have the opportunity to begin exploring solutions for the region, notably non-revenue water, knowledge sharing, and creating more water and energy efficiencies to maximize resources and lessen the impact on the environment.

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State Government of Karnataka in Partnership with SUEZ, BWSS, and NUMA Launches First 'DATACITY' Program in Asia

- Bengaluru joins innovative cities of the world in launching its own data-driven open innovation program following the leads of Paris, Casablanca, Berlin, Barcelona, etc.

SWWW Staff
India

GOVT. OF KARNATAKA has announced the launch of the first 'DATACITY' program in Asia in collaboration with SUEZ, BWSSB and NUMA. DATACITY is an internation-

al open innovation program building innovative solutions to answer the challenges of global cities. The areas of opportunity that could be explored during DataCity are - Smart Mobility, Water and Waste Management, Energy, Smart Buildings, Transparen-

cy & Security, and Pollution Management.

"SUEZ participated in the DataCity open innovation program, organized since 2015 by the NUMA incubator with the city of Paris, the French state and private sector companies, which aimed to meet

the challenges of cities with the help of data. The program transformed Paris into a giant playground to test new urban solutions devised by entrepreneurs through the use of existing data. In India, we want to engage in open innovation program wherein we want

to build a collaborative ecosystem involving customers, innovative start-ups, experts, researchers, and our team to work together to develop solutions. This is the main objective of our partnership with NUMA," said Shyam J Bhan, MD & CEO, SUEZ India.

Sarjan Watertech Receives BIS Certification for Reverse Osmosis (RO) Water Purifiers

According to the company, it is the first recipient of BIS - IS 16240 : 2015 for Reverse Osmosis Water Purifier (RO) certification in India.

Mayur Sharma
India

THIS CERTIFICATION IS only awarded to those water purification companies, who follow stringent quality standards, safety, and durability protocols, in the manufacturing of RO Water Purifiers as per BIS standard IS 16240 : 2015.

Sharing his thoughts on the announcement, Sunil Trivedi, MD, Sarjan Watertech India Pvt. Ltd. said, "Receiving the BIS certification is in line with our mission to deliver the highest quality water purification solutions by adopting global best practices. We strive to continually build sustainable customer relations, build, and retain highly-qualified talent pool, drive investments and deliver profitable growth. We seamlessly integrate our technological



know-how, and R&D expertise to offer products that are a benchmark of 'The Science of Purity.' Our uncompromising rigor in pursuit of product, service and operations excellence has made us the company of choice for most of our clients."

Mueller Water Products to Acquire Krausz Industries

SWWW Staff
USA

MUELLER WATER PRODUCTS, Inc. has signed a definitive agreement to acquire Krausz Industries, Ltd., a manufacturer of pipe couplings, grips and clamps, for USD 140 million in cash.

Krausz Industries provides a full suite of innovative and

proprietary pipe couplings, grips and clamps under the HYMAX brand for the global water and wastewater industries. The company was founded in 1920 and is headquartered in Tel Aviv, Israel. Krausz had net sales of approximately USD 43 million in 2017 with approximately 75% of its sales generated in North America.

"For over a century, the

Mueller name has been synonymous with quality products and innovation," said Scott Hall, President & CEO of Mueller Water Products. "The addition of pipe connection and repair to our solution portfolio enables us to address an even broader scope of needs within the water infrastructure system while expanding our global presence."

India, China and Now Africa for Modern Water's All-Membrane Brine Concentration (AMBC) Technology



Julian Lowe, International Sales Director, Modern Water (left) and Peter Nicoll, Technical Director, Modern Water (right) with Dr Gunter Rencken, Technical Director from WEC Projects of South Africa.

SWWW Staff
South Africa

MODERN WATER HAS entered into a new collaboration agreement with WEC Projects of Johannesburg to promote its innovative and proprietary All-Membrane Brine Concen-

tration (AMBC) technology throughout Africa.

Speaking for WEC Projects, who are a leading South African Engineering, Procurement and Construction (EPC) contractor in the water and wastewater treatment sector, CEO Wayne Taljaard commented: "Modern

Water's proprietary brine concentrator is an innovative solution capable of reducing wastewater treatment requirements and maximizing clean-water reuse in a wide range of industrial applications, including mining, power, oil & gas and desalination plants."

Simon Humphrey, Modern Water's CEO, added: "In WEC Projects, we are glad to have found such a superb partner to promote our AMBC, which complements our excellent new partnerships in India with Advent Envirocare and with Sunup in China."



JAL SABHA

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This hosted and captive audience of the top decision-makers from municipal community would debate and discuss the issues through a strategic mix of technology presentations, case study presentations, and panel discussions.

The off-shore retreat offers you ample opportunities to network and build relationships over a period of 1 night /2 days. All the attendees would be hosted by Smart Water & Waste World at the Taj, Kancheepuram, near Chennai. Their travel and stay logistics would be handled by the Smart Water & Waste World team.

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- Chief Engineers/ Executive Engineers/ Superintendent Engineers of Water/ Sewerage Departments
- Mission Directors/ Project Heads of AMRUT
- CEOs of Smart City Projects

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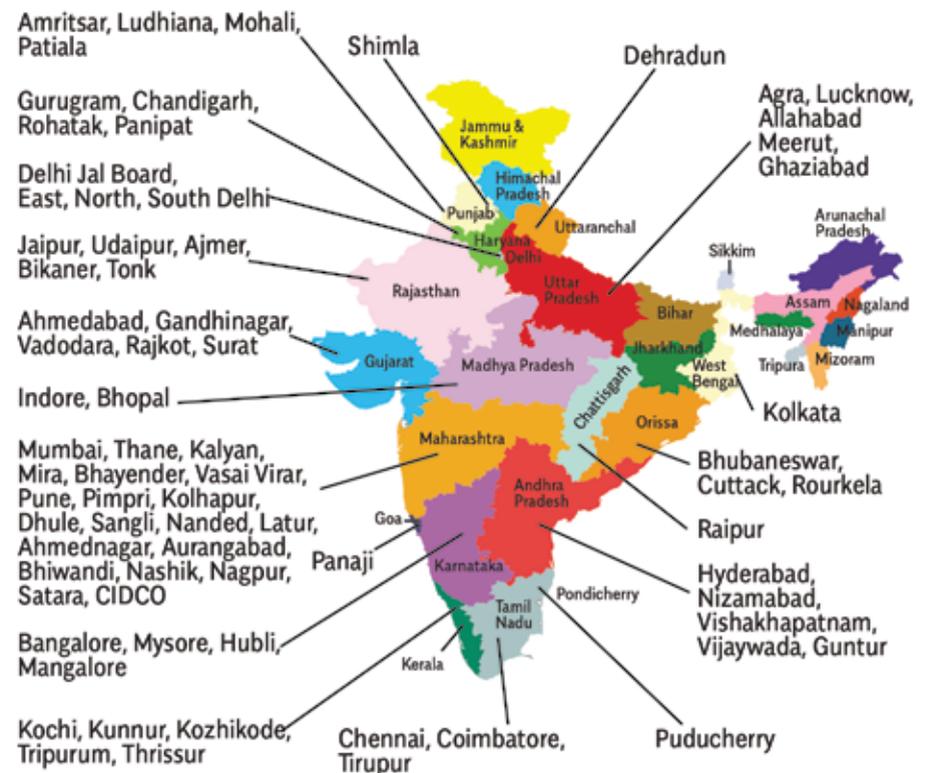
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SMART
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WORLD

SPML Infra Declares Financial Results of Q2 with 102% YoY Revenue Growth



Mayur Sharma
India

SPML INFRA LIMITED has declared the financial results for the quarter ended September 30, 2018. The company's board in their meeting held on 14th November 2018 has approved the standalone financial results for the quarter and declared that the company has

recorded gross revenue of Rs. 4,144.67 million.

The net profit for the quarter rises to Rs. 138.99 million as against Rs. 81.53 million in the corresponding quarter last year.

Subhash Sethi, Chairman, SPML Infra Ltd. commented, "I am pleased with our second-quarter and half-yearly results, which put us on track to deliver a solid year. Achieving over 100 percent growth on year on year basis is particularly encouraging and we view this as a base to build upon. Our performance strengthens our confidence that we are on track to deliver a solid year and an even better next year."

ACCIONA's Net Profit to September Reaches €222 Million

Ebitda grows strongly (+10%) in like for like terms.

SWWW Staff
Spain

ACCIONA'S NET ATTRIBUTABLE profit reached €222 million in the first nine months of the year (-4.2%). ACCIONA improved the Ebitda of its infrastructure (+8.3%) and energy (+1.2%) divisions, which increased group operating profit on a like-for-like basis (+10%). During the last twelve months, the company significantly reduced its debt (-11.4%) and its financial expenses (-9.7%). It has maintained a strong pace

of investment (€926 million).

The Industrial area experienced strong growth in its portfolio during the period (€828 million, +72.3%) with the award by clients of major works such as a waste to energy plant in Australia.

The completion of two desalination plants in Qatar lowered turnover in the water area to €447 million (-12%). However, new contracts in Saudi Arabia and the United Arab Emirates have strengthened the water business backlog to €11.24 billion.

Fluence Awarded its First Waste-to-Energy Harvesting Project in Argentina

- The system will be designed and built for international meat processor ArreBeef Energia.
- Energy harvesting lowers operating costs and allows the client to secure national incentives.

SWWW Staff
Argentina

FLUENCE CORPORATION LTD has received a €1.7 million contract for a waste-to-energy system for its customer ArreBeef Energia S.A., a prominent beef processor in Buenos Aires, Argentina. The system will be designed and built using anaerobic digestion technology developed by Fluence to produce biogas, as well as electrical and thermal energy. The system is being installed

and getting operational onsite from November 2019.

This will be Fluence's first waste-to-energy system in Argentina and will be designed specifically for use in the livestock industry. Fluence's scope of work includes upgrading ArreBeef Energia's existing wastewater treatment plant and adding a custom-designed waste-to-energy system that will use the sludge and by-products from meat processing to produce biogas. The biogas will, in turn, be used to

produce electrical and thermal energy.

Fluence's Managing Director and CEO, Henry Charrabé said: "This project serves as a clear example of Fluence's ability to leverage our global sales organization to penetrate new markets with our innovative waste-to-energy solutions. ArreBeef Energia will be our first installation in Argentina for waste-to-energy, and our first solution that addresses the specific needs of the meat processing business."

Bettina Blottko to Head Liquid Purification Technologies Business Unit at LANXESS



SWWW Staff
Germany

BETTINA BLOTTKO HAS taken over as head of the Liquid Purification Technologies business unit at specialty chemicals group LANXESS. She has succeeded Jean-Marc Vesselle, who will take on new challenges outside the company.

Bettina Blottko has held various positions at Bayer and LANXESS since 1996. Most recently, she headed the Actives and Disinfection business line within the Material Protection Products business unit.

LANXESS board member Rainier van Roesel said, "Jean-Marc Vesselle has made a significant contribution to the strong growth of our water treatment technologies business in recent years and at the same time created a very good basis for future growth. I would like to thank him sincerely for this. With Bettina Blottko, we were able to recruit a proven in-house expert in the chemicals business to lead the business unit into the future. I wish her every success in this endeavor."

LANXESS is a specialty chemicals company with sales of EUR 9.7 billion in 2017.

PRODUCTS

Bentley Systems



Bentley Systems Incorporated has launched **OpenSite Designer**, a built-for-purpose application for the design and construction of civil site projects. It also launched **OpenBuildings**, bringing together its AECOsim building design and Speedikon factory and industrial design applications; and announced the availability of **OpenBuildings Station Designer**, a specialized application for designing rail and metro stations. At the same time, Bentley announced the availability of **OpenBridge Designer**, which combines Bentley's bridge modeling, analysis and design capabilities into one comprehensive package, and **OpenFlows FLOOD**, a flood analysis, and early warning system. In addition, in pursuit of its 'industrialization' strategy, Bentley announced it has rebranded under its Open portfolio several of its applications based on MicroStation technology which collectively accelerates the advancement of its comprehensive modeling environment by connecting digital workflows across disciplines and sharing digital components in its Connected Data Environment (CDE).

Endress+Hauser



Promass A Sensor System promise maximum robustness and precisely measured values with unparalleled repeatability, even in cases where process and ambient

conditions fluctuate significantly. All of this thanks to the innovative sensor concept, which sets new standards in Coriolis measurement technology. Promass A is light and compact - with no losses in performance or robustness. The measuring device is therefore ideally suited for space-saving installation, for example in modular process facilities and skids. The Promass A sensor system is mounted on a base plate that acts as a "shock absorber," effectively shielding the Coriolis measurement from outside interference, e.g. from pipe vibrations. Other contributing factors are the oscillation frequency of the measuring tube, which is significantly higher than that of traditional Coriolis flowmeters, and its completely balanced oscillation behavior. At a specified maximum measured error of $\pm 0.1\%$, high precision measurements down to 8 g/

KSB SE & Co.



KSB SE & Co., Frankenthal, Germany, has extended its portfolio of **Submersible Borehole Pumps**. The new sizes developed by KSB have a diameter of up to 50 inches, i.e. 1250 mm, and a drive rating of up to 5 MW. These pumps will be capable of handling flow rates of up to 5000 m³ per hour at heads of up to 1500 m.

Compared with dry-installed pump sets, the advantage of submersible borehole pumps is the notably longer service life and the fact that pumps with wet motors are not compromised by flooding. KSB is one of the few manufacturers worldwide to offer double-entry designs for particularly high load conditions alongside "normal" single-entry designs. This double-entry design was originally used for drainage applications in mines.

The demand for increasingly higher pump outputs also manifests itself in water supply, cavern, and offshore applications. The drives employed in these pumps are water-filled high-voltage motors for voltages from 1 kV to 11 kV. A proven pressure equalization system ensures that the motors are not exposed to loads due to pressure differences potentially occurring under water. This prolongs their service life rendering regular maintenance unnecessary.

min are possible, or - if the maximum error is permitted to be $\pm 1\%$ - even a quantity of less than 1 g/min can be measured. A top value for Coriolis flow measurement technology.

Flexicon Corporation



The new **TIP-TITE®** Pail Tipper from Flexicon dumps pails containing high-density bulk solid materials into downstream processing or storage vessels dust-free. The unit accommodates pails of up to 19 liters measuring up

to 380 mm in height and weighing up to 340 kg. Intended for powder metals, chemicals, pigments, minerals or other heavy, dense bulk solids, the unit features dual hydraulic cylinders that work in tandem to raise and seat the pail rim against a specially-configured, elongated discharge cone, and then tip the pail to an angle of 45, 60 or 90 degrees with a motion-dampening feature. At full rotation, the discharge cone seals against the inlet of the receiving vessel, creating a dust-tight connection and allowing controlled, dust-free discharge through a pneumatically-actuated slide gate valve. An optional pneumatically-actuated vibrator on the discharge cone promotes complete evacuation of non-free-flowing materials. The pail tipper is constructed of carbon steel with durable industrial finishes, with material contact surfaces of stainless steel. Other models are available in all-stainless steel finished to food, dairy, pharmaceutical or industrial standards.

Kent RO Systems



Kent RO Systems Ltd has launched **KENT Grand Star**. This RO water purifier is equipped with double UV protection and real-time digital display of purity. This new model of water purifier boasts of double UV protection. While one UV protection

is there infiltration, there is also the second one, which is, in-tank UV Disinfection. During long periods of non-usage, the stored pure water may get infected again by bacteria and viruses in the kitchen. This technology will help in overcoming this problem as UV-LED light ensures that purified water never gets further infected in the storage tank. It acts as an extra layer of security and thus ensures that the customer gets 100% pure water at all times. Another defining characteristic is the digital display of purity. KENT Grand Star will display quality of purified water in real time along with displaying key parameters of water purifier like balance filter life, mineral contents in purified water, the flow rate of water, warning signals in case of malfunctioning etc. The multi-stage process of RO+UV+UF+TDS Control+ UV disinfection in storage tank makes the drinking water 100% for consumption. The multistage purification process removes even the dissolved impurities such as chemicals, bacteria, viruses, and salts. Additionally, the model is also equipped with KENT RO's revolutionary Save Water Technology™.

Market-Based Approaches for Sustainability in WASH

Yi Wei is the Global WASH Director at iDE. In this interview, she speaks about her experience with implementing market-based approaches to WASH in Cambodia and other parts of the Indo-Pacific region. She also shares how iDE is taking a human-centered approach to WASH and what makes that different from other approaches.

By Australian Water Partnership (AWP)



Yi Wei

Tell us how you came to work for International Development Enterprises (iDE).

Ms. Wei: My name is Yi Wei and I'm the Global WASH Director at iDE. For those who are unfamiliar with WASH, it stands for Water, Sanitation, and Hygiene. I've been with iDE for almost eight years now, having landed in Cambodia as a volunteer, straight out of college. I wasn't planning on

going into international development, but when an exciting door like this one opens to you, you step through it!

How did iDE begin to develop its market-based approach to WASH?

Ms. Wei: iDE's focus is on rural households and we aim to leverage the mechanism of the market, the private sector, the power of entrepreneur-

ship, to deliver much-needed goods and services. We have been using a market-based approach in the agricultural space for almost 35 years now, but few people were trying to use a market-based approach in WASH when iDE first entered that sector, eight years ago.

The situation then was quite depressing, honestly. I think there was a lot of effort going into improving clean drinking

water and sanitation, but it wasn't gaining much traction; it wasn't having large-scale impact. When I landed in Cambodia we were trying to identify what makes households interested in purchasing latrines and water filters and whether businesses would be willing to sell them long term. Could we make a sustainable solution out of this?

Fast forward to now, eight years later, and globally we have sold over a million toilets and water filters across our six country programs. We have demonstrated that the private sector can be an effective mechanism for distributing these much-needed products and services, and we have come up with a process for doing this and we are replicating it in other country programs. However, I'm not exactly sure how iDE set about taking the approach it used in the agricultural sector and applying it to the WASH sector.

Our founder, Paul Polak, was not an agronomist or economist: he was a psychologist, who first encountered the international development sector when a friend invited him to help with the Somalian refugee situation. He saw that if refugees could have access to transport they could set up a local economy. He realized that people are poor because they don't have money, and they don't have money because they don't have access to economic means of production that can generate income. He applied that thinking to small-holder farmers - who were and still are the vast majority of the world's poor - by developing

transformative technologies they could scale-up through the market. If you give farmers access to irrigation technologies and better inputs, they will be able to increase their yields and their incomes.

In the WASH sector, leaders in iDE saw the clear need for clean drinking water and sanitation. The traditional approach at the time was to hand out free toilets to people who didn't have them. That then evolved into community mobilization approaches, with subsidies becoming taboo. The international development community tried to focus on empowering people to buy toilet hardware and adopt their own solutions, which succeeded to a certain extent but there still was a need for a durable, affordable, aspirational product for people to use, and no solutions on the market. That is where iDE saw an opportunity to apply its market-based experience to WASH.

We are really proud of the fact that we see the user as central to our approach. Paul Polak recognized 35 years ago that to really understand farmers' problems, you need to talk with at least 100 farmers a year. We try to apply that ethos - listening - to everything we do. You don't know what people want or need until you talk to them, and you really don't know if a new idea could work until you talk to someone who might use it. That seems obvious, but for some reason, it is often forgotten.

Tell us about subsidies in the Cambodian market. Has the transition from

subsidies to a market economy in WASH been an easy step?

Ms. Wei: I recall someone at a conference a few years ago saying it is more acceptable in the WASH sector nowadays to mention the word 'shit' than the word 'subsidy'.

First, I want to clarify that iDE is not averse to subsidies. Most of our work is subsidized, in that we receive grant funding from private and public donors. It's not that subsidies are good or bad, but rather that we want to make the most efficient use of scarce resources, such as public funding, to achieve the best outcomes - the biggest 'bang for your buck'.

We look at communities in three tiers. We ask those who are willing and able to pay, to pay; and those who are willing but less able to pay, to use financing mechanisms. Then for those who truly are unable to pay, the market price of the product or service can be directly subsidized.

When we talk about a subsidy, we can mean a free toilet, which is a very explicit hardware subsidy. But from an economics perspective, the term 'subsidized' refers to anything that is not fully merged into the market. Our role has been to convert something that was non-commercializable, non-investable, into something that is commercializable, by bringing in private sector investors. And our way of looking at the community in three tiers helps us make sure only the most-needy people receive the subsidies.

iDE is a market-based organization, and when we use subsidies we aim to do it effectively. Currently, we are moving into more mature markets where the communities are the poorest of the poor; they definitely need direct subsidies, but we want to ensure we apply a nuanced approach that responds appropriately to each specific context. Details matter; it's not a simple yes or no.

The question is: How do you transition from an environment where communities are used to direct subsidies and

handouts, to one where they are willing to buy and invest? That transition was a difficult challenge when we first started.

Existing subsidy programs

were a major obstacle because when people have seen their neighbor be given a toilet for no cost, they expect to be given one as well. They don't accept that there were only, say,

100,000 available, and there is not enough funding to treat everyone the same in a population of 14-15 million. So they resist buying one for themselves, and businesses don't

invest, and it is difficult to get the market moving.

We worked very hard to overcome that situation, in a couple of ways. First, we wanted to make sure our product



Yi Wei in a Meeting with a Women's Microfinance Group, which Helps Enable Rural Households to Finance their Sanitary Latrines.



Yi claims that changing an environment where potential customers have become accustomed to receiving subsidies to using those subsidies to incentivize them to buy toilets and water filters is a big challenge. Back and forth conversations are needed to learn about how a market-based approach might work.

offering to the customer was unique and different. It needed to look different from the subsidy option, and to be more aspirational and something that people would be willing and proud to put money down on and invest in. We positioned it as a desirable product that was not like the free things that poor people got. In other words, product differentiation was an important part of our marketing strategy.

We saw it was also important to work with businesses to help them choose between taking up a contract for 100 toilets right now from an NGO or investing in developing a market to supply 100,000 people in that area. That was not easy because you're talking to businesses who need the cash now and a definite contract, rather than taking on the risk of investing in a potential market.

At a third level, we also worked with other NGOs and government players to show them that to achieve a sustain-

able solution that's scalable they needed a mechanism that was not limited by the number of toilets they could buy. Even if they had \$100 million to spend, they couldn't buy everyone a toilet. We wanted them to agree to develop a self-perpetuating mechanism, such as a market, that can promulgate products that scale seamlessly. This took a lot of interactions and conversations, learning together and producing evidence to show that this alternative way of operating could succeed. We were changing peoples' minds, one conference at a time.

How does iDE use community incentives for its work in WASH?

Ms. Wei: We believe that people, markets, organizations are driven by incentives. The incentives don't have to be tangible or financial in nature: they could be very intangible but very powerful. They are anything that affects your reason for doing, or not doing, something. Incentives are the core of our user-centered approach for understanding what drives, bars or accelerates peoples' behaviors.

One example of how we have applied incentives is in scaling-up our market-based approach with our teams and in our relationships with our partners. With a market-based approach, ultimately you want someone to buy something, and therefore someone has to sell it. Salesmanship is notoriously difficult, especially when you're trying to sell something to a relatively poor population and that thing is not necessarily at the top of their shopping lists. You need to keep the sales-people motivated, and to do that we use incentives. In the private sector, incentives are often financial, but that's unacceptable to the way NGOs typically do their work ... or at least it was when we first started this, about six years ago. So we developed an incentive system to motivate all the various groups of our own staff as well as the private sector actors that we worked with.

For the businesses we worked with, their incentive was profit. The more they sold the more profit they earned. For the field leaders on the ground who at that time were independent sales agents, their incentive was the commission. The more they sold the more commission they earned. And for our own staff who are managing the businesses and the sales agents, if they were able to facilitate more sales, they got more incentives. It was as simple as that. You don't always need to incentivize the end result. Of course, we want the agents to facilitate more sales, but what else leads to more sales? More sales agents on your team. You can incentivize the number of sales agents you're able to recruit and train and retain. You can see it's a very powerful tool that you can modify as you need to, based on the results you're getting.

For an incentive program to be effective you need to have timely data about the outcomes, and so we built a robust real-time data system that allows us to monitor and manage staff performance. We also work with a forward-thinking partner in the Gates Foundation who incentivized us to reach 'stretch targets'. By that, I mean targets beyond the acceptable targets that were part of the grant agreement. If we reached those 'stretch targets' we were able to access a pool of unrestricted funding. As anyone who has any experience working with NGOs knows, unrestricted funding is the pinnacle of desirability.

The power of incentive is such that you can set a clear goal and a reward for reaching that goal, but you don't necessarily have to dictate all the activities. The Gates Foundation didn't say to us, "You have to do X, Y, and Z activities to accomplish those goals." Instead, they say: "Here's the goal; here's your incentive; figure it out," and that creates a space for innovation and creativity that's really focused on top end results that everyone cares about. And it doesn't create a

load of transactions that are not necessarily productive.

Actually, I haven't seen incentives applied anywhere else. For a sales organization or social enterprise doing sales, incentives are probably obvious. For any NGO that is mission focused - I'm sure they all are mission focused - incentives are a powerful way to keep yourselves accountable. Either something happened or it didn't happen, and you get rewarded if you achieve a result that's provable. I think that incentives support an NGO's mission. They improve accountability, too. NGOs often work in very complex environments where it's really difficult to bring about change, and there are always extenuating circumstances that explain why something didn't happen. But in the end, if we care about results and achieving that mission, we should hold ourselves accountable for being rewarded for achieving those results.

As I said earlier, incentives don't have to be financial, although financial incentives are the simplest, most direct way to incentivize behavior. Some work doesn't need to be incentivized: it would be a conflict of interest for the iDE Measurement & Evaluation team to be incentivized based on number of sales, for instance. We could incentivize the M&E team based on the quality of data instead. Incentives are so powerful because you can incentivize whatever behavior you're trying to encourage, and it could be via career promotions, or exposure to conferences for some of your local staff, or whatever is motivating for the person or organization you're trying to incentivize. If money would cause complications, think creatively about other types of rewards that could be used. One challenge in implementing incentives if they're financial is finding partners who are comfortable and able to make that possible. For some donors, a financial incentive might not be an eligible cost. So you need to make sure that the incentive you choose to use is acceptable to

your funding partner.

How does iDE set about scaling-up technologies successfully?

Ms. Wei: I would say that we're trying to scale the market-based approach, rather than technologies. There are three parts to it: design to context, make sure that you have a feedback loop that's giving you the right information to iterate, and have that on the ground presence to iterate.

You need to ensure first that you do the human-centered research that lets you understand what is desired, feasible, viable and financially viable, within those contexts.

Most of our country programs have different products, and that is because we are designing products to suit the particular contexts, the specific needs, wants and desires of our users in that context, and what's possible within that context. For instance, in Cambodia, the initial product we designed is a pour-flush ceramic offset pit latrine. It is successful in Cambodia because that's what people wanted and that's what is possible within the local supply chain. But it's not appropriate in rural Ethiopia where water is scarce.

To operationalize your design, you need to be very iterative. You won't come up with the perfect solution from the 'get go' at any point in time, anywhere, so you need a feedback loop that responds quickly, that is accurate, that gives you the information you need so you can iterate and improve upon the solution.

The third part of scaling, which is very important for iDE at least, is having boots on the ground, doing the day to day grind, interacting with users and with the private sector actors, so as to iterate quickly and appropriately. It's not sexy and it's not an easy catalytic copy-and-paste approach. Our model is very focused on boots on the ground. We work with local government and with local private sector actors. Without those, it would be hard to know what's going on.

Can you tell us about your innovative funding models and how you bring partners together to provide funding?

Ms. Wei: We have learned a lot by looking back on our experiences globally, and on partnerships that have really worked well, and those that could have gone better.

Our very effective partnerships have had everyone around the table sharing the same long-term vision. Also, they have had a harmonized program that was not ‘projectized’; that is, not requiring a separate reporting structure for each donor, different KPIs for each donor. Projectized programs give you a load of transaction costs managing nitty-gritty aspects that should ultimately contribute to the headline KPI but that in practice distract you from the big goal.

We have realized it’s very important to articulate a vision that people can buy into, from the very beginning. And you need to know your partners really well. Just like users, your partners have different needs and desires, and they are constrained by their own organizations in what they can or cannot fund. You need to have an upfront conversation and identify who can contribute what type of resource, whether human, financial, or technical, and at what stage along the process they want to join in.

Looking at how venture capitalists operate, for inspiration, we saw how they raise money over time as a business scales up. They really try to align different investors with different risk-reward profiles. For instance, very early stage investors hope to get into a program on the ground floor and have a huge return, but they’re obviously also taking a huge risk because the initiative hasn’t been proved yet. For later stage investors - let’s take IDEO, a proven business, as an example - if you buy a stock, you own a very small portion of the business so your reward



Yi Wei Testing Out Some Latrine Slabs. These Latrine Slabs were Made by a Microenterprise that iDE had Trained in Burkina Faso.

is less because your risk is less.

We think the risk-reward paradigm is something we at iDE should be much more aware of when we approach different partners. What is their comfort level with different risk profiles? Do they want to be an early stage investor? Are they willing to take on that risk and take a chance on you? Or are you looking at a bilateral donor who really wants to invest in something that is proved but can’t provide large-scale funding? This means knowing the different stages of your program, and what type of risk appetite you are comfortable with, and delivering on and finding partners along the way who can meet those criteria. Ideally, you will gather them all in the same room at the very beginning of the initiative, and be positioning yourselves to be ready for the next stage investor or donor. And you want them to tell you what they need for you to be

investment ready.

I think it’s the fragmented nature of funding for international development that leads to much of the stop and start tendencies of projects - that is, people see them as projects rather than as long-lasting programs.

To be clear, when I say ‘in-

vestment’, I don’t necessarily mean the strict definition of investment where investors will get their money back with an added return. I use the word ‘investment’ even for donors who give us grants because that is an investment in

a long-term long-standing program, as opposed to a short-term grant for a project that will end in three years. A grant is an investment with a negative 100% financial return but a lot of social return, especially for donors who want to play a catalytic role at the very beginning.

“It is much more acceptable to say shit than subsidy in the WASH sector now”.

Yi says that her organization (iDE) is proud of their human-centered approach. She makes it clear that iDE is not against all subsidies and in fact most things iDE does is publicly or privately subsidized. iDE’s role is to use these subsidies more efficiently by taking a product or service that has not been commercialized and adapt it to attract private investors to WASH outcomes.

They like to know that their early stage investment, as seed-funding in the form of a grant that they don’t expect to get paid back financially, has led to the development of a sustainable program.

One other thing I want to

clarify on this topic is about impact investing and the shifting paradigm of funding for NGOs. I’m not trying to say that people should start a social enterprise and try to achieve 100% cost recovery. By definition, the populations we’re serving are marginalized and vulnerable and costly to serve, and it may not be possible to get a 100% cost recovery. It’s really time to be thinking about problems differently: how do you approach your partners; what is the tenor of the relationship; are you in it for the long game; are you developing something sustainable; and how should you think about returns on investment in a way that holds all parties accountable.

The Australian Water Partnership (AWP) is an Australian Government development initiative enhancing the sustainable management of water across the Indo-Pacific.

A Tiny Tale of Two Villages: How Determined Action Builds Hope and Leads to Change



IN ONE OF MY previous columns, I had shared about the fluorosis crisis which had been afflicting a village called Churaman Nagar in Gaya district of Bihar and how the entire system seemed to have failed them. There was a non-functional fluoride removal plant (FRP) which people still used under the assumption that it was giving them clean water. The results were catastrophic with almost every household reporting at least one or more cases of dental and more pertinently, severe skeletal fluoro-

sis. I had written how officials seemed to know that the plant was dysfunctional for years and yet no action had been taken. I remember having come back in a desolate mood that evening.

Today, I am happy to report we decided not to leave the story on that hopeless note. We decided we owed it to the people of that village and in the neighboring Ismailpur suffering from the same problem. They needed to get out of this sorry state of affairs and with their own efforts. The action

needed to be multi-pronged. While for WaterAid India with its existing relations with the Public Health Engineering Department (PHED) of the Bihar government, it was comparatively easy to reach out to the top officials and work with them to address this issue, it was crucial that people from these villages became central to the solution. Not just as passive beneficiaries of some top-down charity, but mobilized for their own long-term interests, taking the role of leadership in their hands.

It was with this clear position in mind that while water quality tests were conducted with people's participation in the process, a series of meetings with the people was organized under the banner of Jal Chaupal: a campaign conceptualized by WaterAid India and its grassroots partners across various states where diverse set of community members particularly women, water practitioners, local officials, civil society workers get together to collectively share

and discuss issues around water and attempt to arrive at local, sustainable solutions.

In the process, three large Jal Chaupals and a week-long campaign on the safe water were organized. People were not only made aware of the perils of the consumption of contaminated water but also how they could change the state of affairs. This resulted in a collective filing of the application for improvement of the FRP to the Executive Engineer of PHED while also highlighting the issue to the District Magistrate, Gaya. Panchayat members attended these Jal Chaupals while the local Tola Sevak (a hamlet of appointed officials) of Churaman Nagar helped organize the entire process under the guidance of our local partner organization Pragati Gram Vikas Sahyog (PGVS).

Armed with this mobilization process on the ground, WaterAid India reached out to the PHED Secretary requesting them to look into the issue in detail. It requested for permission for installation of FRPs in two hand pumps as a stop-gap arrangement while seeking the long-term solution to renovate the dysfunctional FRP.

The following results were obtained with these series of ongoing actions on the ground and in the lobbying corridors:

- A letter seeking an explanation was issued by the Engineer-in-Chief to the Executive Engineer in Gaya on the problem of fluorosis and the non-functionality of fluoride removal plant.
- A fact-finding committee was constituted under the concerned Superintending Engineer to look into the issue of the non-functional FRP and the persistent problem of fluorosis. This fact-finding team was set up after a formal assessment report and a letter was submit-

ted by WaterAid India to the Secretary.

- Soon after, WaterAid India received the approval letter from the Engineer-in-Chief allowing it to provide treated water to villagers through the installation of treatment devices in two handpumps. Post which, restoration of FRP in Churaman Nagar started. Soon enough, two FRPs of Churaman Nagar and Ismailpur were restored by PHED ensuring safe piped water supply to 110 households.
- Besides a long-term institutionalized solution to the issue of safe water, the renovation has also helped the Musahar community in saving a considerable amount of money every month. It was reported that earlier 80% of households were paying Rs. 15 for a jar of 5 liters of water per household for their daily consumption. Now, as per their own calculation, they were likely to save Rs. 450 monthly.

The entire process lasted for about four months but a leadership structure at the local level has been created which is likely to last for many years to come. At least one sincerely hopes so. The threat of a slip back still persists in the absence of any systemic process of operation and maintenance of the FRPs. But this time it seems the people are determined and directly engaged in ensuring this doesn't happen through their active participation in the monitoring process of the same.

Personally, this small story of two villages restores my faith in people's action if thought through and implemented carefully!

Avinash Kumar is Director - Programme, and Policy at WaterAid India.

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25-Year Old Krishna Majhi Stands Outside His House While He has Been Diagnosed with Bone Deformities in Churaman Nagar, Gaya, Bihar, India. Photo Credit: WaterAid/Prashanth Vishwanathan.

WATER AROUND THE WORLD

Smart Water & Waste World covers some of the cutting-edge water treatment technologies being applied around the world, while having an indepth look at the most pressing issues concerning the water sector.



Disruptive Innovations in the Water Sector

An overview of recent disruptive innovations in the water sector, which in the near future are expected to transform water management.

By Nikolay Voutchkov

Introduction

According to a recent United Nations report, almost half of the world's population - some 3.6 billion people - currently live in areas vulnerable to water scarcity and nearly 2 billion people could suffer water shortages by 2025. In response to these challenges, the water supply planning paradigm in the next 10 to 15 years will evolve from reliance on traditional freshwater resources towards building an environmentally sustainable diversified water portfolio where low-cost, conventional water sources (e.g., rivers, lakes, and dams) are balanced with costlier but also more reliable and sustainable water supply alternatives such as water reuse and desalination.

A number of disruptive technologies that are expected to accelerate the process of water utility transformation towards sustainability are presented below. These technologies are expected to result in an exponential acceleration of the utility transition process towards sustainability by disrupting the status quo. In order for a technology to be disruptive, it has to be: (1) unique and (2) significantly (at least 20%) more efficient than the existing technologies.

Digital Water

Digital water is transforming the way cities will use and manage water resources in the future. By 2025, about 80% of utilities in large cities of advanced countries and half of the utilities in large cities of developing countries are expected to have water supply systems incorporating Digital Water features such as advanced metering infrastructure.

The New and Emerging Technologies

Advanced Metering Infrastructure (AMI) Systems

AMI systems are widely adopted by forward-looking utilities. For example, the Public Utility Board of Singapore (PUB) manages the entire water network as a system, including its design, operation & maintenance for 24/7 water delivery. PUB has developed a comprehensive smart water grid. The grid uses more than 300 wireless sensors in the water mains to collect data on real-time pressure, flow, and water quality. Risk assessment and predictive software tools help identify the top 2% of high-risk pipelines for replacement annually. In addition, PUB is planning to deploy sensors for quicker and more accurate detection of contaminants, better data analytics to filter out false alerts, and batteries to match the smart meters' 15-year lifespan.

Another example of AMI implementation is the Macao Water Supply Utility which has implemented an oversight system called Aquadvanced, which monitors consumption data collected from Macao's water network and alerts customers and operators to abnormalities.

In Malta, the Water Services Corporation (WSC) has recently installed an automated meter management system, using technology from SUEZ Smart Solutions, to improve its network performance. WSC also plans to develop reports and software to analyze data from smart meters.

Satellite Monitoring Systems of Water Distribution Systems and Catchments

An alternative trend to AMI systems emerging in recent years is the use of satellites in outer space to monitor leaks in water distribution systems and environmental health of river catchments. Two leading companies offering such technologies - Utilis and Satelytics - have developed software that analyzes satellite images to detect leaks in the distribution system and identify areas in the river catchment that experience environmental challenges.

Leaks as small as 0.1 L/min could be pinpointed by the satellite monitoring system and a single image can cover the area of 3,500 m².

Utilis offers such satellite monitoring service on a monthly and bi-annual basis and has already been adopted by utilities in the UK, Germany, Romania, and South Africa. While at present, the use of satellite images for leak detection is relatively costly (USD 160/mile per year), it is expected that in the next ten years, the price to task a satellite to collect specific information from outer space is expected to diminish significantly and to make this technology more affordable and easy to use. However, even at present the cost of this leak the savings from lost revenue due to water leaks can offset detection service.

The US-based company, Satelytics uses geospatial image analysis from satellites, nano-satellites, drones, and planes to monitor water quality in watersheds. The company monitors the health of vegetation sites using bi-monthly satellite image analysis and identifies whether the vegetation has been damaged or negatively impacted as well as where are the potential "hot spots" of

pollutants such as phosphorus or nitrogen that could trigger algal bloom and damage the ecosystem.

In Singapore, the national water agency - PUB - uses robotic swans to complement its online monitoring system for large-scale watershed management.

Water Reuse

The New and Emerging Technologies

Direct Potable Reuse

Indirect potable reuse has been practiced worldwide for over two decades. Direct potable reuse, is expected to emerge as main source of alternative water supply by the year 2030. At present, a number of US states, such as California, Texas, Arizona and Florida as well as other countries such as Israel and Australia have developed or are underway of developing regulatory framework and advanced technologies which are expected to facilitate the industry-wide adoption of direct potable reuse as alternative source of drinking water supply.

The typical cost for parallel distribution of tertiary-treated recycled water is USD 0.3 to 1.7/m³ whereas the typical cost for highly treated purified water, which could be delivered directly into the distribution system, is USD 0.6 to 1.0/m³, which is comparable to the cost of seawater desalination.

As compared to conventional drinking water plants which use source water from reservoirs, lakes, and rivers, treatment plants for direct and indirect potable reuse include at least two to three additional treatment processes which serve as barriers for pathogens

and trace organics and allow to consistently achieve drinking water quality.

New Advanced Oxidation Processes

The Centre for Water Research at the National University of Singapore (NUS) has developed an emerging advanced oxidation process called Electro-Fenton, which received the Most Disruptive Technology Award at the 2016 Singapore International Water Week. The team's invention degrades a wide variety of contaminants, turning 99.9% of the pollutants in non-biodegradable wastewater into simpler and harmless substances such as carbon dioxide and water.

UV-LED Systems

They are smaller and more robust than conventional UV lamps and can be configured and used in a much wider variety of applications, such as AOC systems, and ballast water disinfection. At present, the production of UV-LED systems is costlier than conventional UV installations. However, in the next 5 to 10 years, the technology is expected to evolve into very competitive and yield significant life-cycle cost savings.

Automated Water Quality Monitoring Systems

Recently introduced innovative technologies, which have advanced online water quality monitoring include:

- Island Water Technologies - which has developed the world's first real-time bio-electrode sensor for the direct monitoring of microbial activity in wastewater treatment systems.
- Microbe Detectives - applies

advanced DNA sequencing to identify and quantify nearly 100% of the microbes in a sample of water, and provides comprehensive microbial evaluations for water quality and disease management.

- TECTA-PDS - has created the world's first automated microbiological water quality monitoring system, which considerably lowers the cost of monitoring.

Enabling Conditions for the Water Reuse

The major water reuse challenges are:

- Economic viability,
- Social acceptance: public perception and support by users and local authorities,
- Policy and regulations,
- Technical issues and energy efficiency,
- Innovation and fast implementation of new tools, technologies, and good practices.

Resource Recovery and Energy Self-Sufficiency

Technologies for energy self-sufficiency aim to recover energy contained in the influent wastewater of WWTPs and to use this energy for wastewater treatment and solids handling. In the next 10 to 15 years, it is expected that a new wave of technologies will be developed, which have the potential to make the WWTPs energy self-sufficient, producing as much energy as they use. At present, most WWTPs deploy technologies that can recover energy from wastewater sludge that cover only 20-25% of the plant total power demand. New technologies expected to be developed by the year 2020 would increase self-sufficiency to 75%, and further energy recovery and reuse technology development are projected to be able to make WWTPs 100% energy self-sufficient by the year 2030.

Energy self-sufficiency and sludge management are inextricably linked. The near-term goal of 75% self-sufficiency would be possible to achieve by the development of advanced technologies for har-

nessing the biogas generation potential of sludge. The target WWTP 100% energy self-sufficiency by the year 2030 is projected to be achieved by using technologies that dramatically reduce energy use for biological wastewater treatment such as nanosize air bubble aeration systems, applying anaerobic treatment processes such as Anammox, as well as using solar and heat power generation systems installed at the WWTP site.

The New and Emerging Technologies

Over the next 10-15 years, wastewater management innovations will focus on advanced membrane-based treatment technologies, anaerobic digestion of sludge, energy reduction for wastewater treatment, and new membranes from biomaterials. Aerobic granulation, for instance, is touted as the future standard for industrial and municipal wastewater treatment due to its energy-effectiveness and cost-efficiency. It has also been noted that plate and frame membrane bioreactor (MBR) systems with higher permeability, less biofouling and outstanding chemicals and temperature resistance will become mainstream wastewater treatment and resource recovery technology by the year 2030.

Phosphorus Recovery from WWTP Sludge

Germany has taken a leading position in this initiative and a number of other countries in central and northern Europe are expected to follow suit in the next five years.

Enabling Conditions for the Resource Recovery

Recently adopted regulations in Germany, Switzerland and Austria mandate phosphorus recovery from wastewater sludge, thereby promoting the recovery of this valuable resource. These regulations are essentially phasing out the land application of nearly all use of sludge from WWTPs and mandating phosphorus recovery from this sludge by

2029 for plants over 100,000 people equivalents (p.e.) and by the year 2032 for plants serving over 50,000 p.e.

While technologies for the extraction of valuable nutrients such as phosphorus already exist, the regulations allowing the use of the recovered nutrients as fertilizers are still under development or non-existent. The European Union (EU) currently is developing revised Fertilizer regulations, which are expected to shorten and simplify the path of the use of products, made from secondary raw materials such as organic and organo-mineral fertilizers, composts and digestates. These regulations are expected to be promulgated by the end of 2018. Two to three more years will be needed before the regulations apply and these products are EU certified for safe use.

Anammox Anaerobic Wastewater Treatment

During the last 20 years, many research projects were conducted on the Anammox process. In 2007, the first large-scale Anammox reactor was built in Rotterdam. It displays the vast possibilities of this new process. It is expected that this game-changing disruptive technology will become a mainstream wastewater process in the majority of WWTPs by the year 2030.

Desalination

While at present, desalination provides approximately 10% of the municipal water supply of the urban coastal centers worldwide, by the year 2030 this percentage is expected to reach 25%.

The New and Emerging Technologies

Near and long-term desalination technology advances are projected to yield a significant decrease in costs of production of desalinated water by the year 2030. In desalination, innovative technologies have been addressing longstanding issues that have hampered the development of this alternative resource. New

technologies are aimed at reducing energy consumption (by 20-35%), reducing capital costs (by 20-30%), improving process reliability and flexibility, and greatly reducing the volume of the concentrate (brine) discharge.

Nano-structured Membranes

A recent trend in the quest for lowering the energy use and freshwater production costs for desalination is the development of nanostructured (NST) RO membranes, which provide more efficient water transport as compared to existing conventional thin-film membrane elements.

A US membrane supplier NanoH2O, recently acquired by LNG, has developed thin-film nano-composite (TFN) membranes, which incorporate zeolite nanoparticles (100 nanometers in diameter) into a traditional polyamide thin membrane film. These new TFN membranes have been commercially available for seawater applications since September 2010. The new membrane elements have 10-20% higher productivity than other currently available RO membranes or to operate at approximately 10-15% lower energy use while achieving the same productivity as standard RO elements.

Nano-structured membranes hold the greatest potential to cause a quantum leap in desalination cost reduction because theoretically, they can produce an order of magnitude more fresh water from the same membrane surface area than the state-of-the-art RO membranes commercially available on the market at present.

Forward Osmosis (FO)

Several companies such as Modern Water, Hydration Technology Innovation, and Trevi Systems have developed commercially available FO membrane desalination technologies, which to date have only found application for treatment of wastewaters from oil and gas industry and

high salinity brines. The Trevi systems FO technology is of potential interest because it uses draw solution that can be reused applying solar power - it is the main innovative technology considered for the ongoing solar power driven desalination research led by Masdar in the United Arab Emirates.

The main potential benefit of the development of commercially viable FO technologies for the production of desalinated water is the reduction of the overall energy needed for fresh water production by 20-35%, which energy savings could be harvested if the draw solution does not need to be recovered and the salinity of the source water is relatively high. Such energy reduction could yield cost of water reduction of 20-25% by the year 2030, especially for non-drinking water production applications.

Membrane Distillation (MD)

At present, MD systems are commercially available from Memsys, which have focused the advancement of this technology application mainly for treatment of produced water waste streams from oil and gas industry. Other companies, such as Memstill, Keppel Seghers, and XZERO MD have recently commercialized MD systems mainly for industrial wastewater treatment and reuse applications. The main cost savings that can result from the application of this technology for large-scale desalination plants is lowering the cost of fresh water production from highly saline seawaters such as those of the Arabian Gulf and the Red Sea and the costs for concentrate management and disposal for brackish desalination plants and RO systems used for potable reuse by 15-20%. Commercialization and industry-wide adoption of such systems is highly likely to transform the water industry by the year 2030.

Electrochemical Desalination

Developed by Evoqua (for-

merly Siemens) under a Challenge Grant from the Government of Singapore, this continuous electrochemical desalination process is based on a combination of ultrafiltration pre-treatment, electrodiolysis (ED) and continuous electrodeionization (CEDI) and is claimed to desalinate seawater to drinking water quality at only 1.5 kWh per cubic meter. This energy consumption is lower than the energy use of conventional SWRO desalination systems. The potential reduction of desalinated water costs this technology can yield is 15-20% by the year 2030.

Capacitive Deionization (CDI)

The technology holds promise because it could theoretically reduce the physical size and capital costs of desalination plants with over 30%. Current carbon electrode technology, however, limits salt removal to only 70-80%, uses approximately two times more energy than conventional RO systems and is subject to high electrode cleaning costs due to organic fouling. New electrode materials as grapheme and carbon nanotubes may potentially offer a solution to the current technology challenges and are very likely to become readily available by the year 2030.

Biomimetic Membranes

Aquaporins are an example of such membrane structures. Currently, researchers at the US, Singapore, and Australia are focusing on advanced research in the field of biomimetic membranes and in July 2018, the company Aquaporin introduced the first commercial FO membrane with embedded aquaporins. Although this research field is projected to ultimately yield high-reward benefits (e.g., overall desalinated water cost and energy use reduction with over two times), currently it is in early stages of development - further research is focused on the formation and production of aquaporin structures, which are incorporated into robust

and durable commercial membranes - such products are expected to be commercialized by the year 2030.

Joint Desalination and Water Reuse

A new trend towards adopting the One-Water concept is the development of technologies for joint desalination and water reuse, where the desalination plant and the potable reuse plant are combined into One-Water Plant producing drinking water at disruptively (25-35%) lower cost as compared to seawater desalination alone.

The One-Water technologies present an opportunity for reduction of the energy and cost needed for desalination by feeding highly treated secondary effluent or RO reject from wastewater treatment plant into the feed water of SWRO desalination plant. Because the discharge from advanced water reclamation plants has an order of magnitude lower salinity than the source seawater, the SWRO system's feed water salinity and energy cost for desalination could be reduced by 20% or more. Such treatment process is referenced as joint desalination and water reuse or One-Water process. An example of such joint desalination and water reuse facility is the Hitachi's Remix system, which has been extensively tested at the 40,000 m³/day Water Plaza Advanced Treatment Plant in Japan.

As direct potable reuse matures and gains worldwide acceptance in the next 10 years, joint desalination and water reuse facilities are likely to become a mainstream trend and attractive low-energy alternative for the production of desalinated water. The benefits and potential challenges of joint desalination and reuse plants in terms of efficiency, reliability, costs and product water quality are currently undergoing thorough investigation in demonstration plants in Japan and South Africa.

Enabling Conditions for the

Desalination

The future improvements of the RO membrane technology which are projected to occur by the year 2030 are forecasted to encompass:

- Development of membranes of higher salt and pathogen rejection, and productivity; and reduced trans-membrane pressure, and fouling potential;
- Improvement of membrane resistance to oxidants, elevated temperature and compaction;
- Extension of membrane useful life beyond 10 years;
- Integration of membrane pre-treatment, advanced energy recovery and SWRO systems;
- Integration of brackish and seawater desalination systems;
- Development of new generation of high-efficiency pumps and energy recovery systems for SWRO applications;
- Replacement of key stainless steel desalination plant components with plastic components to increase plant longevity and decrease overall cost of water production.
- Reduction of membrane element costs by complete automation of the entire production and testing process;
- Development of methods for low-cost continuous membrane cleaning which allow to reduce downtime and chemical cleaning costs;
- Development for methods for low-cost membrane concentrate treatment, in-plant and off-site reuse, and disposal.

These technology advances are expected to ascertain the position of SWRO treatment as viable and cost-competitive processes for potable water production and to reduce the cost of fresh water production from seawater by 25% by the year 2022 and by up to 60% by the year 2030 (Table 1).

In the future, desalination is likely to be adopted as main water supply in most arid and semi-arid regions of the world such as the Middle East, North Africa, the Western

Parameter for Best-in Class Desalination Plants	Year 2018	Year 2022	Year 2030
Total Electrical Energy Use (kWh/m ³)	3.5 - 4.0	2.8 - 3.2	2.1 - 2.4
Cost of Water (USD/m ³)	0.8 - 1.2	0.6 - 1.0	0.3 - 0.5
Construction Cost (USD/MLD)	1.2 - 2.2	1.0 - 1.8	0.5 - 0.9
Membrane Productivity (m ³ /membrane)	28-48	55-75	95-120

Table 1: Forecast of Desalination Energy Use and Costs for Medium and Large Plants

United States, and Australia and in locations of concentrated industrial demand for high-quality water such as Singapore, China, and Northern Chile.

Conclusion

While the water industry faces diverse challenges it is making significant progress towards finding cost-effective and sustainable water management solutions and disruptive technologies, which by the year 2030 are expected to transform water management and elevate its reliance on alternative water resources such as water reuse and desalination. Water professionals worldwide are united in building a future where water is recognized and treated as precious, highly valuable resource, and as a cornerstone of a circular economy.

The main transformational change of the water industry is that it is entering a new era of water management where the old barriers of water and wastewater are slowly fading and where water in all of its states is looked upon as a valuable commodity and precious resource that has to be closely monitored, digitalized, accounted for, and reused rather than being considered just a simple source of supply or waste that has to be disposed of.

Traditionally water utilities have managed water supply and treatment of wastewater, minimizing the impact on the environment by removing nutrients and using the waste generated in a beneficial manner. In order to adapt to the challenges they face in the next 10 to 15 years, utilities

have to develop a diversified portfolio of water supply in which conventional and direct potable water reuse and desalination have a comparable share to that of conventional water treatment sources such as rivers, lakes, and dams. In order for such fundamental transformation of the water industry to occur by year 2030, the fundamental legal framework, which currently regulates water and wastewater separately (e.g., in the US they are regulated by the Safe Drinking Water Act and the Clean Water Act) has to be transformed into a unified One-Water Act that recognizes water as a valuable resource in all of its forms and uses.

About the Author



Nikolay Voutchkov is a registered professional engineer and a board-certified environmental engineer (BCEE) by the American Academy of Environmental Engineers. He has over 25 years of experience in planning, environmental review, permitting and implementation of large seawater desalination, water treatment and water reclamation projects in the US and abroad. Mr. Voutchkov is President of Water Globe Consultants, LLC.

Do We Just Need a Sign to Save Water?

A study finds that the signs create a greater sense of environmental stewardship that could help reduce water consumption.

By Klaus Reichardt



ACCORDING TO A JUNE 17, 2018 report in Al Jazeera, India is facing its worst-ever water crisis. The report, written by Zeenat Saberlin, says that about 600 million people living in India are facing “high to extreme stress over water.” The author cites a study, published by Composite Water Resources Management, an Indian think tank, that warns if this continues, conflicts and related threats are right around the corner.

“Critical groundwater resources, which account for 40 percent of our water supply, are being depleted at unsustainable rates,” the report said. Further, Mridula Ramesh, author of books on climate change and its impact on India, told Al Jazeera that, “there are few or no restrictions on groundwater extraction [in India], leading to wasteful water consumption. In agriculture, crop choice that is unsuitable for a given region is one example of this.”

It appears that greater

awareness of India’s water situation could be one step in reducing consumption. This was one of the goals of an experiment conducted in the US state of Florida by Florida Atlantic University (FAU), where most people in suburban areas have the lawns that are watered frequently, rain or shine. Making people more aware of their water consumption might encourage them to use water more efficiently, helping to reduce consumption. While the study involved residences, the researchers also believed that it could have ramifications for commercial and industrial facilities with lawns and other vegetation areas as well.

Before we discuss the study, we need to know a bit more about lawns found not only in Florida but in suburban areas around the world. The average lawn in the U.S. is 2,500 square feet. It takes, on average, 12,500 gallons of water every month to water that lawn. That totals over 150,000 gallons of water each year just to irrigate

one lawn. If there are 20 houses on a block, all with the same sized lawn and watered just as frequently, this means that just this one block of houses use more than 3,000,000 gallons of water per year just for lawn irrigation.

As we can see, this quickly becomes a massive volume of water. This is why many areas of Florida, just as in similar communities around the world, have implemented day and time water restrictions. These restrictions tell homeowners on what days and at what times they can irrigate their lawns. According to Florida water officials, however, the limits are making no more than a dent in water consumption, far less than what was hoped for. This is why they turned to FAU for help.

The Experiment

FAU selected a residential community and put together a program referred to as “The Rain-Watered Lawn” program. The goal was to determine if

weather-based water conservation strategies were more effective than the day/time water restrictions currently in place.

The test included 627 households divided into two groups: 321 households were designated the experimental group and 306 the control group. The control group continued to observe the water restrictions in place but made no other changes in their lawn irrigation habits.

What the researchers did was rather simple. Throughout the experimental neighborhoods, they placed road signs. The road signs would change regularly, indicating how much rainfall had occurred in the past seven days; remind homeowners that most Florida lawns only needed to be irrigated about once per week, and would include the following message at the bottom of the sign: “Is rainfall alone meeting the water needs of your lawn?”

The researchers also sent out postcards to the experimental group, just to make sure they understood the information on the signs.

After several weeks, the researchers started gathering data. What they found was that in the summer months, when this region of Florida received the most water, there was, what was termed, an “astounding” 61 percent decrease in lawn watering in the experimental group, saving millions of gallons of water per week. But there were no such changes in the control group.

Further, the experimental group continued to use about 41 percent less water than the control group even after the test period. This indicated that a water conservation pattern had developed. Instead

of day/time water restrictions, the control group paid closer attention to the weather and then determined if their lawns needed irrigation.

The Bigger Picture

The researchers suggested that their findings could have more significant ramifications than might initially be realized. “This program has the added benefit of getting people more in tune with the natural water cycle, which might help [water users] prepare for changes in water supply and water policy,” said Ata Sarajedini, Ph.D., Dean of FAU’s Charles E. Schmidt College of Science.

Does this mean we could post similar signs in, for instance, roads around residential neighborhoods as well as industrial and commercial facilities, updating facility managers on water conditions and urging them to use water more efficiently and only as needed?

The researchers believe the answer is yes. They say the signs created “a greater sense of environmental stewardship that could be tied to everyday activities,” all of which could help reduce water consumption in industrial and commercial locations, potentially decreasing water consumption considerably.

About the Author

Klaus Reichardt is Founder and CEO of Waterless Co. Inc., USA. He founded the company in 1991 with the goal of establishing a new market segment in plumbing fixture industry with water efficiency in mind. Along with Waterless No-Flush urinal, which works entirely without water, it manufactures other restroom and plumbing related products.

Data Tools Improve Nutrient Monitoring

Real-time nutrient monitoring systems can help communities address the underlying causes of persistent nutrient loading in surface waters, providing a better understanding of harmful algal blooms and nutrient management strategies that can improve water quality.

By Karlin Danielsen, Nathan Zgnilec, and Vincent Kelly



The Autonomous Nutrient Monitor can Create a Continuous, Real-Time Flow of Phosphorus Data to Help Water Professionals Better Characterize the Mobilization of Nutrients that Contribute to Harmful Algal Blooms.

Harmful Algal Blooms

(HABs) are a major threat to Lake Erie's water quality and

the millions of residents who depend on the lake for their drinking water. Algal blooms are also being found in the

region's rivers and reservoirs bearing nutrient-rich waters. Measuring, disseminating, and tracking nutrient levels

in and entering the lake from tributaries are critical components of understanding and predicting HABs and target-

ing sources to improve water quality.

Communities are also facing new regulations associated

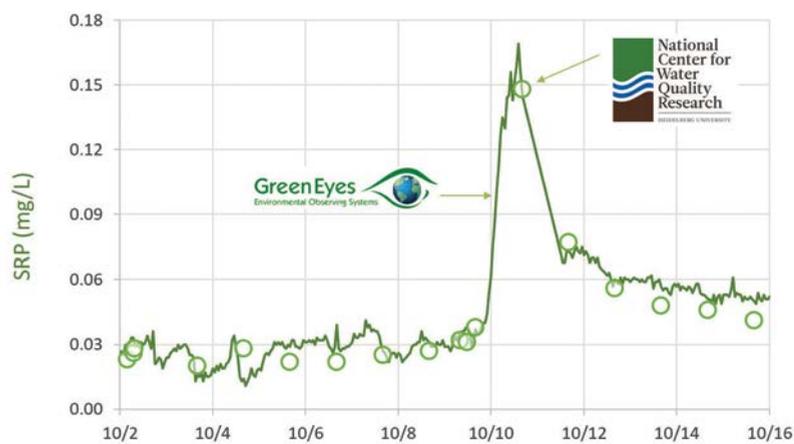


Figure 1: Data Validation (The Autonomous SRP Data were Consistent with the NCWQR Samples).

with HABs. In 2017, municipal drinking water treatment plants along the western shore of Lake Erie were required to develop contingency plans for HAB-generated toxins in source waters. Moreover, the state of Ohio soon will require all wastewater treatment plants to meet new phosphorus discharge limits. Even so, more needs to be done to reduce overall nutrient loading to a level that would inhibit HAB formation.

Many challenges arise in monitoring the nutrients that cause HABs in the Great Lakes and their tributaries, including the high cost of monitoring phosphorus and the lack of continuous data available to support real-time decision making. Although monitoring the water quality of tributaries isn't a new idea, traditional monitoring techniques have inherent limitations. Often, monitoring programs have involved sending out a crew to perform grab sampling or using composite samplers to collect samples and then testing those samples in a lab. Such monitoring methods naturally limit sampling frequency and the timeliness needed to turn samples into valuable information.

Sparking Innovation

Tackling the challenges associated with nutrient monitoring in the Great Lakes is a priority for the Cleveland Water Alliance (CWA), a non-profit organization that seeks

to unite northeast Ohio corporations, universities, government agencies, and others to focus on water quality and promote water's value for the regional economy. CWA established a competition called the Internet of H₂O Challenge (iH₂O) in October 2017, challenging teams to develop next-generation networking and sensor technologies to monitor Lake Erie's phosphorus loads in real time.

One of the competitors, Team GLASS, was headed by an engineering consultant that integrated several technologies to create an affordable way to continuously monitor phosphorus loads. The integrated system was named the Great Lakes Automated Sampling Solutions and Evaluation System (GLASSES). The judges awarded Team GLASS the first-place prize for a field-ready, end-to-end solution based on a validated data set and the affordability to scale the system across a large geographic area.

Real-Time Nutrient Monitoring

Sensor technologies for water quality monitoring have experienced rapid development in recent years. These advances have resulted in wet chemistry robots that can monitor nitrogen and phosphorus by pumping samples into units that analyze soluble reactive phosphorus (SRP), the most bioavailable form of phosphorus, in accordance with US Environmental Pro-

tection Agency-approved colorimetric methods. The ability to continuously monitor SRP levels is significant in tackling HABs because it's the form of phosphorus directly consumed by algae. Such nutrient monitoring systems can produce a continuous data set of phosphorus measurements.

Team GLASS created a reliable, affordable nutrient monitoring system that can generate a continuous real-time flow of phosphorus data. The system meets a wide range of specifications, including affordable pricing, with units available for \$10,000, and the ability to monitor one or more parameters, such as phosphorus and nitrogen. The engineering consultant chose to partner with a nutrient monitoring instrument manufacturer and install the company's nutrient monitoring system for the iH₂O Challenge. The auto-

nous monitoring system was chosen based on its ability to monitor SRP and nitrate + nitrite (N+N).

To support recent advancements in continuous monitoring equipment, many sensors now allow users to view real-time data on a website. Such web-based programs improve traditional methods of viewing data streams. However, multiple probes often are deployed together (such as streamflow, chemical concentrations, and rainfall), and the individual data streams can't be viewed simultaneously. As a result, multiple data sets must be pulled into a separate software package that allows them to be viewed together. Moreover, the software must offer modeling and analysis tools that can manage large data sets.

When forming Team GLASS, the engineering consultant also partnered with a software manufacturer offering an analytical platform that can view and analyze data from multiple parameters in real time. This software platform was integrated with the monitoring instrument manufacturer's device to manage water quality data and support data analysis. Linking the systems with a wireless telemetry unit created an hourly flow of data directly into a program with modeling capabilities.

Proof of Concept

The GLASSES technology was demonstrated in a proof-of-concept deployment on

Rock Creek at the US Geological Survey gauging station in Tiffin, Ohio. Rock Creek primarily drains the agricultural land and is subject to flashy flows with dynamic loading rates of phosphorus, sediment, and other components that form HABs, making it an ideal location for testing new monitoring technologies. The National Center for Water Quality Research (NCWQR) at Heidelberg University in Tiffin has an ongoing nutrient monitoring program at the Rock Creek site, providing an opportunity to validate the autonomous data with a reputable, independent laboratory. Figure 1 shows excellent agreement between the autonomous SRP data and composite samples taken by NCWQR. A similar agreement was observed with an N+N data set.

During the Rock Creek deployment, a storm delivered 0.8 in. of rain. The GLASSES technology captured continuous measurements of nutrient concentrations in Rock Creek during the storm. These measurements were uploaded to the analytical software platform in real time, allowing conditions to be observed as the storm occurred. Figure 2 shows that flow in Rock Creek responded rapidly to the rainfall event. The response to rainfall for SRP and N+N didn't follow the same timing as the flow. Rather, the concentrations peaked one day after the flow peaked.

The software was used to

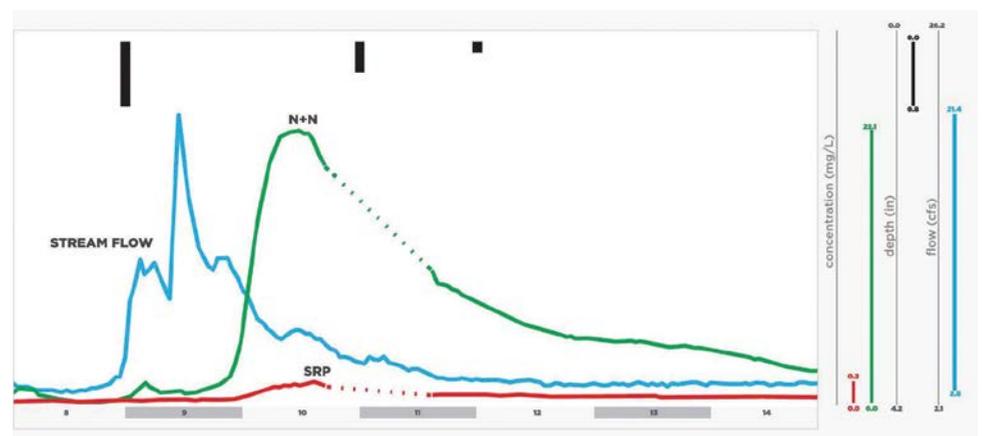


Figure 2: Timing of Flow and Nutrient Responses (Nutrient Concentrations Peaked One Day After the Flow Peaked in Response to a 0.8-in. Rainfall Event - the Dashed Line Indicates a Temporary Failure of Controller).

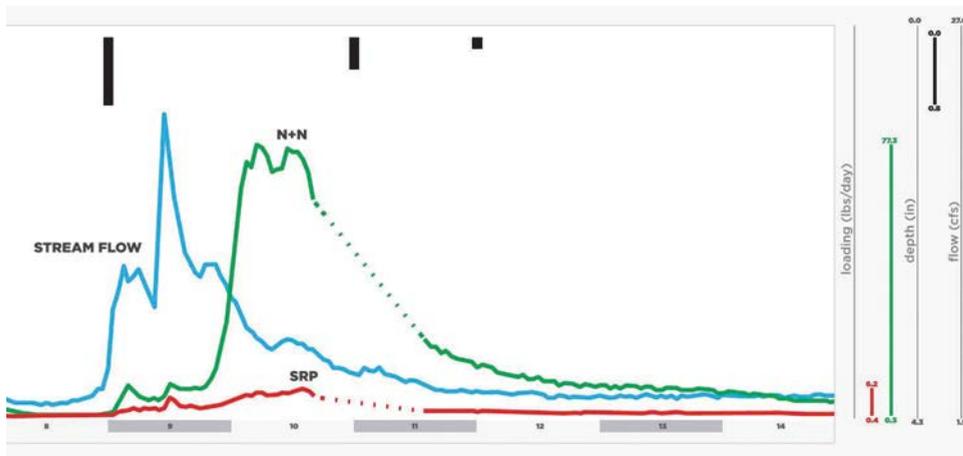


Figure 3: Nutrient Loading (Two Responses are Evident for the Nutrient Loads - Dashed Lines Indicate a Temporary Failure of Controller).

analyze the in-stream nutrient dynamics. Figure 3 illustrates the nutrient loading in Rock Creek in response to the rainfall event. Two responses are evident for the nutrient loads. A small response occurred on the day of rainfall. It's hypothesized that this small load was caused by high-intensity runoff from impervious surface areas in Tiffin, transporting low concentrations of nutrients. On the day following rainfall, a second, larger response was observed. It's hypothesized that this larger response represents subsurface flow, percolating through soil and carrying a larger nutrient load but traveling with a lower flow rate. Thus, this flow arrived a

day later.

This data-set is based on samples filtered through a 70 μ m filter to measure SRP. Although particle-based transport is an important component of nutrient mobilization, the process isn't captured in this data set, which provides insight into soluble-phase nutrient transport exclusively.

The ability to gain an in-depth understanding of system dynamics is only possible with high-frequency, continuous data sets. Flow and nutrient patterns change rapidly in response to rainfall, and those changes are accelerated by impervious areas. Details on the timing of flow and nutrient response provide critical clues

to the processes dominating nutrient transport. Such understanding allows users to select the most effective management practice for a specific site.

Use Data to Build Alliances

Downstream communities are often forced to cope with the water quality they receive from upstream waters, and impaired water bodies directly affect a community's bottom line. Businesses and residents are deterred from locating to a community with an unreliable source of drinking water. Moreover, few people want to visit lakeside attractions or own property near water that's

unpleasant to look at, unsafe to swim in, and foul smelling.

The technologies used in the GLASSES approach offer communities empowering tools to do more than cope. Now communities can participate in identifying pollutant sources and possible solutions. An affordable network of continuous monitoring devices makes regional source tracking a reality. Such a network can identify phosphorus levels from multiple sources, providing the information needed to focus on the largest sources first. Then, with data in hand, community leaders can approach the owners of upstream sources and begin conversations that may lead to strategic alliances.

For example, the 2018 Ohio Domestic Action Plan reported that 87 percent of total phosphorus in the Maumee River could be attributed to nonpoint sources. Agricultural runoff is a known nonpoint source of nutrient loads. In Michigan, the Department of Agriculture and Rural Development is experimenting with smart systems that would retain water in tile drains and allow the nutrient-rich water to percolate back into the fields. These systems have the potential to reduce nutrient loading and simultaneously increase crop yields.

The GLASSES concept could quantify the performance of this or other strategies to reduce phosphorus stream loads on a sub-basin scale. Farmers who see enhanced crop yields in the demonstration studies are then easier to motivate to explore new on-field nutrient management strategies. Proven strategies could be scaled if downstream users are willing to provide matching funds and invest in solutions that protect their own clean water interests. These types of symbiotic alliances are the relationships CWA sought to create as a natural outgrowth of the iH2O Challenge.

New technologies are presenting new opportunities to create high-frequency, continuous data sets that help users move from confusion



Now communities can participate in identifying pollutant sources and possible solutions.

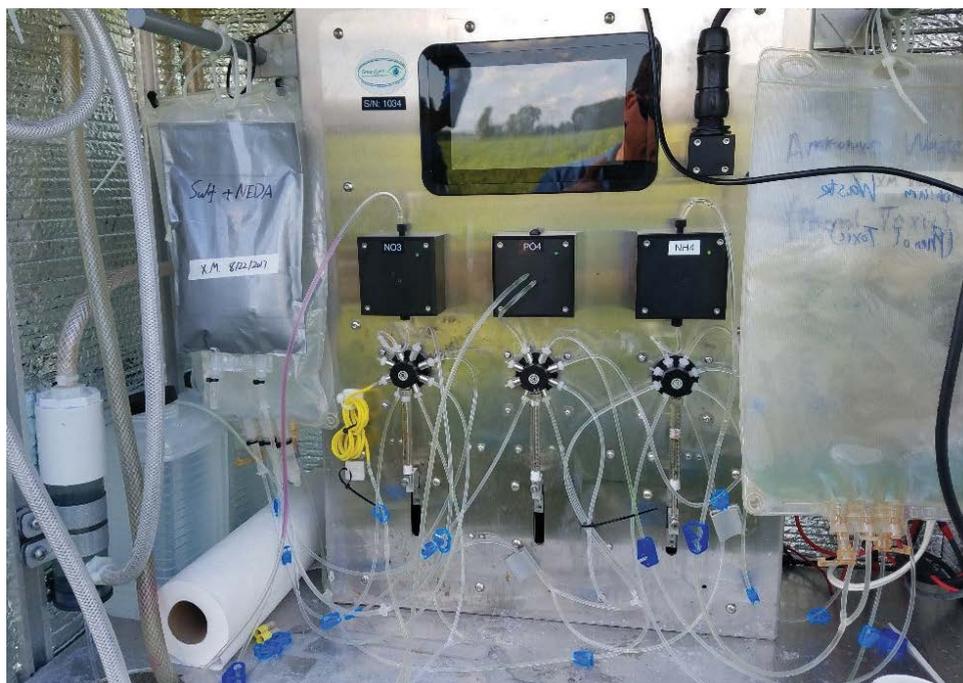
to understanding. The level of detail now available allows communities to recognize the interrelationships that affect pollutant mobilization. These new insights can support communities' efforts to address the underlying causes of persistent water quality issues.

The iH2O Challenge has been a springboard to a new era of water quality monitoring. The concept of integrating technologies to make continuous real-time water monitoring possible can be applied to any parameter for which there's an available probe. GLASSES enables communities to strategize capital improvements and invest in solutions that deliver results.

About the Authors

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Plan for Water Safety and Security

By Abhishek Dutta



Introduction

A Water Safety Plan (WSP) is defined by the World Health Organization (WHO) as “a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer” to ensure safe drinking water.

It is described in the WHO's Guidelines for Drinking-water Quality (GDWQ) as the “most effective means of consistently ensuring the safety of drinking water supply.” It is implemented as a series of steps that are revisited periodically.

The Objective

The objective of promoting WSPs is to broaden the emphasis of water quality management to include operations and management of water supplies. WSPs are locally tailored to respond to factors such as:

- Estimated contamination levels and risks for a specific system,
- Expectations of investors and clients,
- Willingness or ability to recover costs from the community, and
- Expectations of water quality standards including health and, possibly, acceptability aspects.

Brutal Truth About Present Water Supply System in Terms of Water Safety & Security

Safety: Looking at the urban water supply system, India has such ULBs (Union Local Bodies) where water supply is generally for on average 6-8 hrs/day basis. This means we are in a country of intermittent supply. Now, we know that in any intermittent supply, quality

is of course compromised. In most of the cases, water supply networks and sewer networks are laid in the same alignment. As a result, when any leakage occurs in the water network pipeline during supply hours, water is lost through leaks, and during non-supply hours, the contaminated water/ sewer water enters in the pipeline from that particular leakage and gets stagnant. And when the supply starts again, the treated water gets mixed up with the contaminated water and reaches at the customer's end. Now, we can identify two problems on a single platform:

- Age old pipelines and infrastructure,
- Insufficient water to deliver on a 24x7 basis to encounter the above-mentioned problem.

Which option should be used then?

24x7 water supply, on one hand, indeed provides a beneficial water service to the consumers, but on the other hand, it causes more water loss (man-made + leakage originated) than intermittent supply. And we are not in a position to waste the water but need to save water for the future and use the exact quantity which we required for our livelihood.

Hence, I must say, we should explore the other option, i.e., “age-old pipeline and infrastructure”. I think, in the urban water supply system, apart from daily monitoring of water quality in the distribution system and treatment plants, if we do not initiate to improve the underground infrastructure, i.e.:

- Replacing pipeline networks,
- Pressure management tools,
- Schedule an active leak detection problem,
- GIS mapping and integrate quality management system with it, and
- Segregation of small wa-

ter-pockets/ zones/ boundaries/ DMAs and so on - to control water loss and detect unreported leaks as soon as possible, etc.

Any water supply system has to compromise its water quality at the consumer's end - mainly due to unequal water supply system. I am glad to see that India is gradually being conscious about upgrading its water infrastructure to improve water supply system, but the velocity of moving should be a little high in a hugely populated country like India.

Security: Indian citizens still don't have sufficient awareness about using the treated water in a proper way. ULBs should educate local public about the ‘use of water’, and ‘ways to save water at home’. Generally, we compare even serious natural resources like water, petrol, etc. with our ability to buy it. Whereas, we must realize that we should use it gently and save it for the future. Because that day is not far when we are going to have serious issues on the treated water in India.

The Groundwater

India is a groundwater economy. At 260 km³/year, our country is the highest user of groundwater in the world - we use 25% of all groundwater extracted globally, ahead of the USA and China. When we think of water, however, our brains have been programmed to think of large dams and rivers, and not wells. This, despite the fact that India has at least four crore irrigation wells and millions of farmers who use well water in agriculture. India was not the highest extractor of groundwater in the 1960s and 70s, but the “Green Revolution” changed that. At the time of our independence (1947), the share of groundwater in agriculture was 35%, whereas today it is a startling

70%.

The Adoption

The management of water safety through WSPs (or equivalent) is increasingly being formalized globally as an obligation or through strongly promoted good practices for urban water supplies. In a recent WSP implementation progress report, it was noted that “92 countries, representing every region of the world, have implemented WSPs or equivalent risk assessment and risk management approaches.”

The Influence of WSP

Direct Influence

- Drinking-water infrastructure projects, such as water reticulation networks or water treatment plants.
- Water resources infrastructure projects, of which one of the intended beneficial uses is subsequent drinking-water supply.

Indirect Influence

- Projects that draw water from drinking-water sources (dams, weirs, reservoirs, and rivers), or add water to drinking-water sources, and as a result change the flow of rivers or the level of water in water storages (such as agricultural use, and irrigation).
- Projects that either pollute or clean up drinking-water sources, such as environmental remediation projects or infrastructure investments relating to mining or industry.
- Projects that provide basic infrastructure that, in turn, facilitate improvements in water supply and quality, such as power infrastructure investments.

About the Author

Abhishek Dutta is Water & Wastewater Head, AMRUT, UP.

Operating Wastewater Treatment Plants in Flood-Prone and Sandy Areas

Fine screening retrofit combats the forces of nature to deliver efficiency and environmental benefits for wastewater treatment.

By CST Wastewater Solutions



Robert Sabol Displays Grit Extracted by the High-Efficiency Installation

OPERATING WASTEWATER TREATMENT plants in flood-prone and sandy areas throughout Australia and New Zealand is fraught with hazard. Overflows and clogging resulting from storms can not only result in smelly, unhealthy and damaging discharges into environmentally sensitive waterways but also pose OH&S hazards to those charged with the dirty and heavy work of clean-ups.

One organization that has overcome the problem in a long-term and cost-efficient manner is the Richmond Valley Council, which is now reaping the dividends of installing fine screening and waste extractor technologies at its Casino Sewage Treatment Plant.

The fine grit extraction technology supplied by CST Wastewater Solutions for this retrofit is suitable for both local authority and industrial applications, such as food and beverage, manufacturing and processing, mining, energy and resources camps where its low maintenance, high hygiene qualities are appreciated. It is also applicable to agribusiness and installations where low maintenance and high efficiency is a priority for users who don't need to have specialist staff constantly available.

In the Casino application, the new screening and grit removal technologies have proved themselves in service over more than a year in the Northern Rivers Region, where rainfall can vary from about 600-2900 mm a year, with individual falls exceeding 150 mm.

The Casino retrofit project replaced the previous coarse raked screen design, which not only allowed more solids to pass through to foul processing downstream but also had to be manually and laboriously raked out when they clogged during high-flow events.

The new screening retrofit - combined with grit removal and clean bagging processes - captures more solids to reduce potential blockages in tanks and downstream equipment, while reducing odors by sealing the inlet works and by the installation of new odor control units. The project's high-efficiency fine screening SF technology (Screen Extractor for Channel Installation combined with a CST Screw Compactor) is engineered to deliver low-maintenance performance with reduced WHS hazards for municipal and industrial wastewater operators.

The SF allows for a much finer level of screening - 5mm compared with typical old systems at 60 mm or more - which has led to a significant reduction in solids in the tanks, while producing more efficient treatment with less maintenance.

Specified to handle flows of up to 500 liters a second, the Casino installation has coped flawlessly with everything nature had to throw at it in its first year of operation, including some of the worst floods in the district for years.

"It just keeps on turning over, taking out the waste that could block the system's downstream processes and cause unwanted discharges and maintenance," says Casino WWTP Senior Operator Rob-



The Easily Accessible Screen Augers

ert Sabol.

“Now we have no overflows. We can confidently leave it to operate overnight, knowing that it just keeps on working. We’re not worried about coming back to find it has overflowed,” he says.

Compacted and dewatered waste extracted from the system is automatically channeled into the waiting bagging-containers, where it is neatly collected without the need for direct handling of waste.

Nor do operations staff have to get into the screening system with rakes and levers to clear blockages, which was a time-consuming and messy business with old coarse screening.

“Servicing of this system involves next to nothing compared with the old way. It is so easy and efficient. It can’t get any easier, whereas the old coarse screen would just clog up and block.” Sustainability of the new system is further enhanced by the energy savings it produces, typically .8 kw on a 24-hour cycle.

The Casino retrofit also involved the installation of an SDS 20 compactor with two inlets - one for each screen - to dewater screenings to 25-30% dry solids. Each screen has an enhanced design capacity of

250 L/s flow, providing a total capacity of 500 L/s.

The original inlet works at Casino STP were designed with a coarse manual raked bar screen system. The functional components of the treatment process downstream of the bar screen receive a high amount of debris, which formerly impacted the efficiency of the treatment process. The original inlet area also received a high amount of odorous gases, which previously contributed significantly to odors emanating from the treatment plant. In addition to minimizing these issues, the upgrade project involved fitting new technology into an existing layout, including tailoring the screens to fit into the existing formed channel.

CST Wastewater Solutions’ robust and proven units are constructed from AISI 304 or 316 stainless steel without the need for the hanger, intermediate or bottom bearings. Featuring a space-efficient design suited to small sewage plants, the standard unit can handle up to 1000 m³ an hour with custom engineering also available for particular installations. A vertical version is also available to easily retrofit into existing pump stations, and, with depths up to 8m, the screen allows removal of mate-

rial before pumping.

The versatile SF Screen Extractor can be installed in a channel or supplied with the self-supporting tank, complete with inlet and outlet flange and optional bypass screen.

New engineer-and-build water and wastewater treatment and recycling packages from CST Wastewater Solutions are aimed at industries and municipalities that want to lower the cost and complexity of such projects.

The design, supply, and install packages - incorporating global and locally manufactured technologies proven in use by some of Australia and New Zealand’s leading companies and councils - are aimed particularly at:

- Councils seeking engineering assistance to developing clear choices and optimum solutions incorporating advanced low-maintenance technologies providing high levels of water purity while reducing maintenance, waste handling and OH&S issues associated with running them.
- Industries seeking readily constructed or portable, low maintenance solutions for operations particularly in remote, ecologically or environmentally sensitive areas - ranging from resources or

agribusiness developments in the country or outback, through to food, beverage, manufacturing and processing plants sharing precious water resources with urban areas.

Rather than presenting such organizations with a jigsaw of disparate collections of technologies and engineering services options for them to piece together, the packaged solutions focus on clear, properly engineered solutions that deliver what they promise. CST offers turnkey solutions based on a known raw water quality and guaranteeing water quality outcomes thus giving user engineers significant confidence in the outcomes and limiting their exposure and potential concerns, says CST Wastewater Solutions Managing Director, Michael Bambridge.

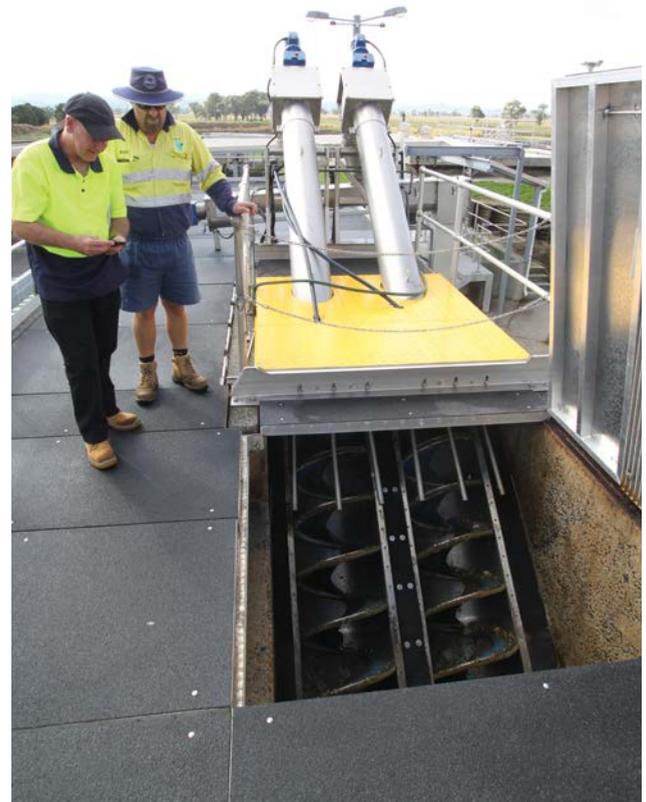
CST Wastewater Solutions is involved in projects, technologies, and services that increase environmental sustainability since its inception over 25 years ago. CST represents Global Water Engineering



Now we have no overflows. We can confidently leave it to operate overnight, knowing that it just keeps on working. We’re not worried about coming back to find it has overflowed.

- Robert Sabol, Senior Operator, Casino WWTP

(GWE) technologies in Australia that are at the forefront of waste-to-energy initiatives, turning a problem, wastewater, into a profit, biogas, which can be used to power boilers, reduce fossil fuel use and converted to electricity.



The System in Operation

A Synopsis of Sinkhole Development and Mitigation in a Newly Residential Roadway

The entire operation from the stabilization of the sinkhole, utility repair and infrastructure repairs to pavement reconstruction took about 20 days.

By Deodat Budhu



ON APRIL 19, 2017, a roadway depression opened within a travel lane in front of a residence at 5561 Cypress Hill Road in unincorporated Orange County, Florida. This depression was originally identified by a resident and brought to the attention of the Orange County Utilities Division who initially thought it may have resulted from a sewer line leak. After extensive video of the sewer main, it was determined that the utility system was in good shape and did not have any leaks or damage to cause this depression. The de-

pression was filled and a probable sinkhole was suspected. The further investigation and permanent remedial action for the depression of the roadway were turned over to the Public Works Department as the right of way and roadway maintenance are under the purview of the Roads and Drainage Division.

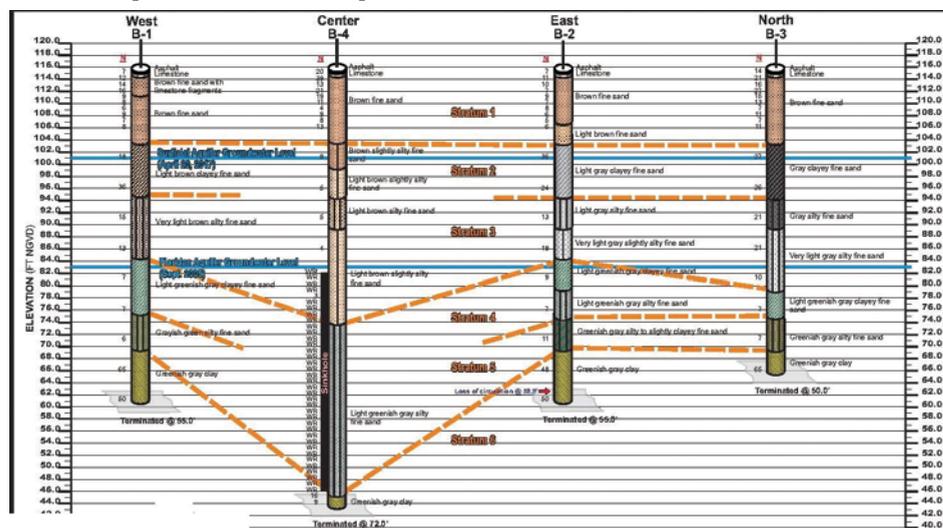
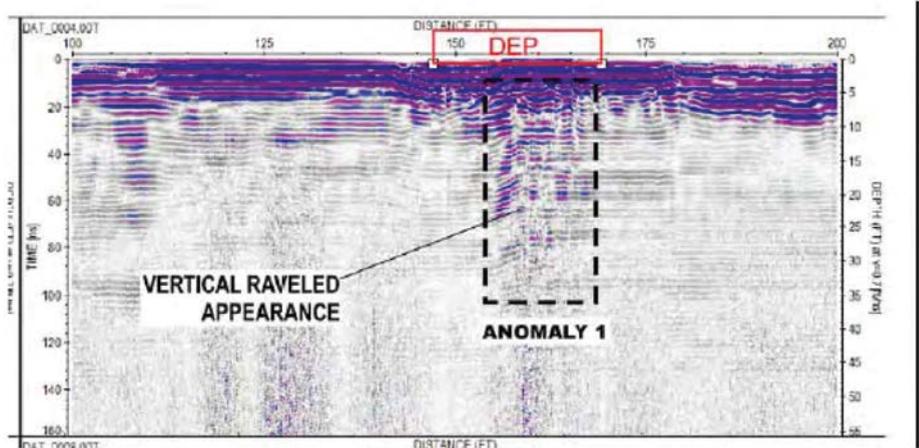
The location of the depression is in the new Orchard Hills single-family residential subdivision where houses are still under construction. The location of the roadway depression is abutted on the

west by residential houses and on the east by a large retention pond which is more than 15 vertical feet lower than the roadway. The water in the pond receded from the floodplain fringe because of a recent drought. Because of the depression and potential of a sinkhole, this affected segment of the roadway was blocked to thru traffic with a detour in place and safety barricades were installed around the depression to prevent pedestrian as well as vehicular access.

Staff performed a quick site reconnaissance of the roadway depression, noted the proximity of residential homes and topography of area slope and considered the drought conditions and the past sinkhole action not far from the area. The site visit resulted in an emergency evaluation service sought from a contracted continuing County Engineering firm, for a geotechnical expert investigation and recommendations. A drilling rig was quickly mobilized from their geotechnical sub-consulting to perform Standard Penetration Test (SPT) borings. The depth of the SPT borings was performed at 50-72 feet below the surface. One (1) SPT boring was drilled in the center of the depression (called B-4), while three (3) other SPT borings were drilled just outside the rim of the depression. These points were radially 10-15 feet from the focal area location. The results of the borings extracted from the geotechnical report are shown below. In addition, Ground Penetrating Radar (GPR) was performed simultaneously.

Observation from the 4 SPT borings indicated that the soil profiles in the focal area showed raveled conditions in the depth intervals of 34-70 feet which suggested downward erosion of sediments into openings and cavities in the underlying limestone. More so, none of the outer borings showed similar zones of void like conditions. The GPR showed void to a depth of 12 feet and a shear face circular roof collapse to 25 feet in depth which corresponded to the top of the raveled zone at the focal area boring (B-4), see above. Hence with the suspect of a sinkhole confirmation which is conical in shape with a diameter of 23 feet and 12 feet deep.

Injection grouting commenced into an injection pipe which was driven to the base of the raveled zone in the B-4 boring. The injection pipe went down to 70 feet and more than 20 cubic yards of grout was pumped. No pressure was built during this injection meaning that the grout was still flowing freely. After the second load of grout was





Geogrid and Sub-Base Preparation

pumped, the sinkhole settled again by about 1 foot at the center and re-cracked along the edges of the pavement. According to the geotechnical experts, this represented a normal pull-down response during grouting and shows that additional stabilization was still required. Subsequently, the following days the injection pipe was raised to a depth of about 60 feet where it met solid material formed from the previous day's stabilization and then se-

quences depth adjustment and additional grouting and solid formation began to show 46, 39, 35, 34 of the grouting progress each day. At 34 feet, which corresponds to the top of the raveled zone, additional grout pumping caused the ground to rise which indicated completion of the grouting. The area was then monitored for several days before other infrastructure and utility repairs could be initiated.

During the initial injection

operation, a service water main broke as a result of the subsidence, filling the work area with water and causing the grouting operation to be suspended. As a result of the broken water main, the depression became more pronounced as the pavement caved in and damaged the existing vicinity curb and gutter. The affected area was squared off and a trackhoe brought to the site to clean the hole of all debris without damaging the injec-

tion pipe in the middle of the sinkhole. The cleaned hole was then filled with imported sand and slightly overbuilt to allow for settlement. This resulted in a few days of delays before the full-scale grouting stabilization could be resumed.

Grouting stabilization resumed the next day and subsequently thereafter for a few more days and a total of 140 cubic yards of cement grout was injected to prepare to stabilize the ground by filling the void space and compacting the soil. After the area was stabilized, the area was monitored and when no further change or movement was measured, the approval from the geotechnical engineers was provided to commence roadway base remediation and incidental work such as repairs of the curbs and gutters and resurfacing.

At the conclusion of the remediation process, the sanitary sewer main was repaired and the base of the roadway extent where the sinkhole was noted was reinforced using three (3) layers of geogrid reinforcement. These layers were installed at depths of 3 feet, 2 feet and 1 foot in a compacted lime rock base material. The curb and gutters were next reinstalled and then the reconstruction of the pavement structure was completed.

As expected, such a sinkhole generated many challenges from inquiries by citizens, home-owner representatives, and the media to construction challenges. From the initial observation and during the commencement of the grouting operations the geotechnical consultant and County Staff provided timely responses to the residents, media and HOA daily on the progress, evaluation, and remedy with an open and direct dialogue.

Moreover, all elected official and senior management were copied on daily updates and progress. This potentially alarming situation, especially in a newly constructed residential subdivision, has been mildly accepted without any major fanfare. This was be-

cause of an immediate provision of requested information and daily progress updates, thereby mitigating a problematic situation in a timely and effective manner.

The entire operation from the stabilization of the sinkhole, utility repair and infrastructure repairs to pavement reconstruction took about 20 days. The overall cost for sinkhole investigation, stabilization and roadway repairs by staff and consultant ended up costing about USD 150,000. The roadway was re-opened and restored to full service. The public was very pleased with the immediate action provided to protect their health, safety, and welfare.

About the Author



Deodat Budhu, P.E., is the Manager for Roads and Drainage Division at Orange County Public Works Department. He has more than 36 years of experience in consulting, contracting, teaching, research and public works in a variety of Civil Engineering disciplines. He is currently responsible for the daily administration and management of 233 employees and an annual Operation and Capital budget totaling USD 85 million. His division is responsible for managing the construction, maintenance & operation of Orange County's roadway and drainage system infrastructure. He has a Bachelor of Science in Civil Engineering and a Master of Science in Water Resources Engineering. He is a registered Professional Engineer in Florida and Virginia with memberships in several professional organizations including ASCE, FSA, APWA, amongst others.



Roadway Paving in Progress

Water Networks and Drinking Water Treatment

Exploring the current challenges in the provision of potable water and water quality issues.

By SEE (Social Entrepreneurs & Enterprises)

Introduction

Across the globe, the water crisis has been an issue of concern. Among the multitude of challenges that plague the water sector, three major areas of concern summarize the water worries:

- The depleting quality of the supplied water
- The reducing amount of water supply
- The inability of water utilities and regulators to meet the citizen expectation

These issues have been leading to growing concerns and insecurities among the people, world over. The citizens now have become more water conscious and there is a surge of inquisitiveness on what a common person should be aware of and how can civil society contribute towards water conservation. This article attempts to address the multitude of challenges and needed interventions, in the supply of drinking water faced across the globe, with special emphasis on the situation in the city of Bangalore, India.

The Problem

Rapid urbanization has led to a severe water crisis. The utilities across the globe are finding it difficult to meet the increasing water demand from the fast-growing population. The changing lifestyle has further added to the per capita water requirement. With limited water resources at hand, the water utilities are hard pressed to adopt desperate measures in order to ensure sustained and equitable water distribution.

While the utilities struggle to meet the growing water demands, lack of adequate infrastructure has been a bot-

tleneck for utilities to achieve the stringent targets required to accomplish the goal of clean and adequate water for all. The supply crisis is not only because of the lack of adequate raw water but also because of a huge amount of leakage of treated water from the existing supply networks. 45 billion liters of water is lost every day in global water systems and wasteful usage poses a big threat to the sustainability of water resource. Currently, one billion people have no access to water and 2.1 billion people lack access to adequate safe water.

The broken networks not only lead to extensive loss of treated water, but they also make the water supply vulnerable to external contaminants backflowing into the pipes, contaminating the treated water and compromising the quality of water supplied to the consumers. The contamination of treated water in the pipes network has been a major concern, especially in the developing countries as it makes all the expenditure and efforts invested in water treatment futile.

The networks across the globe have old and leaking pipes and there is a great shortage of data on existing network health, thereby making the capital investment decision-making extremely difficult for responsible authorities. The insufficient data, lack of adequate infrastructure along with the shortage of human and capital resources are some of the major challenges that lead to underperformance of the water utilities and therefore, increasing crisis and dissatisfaction among the consumers.

The inability of water util-

ities to meet the consumer expectations with respect to quality and quantity of water supplied has not only lead to growing dissatisfaction but also a looming insecurity and concern about the future of the water supply. While the dissatisfaction prevails, consumers are also becoming more aware of water issues, challenges and concerns and many have started adopting a water-wise lifestyle for the sustainability of this life essential resource. The most important questions that concern the common people currently are:

- Will the water crisis impact the overall quantity of water supplied per person, in a few years?
- What can be the best way to ensure safe water consumption if the quality of supplied water cannot be trusted?
- What innovative ways can be adopted to help the utilities in performing better in managing water network?

Bangalore Water supply - Current Status and Needs

Bangalore Water Supply & Sewerage Board (BWSSB) supplies approximately 1350 million liters of water per day through its 8,746 km of pipeline network spread in 570 sq. km of the area. These operations are managed by approximately 2200 employees only, currently working in the department. Shortage of manpower is accompanied by a shortage of resources and infrastructure. Bengaluru consumes almost 50% of Cauvery water reserved for domestic use in the state of Karnataka, however, 46% of this water withdrawn by Bangalore is

lost in the pipe network as leakages and unaccounted for water due to the condition of the existing infrastructure.

BWSSB is currently supplying water to its consumers thrice in a week. The citizens are allocated 150 liters/person/day, however, BWSSB is only able to supply 65 liters/person/day. Severe raw water shortage in river Cauvery accompanied by high levels of losses in the water network has made it extremely tough for BWSSB to meet the demands of the city.

Broken infrastructure has not only led to extensive water losses but also added to the contamination of treated water within the pipes at the points where the pipes are broken. Despite the huge amount of energy and resources spent in treating raw water, BWSSB is unable to maintain good potable water quality in the water supplied to the consumers leading to consumer dissatisfaction. The people in the city are concerned about the quality of water supplied and over 80% of the consumers have started using point of use filtration systems to ensure water safety in their drinking water. The crisis in water supply has also created mass awareness about looming water shortage and concerned citizens of Bangalore have started understanding the need for water conservation and prudent usage, however, a wider awareness and acceptance of water conservation measures is still the need of the hour for the city.

The Need for Solutions Across the Water Value Chain

BWSSB struggles in managing the water network are

plenty, however, the agency has been one of the most proactive agency in the country in adopting innovative solutions across the network. The agency has been vocal about the issues and challenges faced in managing water supply and has been urging technology providers to help them with innovative solutions. Some of the major challenge areas highlighted by BWSSB in the past have been:

- Depleting available water resources and shortage in raw water supply
- Contamination of treated water in the pipe network
- Lack of adequate infrastructure for water supply to match the exponential growth of Bangalore city in the last two decades.
- Old network and leakage of 46% of water leading to the severe resource as well as financial losses
- Skilled workforce shortage leading to a crisis in managing the vast network
- Lack of data on network performance
- Lack of decision support tools to help in sustainable strategic growth

Many of these issues are not just Bangalore specific. For eg. Leakage is an issue across the globe and is as high as 23% for the city of London which is the capital of a very well developed country. Similarly, lack of data on network and lack of decision support tools is a major requirement of most large networks across the globe.

Most water utilities have been looking at the technology space for innovations to overcome the multitude of challenges they face. The water sector is full of opportunities for innovators and en-

trepreneurs alike as there is a whole lot of potential for new technologies and business models to solve the water supply issues.

The sector has been witnessing a slow but steady growth in innovative ideas. Some of the examples include:

- Innovations in leakage detection
- Use of pig trains to quickly repair leakages in pipes
- Use of drones to expedite surveys and monitoring of pipeline
- Use of smart metering to do water audits
- Implementing energy efficiency programmes to reduce incurred costs for pumping & treatment
- Use of telemetry and SCADA to improve data collection across the networks
- Use of Artificial intelligence to improve network treatment and pumping processes, etc.

Demand Side Management Measures

The networks across the globe are evolving and adopting the innovation at a very fast pace opening multiple opportunities for the entrepreneurs. However, no matter what the plan, the rate of improvement of the networks is slow and the projects have their own bottlenecks. In the meantime, it is essential to implement some measures on the customer's side to ensure:

- Improved quality of water consumption by the consumers
- Prudent usage of water to ensure long-term availability

The consumers themselves have become aware of the looming water crisis and many have started adopting measures to be water-wise and safe. The two important questions that most of the common men have regarding water are:

- What is the safest and cost-effective method to treat their drinking water?
- How can the consumers be conservative about their wa-

ter use?

Ensuring Safe Drinking Water - Is Reverse Osmosis Absolutely Needed?

Most consumers install point of use treatment devices to ensure that they are drinking clean and safe drinking water. In the areas of contamination concerns, even government bodies have started installing clean drinking water kiosks to ensure safe drinking water for preventing outbreak of waterborne diseases. While the built awareness for clean drinking water is great, it is also leading to wasteful water usage especially because many people have started depending on Reverse Osmosis (RO) technology for treating their drinking water. RO does ensure the cleanest water output, however, it also is a very wasteful method of treating drinking water. For every 100 liters of water that are treated through RO technology, up to 40 liters are wasted as brine or rejected water that contains the impurities of the raw water.

There are a multitude of innovations and technologies that have emerged and can provide adequate water treatment depending on the water source. The surface water can be treated by disinfection, ozonation, carbon filtration or sand filtration among a few ways to ensure clean and safe drinking water. People can also depend on age old disinfection methods such as storing water in copper containers where copper act as a disinfectant to remove any existing micro-organism in the water. The groundwater can be treated using customized ion exchange technologies ensuring removal of contaminants. Many methods exist to ensure clean and safe drinking water and the users need to be prudent in their choice of water treatment to ensure safe and yet sustainable methods. RO should only be adopted in extreme situations where the hardness levels in raw water are beyond the treatment capacity of any oth-

er method and no other water source is available to provide water. If the household depends on surface water source for the water supply, it is recommended to consult an expert prior to choosing the mode of water treatment for the household.

Managing Homes in Lesser Water - Ensuring Conservative Water Usage

A drastic reduction in average total supply per person per day in last two decades has not just been a phenomenon in Bangalore, but has been witnessed in multiple cities across the world. The state of California in US for multiple years introduced a hose-pipe ban when consumers were not allowed to water the gardens. A similar situation was witnessed in UK in the year 2017 where citizens were advised against watering their lawns and washing their cars. Cape Town is the first city that officially declared inability to provide water to the citizens due to water shortage. Citizens across the globe are concerned about the shortage of water hitting them and there is an increased awareness about conservative use of water. Some of the measures that can be adopted by the citizens

to ensure water conservation and demand control are:

- Use of low water consuming faucets and fittings
- Use of drip irrigation for watering large gardens
- Night time irrigation of gardens
- Wiping cars than washing them
- Recycling of used water for flushing toilets and irrigating lawns, etc.
- Ensuring full wash loads before running a washing machine
- Using water saving appliances such as dishwashers and washing machines

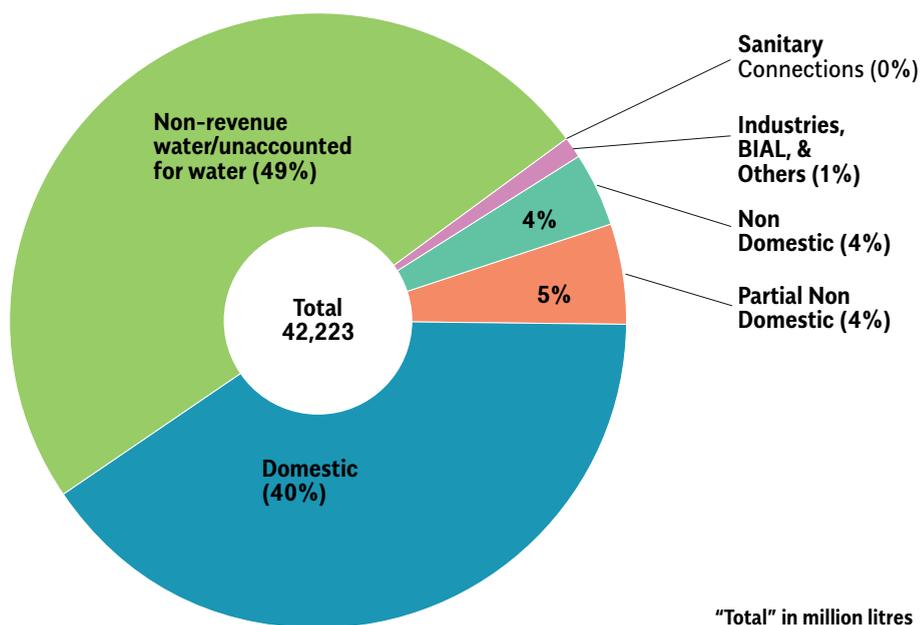
Conclusion

Water is essential for life and it is important to address the issues related to water supply and usage to ensure conservative and sustainable future. The sector has multiple challenges and immense scope for new innovations and entrepreneurship. A sound strategy is required to address water issues and both supply-side management as well as demand side management is absolutely essential for ensuring sustainability of water resources. The utilities require innovation and better support for decision making in water sector and a large business potential ex-

ists in the areas of networks automation, data collection & management, analytics and decision support. With the changing business canvas, newer supply side business models are emerging, creating a wide market for social innovator and entrepreneurs. Addressing the consumers on the demand side has also become a significant area of interest for several entrepreneurial ventures and the market is growing at a fast pace leading to water sector becoming a priority sector for global entrepreneurship.

About the Contributor

SEE (Social Entrepreneurs & Enterprises) is an Indian Institute of Technology, Kanpur (IITK) alumni initiative, supported by the alumni associations of Indian Institute of Technology, Kharagpur, Indian Institute of Management, Ahmedabad and Indian Institute of Management, Bangalore. It aims to build awareness and activism in the social sector by fostering entrepreneurship, bringing all the necessary resources together under one umbrella. Be it mentorship, or networking with impact venture capitalist or inspiring young generation to come up with innovative solutions to social challenges.



Bengaluru's Monthly Water Consumption (Bangalore Water Supply & Sewerage Board)

Solving India's Water Security Puzzle

Realizing nature's water cycle, its varied fates within the community and their interdependency, all these different water forms carry peculiar significance towards reaching a sustainable solution. This is an overview of various such topics aimed towards India's water security goals.

By Archis Ambulkar



Image Courtesy: Pixabay

INDIA'S POPULATION GROWTH, urbanization and migrations from rural areas to cities accompanied by changing weather and precipitation patterns are impacting water supply-demand dynamics in different parts of the country. Water security, conservation, and management have become the priority issues at regional and national levels. Governments, private institutions, and environmental organizations have undertaken several programs to meet these growing water needs. As such, water security is a grave concern today and solving this complex issues will require a thorough understanding of the problem as well as initiatives at technical, social, finan-

cial and political platforms. Considering future challenges, the nation needs to find realistic ways to resolve this crisis on a long-term basis. To achieve this, a comprehensive approach encompassing different forms of water such as freshwater, utility water, wastewater, rainwater, and ocean water is necessary. Realizing nature's water cycle, its varied fates within the community and their interdependency, all these different water forms carry peculiar significance towards reaching a sustainable solution. This article attempts to overview various such topics aimed towards India's water security goals.

As a first and foremost consideration, the impact of the

country's ongoing transformations on existing domestic water and sanitary sewer infrastructures should be evaluated. As one travels across the country, many structural changes can be observed in small towns and metropolitan cities. Urban areas are expanding and experiencing significant vertical growths. Independent houses or empty lots are getting converted into apartment complexes, high-tower buildings, business centers, and malls. These changes are indeed affecting existing drinking water, utility water, and sewer systems. Utilities that were originally designed for individual customers are now required to serve multiple dwelling units. Such rapid

growths are increasing pressures and possibly overloading the water infrastructures. To manage these changes, avoid blockages, overflows or pipe bursts, a proper assessment of water and sewer pipes will be required. Additionally, associated structures such as conveyance mains, pump stations, manholes and treatment plants will need to be reviewed as well. Timely upgrades are necessary to minimize losses, leaks and deliver uninterrupted services to the communities. Proper planning, design, and execution of water and sewer infrastructure improvement projects can smoothen operations of these public works utilities. Water reclamation, recycling, and reuse will

take societies one step closer towards the sustainability goals.

Another key result of urbanization is the rise in the impervious area and associated stormwater runoffs. Construction of newer buildings and roadways are increasing impermeable areas within the cities and towns. These newly developed areas tend to reduce percolation of water into ground during rain events thus generating excessive surface runoffs. Such water can create potential flooding in residential areas and ponding of water. Additionally, rainwater runoffs also tend to carry suspend solids, oils, and other pollutants as they get collected from roadways

and other ground surfaces in contact. Thus, municipalities shall study these evolving hydraulic as well as pollution patterns and perform renovations accordingly. Provision of appropriate road slopes, water collection channels, catch basins, solids capturing screens or filters and other techniques can help to drain urban areas quickly as well as remove basic pollutants from water before it enters the collection pipes. This process will avoid flooding of residences and minimize environmental impact to a greater extent. Areas susceptible to high precipitation shall accommodate sufficiently sized conveyance pipes and rainwater drainage system. Tree plantation along roadsides and provisions for grass strips can alleviate some of the pollution issues. Plants have the tendency to retain water, hold soil as well as uptake nutrients (such as nitrogen and phosphorus) and filter out other contaminants thus assisting with pollution reduction. Vegetation also adds to aesthetics and cleaning air quality.

Further to the above mentioned infrastructure upgrades, India's new look is desperately demanding rainwater conservation and harvesting for developing sustainable water supplies. Majority of India relies on the rainy season for its freshwater supplies. Precipitation helps to fill surface water bodies as well as replenish groundwater levels. However, many cities fail to capture this water source to its full potential due to lack of dedicated rainwater collection systems. On the other hand, in many cases underground systems have inappropriate connections between sewers and stormwater drains. Due to poor conditions of sanitary sewers and inflow or infiltration issues, precipitated water enters sanitary sewers, gets polluted and becomes inaccessible for direct use without significant treatment. Such large volumes of runoffs also tends to overload existing sanitary sewers and downstream wastewater treatment plants causing

seepage, manhole overflows and other problems leading to unhygienic situations. Lack of proper separation between storm and sanitary systems not only reduces the chances for reusing rainwater, but it further complicates health issues. Such observations are more evident in metropolitan and mid-size cities, especially during major rain events once the monsoon arrives. Keeping weather unpredictability aside, the issue is not always about lack of water but it's the inability to capture it in the right form. Hence, to make stormwater readily available and reduce burden on sanitary systems, it is necessary to develop advanced rainwater collection system and isolate inappropriate connections with sanitary sewers. Once separated and isolated, rainwater can then be diverted to replenish desired waterbodies for its sustainable use. Realizing complex nature of existing underground sewers, costs for complete sewer separations can be substantial and impractical in many cases. This problem needs to be approached on case by case basis to find a reasonable way out.

After solving stormwater collection problems, the next step becomes properly conveying this water to reservoirs. Societies rely on the surface water and groundwater resources for their day-to-day water needs. This dependency is more in dry regions and areas that receive limited precipitation. Majority of cities in the country have river, lake or some other form of a reservoir that serves community's water needs. Pipes, canals or culverts can be constructed to carry rainwater runoffs to these existing waterways. Sufficient storage of water in the water reservoirs can ensure ample supplies throughout the year. Such a provision will be more forgiving and could accommodate an extended period of natural droughts or dry runs. Proper management of naturally available water can avoid drying up of rivers, lakes and lowering of groundwater table

which is commonly observable these days. With stormwater system upgrades, newer opportunities will arise to utilize this easily available water form for drinking or utility purposes. Apart from domestic use, plenty of water could become available for agriculture, food production, and industries.

Retaining water within reservoirs is one aspect, however keeping it reasonably clean is another. Many times, waterbodies experience pollution and contamination issues resulting in water quality degradation. Thus, for maintaining water quality, pollution from point and non-point pollutant dischargers (such as industries, municipal treatment plants, agriculture and so on) shall be minimized. Also, already polluted reservoirs shall be cleaned up via sediment dredging, conditioning, treatment, abandoning of direct sewer discharges and other relevant techniques to regain the water quality. With the right approach, changes could soon become visible in smaller creeks, rivers, and lakes. This process may take longer time for major rivers and lakes in India.

Oceans and seas are another comparatively less explored or utilized surface water sources for public use and consumption. This vast reservoir is getting more and more attention as the freshwater bodies on land are drying up or becoming less available. Such alternatives are more relevant for coastal areas than the interior cities. While the focus is on rainwater collection, ocean water can solve a sizable portion of water security issue if it can be converted to freshwater economically. Desalination and other emerging technologies for conversion of saline water into the more usable freshwater form are making waves in the water industry and can potentially change the future of India.

Governments and institutions will play a vital role in making all these changes possible. To tackle water security issues on a broader scale, up-

grades to existing infrastructures are a must. Grants, loans, and incentives for implementing such projects can catalyze the water segregation and conservation process. Construction of new water infrastructures as well as restoration of existing systems can bring about a major transformation in the water conservation arena. Since the scope and extent of this issue are vast, various local, state and federal institutions can approach these problems in a phased manner. Multifaceted programs with significance workforce will be required to achieve real-life changes on the national plat-

form. use water wisely and ensure proper discharge of wastewater to sanitary sewers. Rainwater harvesting, water recycle and reuse on small-scale levels can go a long way towards realizing India's water security objectives. The task is big but not impossible. It will need sacrifice and contributions of current generation so that the progeny can have a better life and plenty of water to enjoy their life. This practical scheme implemented with an integrated effort and right spirit can bring about meaningful "water revolution" to accomplish India's water security objectives.



About the Author

Finally, irrespective of technical, administrative and financial initiatives this dream cannot be fully realized without public support. Public awareness and participation are necessary towards such an endeavor. No doubt, environmental awareness in India has grown in recent times. By understanding the gravity of crisis and importance of water conservation, people can take actions to keep reservoirs clean, minimize pollution from anthropogenic activities,

Archis Ambulkar is a globally-renowned environmental expert with significant contributions towards the water and wastewater fields. His work has entered prestigious Britannica Encyclopedia and Oxford Research Encyclopedia. Mr. Ambulkar is the author of book Guidance for Professional Development in Drinking Water and Wastewater Industry by International Water Association Publishing, UK. He has served as an expert on many international platforms.

Use of MBR Modules in Wastewater Treatment Plants

Two case studies on the MBR modules used in wastewater treatment plants at a hospital in Germany, and at a tuna cannery in Mexico.

By Microdyn-Nadir



Case I: BIO-CEL® MBR Modules - Part of a Comprehensive Solution to Eliminate Micro Pollutants

In July 2011, the wastewater plant at Marienhospital in Gelsenkirchen, Germany was put into operation. It is the first European wastewater treatment plant that focuses on the elimination of micropollutants as well as the purification of the wastewater from the hospital. The plant was built in line of an EU-project called PILLS (Pharmaceutical Input and Elimination from Local Sources) under the aegis of the EmscherGenossenschaft.

The project's goal is to eliminate micropollutants from the sewage water on site, which especially incur in hospitals as residues from pharmaceuticals and radio-opaque substances.

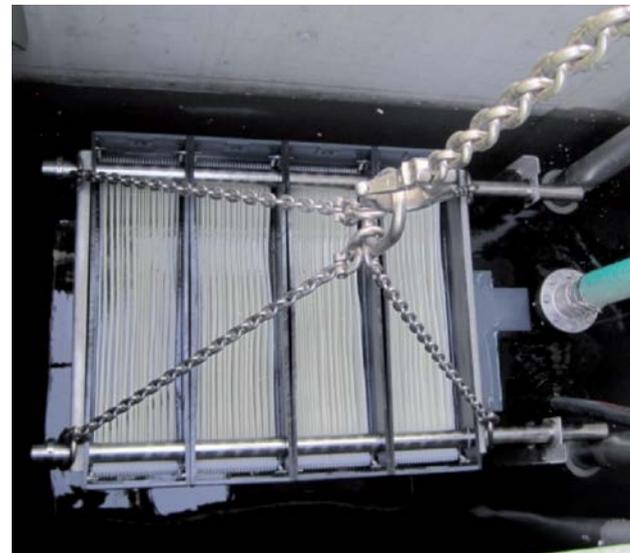
About 75,000 patients are being treated by approximately 1,200 staff members at the Marienhospital per year. Thereby effluents amounting up to 200 m³/d incur. Until now, these effluents have been discharged into the nearby river "Schwarzbach" via the municipal canalization. This

creek currently still serves as an open sewage water drain outlet but is targeted to be renatured and operated effluent-free in the course of the conversion. Amongst others, it will also absorb the purified water from the new clarification plant. This new wastewater treatment plant encompasses, besides a mechanical and biological clarification, a variety of treatment processes, such as an ultrafiltration with submerged modules (MBR technology), an ozonization as well as an activated carbon filtration.

For the ultrafiltration, three submerged BC400 modules by MICRODYN-NADIR have been installed. In total these modules have a membrane area of 1,200 m² through which the biologically purified sewage water is being removed from the aeration tank. The ultrafiltration permeate, which is now free of particles and bacteria, will afterward be led to an ozonization and an activated carbon filtration. Ozone, a strong oxidizer, provokes the cleavage of the micropollutants in solution and converts them into non-hazardous

substances. In addition, the micropollutants are being absorbed by pulverized activated carbon, which is then removed from the water including these trace substances.

The chemical and pharmaceutical industry is facing a multitude of economic and environmental challenges. Not only is it detrimental for a chemical plant's continuous existence in today's global environment to become more and more cost-effective, but the environmental regulations



are also becoming increasingly stringent. Hence, the MBR technology with its high-quality effluent proves to be a good fit for the wastewater plants in the chemical industry. The MBR reference at the Marienhospital in Gelsenkirchen, Germany is a good example of a wastewater plant that is using MBR because of high effluent quality requirements.

Qd, Average	200 m ³ /d
Qh, Max	25 m ³ /h
COD	1900 mg/L (85%oil)
Average Flux	10 LMH
Peak Flux	28 LMH

Table 1: Design Data of MBR Plant

Case II: BIO-CEL®-MCP MBR - Tuna Wastewater Treatment Plant Objective

Located in Mazatlán, Mexico, a tuna cannery needed to update their wastewater

(TP) as well as higher organics (COD/BOD) concentrations.

Materials & Methods

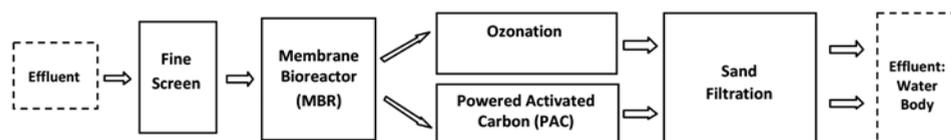
Ten MICRODYN BIO-CEL® 400 membrane modules were installed at the plant. Unit operations for the WWTP are as follows:

- o Dissolved Air Flotation (DAF) treatment
- o Equalization tank
- o 1 mm Rotating mechanical screen
- o 1 Anoxic basin
- o 1 Aeration basin (2 dissolved oxygen zones)
- o 2 Filtration basins
- o Tertiary treatment

The Results

In operation since 2012, the plant continues to deliver excellent results in regard to effluent quality and flow (Table 2). All permit requirements are being met, virtually all solids are being removed and the MBR effluent has an SDI < 3 which allows for further tertiary treatment to treat color and odor by reverse osmosis, ozone, and carbon filters.

The MICRODYN BIO-CEL®-MCP MBR process allows the company to limit their maintenance cleanings (MC) quarterly and extended maintenance cleanings (EMC)



treatment plant (WWTP) to comply with new regulations. MICRODYN BIO-CEL®-MCP MBR process was chosen for its small footprint and low chemical costs. Needing to treat 1150 m³/day (304,000 GPD) of wastewater from tuna processing, this waste stream has exceptionally high total nitrogen (TN), total phosphorus

Overall Number of Installed Modules (BC400F-C100-UP150)	3
Total Membrane Area	1.200 m ²
Date of Commissioning	April 2011

Table 2: Plant Design with BIO-CEL®-MBR System



(From Left to Right: Raw Influent, DAF Effluent, MBR Permeate and Tertiary Effluent)

annually.

About 35% of the tertiary treated water (400 m³/day or 106,000 GPD) is reused for the following applications at the plant:

- o Cooling towers
- o Washing docks/boats
- o Bathrooms
- o Cleaning the WWTP
- o Preparing chemicals for the WWTP

Conclusion

Utilizing the MICRODYN BIO-CEL[®]-MCP MBR process allowed the tuna plant to dramatically reduce BOD, COD, TN, TP, and TSS concentrations in their wastewater and feed a tertiary treatment system. After tertiary treatment, about 35% of the wastewater was reused in other parts of the plant and has saved them USD 76,300 annually in water costs. This system allowed the plant to meet their environmental permit requirements while utilizing less space compared to a Conventional Activated Sludge (CAS) waste

Parameter	Value
Commissioning	May 2012
Number of BIO-CEL [®] 400 Modules	10
Mixed Liquor Suspended Solids (MLSS)	9-12 g/L
Solids Retention Time (SRT)	21 Days
Average Flux	13.9 LMH (8.2 GFD)
Average Transmembrane Pressure (TMP)	70 mbar (1.01 psi)
pH	7.2
Temperature	35°C (95°F)

Table 1: Plant BIO-CEL[®] MBR Operational Parameters

treatment plant. The MCP allowed the plant to reduce their annual chemical usage for system cleaning.

About the Contributor

With locations in Germany, North America, Asia, and Brazil, **Microdyn-Nadir** is a leading supplier of customized spiral membrane elements, MBR modules, and hollow-fiber, capillary and tubular membrane modules. Its product portfolio includes reverse

osmosis, nanofiltration, ultrafiltration, and microfiltration membranes.

For over 50 years, MICRODYN-NADIR has been applying its products in various industrial and municipal applications for water and wastewater treatment as well as in many process applications in the food, dairy and beverage markets and in the chemical industry.

MICRODYN-NADIR is

Parameter	Value
Cost Savings of Tertiary Treated Water vs. Municipal Water	USD 0.53 / m ³
Volume of Water Reused Daily	400 m ³
Daily Water Savings	USD 212
Monthly Water Savings	USD 6,360
Annual Water Savings	USD 76,300

Table 3: Cost Savings of Reusing Tertiary Treated Water Versus Using Municipal Water

headquartered in Wiesbaden, treatment business unit of Germany, and is the water MANN+HUMMEL Group.



Sampling	BOD (ppm)	COD (ppm)	TN (ppm)	TP (ppm)	TSS (ppm)
Raw Influent	5790	12310	785	243	2580
DFA Effluent	2100	3235	472	25	87
MBR Effluent	25	147	15	5	2
Tertiary Effluent	0	0	1	0	0

Table 2: Water Quality from Different Unit Operations at the WWTP

THE PROJECT GOAL

Enhance the company's WWTP to comply with regulations and reuse water at the plant.

Feed

Tuna processing wastewater

Membranes

10 MICRODYN BIO-CEL[®] 400 Modules

MBR Pollutant Removal

- o BOD: 98.8%
- o COD: 95.5%
- o TN: 96.8%
- o TP: 80.0%
- o TSS: 97.7%

Advanced Water Desalination Technology at Akshaya Patra Kitchen

B&P Aqua Systems has successfully supplied and commissioned a new high-efficiency Reverse Osmosis based technology from the USA to Akshaya Patra's one of a kind mega kitchen in Kandi, Telangana, which provides meals to more than one lakh school children on every school day.

By Kiran Kumar



CCRO System with Control Panel

The Challenge

The Infosys Foundation, a not-for-profit initiative of IT major Infosys Limited headquartered in Bangalore, was looking for an efficient Reverse Osmosis (RO) based water treatment technology to produce clean water used in a large, high-tech mega kitchen in Kandi, Telangana. The one-of-a-kind mega kitchen run by the Akshaya Patra Foundation is a not-for-profit organization headquartered in Bengaluru, India, and provides meals to more than 100,000 children on each school day. The entire construction cost of the Kandi kitchen of Akshaya Patra was funded by Infosys Foundation.

Conventional RO systems traditionally used in the country for similar applications deliver recovery rates as low as 50% - meaning only half of the water processed is useable and the other half is wasted.

The efficient use of water was a key requirement for this large kitchen considering the finite amount of water available in the site borewells and potential future depletion of groundwater levels. So, B&P Aqua Systems was contacted to use an advanced technology to purify borewell water at the site that offered maximum efficiency and could make every drop count as well as assure the future sustainability of this critical water source. The clean water requirement for the mega kitchen was more than 20 million liters per year and an expected RO recovery was 90%.

The Solution

B&P Aqua Systems supplied and commissioned a Desalitech ReFlex™ system featuring patented Closed Circuit Reverse Osmosis™ (CCRO) technology to Akshaya Patra's

kitchen. The CCRO system available exclusively from Desalitech has a capacity of 8,000 Litres per hour at a recovery rate of 90%. Compared to a traditional system, the more efficient Desalitech system



CCRO Skid Side View-1

“Desalitech's ReFlex RO system at the kitchen featured a patented Closed Circuit Reverse Osmosis

(CCRO) technology for increasing rate of water recovery from groundwater and minimizing brine waste.”

draws nearly half the well water making it more sustainable, making better use of well water supplies and saving energy. In addition, the Desalitech system is less susceptible to fouling and scaling by design having the flexibility to automatically adapt to variations in well water quality, making it easier to maintain and more reliable than the traditional RO system.

The CCRO system is built with single stage short membrane array which allows for optimal flux distribution, a higher and more precisely controlled cross flow, and concentration variations that disrupt both scaling and organic fouling growth in the system. The CCRO system is an elegant

way of operating crossflow reverse osmosis membranes in a highly efficient and flexible simple filtration device. Like any simple filtration device, the CCRO system features equal feed and permeate flow rates during normal operation mode. At a software-based set point, the system automatically flushes out all the concentrate and then returns to its normal operation mode. The flush is triggered by the CCRO operating software, based on any combination of flow, concentration, pressure and additional set points. During the concentrate flush step, the system continues to be fed and to generate permeate, while concentrate is pushed out of the system in one sweep.



CCRO Pre-Filtration Units

The Results

The CCRO Desalitech system requires less or no biocide, less frequent CIP (Cleanings-In-Place), and less antiscalant. This saves client costs in the form of capital and labor ex-

features of CCRO at Kandi site are here below:

- About 2 lakh liters per day design capacity RO plant uses the latest CCRO technology from the USA for drinking water treatment, a



CCRO Vessels & Chemical Feeds

penses. The new RO system also helps the plant to achieve its sustainability goals of Akshaya Patra and Infosys Foundation by reducing water and carbon footprints. Few salient

first time to India.

- Higher than 90% recovery rate versus conventional RO reducing well water draw by nearly half.
- Annual water savings is ap-



CCRO Skid Side View-2

prox. over 33 million liters compared to traditional RO plants - the equivalent of water required for approx. 800 people or 200 to 300 families every day.

- Potential to increase RO recovery rate even up to 95% for greater sustainability.
- Minimized scaling and fouling of RO membranes increasing reliability and reducing maintenance.
- The plant incorporates energy-saving design and uses low-energy RO elements for operation.
- Easy-to-use with automatic RO operation, and capability to treat higher than design feed water TDS (Total Dissolved Solids).
- Remote monitoring and support for maximum uptime and pre-emptive maintenance.

Conclusion

Against the backdrop of mounting water stress driven by the need to address critical water needs by agriculture, growing urban population and industries, it is critical for India to adopt progressive treatment strategies as a measure to enhance the sustainability of operations and reduce water shortage risks. The CCRO technology, a new development in

“A severe water crisis looms ahead for India unless the country changes the way it manages water - and changes it soon. India faces a turbulent water future. Unless water management practices are changed - and changed soon - India

the water industry, has been a solution to reduce water footprint, and so to save a significant amount of water.

The CCRO technology could be explored to different areas of water and wastewater applications and in different commercial and industrial sectors in the country to conserve water and for a cleaner environment by recycling and reuse of water.

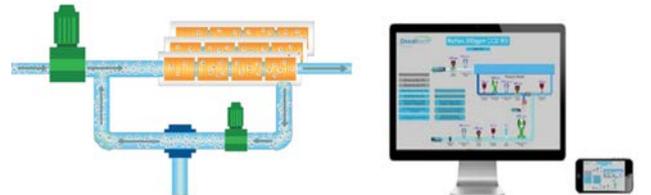
This above example of Akshaya Patra Kitchen at Kan-



PLC and HMI Control Panel

di demonstrates how water shortage challenges can be effectively overcome by using cutting-edge technologies and strategic implementation which resulted in multiple benefits including less energy, reduced raw water consump-

pal clients. Kiran is Mechanical Engineer and holds a Master's degree in Business Administration from the University of Wisconsin, Milwaukee, USA. After relocating from USA to India in 2012, Kiran along with a team from B&P Aqua



This Innovative CCRO Technology Features a Step Change in Reliability, Flexibility and Efficiency Over Traditional Reverse Osmosis. The Diagram Illustrates the CCRO.

tion and lower wastewater generation, and above all the key need of the hour is Water Security and Sustainable Water Future.

Systems based out of Bangalore initiated to address clean drinking water scarcity in schools and other public places in Karnataka especially in Bangalore and surrounding areas.

B&P Aqua is presently working with the help of a local NGO to provide drinking water to six rural schools in Kolar district of Karnataka. Once commissioned, these systems would provide clean water to nearly a thousand children.

About the Author

Kiran Kumar has over thirty years of experience in the global water and wastewater treatment industry serving clients in the Municipal, Power, Chemical Process, Electronic, and Oil & Gas Industrial sectors. Kiran has worked for different water industry companies in India and abroad, which includes nearly 18 years in the USA catering to various global Industrial and Muni-



Novel Technology for Concentration of Brine Using Membrane-Based System

Presenting an innovative and novel approach towards brine concentration, developed by UK-based Modern Water plc out of their pioneering work on forward-osmosis and osmotically-driven membrane processes, with its first full-scale prototype successfully built and operated in India.

By Soham Mehta and Peter Nicoll



Figure 1: Prototype Plant in Ahmedabad

WASTE BRINE, WHETHER from a process, or from an RO-based recycling or desalination, is a major disposal concern that often necessitates expensive thermal treatment leading to Zero Liquid Discharge (ZLD). Traditional Seawater Reverse Osmosis systems are generally employed to concentrate brines to about 7-9% NaCl equivalent, limited by hydraulic pressure that the membranes can withstand. More recently, some Plate & Frame and Disc-type RO configurations which can withstand much higher pressures than traditional spiral-wound Seawater RO membranes have been developed, but challenges remain in overall system design and sourcing of system components at those high operating pressures, limiting their applications. This article presents an innovative and novel approach towards brine concentration, developed by UK-based Modern Water plc out of their pioneering work on Forward-Osmosis and os-

motically-driven membrane processes, with its first full-scale prototype successfully built and operated in India.

While 'brine' is any water that is salty in a given context, the water industry usually refers to it as the reject water from seawater RO membranes or regeneration liquid from ion-exchange systems, which cannot be subjected to further concentration in traditional membrane systems. There is no such generalization of the word 'brine' in the wastewater industry and it covers the entire spectrum of salinity from cooling tower blow-downs to saturated solutions from production processes in the chemical industries. What is common though to both water and wastewaters is that the effluent disposal standards do not permit any waters higher than 2100 mg/L of Total Dissolved Solids (TDS) to be discharged into surface waters or the land. Higher TDS levels are permitted for marine discharges, but by providing outfalls deep into

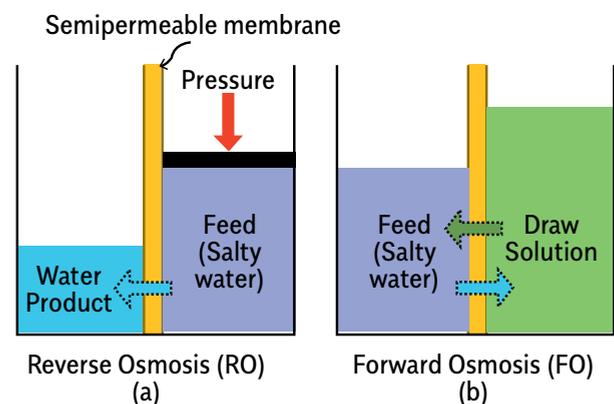


Figure 2: RO & FO Concept

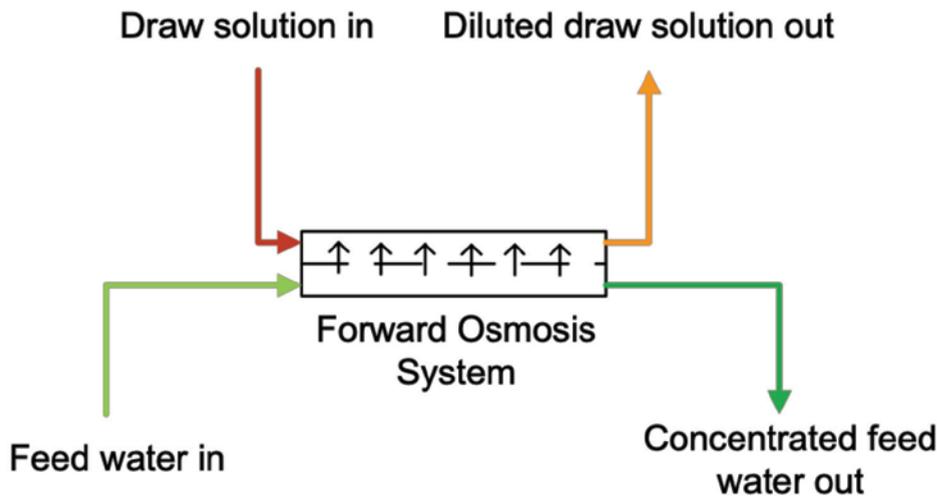


Figure 3: Forward Osmosis Process

the sea with properly designed diffusers to dilute the concentrated brine multiple times so as not to adversely affect the marine biota around the disposal point. In either case, disposal of brine is a serious environmental issue, attracting more and more focus from authorities, courts, and people at large.

When brine disposal is not permitted or restricted, its treatment starts with the concentration of the brine, followed by the separation of the salts by thermal processes. The simplest and most cost-effective method of brine concentration is to 'desalinate' the brine solution using Reverse Osmosis, after essential pre-treatment to take care of sparingly soluble salts that can scale the membranes or particulate matter that can foul the

membranes. The effort always is to maximize the recovery through the RO process in order to reduce the quantity of waste brine reaching the significantly expensive thermal treatment step. With proper pre-treatment and intermediate treatments for removal of sparingly soluble salts, heavy metals and organics, the traditional seawater RO membranes are often used to concentrate the wastewater brines to about 50-70,000 mg/l (5-7%) NaCl equivalent concentration, though theoretical possibility being somewhat higher at 9%. Since the concentrated brine cannot be discharged as per Government of India environmental laws, industries rely on thermal treatments like Multiple Effect Thermo-Compressor Evaporators or Mechanical Vapour Compressor (MVC) Evap-

orators to distill out the water from the concentrated brine, thereby yielding wet salt that is then disposed to a secured landfill. Thermal Evaporators are often staged as a first stage Brine Concentrator and second stage Crystalliser - the former using a more economical falling film configuration to concentrate the brine up to saturation level while the latter adopting a scaling-resistant forced circulation regime to precipitate out the dissolved salts from super-saturated brine.

The Falling-film Brine Concentrator Evaporator, whether using a thermo-compressor or MVC, works on the principle of formation of a thin liquid film in the inside surface of the calandria. In practice, unless the concentration of sparingly

soluble salts and silica is kept below the saturation levels, the film formation is disturbed by scaling of the tubes and the evaporation capacity drops significantly. Concentrated brines are corrosive and hence most often, titanium (Ti) tubes and Ti bonded tube-sheets are used in the calandria and pre-heaters. However, other system components such as piping, valves, and recirculation pumps are often not supplied in corrosion resistant exotic metal alloys due to high cost and hence users end up with reoccurring maintenance and replacements. In effect, the Thermal Brine Concentrators require a significant quantity of thermal energy and are often a nightmare to operate continuously and reliably.

Since the operating costs of Thermal Brine Concentrators are many-fold as compared to RO-based brine concentration, a lot of effort has been done to find solutions to reduce the costs. From solar pans to salinity gradient solar ponds, solar stills to psychometric evaporators, or Membrane Distillation to Capacitive De-ionisation, much effort has been expended to concentrate the brine from the RO step, but with limited success that has not proved to be techno-economically viable and dependable for commercial usage. Recently, high-pressure Plate & Frame and Disc-type RO modules which can handle very high pressures have been developed, that can be used as an additional stage to concentrate the brine. However, getting suitable components for the system as a whole, such as high-pressure pumps, valves, piping, and instruments are still a challenge, as are the capital and operating costs. The impasse now gets broken with a successfully tested full-scale prototype of an all-new non-thermal membrane-based brine concentration technology, developed by UK-based Modern Water plc and built by Advent Envirocare in India.

The membrane-based brine concentration technology has evolved out of the Forward Os-

mosis - Reverse Osmosis based seawater desalination technology invented and patented by Modern Water, a process that has been in commercial operation since 2009 at multiple sites, in the Mediterranean and in Oman. Forward Osmosis, or simply Osmosis, is nature's way of attaining osmotic equilibrium when two fluids of different osmotic pressure, or different concentrations of dissolved constituents, are separated using a semi-permeable membrane. Osmosis is a natural phenomenon first scientifically recorded by the French scientist and clergyman Albert Nollet in 1748, while Reverse Osmosis was invented in the 1950s as a method of desalination.

Forward Osmosis, on the other hand, has only seen commercial applications in the last decade and is characterized by employing a specific draw solution or osmotic agent to extract water from the feed.

Desalination using Forward Osmosis employs a Reverse Osmosis step to concentrate back the draw solution or osmotic agent to the required strength.

Modern Water has over 100 patents in the field of Forward Osmosis and osmotically driven membrane processes. This expertise, from both a practical and technical perspective, has allowed the development of a new patented process, utilizing osmotic principles, specifically aimed at brine concentration. The RO process in Figure 4 is replaced with this novel process or indeed can be deployed on its own, depending on the nature of the brine to be concentrated. The process uses only electrical energy and does not require any thermal energy or vapor compression. The operating pressures are similar to that of seawater desalination RO systems, and so are all appurtenances such as valves and instrumentation. The pre-treatment requirements for membrane-based brine concentration are similar to that of an RO system, taking care of impurities that can scale or foul the membranes.

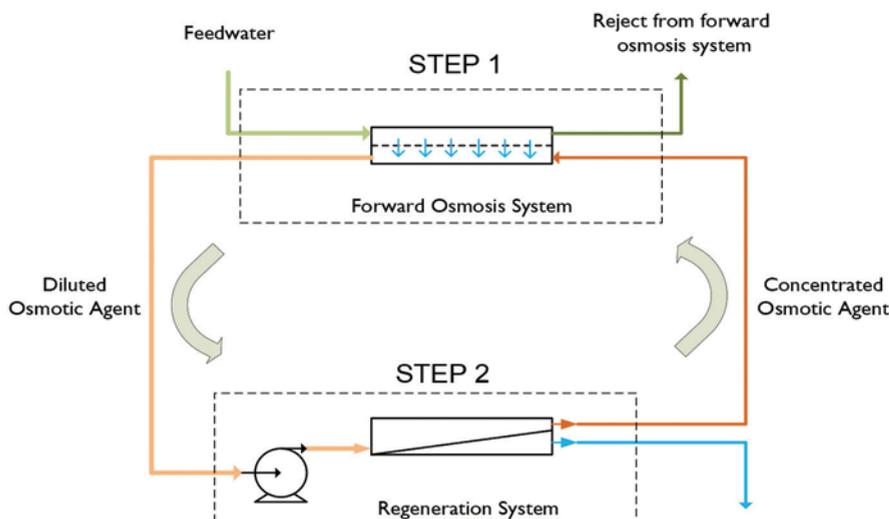


Figure 4: FO-RO Desalination Process

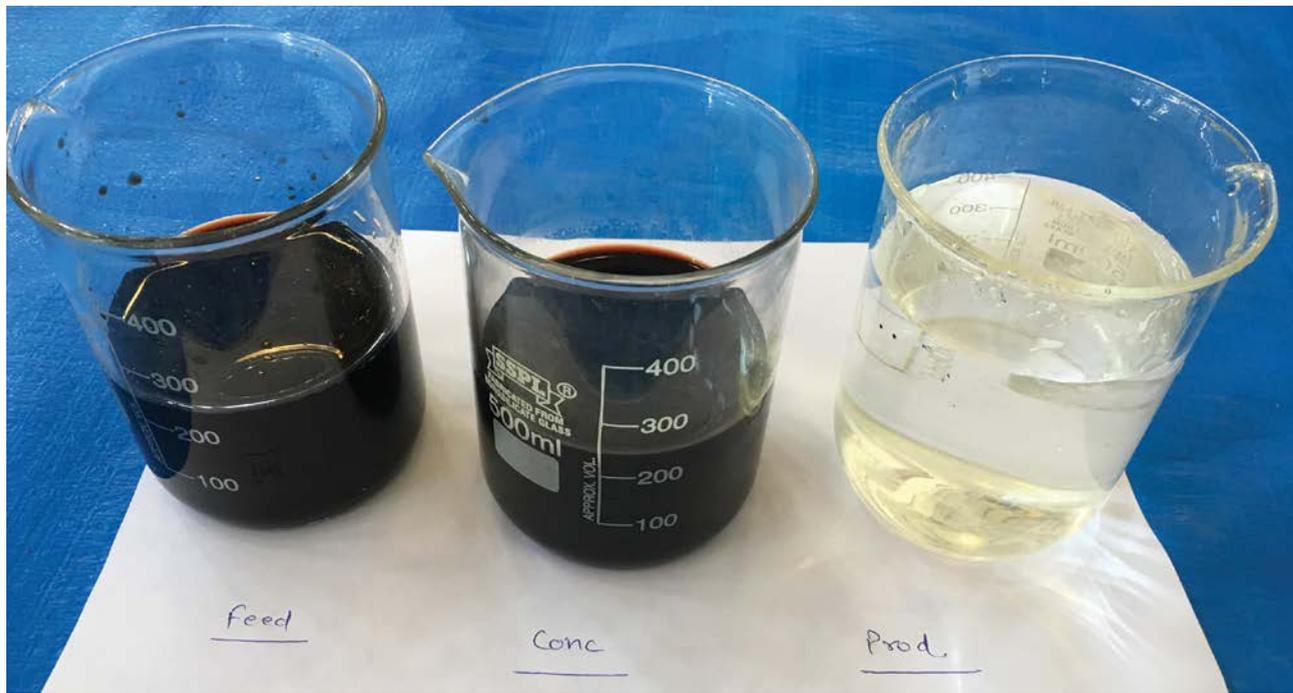


Figure 5: Dye Wastewater Feed, Concentrate and Permeate

Chemical dosing and membrane cleaning systems are also similar. Hence this novel process has similarities with conventional membrane plant, is simple to operate and maintain without any additional operating expertise.

The first prototype of the membrane-based brine concentrator was built in India and tested successfully in late 2016/ early 2017 at Ahmedabad, (Figure 1). The containerized system is designed to

brine TDS of 12.65%, all as predicted by the mathematical modelling of the process. Subsequent to the successful proof-test, the system was shipped to a major dyestuff manufacturer for a pilot test on brine generated from a dye-desalting Nanofiltration system. The trials were successful with a feed TDS of 4-5% being concentrated to 13.5%, thereby yielding 67% average recovery. Figure 5 shows the feed, brine and permeate samples from

ly sodium sulfate, with a target concentration of concentrated brine as 16%. Later, the pilot plant will be shipped to a Central Effluent Treatment Plant for trials on water recovery from a brine having 3-4% TDS.

The membrane-based brine concentrator consumes a fraction of the energy consumed by a thermal brine concentrator or MVC Evaporator. The typical specific power consumption of 7-11 kWh/m³ permeate with the use of energy recovery de-

steam cost is 20% of the power cost, this translates to 78-90 kWh per m³ of water evaporation or 8-11 times more than the membrane-based brine concentrator.

Another interesting application of the membrane-based brine concentrator is in seawater desalination projects. It can produce more water from the reject brine that is being thrown back to the sea. This can help facilities expand their production of water without having to invest in expanding intake structures and headworks. In applications where salt production is integral to seawater desalination, the membrane-based brine concentrator is a perfect fit in producing more water from an existing facility while generating a highly concentrated brine of 16%, or even higher with specially designed additional stages of treatment. The membrane-based brine concentrator also finds application in handling mining industry wastewaters and scrubbing liquid in Flue Gas Desulphurization (FGD) plants, with the first plant of its type currently be constructed for a power station in China.

To summarize, the Membrane-based Brine Concentrator is a major technological

breakthrough in brine concentration technology that can help reduce the brine volumes and significantly cut down the operating cost of ZLD plants. It is a non-thermal system using just electrical energy and consumes a fraction of energy as compared to thermal systems. It feels and operates like standard RO systems and does not call for expert operations. The Membrane Brine Concentrator is not merely a concept in theory, but has been tested successfully with full-size membranes and has been deployed in real life situations for elaborate pilot studies, with proven ability to concentrate the brines up to 16% concentration. It can even be deployed at seawater desalination facilities to produce more water from the reject brine, or for treating mining effluents and FGD system bleeds. The Membrane Brine Concentrator exemplifies the "Make in India" enthusiasm that the country has embraced, and addresses the dire need for a cost-effective solution to the challenging brine concentration need of industries.

About the Authors

Soham Mehta and Peter Nicoll represent Modern Water plc. Peter Nicoll leads the multi-disciplined technical team at Modern Water plc, where he has been instrumental in the development, design and successful deployment of Modern Water's Forward Osmosis (FO) based technologies. He is the inventor of a number of FO and related processes. A graduate of the University of Glasgow, he is a Chartered Engineer and a Fellow of the Institution of Mechanical Engineers. His previous experience includes Director of Business Development for Fichtner Consulting Engineers Ltd where he was responsible for leading the business development and sales functions. He has extensive broad expertise in all the major desalination processes, having held a number of senior roles, both technically and commercially, at Weir Westgarth.

Concentrator Type	Feed Water TDS (mg/l as NaCl)	Max Brine TDS (mg/l as NaCl)	Concentration Factor	Product Water TDS (mg/l as NaCl)	Indicative Energy Consumption kWh per m ³ of Product Water
Type 1 (2 stage)	70,000	128,000	1.83	250	10.5
Type 1 (3 stage)	70,000	165,000	2.36	350	14.7
Type 2 (2 stage)	70,000	128,000	1.83	250	6.8
Type 2 (3 stage)	70,000	165,000	2.36	350	11.3

Type 2 are systems incorporating energy recovery systems

Table 1: Membrane Brine Concentrator Performance

handle a large range of feed TDS, from 3% to 9% NaCl equivalent. At the lowest feed concentration of 3%, it can handle as much as 75 m³/d of brine. The proof-of-concept trials were conducted with a synthetic feed of 7% NaCl and achieved 46% recovery resulting in a concentrated

the plant during the large-scale pilot testing.

The full-scale plant to handle 14 m³/h brine having 4-5% TDS is under installation and slated to be commissioned in February 2018. In the meanwhile, pilot trials are ongoing for an agrochemical waste brine having 6-7% TDS, main-

ly sodium sulfate, with a target concentration of concentrated brine as 16%. For feeds with TDS lower than 7%, the power consumption would still be less. Compared to this, a triple-effect falling film evaporator would consume roughly 300-350 kg of steam and 18-20 kWh per m³ of water evaporation. When the

Tailored Water

By Robert C. Brears



WATER IS A KEY component of local and national economies with the resource often a key input in a variety of industrial value chains. As industrial demand for water increases the sector needs to increase its water productivity. A failure to do so could lead to the loss or disappearance of jobs.

Majority of Jobs Dependent on Water

It is estimated that more than 1.4 billion jobs, or 42% of the world's total active workforce, are heavily water-dependent while another 1.2 billion jobs or 36% of the world's total active workforce are moderately water dependent. In total, 78% of jobs in the global workforce is dependent on water.

Water-Dependent Industries

Half of the global workforce is employed in eight water and natural resource-dependent industries including agriculture, forestry, fisheries, energy, manufacturing, recycling, building, and transport. Currently, industry and manufacturing account for around 4% of global water withdrawals. By 2050, it is projected that manufacturing alone could in-

crease its water use by 400%.

Meeting Rising Demand with Nonconventional Supply

To ensure industry has access to adequate supplies of good quality water and maintains productivity, utilities have been researching and developing 'non-conventional' sources for large-scale customers. Examples of which are as follows.

Research on Industrial Wastewater Reuse

Singapore's Public Utilities Board (PUB) has been conducting research on recycling and reuse of industrial wastewater. Industrial wastewater is a by-product of manufacturing processes at industrial or commercial premises. With suitable treatment, industrial wastewater can be recycled and reused as the boiler or cooling tower feed water in addition to irrigation and toilet flushing. PUB has also been conducting research on Low-Temperature Thermal Desalination (LTTD), a desalination process that utilizes low-grade industrial waste heat to produce high-quality freshwater. This requires minimal electric-

ity demand as waste heat can come from various sources including power plants, refinery plants, and waste incineration plants, etc.

Tailored Industrial Water in Flanders

In Flanders, De Watergroep provides tailored industrial water for industry and service business customers. The water utility's "Industry and Services Business Unit" charts the company's internal water streams, analyses sources of available water, including groundwater, surface water as well as wastewater or reusable process water, and seeks ways of optimizing water consumption. The quality of water supplied depends on the customer's requirements, for example, whether they require cooling water or demineralized water etc. The Business Unit usually carries out its industrial water projects according to the concept of Design, Build, Finance and Operate (DBFO) contracts. The Business Unit has also developed a mobile pilot installation and drilling team unit for business customers to see how the utility can match desired water quality with available water resources. The pilot system uses various techniques including ultrafiltration and reverse-osmosis on a small-scale, enabling customers to make decisions on investments and the techniques to be used.

Customized Process Water in the Netherlands

Evides, a water utility that provides drinking water to 2.5 million consumers and businesses in three Dutch provinces of Zeeland, the south-western part of Zuid-Holland, and the south-western part of Noord-Brabant, offers industrial water, or 'process water' that is customized for specific requirements and preferenc-

es of each customer. In 2017 alone, the utility provided 96.9 million cubic meters of industrial water and 158.7 million cubic meters of drinking water through more than 14,000 kilometers of the pipeline network. Evides Industriewater focuses on providing process water to the chemical industry, petrochemicals, and food industry with an overall emphasis on tailoring water to the needs of customers. The utility delivers different process water based on a Design, Build, Finance, and Operate contract, which involves Evides Industriewater, on behalf of its customers, purifying water and reusing water. Some of the main industrial water products Evides Industriewater offers to customers includes agricultural and irrigation water, cooling water, industrial water, and demineralized water. Demand has now resulted in Evides Industriewater providing solutions to 75 installations, including 12 DBFO plants as well as mobile installations in the Benelux and Germany.

Fit for Purpose Recycled Water

Queensland Urban Utilities supports the sustainable use of recycled water across its service territory with numerous environmental benefits including conservation of water resources, reduced nutrient loads being released into waterways, improved quality of public assets e.g. sporting field surfaces, and support of agriculture where environmental sources of water are insufficient. A key aspect of the utility's recycled water program is that recycled water must be fit for purpose. Specifically, Queensland Urban Utilities provides various qualities, or classes, of recycled water treated to meet the customers' requirements from each recycled water schemes, with

the price decreasing with quality. The classes are Class A+ recycled water, which is very highly treated recycled water and is usually only required for industrial process water or for the irrigation of minimally processed food crops), Class A and B recycled water, which is recycled water that requires additional treatment processes above the normal sewage treatment processes that are sufficient to allow effluent to be discharged into the environment, and Class C recycled water, which is the lowest quality of recycled water supplied by the utility.

Malta's New Water

Malta's Water Services Commission has established the New Water program, which involves treated wastewater going through ultrafiltration to remove bacteria, reverse osmosis to remove chemicals, and advanced oxidation to remove remaining pollutants. Each year the program produces 7 million m³ of high-quality water suitable for safe crop irrigation. This will potentially meet up to 35% of the current total demand of the agricultural sector. In addition, the high-quality water can be used for landscaping and industry, ensuring New Water is fully utilized during periods of low demand by the agricultural sector. Currently, New Water is available through hydrants, which are accessed by electronic cards. As of 2018, seven hydrants are available in the North region of Malta. Moving forward, the program is developing three additional networks to increase the number of hydrants available for water users.

Robert Brears is the author of Urban Water Security, Founder of Mitidaption, and Our Future Water."

[@Mitidaption](#)

When Communities Lead the Way

A community in a remote village in eastern India comes together to break free from the struggles of access to clean water. The intervention changes their lives in more ways than they had ever imagined.

By Ishita Rampal



Photo Courtesy WaterAid/ Prashanth Vishwanathan)

AS YOU TRAVEL further exploring the interiors of Gaya district in Bihar, amidst acres of agriculture land lies a small village called Zindapur. Home to 56 families, a majority of the community members are daily wage laborers, who either work at the nearby brick factory or at the farmlands owned by affluent landowners. Their meager income is heavily

dependent on the pretext of if they manage to get work, thereby trapping them in a vicious circle of poverty.

“The wages we earn on a daily basis are not sufficient and also vary for men and women. While my husband gets an amount of money for his work, women like me are given rice instead...it becomes difficult to manage the expenses for

our family,” shared twenty-year-old Mamta Devi.

A community struggling with poverty, basic facilities like clean water and decent toilets were undoubtedly not available in every household nor were a priority.

However, today each household in the community has access to clean water through a mini piped water supply

scheme. With a submersible boring and a water storage tank, water is made available to the community members. A person-in-charge from within the community is responsible to switch the water motor on thrice a day. Long queues at the water point, arguments, and fights with each other to collect water first, and the ordeal of spending hours at the

water point every day are long-gone practices for Zindapur village.

In contrast, the situation was not the same until a year ago. “I cannot even count the number of times I went to the nearby water point or even the number of buckets I filled in a day. I used to spend a minimum of 2-3 hours a day to collect water,” recalls Mamta.



Photo Courtesy WaterAid/ Prashanth Vishwanathan)

In Zindapur village, women would walk for about 1 km to reach the canal and collect water. Although the village did have a well in close vicinity, it belonged to a landlord of the farm. The landlord never objected, but the community members would try and use the well water as less as possible.

Mamta's father-in-law, Babulal Paswan, 70, shared, "It was too difficult to collect water earlier, especially for us at this age. My son and daughter-in-law would collect water for me as well, but that meant spending more time at the water point. Earlier, we had to wait near the well, keep it clean so the water consumed was not too dirty, and even ensure that no one falls in the well as it is at the ground level itself." The situation was worse when at times some of the community members were forced to skip work and the day's income, only to be able to collect water for the household needs. Often children would be late for school or would drop out in even worse cases.

All the daily struggles forced the community members to gather together and discuss possible solutions. WaterAid India and its partner, with support from the HSBC Water Programme soon stepped in and facilitated community-level

meetings and discussions. Leaders from within the community actively participated and were dedicated to working towards finding a solution to end their water woes. After numerous meetings attended by the Sarpanch, concerned authorities and government officials, the installations of water taps at each household were initiated.

Although it was a long wait, in the year 2017 the taps were finally installed through a



(Now) I do not have to worry about filling buckets and storing water, or leaving my two-year-old with someone at home so that I can collect water. We just open the tap, and water is available for the family.
- Mamta Devi, Zindapur Village, Gaya, Bihar

mini-piped water supply model and were ready for use with clean water for the villagers at their household premises. The water is also tested by WaterAid's partner twice a year to ensure that it is free from any form of contaminant.

"We are able to collect water within minutes. I do not have to worry about filling

buckets and storing water, or leaving my two-year-old with someone at home so that I can collect water. We just open the tap, and water is available for the family," shared Mamta excitedly.

A simple model of storing water in a tank and connecting it with a piped connection at each household in the community has shown a great impact. Women like Mamta are now able to complete their household chores on time, spend

time with their children, and even work for a few hours to add to the family's income. Meanwhile, the children are able to go to school, study and play like any other child of their age, and the men are able to go to work regularly.

The community members are still not at rest though! Keeping in mind the scarcity of



water experienced for all these years, they have now decided to manage their water resources better as well as take ownership. They plan to clean the nearby well and make it ready for rainwater harvesting. With the onset of monsoons, the community members plan to collect the rainwater and then cover it so that the water can be used for other household or non-potable purposes such as washing and cleaning. Access to water has not only ensured the availability of water at all times but has also made the community members sensitive towards the resources that are available to them and the resources they can conserve.

About the Author

Ishita Rampal is the Content Officer at WaterAid India. With her Masters' degree in Development Communication and Extension, Ishita has had the opportunity to work at the grassroots as well as at the planning and implementation level. Her core competencies include conceptualizing communication strategies and building relationships in the area of media and communication. Previously, Ishita has effectively held and organized events and campaigns on social issues. Along with a flair for writing, Ishita is also fond of photography and travelling.

FEATURED PROJECT

LEAKman Project, Denmark

Joining Forces Against Water Loss...

What would happen if nine of the most innovative players in the Danish water industry got together to create a complete solution to fight water loss? The LEAKman project will provide not just the answer to that question but also valuable knowledge to the companies involved as well as water utilities everywhere.

By Stig Knudsen



DANISH SUPPLIERS OF water technology have long been known for delivering innovative products that each contribute to reducing water loss and Denmark's average level of water loss is among the lowest in the world at only 7.6% in 2016. However, there has never been one solution integrating all of them. Until now.

In the LEAKman project, nine Danish companies have joined forces to create a comprehensive state-of-the-art solution that can reduce leakages and help solve the challenge with Non-Revenue Water (NRW), which is a severe and global problem.

A Full-Scale Real-Life Test Bubble

The LEAKman project brings together suppliers of each of the individual systems and components that make up a water utility's daily setting. The project aims to integrate and optimize existing products in a shared mission to fight water loss: "The goal is to get the existing elements to work together - and to exchange data and knowledge to make us all smarter in the process," explains Klavs Høgh, project manager at LEAKman initiator, NIRAS.

The project partners include the two water utilities, HOFOR and Novafos, who have put their distribution network at the disposal of the participants

to enable a full-scale implementation in four demonstration areas. According to Klavs Høgh these real-life test labs are key to ensuring the value and applicability of the findings from the project: "Everything is connected, so we need to see how the individual parts interact in practice - not just on a computer screen."

"You need to know what you're looking for" Kamstrup's role in the LEAKman project is focused on making the water consumption more transparent, which specifically involves delivering the almost 5,000 remotely-read smart meters that have now been installed in the demonstration areas.

"To reduce water loss, you have to find leaks fast and to do that, you need to know what you're looking for. That's where we come in: mapping water loss through remote network reading and info codes," says Stig Knudsen, Product Manager at Kamstrup.

In addition to measuring consumption, the new meters will notify the utilities about leaks and bursts, temperature variations, tampering, backflows and enable ongoing online monitoring of the water balance in the District Metering Areas (DMAs). They therefore avoid manual meter readings, estimated calculations and time-consuming follow-ups on inaccurate or missing readings.



The goal is to get the existing elements to work together - and to exchange data and knowledge to make us all smarter in the process.
- Klavs Høgh, Project Manager, LEAKman Initiator, NIRAS

ABOUT THE PROJECT

LEAKman is a lighthouse project under the Danish Eco-Innovation Program supported by the Ministry of Environment and Food.

Novafos, and Schneider Electric.

Supplied by Kamstrup

4,800 MULTICAL® 21 water meters and a number of pressure sensors that are all read remotely through a READY network.

Project Partners

AVK Group, DTU (Technical University of Denmark), Grundfos, HOFOR, Kamstrup, Leif Koch, NIRAS,

Timeline

2016-2020

Kamstrup also provides pressure sensors that allow the utilities to perform pressure optimization based on the knowledge of the actual pressure at the critical points of the distribution network rather than on theory and assumptions. Pressure sensors will also reveal any unexpected events and enable the utilities to monitor their network to track and possibly avoid pressure surges.

The Kamstrup solutions in the LEAKman project are further directly integrated with online hydraulic models, which allows for highly accurate calculations of pressure optimisation potential, demand forecasting and much more.

Innovation at its Finest

For Kamstrup, participating in the LEAKman project was an easy choice. "There is so much expertise and knowledge in the Danish water industry, that this project just

makes perfect sense. We are very excited to be part of it and see the difference we can make," says Stig Knudsen.

In addition, the findings from the demonstration areas will provide valuable and specific knowledge about Kamstrup's meters and pressure sensors. "We really want to prove our integration into the full water management system. This will allow us to see how we can further develop it," says Stig Knudsen.

And to him, that's what innovation is all about: "Innovation is a 'Show, don't tell' kind of playing field. We can claim to be innovative all day long, but it is in projects like this that we actually prove it."

Easy Integration Creates Synergy

All utilities might not need the full solution, but according to Klavs Høgh there is a huge potential in even just combining some of the individual elements: "Different product

combinations will create synergies that benefit not just the utility but the suppliers as well. In those cases, one plus one equals much more than two."

This places significant demands on the openness and interfaces of the different systems to ensure that they can be easily integrated into a multi-supplier solution. "Kamstrup's solution is extremely flexible because it is based on standardized meter data and has the right interfaces to interact smoothly with other systems. The meter data is collected through the meter reading system READY but can easily be exported to e.g. the utility's SCADA system," explains Stig Knudsen.

Much More to Come

Data has started coming in from the demonstration areas, and the partners can now begin to interpret and refine them. Some of the more advanced use cases for hourly

smart meter data include improving the quality of consumption variation curves, establishing the connection between distribution pressure and consumption as well as introduce the use of coincidence factors for dimensioning pipes. As more and more data becomes available, other use cases are expected to follow and contribute to paving the way for new leak detection possibilities.

About the Author

Stig Knudsen is a Product Manager at Kamstrup. He has been working with different issues in the water industry since 2003 both on the utility side and now as a supplier. One of his characteristics is that he has always been in the nexus where technical and commercial issues meet. His work often involves both introduction of new products and approaching new markets.



Unlock AMI's Potential with Data Analytics

Advanced metering infrastructure can collect and combine data from many sources, helping water utilities boost business and operational performance.

By Dan Pinney



Water Utilities are Turning Toward AMI Systems as Part of Larger Smart Grid Initiatives. AMI Systems Provide Two-Way Meter Communications, Offering Utilities Predictive Capabilities to Help Boost Business and Operational Performance.

ADVANCED METERING Infrastructure (AMI) has created new efficiencies for water utilities. Equipped with the latest analytics technology, a utility can leverage the vast amount of data flowing through an AMI system to anticipate demand, address issues such as leak detection, and help customers understand their consumption patterns.

Creating a Smart Water Utility

Today's AMI systems are helping water providers become smart utilities, automating data collection, and providing new insights. Previous

data collection methods required technicians to perform site visits and record meter data monthly. AMI reduces and often eliminates the need for walk- or drive-by meter reading.

AMI also provides a massive increase in the amount of available data for water utilities, delivered with greater accuracy thanks to improvements in metering technology. Advanced meters, when connected to a head-end system through a dedicated communication network, can provide data to measure flow accurately down to 0.11 GPM as often as every 15 min. By combining AMI with Supervisory Control

And Data Acquisition (SCADA) technology and other systems, water utilities are receiving thousands of times as much data as they did just a few years ago.

Although this data explosion has opened new possibilities for utilities, it's also created a significant challenge. Some utilities may not possess a full-time Information Technology (IT) staff or the resources needed to analyze and glean insights from this wealth of data. So, how do utilities best manage this increased data stream in addition to their staffs' many daily tasks, yet remain focused on meeting their customers' needs?

This is where advanced analytics comes into play. As AMI adoption has increased, so too have the capabilities of analytics software made available with the technology. Such software can be offered via innovative cloud-based or software as service models, eliminating the need for utilities to invest in expensive software that requires a lot of time to install and learn how to use.

The latest analytics software can efficiently store and validate information collected from smart meters, SCADA systems, and customer billing and information services, offering predictive capabilities to help boost business and

operational performance. With advanced analytics, water utilities can:

- Remotely and continuously monitor and diagnose problems
- Pre-emptively prioritize and manage maintenance issues
- Remotely control and optimize water distribution networks, delivering the right amount of water where and when it's needed most
- Comply transparently and confidently with regulatory requirements regarding water quality and conservation
- Provide customers with the information they need to make informed choices about water usage

By combining sensors with advanced analytics technology through their AMI systems, utilities gain the ability to translate capabilities across multiple disciplines - from wastewater treatment to quality assurance. Thus, AMI will continue to evolve with the way service providers use data to help power initiatives such as the Internet of Things (IoT) and smart city applications.

Accounting for Every Drop

Nonrevenue water continues to be a pressing issue for many utilities, and it's an area that's ripe for data analytics. Because of real and apparent water loss, some utilities bill only for roughly 70 percent to 80 percent of the water they provide. Apparent losses are caused by failures in data and billing systems, customer meter inaccuracies, and unauthorized consumption. Real loss happens when there's some type of leak or spill, where the water ends up in the ground or in a stream and not with the customer. Nonrevenue



In Addition to Customer Water Usage Data, AMI Technology Helps Utilities Receive Data on Water Pressure and Leaks in Remote Areas of Network, Such as Pump Stations.

water isn't a new trend, but innovations in data analytics technologies are helping utilities combat it, particularly when used as part of a broader AMI deployment. Combining enhanced solutions for smart metering, measurement, communications, and analytics can help close the gap between the volume of water the utilities supply and the water driving revenue each month.

This can happen in a variety of ways. Simply installing new meters can help utilities jumpstart the revenue curve and potentially save thousands of dollars annually. But leveraging enhanced data analytics technology with automated billing and AMI systems can more accurately pinpoint where the loss occurs. By analyzing AMI data over a period of weeks, months, and years, utilities can more effectively identify where the loss occurs and take proactive measures to stop this loss from happening, saving a lot of money in the process.

By leveraging an automated billing system integrated with AMI and data analytics, utilities can also streamline the billing process, reducing

the time and errors associated with the manual billing process. Additionally, smart alarms can be configured as part of an integrated system, allowing utilities to detect efforts to circumvent meter registration, restrict access from unauthorized personnel, and detect attempted theft.

With innovation in technology and AMI systems, utilities can also advance their water distribution management and monitoring systems to protect infrastructure against leaks and spills. Advanced options such as a mass balance give utilities a zonal view of deployed water meters for enhanced management. Acoustic and fluid energy solutions take leak detection to the next level by allowing users to monitor distribution lines, localizing the identification of leaks with more precision based on flow and pressure data. Advanced leak detection platforms use the latest technologies, such as smart balls, infrared cameras, and other in situ devices, to monitor pipes for cracks or other issues that cause leaks.

By reducing nonrevenue water, either through real or apparent losses, utilities can

capture more revenue and reduce production costs. This allows utilities to reinvest in new systems that improve infrastructure and support additional benefits to streamline operations.

Ami Insights in Action

The city of Hendersonville, N.C., is a good example of a water service provider that has leveraged data analytics to improve daily operations. The city installed a traditional AMI system in which water meters transmit usage data every hour and combined it with pressure sensors deployed in strategic locations throughout the city's water distribution system. Within minutes, the system enabled the city to identify a pipe break that had occurred overnight. Before AMI, it would have been up to city employees to detect the problem manually, and it probably wouldn't have been addressed until hours or even days later.

Integrated data insights allowed Hendersonville employees to identify the issue quicker and locate exactly where the pipe break occurred. Coupling its AMI system with geocoding capabilities, which are available in most utilities in North America, the city monitored pressure changes at various sensors around the break's location. The data streams analyzed through the cloud-based system allowed workers to quickly pinpoint the break within 100 yards.

The benefits of using AMI to monitor water distribution go beyond saving money. The technology also can be used to minimize public disruptions and serve communities. In the case of Hendersonville, the pipe break occurred on a wa-

ter main near a major road. If the issue had gone on longer because the utility couldn't detect or locate the break, it could have resulted in significant damage and disruption to the community, along with the loss of hundreds or even thousands of gallons of water from which the city wouldn't be able to collect revenue.

Connected Utilities - Smarter Customers

Utilities and municipalities frequently operate in silos that rarely communicate. Leak detection might be handled in a different department than meter reading or billing. Separate departments also frequently handle water, electricity, and street lighting. As AMI technology and data analytics continue to advance, opportunities to leverage their interconnectedness will increase to benefit various departments.

Such opportunities also extend to the customers whom utilities ultimately serve. By providing accurate data through easy-to-use customer portals, utilities can empower their customers to better manage their own consumption and tackle personal goals in areas like sustainability.

Washington Municipal Utilities in Washington, Ind., provides a prime example. When it came time to upgrade the utility's outdated infrastructure, city leaders wanted a flexible solution that would unify water and electric metering under a single system. To make this happen, the city deployed AMI technology coupled with advanced analytics. The new system allows staff to manage power and water remotely with one network. The system helps the city save time and resources, seamlessly integrating and analyzing customer usage data for more accurate and efficient billing.

The city also extended the benefits of enhanced data insights to its customers. When a customer calls to discuss a bill, the city's customer service staff can quickly find it and review the customer's usage. Timely and accurate data em-

power Washington residents to make informed decisions about their water and power consumption.

The Road Ahead

As technology advancements evolve under the umbrella of big data and IoT innovation, AMI technology, and advanced data analytics will continue to make cities smarter. Benefits of this shift will include better stewardship of customer dollars and more informed decision making by customers, allowing utilities to go beyond metering to truly intelligent resource management.

Although many water utilities today focus on data collection, the industry is shifting. It's no longer just about the data. It's about the ability to act on that data. Utilities that leverage AMI technology and data analytics can improve efficiencies now, with the promise of increasing opportunities in the future. By providing advanced capabilities, such as interpreting water age for better quality control, the possibilities are limitless. Utilities that monitor and stay ahead of the latest developments will be in the best position to capitalize on tomorrow's technology breakthroughs.

About the Author

Dan Pinney is Global Director of Water Marketing at *Sensus*, Raleigh, N.C.

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Connecting Utilities and Customers (AMI Allows Utilities to Empower Their Customers to Better Manage Their Own Water Consumption Through a Variety of Smart Devices).

Cost-Effective Tools for Reducing Non-Revenue Water Loss (Leak Detection, Condition Assessment, and Pressure Management)

This article focusses on two cost-effective approaches that help utilities to get a handle on Non-Revenue Water (NRW) quickly and effectively.

By Martin Topps



Deploying a Mueller Water Products Echologics ePulse Acoustic Sensor for Measuring the Structural Integrity of a Water Distribution Main.

EVERY WATER UTILITY has some degree of leakage or water loss within their water distribution system which, when understood, can be dealt with in many ways. Despite this, excessive water loss has continued to grow, as aging infrastructures further deteriorate often due to a lack of funding for rehabilitation. As populations increase, new customer demand increases the stress on the already overloaded pipe networks and the problem compounds.

This article focusses on two cost-effective approaches that help utilities to get a handle on non-revenue water (NRW) quickly and effectively.

Leakage Detection and Condition Assessment

A sound approach in reviewing water loss reduction should include a leak detection and condition assessment plan. Echologics technology, a Mueller Water Products brand, non-invasively detects under-

ground leaks and assesses the condition of water mains without disrupting service or inserting anything into the pipe system. This is achieved using acoustic sensors attached to existing components such as fire hydrants, valves or directly in contact with a pipe. These sensors listen for the sound that a leak creates, and correlate the position of the leak. With condition assessment, a sound wave is induced in the pipeline and acoustic sensors capture data that is analyzed using proprietary algorithms to assess the integrity of pipelines.

Implementation of an Echologics leak detection or condition assessment program typically starts with a proof-of-concept pilot project to document success and determine potential return on investment (ROI). Before laying out a pilot program, it is important for the supplier and customer to agree upon the concept being tested, the capital costs, the relative

cost of services, and the criteria on which the performance is going to be evaluated. Evaluation criteria can range from the simplicity of system installation to supporting-software features and the ease of user operation.

The key to success in maximizing savings and minimizing water loss depends on early detection of leaks. Acoustic sensors find leaks long before they become detectable by conventional techniques. Early detection reduces the duration of leaks and often means that leaks are repaired before they progress to costly water main breaks. Here are two examples:

- EchoShore-M was installed in a water utility in Malaysia

to survey more than 3,000 km of pipeline. Within the first 17 months of deployment, the utility identified and located 252 leaks and was able to save more than 25 million liters per day. The utility expanded its leak detection program to survey an additional 1,500 km of transmission mains at an average rate of 40 km/week, accurately pinpointing 120 leaks and saving an additional 7.9 million liters per day. That's a saving of 32 million liters per day - enough water to supply an additional 152,000 residents every day.

- ePulse condition assessment was used to help determine if and when certain sections

of pipe needed replacement, in a UK Water company that manages 35,000 km water distribution network. The company was due to replace 402 km of the pipe but ePulse was able to show that 198 m was actually in good condition and did not need to be replaced. As this section ran under an environmental protection area, the complexity of the work and risk of negative environmental impact would have added to the cost. This led to a direct cost saving of over USD 150,000.

Pressure Management

Control valves have been used for many years to help



Measuring and Calibrating a Mueller Water Products Singer Pressure Reducing Valve to Regulate Flow and Daytime/Night-time Pressures to Eliminate Overpressure and Reduce Leakage.



Echologics Team Listening for Leaks On Site

control NRW loss and are an essential part of any water distribution system. Pressure is proven to have an effect on leakage volume and pipe burst frequency. The relationship between pressure increase and leakage volume is quite complex and depends on pipe material, soil conditions, and age of pipe. The ratio can be anywhere from 1:1 to 1:3 meaning, in the latter case, a 10% increase in pressure would see a 30% increase in leakage volumes.

Pressure Reducing Valves (PRVs) are often used to control system pressures, allowing acceptable pressures to meet customer demands while maintaining a maximum pressure limit to help in controlling leakage levels. Some utilities are using timer systems with multiple pilots to set multiple pressure settings throughout a 24-hour period. Singer - a Mueller Water Products brand - valves allow high pressure during high demand and low pressure during low demand.

Another bonus in installing PRVs is the effect of reducing

burst frequency in old pipelines. Often the main reason for a water utility experiencing high leak and burst frequencies is the aging pipe network, still in operation beyond its expected lifespan. Pipes weaken with age, pressure spikes can cause the pipes to burst. Pipe bursts often happen in off-peak periods or at night time, because the demand is lower and the water pressure in the pipe is higher.

When considering a comprehensive water loss and leakage solution, it is common practice for water utilities to hire a consulting firm that specializes in this discipline. After completing a water audit, a consultant will usually analyze the system and begin to establish DMAs (District Metered Areas) which typically consists of a meter and pressure reducing valve. These DMA's are often designed to be a dedicated pressure zone for between 2,000 and 3,000 service connections (but this number can vary subject to population and utilities' strategy to find the smallest leak).

The meter then measures the overall flow into that specific pressure zone while the consumer, industrial and commercial meters used for billing, measure flows out of the zone. Calibrated meters will provide leakage rates in that zone. With this information, leakage location teams can be directed to the most challenged zones and

identify areas with the greatest need. DMAs are most effective if you can provide one source into a DMA zone and avoid multiple meters and PRVs feeding off a looped system. With this approach you can adjust the pressure reducing valve specifically to each zone and set the pressure in that zone to supply exactly what

your customers require, small towns or cities of 10,000 people or less, may end up with 4 or 5 DMAs or pressure zones. Large cities with many millions of residents may have 100-200 pressure zones. Each DMA will often give a payback of six months to a year when evaluating the cost of the water that would otherwise be lost.

In conclusion, leak detection and condition assessment solutions, along with pressure reducing valves, are becoming vital and affordable water conservation tools for managers of water distribution systems around the globe.

About the Author



Martin J. Topps, Vice President of International Sales for Mueller Water Products, has been working with utilities for over 35 years, both for a UK water utility and for a number of multi-national suppliers to the utility sector.

Managing Pressures with DMAs

By managing your pressures with DMAs or pressure zones, annual maintenance budget can be decreased and water loss associated with pipe bursts plus consequential damages reduced. Here are two examples:

• INDONESIA

Singer applied its water loss control and pressure management solutions for a customer in Indonesia experiencing severe problems with over-pressure pipe failures, significant water loss, and low reservoir levels that frequently deprived a third of one city's population of reliable water supply. A special meter-controlled and pilot-operated pressure control valve achieved an astounding 75% reduction in water loss, a 300% reduction in pipeline breakage, and a 33% reduction in electrical power consumption

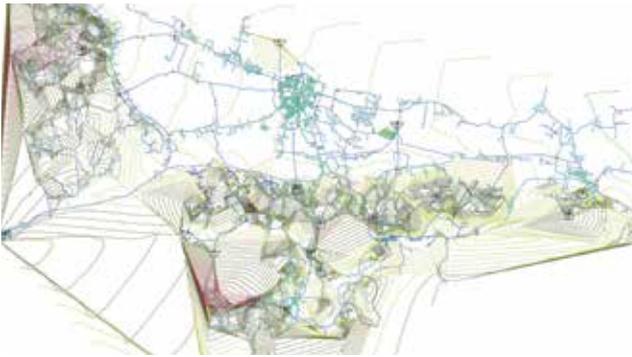
used by reservoir supply pumps - saving enough water to permit thousands of new service connections.

• MALAYSIA

Another utility in Malaysia needed help resolving a serious water loss problem caused by aging infrastructure. Through an NRW audit, it was determined that 168 DMAs needed to be established to manage the pressure of the entire distribution system. By installing a combination of 138 Singer pressure reducing valves in the DMA's, and Singer altitude valves at reservoirs, the utility was able to realize a savings of over USD 5 million per year. Overpressure pipeline failures dropped by 93%, from 3000 per year to only 200 per year, and today's optimized reservoir water levels are helping to delay water rationing for almost a million residents during their dry season.

Reducing Water Loss for Croatian Water Supply Network

By Cyndi Smith



The Network Model Developed in WaterCAD was Integrated into the Network's GIS Database to Ensure Accurate Data and a Reflection of Reality.

Developing a Hydraulic Model

Varkom D.D. (Varkom) brings water and wastewater utility services to 175,000 people across seven townships and 20 municipalities in Varaždin County, Croatia. The organization wanted a feasibility study completed to help better manage its assets spanning the 1,650-kilometer supply network, which included 23 water tanks and 36 pressure stations.

As an organization specializing in preparing and supervising hydraulic structure construction, Hidroing d.o.o. (Hidroing), in partnership with three other companies, undertook the EUR 500,000 feasibility study to develop a precise hydraulic model for Varkom. The goal of the model was to assess network performance, recommend improvements, and propose future development measures.

Hidroing was responsible for 1,262 square kilometers of the network and needed to

complete a hydraulic model within a year. The project consisted of water loss analysis, field measurement, District Metered Areas (DMAs) zoning, and pressure management. The biggest challenge, however, was phasing the development of the hydraulic model, as the field data came in eight phases during the project's timeframe.

Providing Accurate Model Data

To develop a model that reflects reality, Hidroing integrated the WaterCAD model directly to the GIS database, obtaining background maps, a 3D terrain model, and meter data that included meters for every commercial, residential, and institutional building. Using WaterCAD as the main modeling platform, the team could connect the model to the different data assets, reducing the time needed for model preparation and alterations. This connectivity allowed users to quickly and precisely

In a Nutshell

- o **Organization:** Hidroing d.o.o.
- o **Solution:** Water Networks
- o **Location:** Varaždin, Varaždin County, Croatia
- o **Project Objectives:** Develop an accurate hydraulic model for a

- 1,262-square-kilometer section of a water network. Assess the network performance, recommend improvements, and propose future development measures for Varkom's water network.
- o **Products Used:** WaterCAD

input data into the model, swiftly providing an accurate representation of the site.

The project team connected a detailed database with 41,000 water meters to the model to incorporate the most accurate water demands in the model. Information included the owner name, address, yearly consumption, and type of user, making it easy to switch between season consumption periods and enabling direct demand allocation. Additionally, the project team added sub-models, which allowed team members to work on almost every main task simultaneously, saving three months on delivery.

For the 3D terrain model, WaterCAD's TRex functionality allowed the team to allocate accurate elevations for the entire area, avoiding possible problems during pipe calibration based on pressure. The final model was Hidroing's most precise model to date.

Improving Decision Making

The main benefit seen by the project team was improved calculation accuracy for better decision making, with all information in one easily accessible location. Using the LoadBuilder capability within WaterCAD, the team applied water loss per DMA, enabling a direct connection of real losses to pipeline length inside the DMA selection set. In the next phase, the team calculated water loss using the Fixed and Variable Area Discharges (FAVAD) method, correlating pressure and water loss by

implementing WaterCAD's flow emitter capability to simulate leaks. These capabilities allowed Hidroing's team to identify the best scenario for pressure management with the calculation of financial benefits due to water loss reduction.

The improved accuracy of this model was an important capability for the system owner. Hidroing used various WaterCAD capabilities for energy calculation, leakage reduction, demand allocation, and other important data. The owner felt secure when making decisions based on the model as the data was accurate and up-to-date. The model allowed the owner to have a new view of the water network because all the vital information was located in one place.

Reducing Water Loss, Achieving Significant Savings

Hidroing helped the system owner reduce water loss by 2 million cubic feet per year by using various capabilities in WaterCAD. These savings will help the owner accumulate funds for future network development as well as increase service quality for the entire

county. The savings also positively affect the surrounding environment, as the water is pumped from underground wells. Since the pumps are not using as much energy as they were previously, the network now reduces carbon dioxide emissions in addition to water and energy usage.

By implementing WaterCAD during the modeling process, the project team saw significant savings for its own work. For instance, Hidroing needed fewer experts to help with the model development, which saved the organization money. The team also estimated that 70 percent of the time was saved directly in model preparation and an additional 70 percent of the time was saved in model management and preliminary design. Overall, the project team conserved 600 resource days by using WaterCAD and completed the project within the required 12-month deadline.

About the Author



Cyndi Smith is a Senior Industry Marketing Director for Bentley Systems' utilities, water, and communications industries.

Fast Facts

- o Varkom D.D. provides water and wastewater utility services to 175,000 people in Varaždin County, Croatia.
- o Hidroing created a GIS database for the water network to allocate accurate water demands and eleva-

- tions in the model for the EUR 500,000 project.
- o By directly connecting the WaterCAD model with the GIS database, spreadsheets, and background maps, users could quickly and precisely load data into the model.

ROI

- o Using WaterCAD's sub-modeling capabilities enabled the project team to deliver the project three months ahead of schedule.
- o The project team reduced the time needed to com-

- plete the project by 600 resource days.
- o An estimated 70% of the time was saved in model preparation and more than 70% in model management and preliminary designs.

Digital Water: How Leak Remediation Through Data is Becoming the World's Least Expensive Water Resource

The World Bank estimates that we collectively lose 32.6 trillion liters a year through leaks. In some cities, leakage can consume 35 to 50% of the water produced.

By Michael Kanellos

LEAKAGE STANDS AS one of the primary challenges and primary opportunities for water utilities.

Globally, the World Bank Estimates that we collectively lose 32.6 trillion liters a year, or nearly enough to fill China's Three Gorges Dam, through leaks.

In some cities, leakage can consume 35 to 50% of the water produced. Lost water, of course, means more than wasting a valuable commodity.

Because power can be 30% of the cost of producing water, leakage can artificially raise greenhouse gas emissions and prevent communities from reaching their sustainability goals.

Similarly, leaks in wastewater networks, meanwhile, can be a source of health problems and legal violations.

On the other hand, the volume of water being lost - combined with advances in software and sensors for detecting and monitoring leaks - has effectively made leakage one of the most, if not most, economical source of water available to a community.

In the U.S., for example, recovering water from leaks costs on average USD 1.21 per 1,000 gallons, according to data from Bluefield Research, or less than half the cost of traditional water (USD 3.90 per 1,000) and far less than newer solutions like desalination, which averages over USD 8.00.

Leakage control is even less expensive than encouraging consumers to conserve, according to data from the California Public Utilities Commission.

Maynilad, the privatized wa-

ter authority for Manila, serves millions of customers over 540 square kilometers: it manages nearly 7,500 kilometers of water and sewer pipes and 19 reservoirs. In 2007, nearly 20% of the citizens in its service territory could not even get service, roughly had did not have 24-hour service and over half did not have sufficient pressure.

As part of an operational overhaul, the company pursued an aggressive program to monitor metrics like water flows while mapping consumption against its geographies.

By 2013, it was servicing 94.7% percent of its customers, 97% had a 24-hour service and 99% had sufficient pressure. At the same time, Maynilad recovered 640 million liters of treated water, thereby reducing losses by 27%, while increasing its customer base from 6.4 million to 9 million.

But what about small cities with relatively modest budgets and small staffs?

White House Utility District (WHUD), Tennessee's largest geographic water utility serving approximately 90,000 consumers and businesses, is using data to stem water loss and create savings for its customers. Detailed in a newly published paper, the District's work began in 2015 with a dilemma: how to meet growing demand for water within the budget and capital constraints faced by municipal and mid-sized utilities everywhere?

Early projections indicated that WHUD might need to invest up to USD 15 million to USD 20 million in transmission upgrades and treatment

plant expansions to meet its service commitments. Expanded capacity would also mean higher expenses in terms of energy - approximately 30% of the cost of producing water - employees, chemicals, and maintenance.

Rather than launch an expensive construction project, WHUD opted to develop a system to pinpoint underground leaks through software and smart meters. First, WHUD segmented its service territory into 33 district metered areas (DMAs). Data from this network of meters was then delivered to OSIsoft's PI System, a software platform that collects, cleans, and structures data from different devices to give engineers and technicians real-time insight into their overall operations and asset health.

To understand consumption patterns, WHUD monitored water consumption rates between 1:00 a.m. and 4:00 a.m., when few consumers would be awake and legitimate consumption would be at the lowest level within a DMA. If a DMA exceeded a threshold value of 0.5 gallons per minute per household during this time period, PI System data would be employed to narrow down the location of a potential leak. The data would then be placed on an ESRI ArcGIS map so maintenance crews could prioritize repairs.

The Results

In 2015, the first year of the program, WHUD found and sealed leaks losing USD 400,000 worth of water. In the second year, it found another USD 500,000 worth of leaks, resulting in USD 900,000 of

saving in 2016 and the cumulative savings to USD 1.3 million, thereby paying off the budget of the project. (Remediated leaks become a recurring revenue stream: The USD 400,000 worth of water recovered by fixing the 2015 was repeated in 2016 and every year thereafter.)

In 2017, WHUD found USD 350,000 more leaks, raising the total water recovered or not lost in that year to USD 1.65 million and the cumulative total to nearly USD 3 million.

- o WHUD had an infrastructure leakage index (ILI) of 2.86 in 2012, which meant it was losing approximately 32% of its water through water main leaks.
- o In less than four days, WHUD discovered what local residents believed was a stream was, in fact, a water main leak spilling approximately 147 million gallons a year, or enough for 2,239 homes in the area.
- o WHUD later discovered another "stream" created by a leak that had spilled 500 million to 1 billion gallons since the late 1980s.
- o The 'smart meter' approach also allowed WHUD to avoid USD 200,000 worth of SCADA upgrades and recover USD 30,000 in employee time and productivity.
- o The time needed to prepare reports on potential problems dropped from six hours to ten minutes.
- o Perhaps most importantly, WHUD avoided the multi-million capital expansion. WHUD estimates that the interest payments on the

bond payments alone would have come to USD 600,000 per year. WHUD predicts it will not need a major capital expansion until 2028.

"Without us knowing there was a problem in that area, we would have never been able to stumble upon that leak," said Carl Alexander, GIS Director at WHUD. "Since implementation, this has held true with potential leaks being found daily, some so small they could have gone undetected for years. We have also been able to proactively notify customers that they may have a leak, so it has really been win-win."

White House Utility District has demonstrated what can be accomplished through digital technology.

Just as important, WHUD has shown that analytics and Big Data aren't just for large utilities with extensive engineering departments.

And, while water utilities are often very conservative organizations, results like this show that the industry could become one of the most important test beds for analytics.

About the Author

Michael Kanellos is the Industry Champion, Water, for OSIsoft.

IN THE US, recovering water from leaks costs on average USD 1.21 per 1,000 gallons, or less than half the cost of traditional water (USD 3.90 per 1,000) and far less than newer solutions like desalination, which averages over USD 8.00.

Namami Gange

- Twelve projects worth Rs. 929 crore approved. 2 Sewage Treatment Plant (STP) projects in Delhi given a green signal.
- Two sewage infrastructure projects worth Rs 425.41 crore inaugurated in Varanasi/ Foundation stone for a project worth Rs 72.91 crore laid in Ramnagar.
- Composite sewerage projects approved in Agra.



File Photo: The Union Minister for Water Resources, River Development & Ganga Rejuvenation, Nitin Gadkari (Photo Courtesy: PIB India)

New Projects Approved/ Sanctioned Under Namami Gange

The Executive Committee (EC) of the National Mission for Clean Ganga has approved 12 projects worth Rs. 929 crore under the Namami Gange programme.

Two Sewage Treatment Plants (STPs) have been sanctioned for Delhi for creating 340 MLD waste treatment capacity at a cost of Rs. 580 crore. The first is an STP of 318 MLD capacity at coronation pillar. The second is a project in Chattarpur assembly constituency where various sewage pumping stations and 9 STPs of total 22.5 MLD capacity will be constructed. The Central Government will fund Rs. 256 crore for this project.

For Uttar Pradesh, projects have been approved with the total cost of Rs. 128 cr. One existing Common Effluent Treat-

ment Plant (CETP) of 6.25 MLD capacity for textile printing units in Mathura Industrial Area has been taken up for upgradation. One project for treatment of Rampur Drain in Rampur, using NSN-Technology based Bio Oxygenation and another project for treatment of 30 drains and third-party inspection of 123 drains in the state has been approved.

For inspection and monitoring of industries, STPs and CETPs by third party technical institutions, an amount of 0.98 cr has been sanctioned for the strengthening of UP Pollution Control laboratories.

For West Bengal, two projects have been sanctioned at a cost of Rs. 50 cr. One project has been approved for upgrading the STP in Kancharapara from 13 MLD to 18 MLD capacity, along with its operation & maintenance for the next 15 years.

Sewage Infrastructure Projects in Varanasi and Ramnagar

Prime Minister Narendra Modi dedicated three sewage infrastructure projects to the nation costing Rs 425.41 crore for the city of Varanasi and laid the foundation stone for another project.

The first is a 140 MLD Sewage Treatment Plant (STP) at Dinapur built at a cost of Rs. 235.53 crore. The project includes 10 years Operation & Maintenance agreement. The second project includes three sewage pumping stations at Chaukaghat (140 MLD), Phulwaria (7.6 MLD) and Saraiya (3.7 MLD). The total cost for the 3 pumping stations was Rs. 34.01. The third project is the construction of 28 km long relieving trunk sewer, rising mains and interceptor sewers along Varuna and Assi at a cost of Rs. 155.87 crore.

PM also laid the foundation stone for Sewerage Management Scheme for Ramnagar at a cost of Rs. 72.91 crore. This included a 10 MLD STP and intercepting and diverting 4 drains.

Composite Sewerage Projects in Agra

Namami Gange projects in Uttar Pradesh, Bihar, West Bengal and Himachal Pradesh worth Rs. 1573.28 crore have been approved by the Executive Committee (EC) of National Mission for Clean Ganga (NMCG).

In a meeting held in the presence of Union Minister for Water Resources, River Development and Ganga Rejuvenation, Nitin Gadkari and UP Chief Minister Yogi Adityanath, it was decided that a comprehensive solution need-

ed to be worked out to address Yamuna's pollution issues in Agra.

The project for Rehabilitation/ Renovation of Agra Sewerage Scheme (Interception & Diversion Works) has been conceived at a total cost of Rs. 857.26 crore including the O&M cost for 15 years. The major components of the project include tapping of 61 nalas/drains, construction of 3 Sewerage Treatment Plant (STPs) of total capacity 166 MLD, construction of 10 decentralized STPs of 9.38 MLD and renovation of 2 existing STPs, laying of rising main of 17.61 km, renovation of Sewage Pumping Station (SPS), renovation of STPs renovation of interception work, upgradation of STPs (for chlorination), and operation & maintenance for 15 years.

G-Governance of Namami Gange Programme through Geospatial Technology

- o Geographical Information System (GIS) technology is widely used in river basin management. NMCG has signed an MoU with National Remote Sensing Centre (NRSC) in the use of geospatial technology in June 2015. They have developed Bhuvan Ganga Geoportal and Bhuvan Ganga Mobile Application.
- o Bhuvan Ganga Geoportal is available for water quality monitoring, hydrological monitoring, geomorphological monitoring, bio-resources monitoring, and comprehensive geospatial database.

- o Use of Drones and vehicles with cameras have also helped in identifying polluted Nalas joining the river Ganga.
- o IIT Kanpur is executing a project on 'Reconstructing the Ganga of the Past from Corona archival imagery'. Deliverables of Corona project would be to make all processed Corona images available for upload on the public portal such as Bhuvan.
- o Another project under execution is on 'Generation of Digital Elevation Model/ Digital Terrain Model using suitable sensors on an airborne platform for a corridor along the main stem of River Ganga' by Survey of India.

WABAG's 140 MLD STP Inaugurated by PM Narendra Modi in Varanasi

- Rs. 235.53 crore contract is the largest project implemented under Ganga Action Plan - Phase II.
- WABAG to operate & maintain the facility for a period of 10 years.



Dinapur STP, Varanasi

PRIME MINISTER OF India, Narendra Modi recently inaugurated a first-of-its-kind Sewage Treatment Plant (STP) at Dinapur, Varanasi with the capacity of 140 Million Liters per Day (MLD). The contract valued at Rs. 235.53 crores is executed by VA Tech WABAG Limited. The company will also be responsible to operate & maintain the facility for a period of 10 years. This project is a major step in contributing to the reduction of pollution of the river Ganga.

The project funded by JICA is the first and the largest sewage treatment project to be implemented under the "Namami Gange" mission. The treatment plant employs the activated sludge process and is powered by green power from sewage (biogas), significantly reducing the carbon footprint apart from lowering operation-

al cost. This is in line with PM's vision to power India through green energy and India's ratification at the UN Climate



Change Convention. The plant boasts of 4,000 m³/day balloon type double membrane gas holders, the largest of its kind in India.

Rajneesh Chopra, Global Head, Business Development, said, "The Varanasi sewage treatment plant, demonstrates to the nation the capability of WABAG to build world-class facility purely implemented by an Indian multinational

- vindicating our Prime Minister's vision of Make-in-India along with his dream of a Clean Ganga."

The project will enhance the sewage treatment capacity in the city from 102 MLD to 242 MLD. The project is located in Dinapur village, approximately 7 km from Varanasi and will cover an area of approximately 6.2 hectares, adjacent to the existing 80 MLD STP.



As an Indian multinational, we are really proud to be part of the mission to clean the holy Ganga, which is considered sacred and a lifeline to millions. We are happy that this marquee project implemented by WABAG, is being dedicated to the nation by our Hon'ble PM under the 'Clean Ganga' mission which is dear to his heart.

- Rajiv Mittal,
MD and Group CEO, VA Tech WABAG Limited

Smart Water & Waste World Exclusive

Mayur Sharma interacted with Rajneesh Chopra (Global Head, Business Development, VA Tech WABAG Limited) about the Sewage Treatment Plant (STP) project in Varanasi, Namami Gange, and other similar projects...



Q. Please explain the features of activated sludge process (which is powered by a biogas-based power plant) used for this STP.

Mr. Chopra: We would first like to express our gratitude to the Government of India, Government of Uttar Pradesh, National Mission for Clean Ganga and the Uttar Pradesh Jal Nigam for embracing a comprehensive wastewater treatment model with resource recovery and entrusting the responsibility to WABAG to demonstrate such a role model concept at Varanasi, which can be applied in future Namami Gange projects.

Activated Sludge Process (ASP) is a proven technology that has been in application for decades now. WABAG with its in-house capabilities and global credentials provides a

value proposition in terms of optimizing the capex as well as the opex coupled with enhanced efficiency to achieve the desired levels in treated wastewater. Most of the technologies that have evolved over the last decade are more or less a variant of the ASP and hence, ASP is still preferred globally for ongoing as well as upcoming projects.

The salient feature of employing ASP is its very good performance achieved in terms of BOD and TSS removal. In addition to this, given the variation in influent load in Indian cities, ASP's performance is not significantly affected due to normal variations in wastewater characteristics and seasonal changes. Furthermore, this technology helps resolve a key challenge in Indian cities today - low land availability.

For the sustainability of any

treatment process, uninterrupted power is a must. This is achieved at the Dinapur STP by employing a green, renewable and non-polluting mechanism - power from sludge biogas. Such a model not only reduces the carbon footprint but is also in line with Government of India's ratification at the Paris Climate Convention 2015 wherein India has agreed to produce 40% of its energy requirements from non-fossil sources.

Q. How do you see WABAG's role in the upcoming projects under Namami Gange and Ganga Action Plans?

Mr. Chopra: We would like to start off by saying that as an Indian multinational, we are proud to partner in our Prime Minister's vision to clean River Ganga through the flagship

"Namami Gange" program. The recently inaugurated Varanasi STP, which is the first and the largest sewage treatment plant under Namami Gange, will be a milestone project in making holy Ganga "Aviral" as well as "Nirmal" in line with our PM's vision.

To reiterate our commitment to the 'Clean Ganga Mission', in addition to Varanasi project which will reduce the volume of untreated sewage flowing from Varanasi into Ganga by almost 50% (14 crore liters), WABAG has been purifying around 55 crore liters of untreated sewage every day being discharged into the Yamuna from the National Capital Region (NCR). We are also executing projects under the Namami Gange mission at Haridwar and Patna, thus cumulatively treating around 100 crore liters of untreated sewage which was being discharged into river Ganga. Furthermore, for the first time in history, we are planning to raise funds for Hybrid Annuity Model projects, as part of our commitment to Namami Gange.

It is also appropriate to mention here that WABAG was chiefly instrumental in cleaning the Danube River running across Austria and this proven experience will vastly help us contribute to the 'Clean Ganga' mission.

Q. Are there more of such projects in the planning or construction stages?

Mr. Chopra: WABAG is executing projects along the Ganga belt - in Uttarakhand, NCR (National Capital Region), and Bihar.

First, the Rs. 296 crore rehabilitation and upgradation project for a 186 MLD wastewater treatment plant

at Rithala, New Delhi, under the Yamuna Action Plan. The scope includes design, supply, construction, and commissioning including operation & maintenance for 11 years. The project is financed by Japan International Cooperation Agency (JICA). The upgradation includes WABAG designing and constructing a biogas power generation unit from sewage, reducing dependence on the power grid. This is another fine example of our commitment to providing sustainable solutions and promoting a waste-to-wealth concept.

Furthermore, we are executing two sewerage projects with BUIDCO in Bihar. First is a comprehensive sewerage scheme at Karmalichak comprising a 21 MLD pumping station coupled with 97 km of sewage pipeline at a cost of Rs. 253 crore. Second is a novel 60 MLD wastewater treatment plant at a cost of Rs. 147 crore in Pahari which integrates a new technology called Nereda, contributing to enhanced efficiency, nutrient removal, and land footprint optimization.

Third, a rehabilitation and upgradation order for two wastewater treatment plants in Uttarakhand - Jagjeetpur (27 MLD) and Sarai (18 MLD). The project assumes significance given that they are in close proximity to Haridwar - one of the holiest places along river Ganga.

We have also submitted bids for three projects in Bihar, West Bengal, and Uttar Pradesh and are upbeat given our proven expertise and commitment to the 'Clean Ganga' mission from a sustainability perspective. We are keenly looking at upcoming projects to partner for the nation's welfare and prosperity.

Central Event Management Solution to Improve Water Efficiency at Brisbane Airport

Represents deployment of TaKaDu's digital technology in a non-utility entity.



Brisbane Airport Corporation is Deploying TaKaDu's Central Event Management in its Water Network

TAKADU RECENTLY announced that Brisbane Airport Corporation (BAC) in Australia, is deploying TaKaDu's Central Event Management solution to improve the efficiency of its water network operations and reduce water loss.

Based on big data analytics, TaKaDu's automated cloud-based service enables utilities to detect, analyze and manage network events and incidents such as leaks, bursts, faulty assets, operational failures, and more. TaKaDu can also be seamlessly integrated with many other IT systems (asset management, CRM, etc.) and other detection technologies (for example acoustic).

Krishan Tangri, General Manager Assets, Brisbane Airport Corporation (BAC) said, "BAC manages a water network spanning 49 kilometers across Brisbane Airport's

2,700-hectare site, supplying 300+ businesses and more than 23.4 million people every year.



"Having the ability to detect faults or operational failures as soon as possible to prevent service interruptions is critically important, so we're very pleased to have TaKaDu's digital technology to help us

strengthen our visibility, increase operational efficiency and reduce water losses," Mr. Tangri said.

Amir Peleg, TaKaDu's Founder & CEO, said, "We're delighted to add BAC to our portfolio, demonstrating how our core value proposition can apply to many types of network operations. Operating like mini-cities, airports are a perfect example of entities that can benefit from our centralized software solution. As a SaaS-based system, our solution can help them get up and running in a very short time."

Brisbane Airport Corporation (BAC)

BAC is the operator of Brisbane Airport (BNE), gateway to Queensland and the third largest airport in Australia by passenger numbers.

Smart Water & Waste World Exclusive

Mayur Sharma interacted with Amir Peleg (Founder and CEO, TaKaDu) about this project...

Q. Please summarize the role of "Central Event Management Solution" in this BAC project.

Amir: CEM will play a key role in increasing visibility, increasing operational efficiency and reducing water losses, as a single layer that combines all the events and incidents in their water network - a central solution that will be used for all events!

CEM combines data and information from several sources, uses strong analytics to detect anomalies, and integrates with other IT systems to provide a single layer of information about events and incidents for smarter decisions.

Q. What are the challenges, and timelines of BAC project? Have you done similar projects at other locations?

Amir: The Brisbane Airport contract is a great example of how large enterprises and facilities (like airports or other campuses) can use TaKaDu's technology to monitor their water network and enhance their efficiency.

This is the first project like that for TaKaDu but we see an interest from other, similar entities around the world. Water efficiency is a challenge in many territories.

Q. What are some of the other software solutions which the airports around the world can employ to improve water and wastewater efficiency?

Amir: TaKaDu's CEM platform is seamlessly integrated with SCADA, enterprise and IT systems, including Enterprise Asset Management (EAM), CRM (call centers), AMI data, acoustic loggers, and more. These can all be used by airports for improving water efficiency.

However, we cannot comment on what solutions are already deployed. What we do see is a growing trend that with more and more data accumulated, there is a need for strong analytics i.e. TaKaDu.

Yorkshire Sculpture Park Selects WPL Wastewater Treatment

- WPL HiPAF® selected for the prestigious £3.6m visitor center.
- The environmentally sensitive project required a resilient system.
- RIBA-accredited CPD seminar led to the contract.



WPL Provided a High Specification Two-Tank Modular WPL HiPAF Treatment System to Deliver High Quality Discharge for YSP. Image Courtesy of YSP.

WASTEWATER TREATMENT SPECIALIST WPL has supplied a packaged wastewater treatment system for Yorkshire Sculpture Park's new £3.6 million visitor center. The prestigious outdoor gallery in Wakefield, West Yorkshire, the largest of its kind in Europe, will open its new center, to be known as The Weston, on 30th March 2019.

Designed by award-winning architectural practice Feilden & Fowles, which specializes in environmentally sustainable buildings, The Weston is nat-

urally ventilated and features an air-source heat pump and a dense green roof. It also incorporates a pioneering low-energy environmental control system to maintain favorable conditions in the gallery all year round.

Hampshire-based WPL was originally approached by buildings and services consultancy Skelly & Couch following a lunch-and-learn CPD seminar with technical sales manager Dominic Hamblin. The WPL Off-Mains Drainage Seminar is accredited by the

Royal Institute of British Architects (RIBA) and explains the options available when mains sewerage is not possible.

The Environment Agency consent for YSP required high-quality discharge to the River Dearne and WPL provided a high specification two-tank modular WPL HiPAF - high performance aerated filter - treatment system. The HiPAF was installed by Alive Construction along with du-

pact on the site, fitting sympathetically into the historic landscape which boasts works by Barbara Hepworth, Henry Moore, and Andy Goldsworthy. The Weston includes a restaurant, gallery, public foyer and shop and is set into a hillside in a former quarry.

Dominic Hamblin said, "This project has been a pleasure to work on. I'm very proud that WPL is playing a role in bringing more people to Yorkshire Sculpture Park by provid-



Artists Impression of the Weston at YSP. Image Courtesy of YSP.

ty-standby blowers and GSM telemetry, also provided by WPL, to give extra resilience.

The bespoke system is designed for a maximum flow of 18 m³/d, discharge of 22 kg/d biological oxygen demand (BOD) and 3 kg/d ammonia. YSP welcomes 500,000 visitors annually and required a system that could manage the seasonal fluctuations in load while complementing the environmental ambitions of the wider project.

Most importantly, the underground treatment system makes a minimal visual im-

ing wastewater treatment for this stunning new visitor center and returning a steady flow of high quality treated water to the environment."

Peter Murray CBE, Executive and Founding Director of YSP said: "We're excited to complete construction on The Weston which is an important part of Yorkshire Sculpture Park's future. The new center is a reflection of our ambition to increase long-term resilience and sustainability by building audiences, further developing our artistic programme and in-



We are pleased to have been selected to provide the wastewater treatment system for Yorkshire Sculpture Park's inspiring new visitor center. This contract builds on our success in the tourism and leisure market where seasonal flows, environmental protection, and visual aesthetics are major considerations for our clients and their customers."

- Gareth Jones, Managing Director, WPL Ltd.

creasing visitor income.

"We are very grateful to the many different organizations who have made this project possible, including our visitors who have provided invaluable support."



The Weston Visitor Centre Under Construction at YSP. Image Courtesy of YSP ©Jonty Wilde.

PRODUCTS

NETZSCH Pumpen & Systeme GmbH



NETZSCH Pumpen & Systeme GmbH has announced the new **N.Mac™ Twin-Shaft Grinder**, designed to protect pumps and processes. The N.Mac is designed to fragment a variety of materials and is ideal for wastewater treatment, biogas and biomass plants, food, animal processing, and other waste and industrial applications. Available in both channel

and inline (flanged) housing construction, the N.Mac can be installed into effluent channels or upstream from a pump. Complementing existing NETZSCH product lines, the N.Mac expands grinding technology offerings, providing an upstream application to core NETZSCH pump technology. Models feature from 1 to 6 cutter cartridges per shaft. Available accessories include a control panel to ensure operator and equipment safety, a cutter cartridge cleaner that keeps the area free to cut and allows fluid passage, and a transmission shaft extension that elevates the electric motor to above the fluid limit.

Opto 22



Opto 22 has released the groov serial I/O module, **GRV-CSERI-4**. This module plugs into a groov EPIC® chassis alongside Opto 22's new groov Edge Programmable Industrial Controller (EPIC) and discrete and analog I/O modules, to provide the mix of

FND Science and Technology Group



FND atmospheric **Air Water Generator** is a high-tech product which is using physical tech to absorb and purify water from the air, then processing it into high-quality drinking water.

FND's AWGs use 3-layer air filtration, 4-layer to 8-layer water filtration exclusive patent (high-efficiency modified molecular sieve technology), and water molecule activation technology to remove harmful substances and make water fresh, safe and taste good.

It has been used in manned spacecrafts "Shenzhou 5" and "Shenzhou 10". Its water quality is in compliance with the World Health Organization's 6 major criteria for healthy drinking water and drinking water standards in developed countries.

analog, discrete, and serial signals you need at any location. Many industrial automation applications require communication between the controller and multiple serial devices. This new module provides four independent and isolated serial ports for this purpose, communicating with RS-232 or RS-485 serial devices. Up to 4 modules can be installed in one groov EPIC chassis, providing a total of 16 serial ports to support these communication requirements. The rugged module operates in temperatures from -20 to 70 °C (-40 to 85 °F) and relative humidity. The GRV-CSERI-4 I/O modules are hot-swappable - which means they can be installed or removed without turning off the unit or stopping control - and self-identifying; as soon as you mount the module on the chassis, it communicates to the processor and identifies itself. Each module is factory tested twice before shipment and is guaranteed for 30 months.

SUEZ Water Technologies & Solutions



SUEZ, through its Water Technologies & Solutions business unit, has introduced the expansion of its **ZeeWeed 500** family of membranes to address the needs of smaller membrane bioreactor (MBR) plants. With the addition of two

ZeeWeed 500 products, SUEZ is making this trusted, reinforced hollow-fiber ultrafiltration (UF) membrane available for all municipal, commercial and industrial applications at any flow range - from micro-sized to mega-sized wastewater treatment plants. ZeeWeed 500S for Small Simple Systems: Build greenfield

plants, expand existing facilities or retrofit unreliable membrane products with this small configurable series with integrated aeration to allow for geometrical and design flexibility. ZeeWeed 500M for Micro-Flow Systems: A unique UF hollow-fiber membrane for ultra-low flow systems, unique applications or research efforts to directly model the quality and performance of the larger 500 product.

Val-Matic Valve & Manufacturing Corp.



Val-Matic's **Swing-Flex®** Check Valves are designed for many years of maintenance free service. The Swing-Flex® Check Valve has a non-clog design with only one moving part and a short, 35° stroke provides fast closure to minimize slamming and slam related surges. It is constructed of ductile iron with cold working pressures up to 250 psi making it ideal for systems where traditional 125 lb. valves were unsuitable and for those where surges may be a concern. The valve design and performance has been verified through an independent 1,000,000 cycle test. The valves smooth, unrestricted flow path makes it an excellent choice for sludge and slurries. Swing-Flex® Check Valves are both NSF/ANSI 372 Certified Lead-Free, NSF/ANSI 61 Certified for Drinking Water and are designed and manufactured to AWWA C508.

LANXESS Invests in Production for Ion Exchange Resins in Germany

- Investment of seven-figure EUR amount.
- The project to be completed in the first half of 2019.



LANXESS is a leading specialty chemicals company with sales of EUR 9.7 billion in 2017 and about 19,200 employees in 25 countries. The company is currently represented at 73 production sites worldwide.

SPECIALTY CHEMICALS COMPANY LANXESS is investing in its ion exchange resin production facility at the Leverkusen, Germany, site. The company is optimizing its process technology and operating efficiency for a seven-figure EUR amount. The project is scheduled for completion in the first half of 2019.

Demand for ion exchange resins is, for example, rising in the battery industry, driven in particular by the trend toward electromobility.

The metals essential for battery cell production - lithium, nickel, and cobalt - can be extracted by means of ion exchange resins.

Little All-Rounders

Ion exchange resins are

polymer beads that absorb undesirable substances in fluids. Depending on the substance, differently functionalized beads are used.

Possible household applications include, for example, softening water in dishwashers and cartridges in household water filters. Here, ion exchange resins remove undesired calcium and magnesium salts or lead and copper ions from tap water. This improves the quality and taste of the drinking water.

In power plants, the polymer beads are used in the production of highly purified water and steam. Deposits and corrosion can thereby be prevented and efficiency, operational safety, and service life increased. Furthermore, ion exchange resins

help in removing selected heavy metals, such as mercury and cadmium, and organic pollutants from both groundwater and industrial wastewater.

A Leading Provider of Water Treatment Solutions

The LANXESS Liquid Pu-

rification Technologies (LPT) business unit is one of the world's most important providers of water treatment solutions.

In addition to ion exchange resins, the specialty chemicals company offers membrane filter elements for reverse osmosis and ultrafiltration membranes.

LANXESS is one of very few companies to offer these two different, complementary water treatment technologies from a single source.

In addition to Leverkusen, the business unit operates further plants for the production of ion exchange resins in Bitterfeld, Germany, and in Jhagadia, India.

Moreover, LANXESS manufactures reverse osmosis membrane filters in Bitterfeld.

The LPT business unit is headed by Bettina Blottko and employs around 530 people worldwide, with roughly 120 of those in Leverkusen.

“For our ion exchange resins business, we see great potential in numerous future-oriented industries. We intend to make even better use of this potential by optimizing our technology,” said Rainier van Roessel, member of the Board of Management at LANXESS AG. **“At the same time, with this investment, we are further strengthening the position of the Leverkusen site as the heart of our production operations in Germany.”**



Dr. Rainier Van Roessel

Experienced Telford Team Launches Broad-Based Engineering Services

Telford Engineering Solutions Pty Ltd (known as TES) is a diversified multi-disciplined design, modelling, drafting, and engineering organization, providing solutions within the mechanical, structural, civil, electrical, environmental, mining, energy, municipal, material handling, wastewater, waste-to-energy, and recycling sectors.



Gary Telford (Centre), with Team Members (From Left) Doug Read, Senior Draftsperson, Daniel Wade, Senior Draftsperson, Megan Abercrombie, Electrical Draftsperson, and Kim Flanagan, Administration Manager

AN ENGINEERING TEAM with decades of experience in major resources, construction, and infrastructure projects has formed a new company to offer broad-based and cost-efficient solutions to start-up, refurbishment, site revitalization, and process improvement projects nationally.

“We deliver a broad range of skills and experience from one source, offering skilled

design to create measurable profitability and productivity for clients,” says TES Managing Director and Lead Design Engineer, Gary Telford.

“Our advantages to clients in the established industry as well as growing new recycling and environment-focused sectors include our multidisciplinary skills, combined with our proven experience across a broad range of mate-

rial handling projects. These range from the design and implementation of new facilities, through to upgrades and modifications to existing material handling systems across a number of industrial and resource sectors, including recycling, coal and iron ore,” he said.

The TES team is also an industry innovator, designing and developing concepts such as modular conveyor systems that save time and money in bringing mining, materials handling and waste-to-energy projects to fruition, even on remote sites and on sites where custom-engineering would involve extensive engineering and delay.

TES will also continue and expand its team’s long association with major clients and partners in the resources and infrastructure sector, including particularly the Chute Technology Group, of which Gary Telford is a Joint Founder, along with Materials Handling



Engineer Dennis Pomfret of Dennis Pomfret Engineering and the Managing Director of TW Woods Construction, Tom Woods. Chute Technology and TES team members have been involved in major recent resources and infrastructure projects, including coal loader capacity upgrades, municipal and state marine infrastructure design and construction projects and the rehabilitation, recommissioning and process improvement of Glencore’s Integra mine.

The TES team, working with long-established partners, has also been involved in projects for companies such as Delta Energy, Incitec Pivot, water and wastewater authorities, Integra Coal, Laing O’Rourke, Xstrata and surface and underground mining companies throughout Australia including iron ore producers in the Pilbara and coal companies in Queensland.

“Our understanding of the special requirements of higher-level design - together with the ability and experience of our design team to anticipate critical design requirements - ensures project efficiency and success.”

TES’ design modelling, design drafting and detail drafting team skills include Structural Drafting; Mechanical Drafting; Civil Drafting; Electrical Drafting; Materials Handling Drafting; Conveyor Drafting; DEM (Discrete Element Method) Modelling Reviews; Transfers, Chute, Hopper and Bin Drafting; Mobile Mining Equipment Drafting; QDS Compatible Equipment



Using cutting-edge design and modeling technology, our highly trained and experienced design drafting and detail drafting team develops conceptual and layout designs, prototype modelling, workshop and as-built drawings incorporating various projects for plant, equipment, manufacturing, and construction.

- Gary Telford, Managing Director & Lead Design Engineer, TES

Drafting; Building Services Drafting; and Fire Equipment and Evacuation Plan Drafting.

TES works directly with major organizations requiring process innovation as well as with partners requiring a proactive, broad-based and proven team to complement their own capabilities.

POST EVENT

4th India Industry Water Conclave 2018 & 6th FICCI Water Awards

November 1, New Delhi, India



INAUGURATING THE 4TH Edition of 'India Industry Water Conclave on Sustainable Water Management' & the 6th Edition of FICCI Water Awards, organized by FICCI in association with the Ministry of Water Resources, River Development & Ganga Rejuvenation, UP Singh, (Secretary, Ministry of Water Resources, River Development & Ganga Rejuvenation, Government

of India) said, "The severity of water scarcity is real as the rate of groundwater extraction is 200% more than the rate at which it is being recharged. Further, the days of building large dams are numbered as the best sites have already been utilized, construction costs have skyrocketed and land acquisition and rehabilitation and resettlement costs have made projects unviable."

The focus must, therefore, shift to managing demand, he said and emphasized the need for incentivizing water use efficiency in agriculture and industry groundwater management through water budgeting at the panchayat level. He also released the 'FICCI Compendium of Best Practices: Recognizing Excellence in Water Management & Conservation' and felicitated the winners of the FICCI Water Awards.

Dr. Mihir Shah, Chair of the Jury for FICCI Water Awards, President, Bharat Rural Livelihood Foundation and former Member, Planning Commission, said the awards were an exemplar of the innovations that can address the water challenges of the 21st century, and carry examples that can be emulated throughout the country.

Naina Lal Kidwai, Chairper-



FICCI Water Awards

- ITC Maurya was awarded the first prize in the category of 'Industrial Water Efficiency'.
- In 'Innovation in Water Technology', the first position was jointly shared by **Transchem Agritech Pvt Ltd and Watsan Envirotech Pvt Ltd**. The third position was bagged by NTPC Limited.
- **HSBC - WASH Project**, in partnership with South Asian Forum for Environment (SAFE) - won the first prize in the 'Community Initiatives by industry' category.
- In the Category 'Urban Wastewater Management', the first prize was received by **Surat Municipal Corporation**.

son, FICCI Water Mission and Past President, FICCI, spoke of the need to bring technology and innovation in the policy space so that innovations could flourish and business models on water use could be created.

Speaking on 'Policy Reforms Towards Sustainable Water Management', Shashi Shekhar, Former Secretary, Ministry of Water Resources, RD & GR, Government of India, said that the role of the private sector was crucial in sustainable water management. KC Naik, Chairman, Central Ground Water Board, mentioned the importance of demand-side management and added that extensive education of stakeholders, change of cropping pattern, the creation of market

frameworks, use of sprinkler irrigations and underground pipelines can be effective tools for sustainable management.

Arun Lakhani, Chairman and Managing Director, Vishvaraj Infrastructure Ltd., said that there is a need for greater accountability for water and also a need for telescopic tariff and metering.

Rajneesh Chopra, Global Head - Business Development, VA Tech WABAG Ltd. spoke of the importance of introducing ratings for water use appliances for effective water conservation and management, and credit rating of municipalities, integrating water and wastewater management to achieve circularity.

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POST EVENT

AICE'18

November 16-17, Hyderabad, India

The conference was attended by over 270 delegates, which was 25% more from last year, drawn from the government and industry.



Panel Discussion (from left to right): David LaFrance - CEO - American Water Works Association, Dr. Jeevananda Reddy - Former Chief Technical Advisor - WMO/UN & Expert - FAO/UN, Sanjay Kamat - Chair AWWAIndia & VP Corporate Initiatives & Strategy - Tata Projects, Dr. DM Mohan - Consultant - World Bank on Rural and Urban Water Supply & Sanitation, Dr. M Satyanarayana - Executive Director - Hyderabad Metropolitan Water Supply & Sewerage Board (HMWSSB), and Dr. G Rameshwar Rao - Chairman - IEI Hyderabad

THE AMERICAN WATER Works Association, India organized its second international annual conference 'AICE'18 - Total Water Solutions' in India on 16-17th November 2018 in Hyderabad.

Pursuant with its stated goal, AICE'18 endeavored to unite the Indian water industry with an objective to bring together policy-makers, utili-

ties, practicing engineers and academicians in order to find innovative solutions for the challenges facing the water industry.

The conference was attended by over 270 delegates, which was 25% more from last year, drawn from the government and industry. David LaFrance, CEO, AWWA; Jim Williams, Incoming President,

AWWA; and Sanjay Kamat, Chair, AWWAIndia Strategic Board interacted with leaders from HMWSSB, CMWSSB, RWS, GHMC, PHED, Foundation for Futuristic Cities, World Bank, and many more distinguished attendees over a period of two days.

The conference had over 25 presentations classified under various sessions such

as utility management, water supply regulations - drivers and reality, rural water supply & sanitation, recovery, reuse & sustainability, and water sector - lessons learned & opportunities.

Presentations touched upon the most pressing challenges faced by India including non-revenue Water, ensuring clean and safe drinking water, policy and regulations for the water, etc.

Various innovative technologies were presented to help

They exchanged ideas on making the water sector more inclusive and diverse.

Majority of the attendees at the AICE'18 said that the technical content of the conference was excellent and covered a diverse set of topics ranging across the spectrum of water and wastewater management.

This is what the attendees had to say after the AICE'18 conference: "Please conduct these type of conferences at least once in two months in Hyderabad", "Very good ef-



Delegates at AICE'18

solve some of these challenges.

The 2nd 'Women's Networking Forum' was organized on the sidelines of AICE'18. The attendance of women water professionals jumped by 42% from last year.

forts to focus on water-related problems", "Conference was lively and exciting in all way", and "An event with Technical Invoice".

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Women's Networking Forum: David LaFrance with All Attendees

Some of the key speakers included Karuna Gopal, President, Foundation for Futuristic Cities; K Ashok Natarajan, CEO, Tamil Nadu Water Investment Company Ltd; Dr. M Satyanarayana, Executive Director, Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB); Meena Narula - Country Director, Water For People India; Dr. T Prabhushankar, IAS, Executive Director, Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB); and DG Sonwane, Group Sector Head, Built Environment - Tata Consulting Engineers Ltd.

POST EVENT

XII World Aqua Congress

November 22-23, New Delhi, India

'Aqua Excellence Awards' were key-highlight of the event. These awards are given to promote, encourage, and recognize innovations and contributions in the field of environment, and humanity.



THE AQUA FOUNDATION, India organized its twelfth World Aqua conference (Theme: Enhancing Water Use Efficiency) in New Delhi, India from 22-23 November 2018.



The technical committee of the congress received more than 200 abstracts of scientific papers this year - covering different themes of the conference from more than 9 countries. Out of these, 23 full



papers were invited for inclusion in the conference deliber-

ations.

Following eminent personalities from various fields addressed the gathering during the inaugural session:

- Dr. Sanjay Rana, Chairman, Aqua Foundation
- VK Kanjliya, Secretary, Central Board of Irrigation & Power
- Dr. DK Chadha, Former Chairman, CGWA/CGWB and Chair Prof & Chairman, Manav Rachna International University
- Dr. PR Swarup, Director General, Construction Industry Development Council

- AB Pandya, Former Chairman CWC and Secretary

Lifetime Achievement Award

Justice Swatanter Kumar (Retd.) was conferred upon Life Time Achievement award for his contributions towards the cause of environment while working as chairperson of National Green Tribunal.



IN CONVERSATION

Mayur Sharma talked to Dr. Sanjay Rana, Chairman, Aqua Foundation about the event...

Q. What is the motivation behind organizing this event every year?

Dr. Rana: I personally believe that in life anything which you are doing with passion - you are able to do that in a consistent manner. The World Aqua Congress was started by a group of people who were passionate about water. Water is not our business. We are an

NGO. We felt that there was a great need for information sharing, knowledge dissemination, and capacity building in the field of water and environment. The motivation was to bring all stakeholders at one place - one platform - so that a regular dialogue could take place. That passion is still alive. That drives us and keep us motivated.

Q. Your comments on this year's event and its results?

Dr. Rana: We have got good quality technical papers this year. We are covering holisti-

cally all the aspects of water efficiency. Talking about the industry support though, it is still very limited. We can even call it cold in terms of exhibiting and giving tech-talks.

The most special things about World Aqua Congress is that whatever recommendations we draw from here, we send it to various ministries, and then try to follow it up, so that they actually come up in their policy document. Hence, the positive developments in that regard give us the maximum satisfaction and encouragement.

ICID-CIID

- SMasood Husain, Chairman, Central Water Commission
- UP Singh, Secretary, Ministry of Water Resources, River Development and Ganga Rejuvenation, GOI
- Justice Swatanter Kumar (Retd.) and Former Chairperson, National Green Tri-

bunal

Aqua Foundation is a Non-Governmental Organization working on key aspects of humanity. It was founded in the year 1998. Aqua Foundation has been organizing international conference 'World Aqua Congress' since the year 2007.

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