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THE THREE R's – NECESSITY OF TODAY

We all agree to the fact that water is a valuable resource available in limited quantity and essential to the existence of the human race. Just like any other valuable resource it becomes mandatory that we use water carefully and most importantly recycle it and reuse it. Water reuse and recycling makes the non-potable wastewater useful, thus saving the economic and environmental costs related to establishing new water supplies. Today, it is high time we must follow the concept of three R's (reduce, reuse and recycle water) for the wellbeing of our planet and our future generations. We can reduce water wastage by using it wisely.

There are a few facts about water that all of us need to keep in mind and its very important that we remember them, so that we have enough water, which would ensure we live a healthy life and have enough that we can pass to our next generation. Water is a finite source. According to the Food and Agriculture Organisation (FAO), "water is a finite resource: there are some 1,400 million cubic kilometres on earth and circulating through the hydrological cycle. Nearly all of this is salt water and most of the rest is frozen or is underground. Only one-hundredth of 1 percent of the world's water is readily available for human use." What this means is that usable water that is available for use by humans, is a small fraction, of the water that is available on this earth, and that we need to use it judiciously.

At a global level, about 359 billion cubic metres of wastewater is produced each year which is equivalent to the size of about 144 million Olympic-sized swimming pools. As per a report by the Central Pollution Control Board 'Status of sewage treatment in India' the estimated sewage generation from Class I cities and Class II towns (as per 2001 census) is 29,129 MLD and this is expected to be 33,212 MLD at present assuming 30% decadal growth in urban population. We can use this wastewater, to our advantage, if the same can be recycled. The reality however, is very different. As per UN water, globally, 80% of wastewater flows back into the ecosystem, without being treated or reused, contributing to a situation where around 1.8 billion people use a source of drinking water that is contaminated with faeces, putting them at risk of contracting cholera, dysentery, typhoid and polio. As per a study by Lancet, in 2019, pollution was responsible for 2.3 million premature deaths, in India. Out of this air pollution was responsible for 1.6 million deaths, and around five lakh deaths were caused due to water pollution.

We are the second most populated country, in the world, after China, and have about 17.1% of the world population but only have 4% of the world's water. That itself creates a mismatch where close to 17% of the world population has to make good with just 4% of the world's water. The pressures of increasing population and rapid industrialization have only increased the stress on



water. As per government data, the average annual per capita water availability in the years 2001 and 2011 was assessed as 1,816 cubic meters and 1,545 cubic meters respectively which may further reduce to 1,486 cubic meters and 1,367 cubic meters in the years 2021 and by 2031 respectively.

Looking at our situation, it comes becomes clear that reduction in water usage, recycling and reusing of the waste water are the need of the hour and a necessity in case we want to pass on the valuable resource called Water to our future generations...It is time to think and Act...

Thanks & regards,

Deepak Chaudhary

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WABAG LED JOINT VENTURE SECURES DBO ORDER TOWARDS SOUTH EAST ASIA'S LARGEST SEA WATER DESALINATION PROJECT WITH CAPACITY OF 400 MLD, WORTH ABOUT INR 4,400 CRORES, FUNDED BY JICA

March 31, 2023: VA TECH WABAG ('WABAG'), a leading pure-play water technology Indian Multinational Group, further enhanced its leadership position in the Global Desalination market, by securing a Design, Build, Operate ('DBO') order, for the 400 Million Litres per Day (MLD) Sea Water Reverse Osmosis ('SWRO') Desalination Project from Chennai Metropolitan Water Supply and Sewerage Board ('CMWSSB') worth about INR 4,400 Crores. The project is scheduled to be executed under the leadership of WABAG in joint venture with Metito Overseas Limited ('Metito').

This DBO order includes the scope of Design, Engineering, Procurement, Construction, Installation, Testing and Commissioning of the 400 MLD SWRO Desalination plant and the associated sea water intake system over a period of 42 months followed by 20 years of Operation & Maintenance ('O&M'). The desalination process will include Lamella Clarifiers, Dissolved Air Flotation System, Gravity Dual Media Filters followed by Reverse Osmosis and Re-mineralization to produce clean drinking water which will be further distributed by CMWSSB to the residents of South Chennai.

This project is a landmark project for Chennai and India since this project when completed, will be the Largest Desalination plant in the South East Asian



Region. This project which is being funded by Japan International Cooperation Agency ('JICA') will enhance the water security for the city of Chennai through a stable source of drinking water in the form of Desalination. This project will also make Chennai, the Desalination Capital of India with almost 750 MLD of Desalinated water to be produced along the coast of Chennai. With the 400 MLD SWRO Desalination plant, Wabag will be responsible for about 70% of the water production through Desalination in Chennai.

Commenting on this order win, Mr. Shailesh Kumar, CEO – India Cluster said, "This is historically the largest ever order for Wabag. I'm extremely happy that we have been awarded this massive, prestigious and important Desalination plant order in Chennai from our trusted customer CMWSSB with whom our association spans over 2 decades now. Wabag has won this order against Global competition reinforcing our technological superiority and competitiveness in the Global Desalination space.

This is a testament to our leadership in the Global Desalination space and puts Wabag on an inclined growth path for the future. I'm also elated that this landmark order coincides with Wabag being ranked 3rd Globally among private water operators and among the Top 10 Desalination players globally by GWI. The project when completed will not only be a landmark project for Wabag, but a testament to Tamil Nadu's commitment to building Water security for Chennai and the State, making it a model for the whole country."

LANXESS INCREASES SALES AND EARNINGS SIGNIFICANTLY IN FISCAL YEAR 2022

Sales up 32.6 percent year-on-year at EUR 8.088 billion

Acquired Consumer Protection businesses make positive contribution

EBITDA pre exceptionals increase 14.1 percent to EUR 930 million

Dividend proposal for fiscal year 2022: EUR 1.05 per share



Guidance for fiscal year 2023: Earnings expected to be at the 2022 level

Guidance for Q1 2023: EBITDA pre exceptionals of EUR 180 million to EUR 220 million expected

CEO Matthias Zachert: "Our strategy has stood the test – LANXESS has successfully managed a year with many adversities."

Mumbai, March 27, 2023 – In an environment characterised by many upheavals, LANXESS closed fiscal year 2022 successfully. The specialty chemicals company's sales and earnings have increased significantly.

Group sales amounted to EUR 8.088 billion in 2022, up 32.6 percent on the previous year's figure of EUR 6.101 billion. EBITDA pre exceptionals increased by 14.1 percent

to EUR 930 million compared with EUR 815 million a year earlier. Earnings were therefore within the recently forecast range of EUR 900 million to EUR 950 million.

LANXESS passed on the significantly increased costs for raw materials and energy to the market in full via a successful increase of selling prices. The growth was especially driven by the Specialty Additives and Consumer Protection segments. The latter benefited in particular from the contributions from IFF's Microbial Control business acquired at the beginning of July 2022 and from the U.S. company Emerald Kalama Chemical acquired at the beginning of August 2021. Lower sales volumes, especially in the final quarter of 2022, had a negative impact on earnings.

"We mastered 2022 successfully and increased our earnings despite the adverse conditions. This shows that LANXESS is weatherproof. Our strategy has stood the test. Thanks to our products' leading market positions, we passed on the extreme

cost increases in full. In addition, we sharpened our focus on specialty chemicals and reinforced our presence in North America. This provides additional stability and growth,” says Matthias Zachert, CEO of LANXESS. “However, 2023 will not be easier. The reduced demand that we already felt in the final quarter of 2022 is currently continuing in the new year. But I am convinced that we will make it through this economic slump thanks to our stable positioning.”

The EBITDA margin pre exceptionals reached 11.5 percent, against 13.4 percent a year ago. The decline resulted from the passing on of significantly increased costs and lower sales volumes.

Net income from continuing operations increased considerably by 60.0 percent and amounted to EUR 184 million, against EUR 115 million a year ago. This does not include the results of the High Performance Materials business unit, which was spun off and reported as a discontinued operation.

For 2023, LANXESS expects EBITDA pre exceptionals to be at the level of the previous year. At the same time, the Group anticipates a recessionary business environment in the first half of the year. The persistently high energy prices from the fourth quarter of the previous year will also make an impact at the start of 2023. The repercussions of the war in Ukraine and changes in raw material and energy costs remain sources of uncertainty. For the first quarter of 2023, LANXESS expects EBITDA pre exceptional of between EUR 180 million and EUR 220 million.

WABAG FORAYS INTO BANGLADESH WITH A WORLD BANK & AIIB FUNDED DBO ORDER WORTH ABOUT RS. 800 CRORES

March 17, 2023: VA TECH WABAG (“WABAG”), a leading pure-play Water Technology Indian Multinational Group, has secured an order worth about Rs. 800 Crores towards Design, Build and Operate (DBO) for Reconstruction, Expansion and Operation of Pagla Sewage Treatment Plant (STP) with a capacity of 200 Million Litres per Day (MLD) at Pagla in the City of Dhaka, Bangladesh for Dhaka Water Supply & Sewerage Authority (Dhaka WASA). The project is funded by Multi-lateral Funding Agencies like World Bank and Asian Infrastructure Investment Bank (AIIB) under Dhaka Sanitation Improvement Project (DSIP).

The scope of the project includes Design, Engineering, Supply, Construction, Installation and Commissioning of the 200 MLD STP followed by Operation & Maintenance (O&M) for a period of 60 months. This project has the potential to be expanded to 600 MLD in the future, fuelled by city's growing needs.

This plant will operate based on Activated Sludge Treatment Process where it uses Green Fuel (Biogas) generated during the waste water treatment process producing Green Energy required for running the plant. This process also meets the Environmental norms and the production of Renewable Energy contributes to cause of combating global climate change.

Commenting on this order win, Mr. Arvind Dullu, Regional Business Head – South Asia said, “I’m extremely happy that we are following our stated strategy of making inroads into new markets and focusing on projects funded by Multi-lateral agencies. This project was won against international competition based on our technological superiority & competitiveness and is yet another significant milestone for Wabag. We are thankful to our client for the confidence they have reposed in us and this project will surely be a key reference in our journey.”

BENTLEY SYSTEMS ANNOUNCES INFRASTRUCTURE PROJECTS ACHIEVE MEASURABLE RESULTS WITH LUMENRT FOR NVIDIA OMNIVERSE, POWERED BY ITWIN

EXTON, Pa. – March 23, 2023 – Bentley Systems, Incorporated (Nasdaq: BSY), the infrastructure engineering software company, today announced how infrastructure organizations across industries and around the globe are leveraging the power of LumenRT for NVIDIA Omniverse, powered by iTwin, a solution enabling infrastructure organizations to create compelling visualizations and project deliverables with unprecedented speed and quality, make better-informed decisions, and win more projects.

LumenRT for NVIDIA Omniverse is the first engineering software application in the market built on Omniverse, a platform for creating and operating industrial metaverse applications. The integration of NVIDIA Omniverse and Bentley iTwin enables real-time, immersive 3D/4D experiences to enhance the visualization and simulation of infrastructure digital twins. The combined capabilities are delivering new possibilities and incredible results for some of the world's largest and most complex infrastructure projects.

An early adopter of LumenRT for NVIDIA Omniverse is Brigantium Engineering, an engineering and consulting services contractor working on the ITER project in southern France, where 35 nations are collaborating to build the world's largest tokamak and the first fusion device to produce net positive energy output across the plasma. Although the official language on the ITER project is English, there are more than 45 native languages spoken in the head office. Further complicating coordination, not all participants are accustomed to interpreting 2D drawings and Gantt charts.

To overcome these language and communication barriers, Brigantium is leveraging LumenRT for NVIDIA Omniverse to provide an interactive 4D model that is intuitively understood by everyone, vastly improving and streamlining communication. Brigantium expects that this increase in user engagement and improved feedback will result in profoundly improved cross-departmental communications, quicker execution times, reduced errors, and less lost time, amounting to overall team efficiency gains of up to 80%.

"The power of LumenRT for NVIDIA Omniverse, combined with the iTwin Platform, will allow our project teams to effortlessly combine models from multiple design tools and instantly create high-fidelity, engineering-accurate visualizations that communicate the design intent of the project. These kinds of visualizations are critical to project communications," said Lynton Sutton, Managing Director, Brigantium Engineering. "In the past we relied on specialists devoting valuable time and effort toward creating these essential project deliverables. It was inefficient, but necessary. Now, with LumenRT for NVIDIA Omniverse, everyone on the project can create compelling visualizations in less time and of higher quality than previously possible."

LumenRT for NVIDIA Omniverse is also bringing innovation to the Tuas Water

Reclamation Plant (TWRP) being built by PUB, Singapore's National Water Agency. A giant step toward closing the water loop for Singapore, the TWRP is a one-of-a-kind, multidiscipline mega project to build a treatment facility for industrial and household wastewater. A project of this scope and complexity presents major challenges in coordination and communication across 16 different contractors on designs and construction representing 3,500 separate BIM models. "Preparing for monthly stakeholder review sessions with our client used to be quite time consuming – to assemble and align all the model data and to create renderings and videos to share with the client. With the BIM model management of ProjectWise powered by iTwin, assembling the data is effortless," said OhSung Kwan, TWRP BIM Manager, with Jacobs. "With LumenRT for NVIDIA Omniverse, preparing renderings and videos takes much less time and we can explore more options with immersive VR. With these solutions together, we have reduced our preparation time for model review sessions, saving project costs and allowing more time to focus on collaboration with our client."

By leveraging the iTwin federated model for visualization, LumenRT for NVIDIA Omniverse enables rapid change propagation that simplifies visualization workflows by linking directly to a single federated infrastructure digital twin so when changes occur, they are synchronized automatically, which allows the project stakeholders to review safety, quality, and design changes. Project teams can also create immersive virtual-reality and augmented-reality design experiences for stakeholders, a capability that has become increasingly sought after for visualizing industrial-scale projects. As projects become larger and more complex, such virtual-reality and augmented-reality design experiences offer a more compelling way to engage customers in order to win new work, and then to sustain the win by keeping stakeholders informed and engaged.



Mechanical Screens

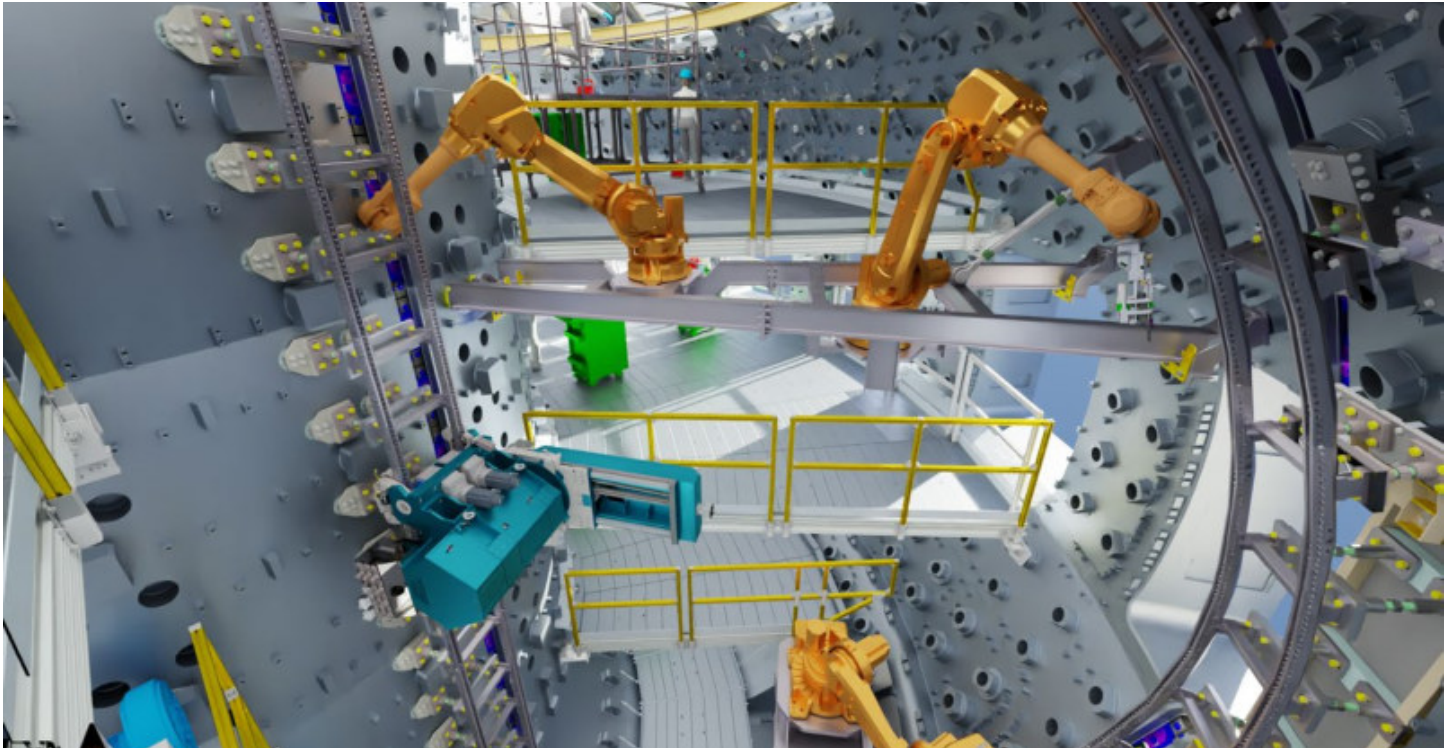
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While Brigantium and PUB are benefiting from improved communication and collaboration, engineering professional services firm WSP finds LumenRT for NVIDIA Omniverse and the iTwin Platform instrumental for winning new projects and maintaining stakeholder engagement. WSP is utilizing LumenRT for NVIDIA Omniverse to produce compelling visualizations for the multibillion-dollar I-5 Interstate Bridge Replacement (IBR) Project between Oregon and Washington in the United States. The existing Interstate Bridge serves as a vital trade route for regional, national, and international economies, but the aging infrastructure is inadequate for modern traffic and is also at risk of collapse in the event of a major earthquake.

Washington State Department of Transportation (WSDOT) and Oregon Department of Transportation (ODOT) are supporting the use of a digital twin developed on the iTwin Platform throughout the full program cycle, from public outreach with conceptual design, through detailed design, into construction, and eventually for continuous operations and asset management. One of the many advantages to this approach is that it enables WSP to sync change sets and seamlessly and rapidly generate updated visualizations without time-consuming imports and exports.

“WSP has committed to using infrastructure digital twins for all the benefits they provide, not the least of which is being able to create compelling visualizations quickly and easily, first to win the work and then sustain the win by keeping stakeholders informed and engaged throughout the project,” said Tom Coleman, Vice President, WSP USA. “Bentley’s workflows in the conceptual phase allowed us to engage stakeholders sooner and more effectively. We were able to produce many times more conceptual designs than we ever could in traditional methods. The team produced well over 30 conceptual designs for the client to evaluate.”

These are only the first of many success stories likely to come from the now public availability of LumenRT for NVIDIA Omniverse.

“The results being achieved by the early adopter users of LumenRT for NVIDIA Omniverse demonstrate a unique advantage for project teams working with infrastructure digital twins by providing powerful new digital twin-native workflows

that make visualization advantageous to apply on projects of every scale,” said Lori Hufford, Vice President, engineering collaboration, with Bentley.

The combination of iTwin and NVIDIA Omniverse provides an unmatched, high-performance user experience for infrastructure organizations at a scale that has previously not been possible. ProjectWise, powered by iTwin, leverages Bentley’s infrastructure schemas to semantically align design file data across multiple disciplines, mapping the information to a common schema that is open and extensible. The result is that all data is retained and not lost along the way as an asset moves from one phase to the next.

“Creating project visualizations during work-in-progress can be extremely time consuming, particularly as we need to combine or isolate different disciplines, assemblies, or specific parts of the model, which has meant a lot of juggling of files and separate, manual partitioning of models and one-off visualizations,” said Jarred Myburg, Development Manager – design tools & visualization, Hatch Ltd, another early adopter. “The alignment of model data by iTwin made it easy to employ LumenRT for NVIDIA Omniverse to streamline creation of visualizations of various parts of the model at different stages and tell a compelling story much more quickly, making visualizations much more effective to employ throughout projects.”

“The scale and complexity of the infrastructure projects described here demonstrate the need for AI-enhanced real-time visualizations to support the successful execution and delivery of these projects through improved communication across multiple stakeholders — iTwin and NVIDIA Omniverse help to solve these problems,” said Richard Kerris, Vice President of the Omniverse developer ecosystem, with NVIDIA.

NVIDIA Omniverse provides a graphics pipeline for AI-enhanced, real-time visualization, and simulation of infrastructure digital twins, allowing engineering-grade, millimeter-accurate digital content to be visualized with photorealistic lighting and environmental effects on multiple devices, including web browsers, workstations, tablets, and virtual-reality and augmented-reality headsets, from anywhere in the world.

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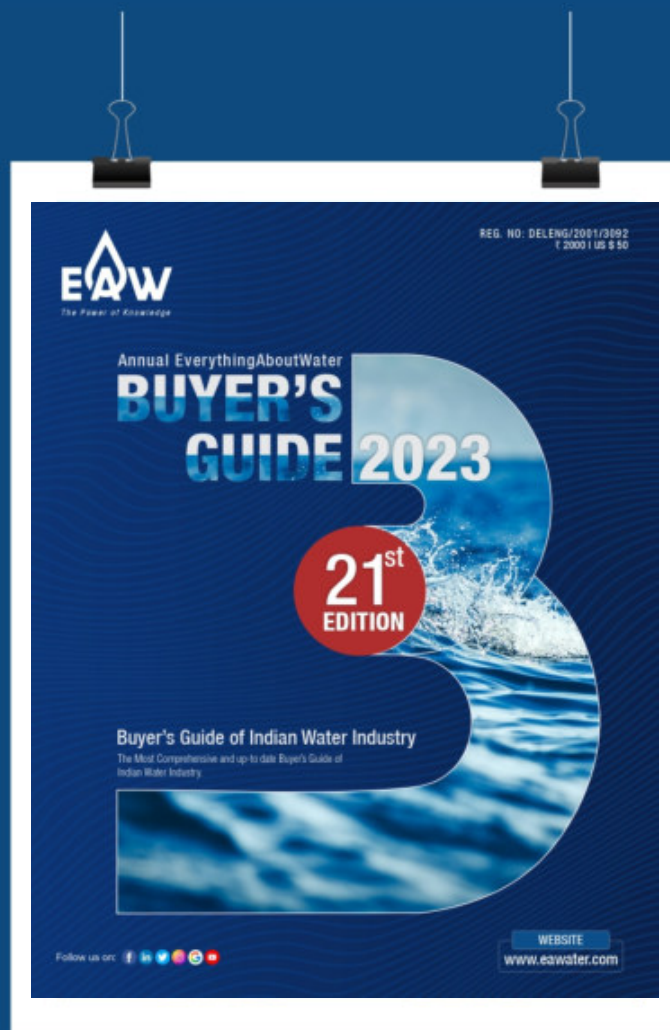
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LG CHEM SUPPLIES REVERSE OSMOSIS MEMBRANES TO THE LARGEST SALT LAKE LITHIUM EXTRACTION PROJECT IN CHINA

SEOUL, March 22, 2023 – LG Chem supplied reverse osmosis (RO) membranes to China's largest salt lake lithium extraction project. LG Chem today announced that the company has shipped more than 10,000 RO membranes to the Guoan lithium extraction project led by CITIC Group, China's largest state-owned investment company. The Guoan project, which kickstarted its full-scale operation in Qinghai province this year, is the largest salt lake lithium extraction project in China.

TUS-Qingyuan which manages the lithium extraction project across EPC, engineering, procurement, and construction expects to produce 20,000 tons of lithium carbonate annually by using LG Chem's RO membranes. This is equivalent to manufacturing batteries for nearly half a million EVs. In addition, this is the world's largest lithium extraction project using a filtration device.

RO membrane significantly reduces the amount of energy required for lithium production. To obtain lithium dissolved in salt lakes, water must be evaporated to increase its concentration which had been performed by applying heat to remove water. With the reverse osmosis process using RO membranes, however, it allows to quickly filter out the water molecules without applying heat.



LG Chem's RO membrane is primarily used for seawater desalination, characterized by a high level of impurity removal rate and a high production flow. In addition, the company's products have been recognized for excellent durability compared to those of its competitors, as several lithium extraction projects in China other than the Guoan project implemented LG Chem's product.

Five out of nine salt lake lithium extraction projects in China adopted the RO membrane method. As a result, the RO membrane market in China expects to grow by more than 8% each year, reaching a market size of KRW 2.2 trillion (CNY 11.9

billion, USD 1.68 billion) by 2025. LG Chem plans to expand sales of its RO membrane in other salt lake lithium projects in China and South America.

For efficient lithium extraction, LG Chem is collaborating with Korea University to develop RO membranes for next-generation direct lithium extraction (DLE) process that extracts lithium from the directly from salt lake which significantly reduces the lead time for concentrating lithium from months to hours. LG Chem is conducting research on identifying RO membrane element that increases lithium's recovery rate and purity with higher levels of durability. Once the DLE is applied at full-scale, the process becomes more straightforward with higher extraction efficiency while significantly reducing environmental pollution throughout the lithium production process.

"In line with the surge in global demand for lithium, LG Chem will lead the market by combining our global leadership in battery materials and RO membranes," said Dr. Hyung Hoon, Head of LG Water Solutions. "We will continue to offer differentiated values for our customers by developing a sustainable and eco-friendly lithium production process."

TERI, DEW PROJECTS & CHEMICALS TO COMMERCIALISE TADOX TECHNOLOGY FOR WASTEWATER TREATMENT

The Energy and Resources Institute (TERI) signed the TADOX Technology and Trademark License (TTLA) agreement with Dew Projects and Chemicals, Noida, for the commercialization of TERI's patented wastewater treatment technology for municipal and industrial wastewater treatment and reuse in New Delhi.

The economics of adequate treatment of wastewater, reuse and mandate to achieve zero liquid discharge (ZLD) has long been a challenge for industries. Advanced oxidation technologies like TADOX offer an economically viable and widely applicable





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solution to tackle the problem by making the process sustainable and energy efficient, noted Dr Vibha Dhawan, director general, TERI.

TADOX involves UV-photocatalysis as an advanced oxidation process (AOP) leading to oxidative degradation and mineralization of targeted pollutants. It also uses novel approaches which result in reduced use of chemicals in the overall treatment, as well as minimizing the quantum of sludge, preventing secondary pollution, and providing highly resource and energy-efficient treatment.

Shashi Kant Thakur, director, Dew Projects and Chemicals, Noida, highlighted, "Through TADOX we will be able to solve two of our biggest challenges of energy use and capex and opex."

Dr Praveen Arora, Scientist-G and head, water technologies cell, Department of Science and Technology, government of India, said, "It will act as a model for development for other technologies for water treatment."

Dr Suneel Pandey, director, environment and waste management division, TERI, said, "Once taken to commercialization it can help solve several challenges related to wastewater treatment."

Recently a 20 KLD TADOX wastew

ater treatment plant has been commissioned in a common effluent treatment plant (CETP) of a textile cluster in Kanpur through the funding support of the Namami Gange program. The plant was inaugurated by G Asok Kumar, IAS, DG-National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, GoI.

Dr Nupur Bahadur, senior fellow and associate director, environment and waste management division, TERI, and head, NMCG-TERI Centre of Excellence on Water Reuse and the inventor of TADOX emphasized the role of ecosystem and funding support through DST and NMCG, which helped her and the team to reach here.

NOD LIKELY FOR 40MLD WATER TREATMENT PLANT

The major irrigation department authorities are likely to grant permission for the proposed 45 MLD water treatment plant of Kinfra, which is going to be set up in the Periyar River at Aluva.

Earlier, the department authorities had opposed the project citing that the water carrying capacity of the river sharply declined after the 2018 floods. But it is learnt that the department would consider granting permission for the project in a meeting to be convened by industry minister P Rajeeve in the coming days.

The project has already invited criticism from environmental activists as the intake of large quantities of water for industrial purposes would pose a death knell of the river. It was after a dispute over the project between the irrigation authorities and the industrial department that the minister decided to convene a meeting.

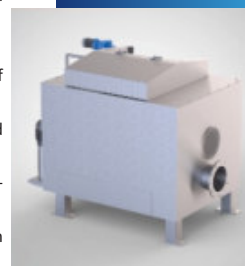
Sources with Kinfra said that a latest study report based on the water level in 2021 shows that there is sufficient water in the river even after flood and there are no practical difficulties for the irrigation department authorities to grant permission for the plant.

"We have already promised the government that the quantity of intake of water would be only 10 MLD in the beginning and it would reach the maximum capacity of 45MLD only by 2050," added the source.

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CELEBRATING WORLD WATER DAY 2023



WORLD WATER DAY QUOTE FROM VA TECH WABAG

By Rajneesh Chopra, Global Head – Business Development, VA TECH WABAG LIMITED

The theme of World Water Day 2023 could not have been more appropriate given the alarming water crisis globally and the setback because of the pandemic on the progress of UN SDG 6. To achieve SDG 6 by 2030, we need to align our vision towards water sustainably and security globally and accelerate the progress together.

WABAG's vision is aligned to UN SDG 6 and its own ESG Targets. Our motto "sustainable solutions for a better life" has been in existence even before SDGs were formulated. WABAG has ensured

access to clean & safe water and sustainable sanitation to millions across the world. Our endeavour has been to reduce water footprint for industries to achieve water security for them. We continue to provide cleaner technologies for a greener world.

Achieving SDG 6 is not just the responsibility of Governments and Social Organisations, but each and every citizen has to contribute to make it happen, for their survival and as well as for the future generation.



WORLD WATER DAY QUOTE FROM KPMG

By Sumouleendra Ghosh, Associate Partner, KPMG in India and Global Infrastructure Water Sector Lead of KPMG

The Indian water sector is at an important crossroad. Increasing demand coupled with dwindling freshwater resources as led to a situation where the country is staring at significant water stress in the near future. Today, the water sector in India finds itself grappling with two realities - the need for managing water optimally and the challenge of meeting the growing water demand from competing needs of domestic, agricultural and industrial sectors.

In the recent past, India has witnessed significant public spending in the water sector – through several flagship programs launched by Government of India, such as Jal Jeevan Mission, AMRUT (I & II) and NamamiGange Mission. We are also witnessing several major trends in the water sector – both in India and across the world, mainly as a response to the challenges being faced. These trends are going to define the water sector in the future.

First, there is a paradigm change in focus from asset creation to service delivery. This change in focus can be witnessed in both program design and monitoring. In the future, this is expected to gain center stage, with program evaluation to be conducted based on outcomes, rather than physical and financial achievement. Secondly, there is a growing focus on private sector involvement in

asset creation, asset management and service delivery in the water sector. Different PPP business models like HAM and DBOT, are being explored to encourage private players to actively participate in the sector. Finally, there is a growing emphasis on digitalisation and automation, including smart utility solutions, Big Data, AI/ML, IoT, etc.

Finally, there is a growing realisation that water resources need to be managed in an integrated and holistic manner. Both problem definition and solution design in the sector should happen keeping in mind the circularity of water resource. For example, source sustainability and water demand management are interlinked with wastewater management and reuse of treated wastewater. Also, different types of water demand like domestic, industrial and agricultural demands are linked to each other and should be managed in a holistic manner.

So, in a nutshell, integrated water resource management with a clear focus on outcomes and impacts – strengthened by the power of technology and private sector efficiency and innovativeness will help mankind to address water challenges going forward.



RISING POPULATIONS EXACERBATE LACK OF RESOURCES

By Mr. Rajesh H, Manager– Water Industry, ifm electronic India Private Limited

India's water supply comes mainly from rivers and groundwater. The greatest challenge consists in the lack of water, and this problem is becoming more serious as the population increases. We are approaching a zero point in many parts of India – water supplies are practically exhausted. Tap water is not potable. To make it drinkable, it has to be filtered using a domestic reverse osmosis plant.

The increasing scarcity of water has led to improvements in the supply infrastructure. Water losses have been significantly reduced thanks to modern automation solutions for supply pipes and pumping stations. ifm contributes to these efforts by providing condition monitoring solutions, for instance. In this way, defective pumps can be detected at an early stage and unplanned downtimes reduced. Also, there is a legal requirement to purify domestic and industrial wastewater to make it available for reuse.



WORLD WATER DAY: ACCELERATE TO COMMEMORATE

By Mohammed Naser Azeez, Managing Director, Aquality Water Solutions Pvt. Ltd.

Water is the most vital resource that we all use every single day. At global level, 2 billion people lack access to safely managed drinking water at home. The United Nations report on how climate change is affecting world's water resources has estimated that around half of the world population, nearly 5 billion people will face at least one month of water shortage by 2050. Lack of adequate water facility near homes is forcing women and girls in 8 out of 10 rural households to collect water for their family.

India's population is expected to rise from 1417 million currently to 1670 million by 2050, drastically increasing the demand for water. Several billion extra litres of water per day will be needed for public water supply while the demand for industries and agriculture will also grow exponentially. Unless major changes are made to our water management system, we simply won't have enough water to meet this demand.

The theme of World Water Day this year bring in focus the growing need of accelerated efforts to change the scenario of water provision for everyone under the Sustainable Development Goal-6 (SDG6) and encourage people to use water judiciously and live more sustainably. Water demand is rapidly rising due to population growth, urbanization and increasing pressures from the agriculture, energy and industrial sectors.

The economic progress worldwide has given rise to per-capita income which led to more consumption and life style changes together with increased awareness about the importance of safe drinking water, created huge demand for water. Access to

safe water is intrinsically linked to human health and well-being which is under tremendous challenge with reducing resources and increasing contamination.

In my opinion, the most effective way to address the prevailing and emerging water challenges is to deal with it in most holistic manner. Each nation can follow the Singapore example to establish a single authority that deals with the entire water system – from the source at catchment where water drops to where it finally ends in the ocean. We need radical changes in policies and governance with swift decision making for holistic water management that also make water saving attractive and easy to implement for people and industries.

Aquality Water Solutions Private Limited works closely with industries and institutions in a number of areas concerning water for health and productivity including water treatment for producing clean and safe water. As a strong mission driven organization, it has worked relentlessly with the sole intention of providing clean drinking water facility to its domestic and industrial clients. It has contributed immensely to the water treatment segment that has helped in improving quality of life of citizens with commitment, technological innovations and quality excellence.

The pandemic has shown that with a clear goal, diverse parties can collaborate and move at pace, sparking innovation. Every policy, plan and action need to be accelerated to bring the change towards creating a sustainable, resilient, and inclusive world with water positivity which places people and planet over profit.



CLEAN WATER: FOR PEOPLE & INDUSTRIES

By Abdul Rahman Mohammed, CEO, Sahara Industry

Clean, safe and easily available water is important for people, production and the planet. Apart from drinking and domestic activities, it is also used for cleaning, agriculture, food production, and all commercial purposes. Economic development of a nation largely depends on adequate availability of safe water. Appropriate water supply and sanitation and better management of water resources not only boost countries' economic growth but also greatly contribute in poverty eradication and public health.

The theme of World Water Day this year is about accelerating change to solve the water and sanitation crisis. Water affects us all in a major way, so everyone is needed to take action to enhance its sustainability. The theme is a thoughtful one, calling upon everyone residing on the planet earth to contribute, make a difference by changing the way we use, consume and manage water in our lives. Water is everyone's business and every action counts towards ensuring water for all as per Sustainable Development Goal-6 (SDG6) defined by the United Nations and agreed by member countries. SDG6 envisage making access to safe drinking water and sanitation for everyone by 2030, a fundamental to everyone's health, dignity, and prosperity. Yet, billions of people around the world still deficient of safely managed drinking water. It is a huge

task given the time frame agreed upon in 2015 and now only seven more years available to make it happen.

Wastewater Scenario

Demand for water is rapidly increasing with the population growth, faster pace of urbanization and increasing pressures from the agriculture, energy and commercial production sector. When the demand for clean water is increasing, the production of wastewater is also rising exponentially. Urban India which is currently producing over 72,000 MLD (million litres per day) of municipal wastewater apart from 62,000 MLD of industrial wastewater, is finding it difficult to properly manage it. Almost 70 percent of generated wastewater is not receiving any kind of treatment prior to disposal at water bodies.

Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio among others. Inadequate or inappropriately managed wastewater exposes people to preventable health risks while making drinking water dangerously contaminated and chemically polluted.

Way Ahead

To achieve the target agreed under SDG6, the pace of water infrastructure development would need to multiply between double to four times for the world to achieve universal coverage with basic drinking water services by 2030. With focused approach to make a difference in the way water and wastewater being treated, Sahara Industry has designed and manufactured advance treatment systems, membranes, softeners, ozonators, and sterilizer for water and wastewater treatment. The innovative solutions created by the company have contributed

immensely by effectively treating municipal and industrial water thus helping to safeguard the health of people and increasing production in industries.

Investing in water infrastructure development for making provision of clean drinking water supply will result in many benefits, including quality of life, economic progress, environmental sustainability and overall health of people. Every dollar invested in water and sanitation interventions gives a \$4.3 return in the form of reduced health care costs, reduced pollution of water and land resources, and gains in quality of life.



ACCELERATING CHANGE TO SECURE WATER SUSTAINABILITY

By Anil Sethi, Chairman, Pump Academy Private Limited

Globally, over 2 billion people lack access to safely managed drinking water at home. The latest data from WHO and UNICEF on access to clean water, adequate sanitation, and hygiene also reveal that 8 out of 10 people who continue to lack basic drinking water services live in rural areas. In 2015, the world leaders committed to United Nations' Sustainable Development Goal-6 that envisages creating facilities for safely managed water and sanitation for everyone by the year 2030. Clean water and sanitation is integral to achieve a safer world which was reinforced further by the coronavirus pandemic. Almost halfway mark on the SDG-6 commitment, the target is tracked and found that the governments must work on average four times faster in the remaining half period to meet this goal on time.

The theme of World Water Day this year highlights a different aspect of freshwater. UN has suggested a theme - "Accelerating the change to solve the water and sanitation crisis" for World Water Day 2023. It places the focus on working expeditiously to make safely managed drinking water from an improved water source that is located on premises, available when needed, and free from faecal and other contamination. This task needed an approach which is smart and intelligent embedded with technological intervention in creating sustainable water infrastructure while making the existing water resource and supply system robust and resilient.

Pumping system is an integral part of water infrastructure that enables the utilities to achieve and maintain compliance with safe drinking water while limiting water losses in the distribution network. Smart pumping system improves security, scalability, and longevity of water infrastructure. Water utilities are actively looking

for technological support for smart management as inefficiency of pumping systems has become a big concern. After comprehensive research and development, Pump Academy Private Limited has introduced a smart pumping solution based on IoT frameworks called iPUMPNET, which aims to increase energy efficiency and overall improvement in pumping stations management. This technologically advance and complete automated system facilitates water utilities with real time monitoring through an intuitive dashboard interface accessible on website and mobile applications.

Inadequate management of urban water supply with run down machineries and distribution networks significantly compromises the drinking-water facilities of hundreds of millions of people with dangerously contaminated water. When water comes from improved sources of smartly managed water supply system, people spend less time and effort in collecting it, meaning they can be productive in other ways. This can also result in greater personal safety and improved economic activity. Better water sources also mean less expenditure on health, as people are less likely to fall ill and incur medical costs and are better able to remain economically productive.

With ever increasing demand of safe water and enhanced productivity, the need for technological intervention in water distribution network including pumping systems is expected to grow. To ensure efficiency and keep up with changes, it is essential that water utilities in India should remain updated with technical advancements while maintaining sustainability. And that will be proper acceleration the change to secure better water sustainability in true sense.



ACCELERATING CHANGE TO SOLVE THE WATER AND SANITATION CRISIS

By Dr. P S Harikumar, Chief Scientist (Retd.), Centre for Water Resources Development and Management (CWRDM)

As one of the SDG goals of UN is (Goal 6) improving water quality by reducing pollution, eliminating dumping, and minimizing the release of hazardous chemicals, the discharge of waste from the domestic and industrial sector needs to be treated according to standard norms. Treatment of wastewater in developing countries is rather tardy. This has a negative impact on the environment, and the situation should be changed as soon as possible. Due to the better financial situation and to more stringent standards, wastewater sewerage and treatment are much more developed in industrialized countries. One of the most promising technologies for

the application of wastewater treatment in developing countries is nature-based solutions, due to its characteristic properties such as the use of natural processes, simple construction, simple operation and maintenance, process stability, cost effectiveness, etc. As the theme for World Water Day is 'Accelerating change to solve the water and sanitation crisis', humans have to take appropriate actions to encourage people to take action in their own lives to change the way they use, consume and manage water. One way to achieve the goal is through nature-based solutions in wastewater recycling, climate resilience adaptations, water treatment, etc.



RESPECT ... GREET ... THANKS ... LOVE THE WATER!

By Dilip Yewalekar, Senior Vice President, Jain Irrigation Systems Ltd.

India falls under medium to high water stress countries and @ 54% area are under water stress. India is considered to be a country facing water stress because of it has a large and growing population, agricultural activities, industrialization and fast urbanization. Additionally, climate change has contributed to unpredictable rainfall pattern and water scarcity in many parts, resulting in the threatening the livelihoods of millions of people and the country's' economic growth.

Water is undoubtedly the most precious resource on our planet. It is essential for all forms of life, and our survival depends entirely on its availability. However, despite its significance, water is often

taken for granted, wasted, and polluted. It's high time we start respecting water and taking measures to conserve this Valuable resource.

Water is also essential for agriculture, industry, and energy production. Without it, we would not be able to grow crops, produce electricity, or run our industries. Secondly, we must take steps to conserve water.

There are numerous ways in which everybody can respect water, thanks to water by using water judiciously and contribute in reducing wastage on day-to-day basis. For example.

Activity	% of water savings
Replacing/Repairing leaking Taps at kitchen, Bath, WC and plumbing pipes	3-5%
Operation of Cold /Hot water Taps	5-8%
Use Drip / Micro Sprinkler Irrigation for Garden, lawn-Landscape instead of hose irrigation	15-25%
Use High pressure jets for Washing of car, floor, tiles, walls etc	5-10%



WORLD WATER DAY QUOTE FROM DAIKI AXIS INDIA

By Mr. Kamal Tiwari, CEO, Daiki Axis India Pvt. Ltd.

Water resource management has become an important concern globally, with dwindling freshwater supplies across the world, it is vital for governments as well as Industries to adopt sustainable and cost-effective strategies to save water and promote greener economies. Access to clean, pure water has long been a problem in developing countries. Water-treatment plants, structured pipelines, and other critical infrastructure such as Decentralized sewage treatment plants that treat residential wastewater and promote the reuse of the treated water for local consumption are in great demand. Decentralized treatment of domestic wastewater can resolve many issues, like pollution abatement, reducing the load on freshwater resources, resolving sanitation issues, and enabling a circular economy, which can contribute significantly

to accomplishing SDG goals. The water industry has been actively assisting in the reuse, cleansing, and recovery of freshwater as well as the recycling of spent water. The recovery of wastewater leads to efficient disposal and transportation of industrial waste as well. The water industry is critical to the country's total growth and even the preservation of severe climate change such as unpredictable monsoons and droughts, that are impacting the population throughout, Households may benefit from the recovery and reuse of water and even help in sustaining groundwater. It is the need of the hour to take these steps to protect and conserve water and emphasize how we must utilize water and understand its crucial importance in our lives.



INDIAN WATER INDUSTRY: THE ROLE WATER PLAYS IN THE DEVELOPMENT OF THE COUNTRY

Dr. Syamal Sarkar (Ph.D.), IAS (R), Former Secretary, Min. of Water Resources & DoPT, Distinguished Fellow, TERI (The Energy and Resources Institute)

Water is essential for the economic growth of any country. In a growing economy like India industry plays an important role for water intake keeping in mind their production output. In 2000 the water demand of Indian industry was about 10 bcm and it is projected to increase to about 193 bcm in 2050 given the business-as-usual scenario. If India falls into the category of a 5 trillion-dollar

economy in the coming years, the water demand will be much more than the above projection. By 2030, India's water demand will be twice the available water supply.

Thermal power plants in India is the highest water intensive industry in India. In power plants water is used for many purposes:

cooling powers, ash handling etc. About 70% of total water consumption takes place in cooling towers and ash handling processes. Water can be saved substantially if water use efficiency is increased in these segments of the power production process. The discharge water of the industries, if safely treated, can be reused in the industry. India is a water stressed country and is expected to touch water scarcity benchmark in the coming years. This situation calls for conservation and saving of water

in all sectors and treat and reuse of water in industrial sector, domestic sector, and agriculture sector. The UN Sustainable Development Goal 6 relating to water and sanitation could be achieved by India by 2030 if there are 'accelerating changes' in the programmes relating to sustainable water management in the country along with partnership and cooperation of various stakeholders.



MAKING WATER A PART OF ECONOMIC DEVELOPMENT

MandarrKkamthe, Senior Product Manager–Water at Asian Contec Ltd. (Stanlay)

Improved water supply and sanitation and water resources management boosts countries' economic growth and contributes greatly to nation's growth. Resolving water related challenges requires that the costs for improved water supply and sanitation and water resources management be seen as sound public and private investments and key to a strategy that boosts economies, enables individuals and businesses with a fair chance to prosper. Simply put water and related services must be made part of the economic development business. Water and economy are inextricably linked. A country's overall development strategy and macroeconomic policies – including fiscal, monetary and trade policies – directly and indirectly affect demand and investment in water-related activities. Perhaps the most obvious examples are reforms to trade and agriculture that affect terms-of-trade and production and cropping patterns and thus ultimately determine water resource use and allocation.

With the continuing importance of globalization and economic reform, many developing countries are implementing fundamental

changes in macroeconomic policies. Many macroeconomic reforms call for a greater reliance on market incentives, open trade, fiscal austerity and the phasing out of producer and consumer subsidies (input and product markets). Government measures to reduce budgets or preserve the status-quo also imply increased competition between and within sectors that rely heavily on public investments for the funding of new development projects. Given this, the overall economic, social and environmental benefits of investment choices and the benefits of alternative funding sources must be carefully addressed. There is currently a high degree of awareness of the pressing social and environmental challenges the world is facing. 2 in every 10 people on earth lack access to safe water supply, and 4 in 10 lack access to basic sanitation service; there is also an awareness of increasing water demands and widespread cases of dwindling and mismanaged water resources and the inadequacy of water infrastructure. The water-related challenges and the urgency to resolve them have been confirmed and re-confirmed at the highest levels.



WORLD WATER DAY QUOTE FROM KRITSNAM TECHNOLOGIES

Dr. Jagadeesh, Senior Research Engineer and Sustainability Lead, Kritsnam Technologies

Once upon a time, in a small village called Madanapalle in the Chittoor district in India, lived a farmer named Ravi and his wife Sita. They had a small piece of land on which they grew their crops. Every year, they faced the difficult challenge of managing their water supply, especially during the dry seasons. They had to rely on the monsoons to fill their wells, which often left them with little or no water for their crops.

One day, Ravi and Sita heard about the importance of water conservation and the advancements being made in the Indian water industry. They decided to attend a workshop on water management, where they learned about various techniques to conserve water, such as rainwater harvesting and drip irrigation. They also learned about the latest technologies that could help them manage their water supply more efficiently. After the workshop, Ravi and Sita implemented these techniques on their farm. They installed a rainwater harvesting system and a drip irrigation system, which helped them conserve water and increase their crop yield.

They also learned about the importance of water quality and started using water testing kits to ensure that their crops were not contaminated with harmful chemicals. Over time, Ravi and Sita's farm flourished, and they were able to sell their surplus crops in the market.

They also started educating their fellow villagers about water conservation and the importance of managing their water resources. With their efforts, they were able to create a water-secure environment in their village, which helped the community to prosper.

In conclusion, water plays a crucial role in the development of India, especially in agriculture. The Indian water industry has made significant advancements in water management, which has helped farmers like Ravi and Sita to conserve water and increase their crop yield. With the right techniques and technologies, water can be managed sustainably, ensuring a better future for India and its people.



WATER SECURITY AND FOOD SECURITY IN INDIA

Mridusmita Debnath, Civil Engineering Department, Indian Institute of Technology Guwahati, Assam, Scientist, Division of Land and Water Management, ICAR—Research Complex for Eastern Region

Forecasts on demographic growth and economic development specified a significant increase in food demand to almost double by 2050. Rising food prices are a clear indication of that. Further, demographic projections confirmed that more than 50% of the population worldwide will suffer water scarcity by 2025. Thus, the conflicts among water-demanding sectors and uncertain climate aggravate the situation in agriculture. Moreover, with limited land resources, crop area augmentation is impossible, giving rise to an urgent need for agricultural water management by quantifying future food and irrigation demand.

Agricultural water demand occupies the lion's share and nonconventional water use for irrigation can significantly bring down the water need use such as rainwater harvesting and recycling irrigation water. Also, importing water-intensive crops in

the international food trade is similar to considerable water savings for those countries and ensuring food security. Hence, the term is coined as 'virtual water'. Many of these approaches focus on developing countries' crop production and food security. Several studies have evaluated the potential benefits of crop diversification in changing climate (Maroufpoor et al. 2021; Bhogal and Vatta 2021). Moreover, rice being the staple food of half of world's population, the monocropping of rice prevails in a major cultivated area of India. The virtual water trade showed significant water outflows in India through rice export, which urges the need for water-efficient rice production (Saxena et al. 2023). Therefore, basic adaptive strategies, including changes in crop pattern, type of crop, and crop breeding which use less water for more production, are required along with improvement in existing irrigation infrastructure to use water efficiently and feed the growing population of India.



INDIAN WATER INDUSTRY AND THE ROLE WATER PLAYS IN THE DEVELOPMENT OF THE COUNTRY

By Dr Anil Kumar Mishra, (Bacteriologist), Delhi Jal Board, Govt of NCT Delhi

Water is an essential and vital component of life and required for performing different type of metabolic activities in all type of living organisms. In present scenario, water scarcity and contamination (physical, chemical microbiological, radiological contaminants) are major problem in India and worldwide. Due to rapid growth of population, urbanization, industrialization and agriculture activities, water resources are under stress and gap between supply and demand (required for various activities like bathing, cooking drinking, sanitation, irrigation, industries etc.) increasing every year. Different national and international agencies are issuing directions/guidelines for conservation of water resources, avoid polluting water bodies/ ground water, sustainably use of water etc. Climate change also playing pivotal role for increasing stress on water resources. Worldwide, a significant number of population not getting sufficient quantity of potable and wholesome drinking water (as per norms), resulting their health related complexity are increasing due to different type of pollutants.

Water is central hub for all type of economies (agriculture, industries etc.), required for sustaining life on earth and other activities. Without water, we cannot get anything like food,

oxygen, shelter etc. It is also playing important role in climate change/ maintaining environment. In the view of above facts, various agencies like Government, NGOs, regulatory organizations, public and other stakeholder making their best efforts to manage it in useful manners, so that sufficient quantity of good quality of water (potable and wholesome) may be available for everything like plants, animals and others activities like agriculture and other industries. In present scenario, Ground as well as surface water pollution is a serious issue and this problem must be sorted out for the survival of life on earth.

In conclusion, I would like to make suggestion to all the stakeholders that every one respect water and its resources; as water is 100% natural and any substitute is not available for it. Use it judiciously and sustainably, so that our future generations may get sufficient quantity of potable and wholesome drinking water. If we may not maintain it properly, significant number of population may not get good quality of water in coming decades. Everyone focus for proper conservation and management of water, adopt various technologies required for reduction of NRW, adaptation of rain water harvesting, follow different R's related to water etc.



WATER INDUSTRY AND THE ROLE IT PLAYS IN THE DEVELOPMENT OF A COUNTRY

Dr. Ajit Vishnu Salvi, Dy. Chief Engineer (S.O.), Brihanmumbai Municipal Corporation

Water is elixir of life. It has quantitative limitations and qualitative vulnerability. Water is essential for manufacturing, Agriculture, Commerce, many types of energies, Economics and the existence of human & other life forms. However, one should not forget that water can never be manufactured. Cloud seeding technology still has long distance to go. Water is at the core of sustainable development and is critical for socio-economic development, healthy ecosystem and for human survival itself. It is vital for reducing the global burden of disease and improving the health, welfare and productivity of population. The water industry is essential for the development of any country and particularly fast developing country like India. It is critical for ensuring access to clean and safe drinking water, effective management of wastewater, supporting economic development and promoting

environmental sustainability. The industry plays a crucial role in conservation of water resources, protection of aquatic ecosystems and management of water related disasters such as floods and droughts. As such governments, Private Organizations, NGOs and individuals should prioritize investment in the water industry to ensure its continued growth and development. Effective Budget allocation towards the water industry is essential for the effective management of water resources and industries dependent on it. Government need to take into consideration the needs of Water Industry, prioritize areas that require immediate attention, ensure equity and accessibility, promote sustainability, encourage Public-Private partnerships and regularly monitor and evaluate the effectiveness of budget allocation.



ONLINE MONITORING OF WASTEWATER EFFLUENTS IN INDIA

Lukas Kornfeind, Application Manager, Badger Meter Water Quality International

Surface and ground water are the major sources for drinking water worldwide. Therefore, their protection is the basis for public health and in the interest of many governments. To examine the current situation, the Central Pollution Control Board of India (CPCB) published, the guidelines for online monitoring systems of wastewater effluents. 17 categories of effluents, from common effluent treatment plants and STPs up to industrial dischargers like pulp & paper, oil refineries and dye & dye units, were defined. For these categories emission monitoring systems should help to track the discharge of pollutants. COD, BOD, TSS, oil indicators, pH and Ammonia, were parameters of special interest. More than 1000 s::can online monitoring systems are installed only in industrial effluents tracking the quality of the water, either sweeping into the groundwater or directly entering into the surface water. s::can uses

online UV/Vis-spectrometers for measuring multiple parameters at the same time in a single probe. With measurement intervals less than two minutes, even small, but possibly high polluted emissions of COD, BOD and TSS, can be recorded. The combination of organics (COD, BOD) and classical parameters like pH illustrates the harmfulness of the pollution discharged into the environment. As the industrial and municipal plants are spread all over the country it was necessary to centralize the information of the s::can probes. Therefore the s::can monitoring systems sending the data via GPRS directly to the online platform of the CPCB. Beyond that s::can monitoring stations are installed in many rivers, all over the country observing their water quality for indicators of pollution. Together with wastewater monitoring this strategy provides a powerful tool for future measures.



WORLD WATER DAY QUOTE FROM BIOPETROCLEAN INDIA

Mr. Bhaskar Sharma— CEO, Bio Petro Clean India Private Limited.

Biopetroclean India Pvt Ltd recognizes the importance of water and the need for sustainable management for water resources. This World Water Day, we join the global community in raising awareness about the importance of water and the need for efficient water management practices.

At BPC, we are strive to providing innovative and eco-friendly solutions for wastewater treatment. Our patented technology utilizes natural biological processes to break down pollutants in wastewater and covert them into harmless by products.

As we mark World Water Day, we believe that it is important for all stakeholders to work together to ensure that everyone has access to safe and clean water. We encourage industries, government and communities to adopt sustainable water management practices and invest in innovative solutions for water treatment and maximize reuse.

At Biopetroclean India Pvt. Ltd., we remain committed to our mission of providing sustainable solutions for wastewater treatment and contributing to a cleaner future.



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1. LANXESS India wins the prestigious CII Western Region SHE Excellence & Innovation Award 2022

LANXESS India has won the prestigious 17th Edition of CII Western Region Safety, Health and Environment (SHE) Excellence & Innovation Award 2022 in the Manufacturing Category (large) for its Jhagadia site.



The award is a mark of recognition from CII for the Leadership, Vision & Efforts made by organizations in following path-breaking practices in Safety, Health & Environment. It ensures the commitment of the industry to SHE excellence instilling high SHE consciousness among all employees and utilizing the best SHE practices. It also provides an opportunity to industry stakeholders to learn and adopt best safety management practices followed by successful organizations.

The criteria for evaluation included innovation, uniqueness, people involvement, motivational factors, replicability / horizontal deployment and environmental & sustainability initiatives adopted by the organization.

2. ABB reveals an additional 8.56 billion cubic meters of wastewater a year needs to be treated to meet UN goals

Global wastewater treatment capacity needs to increase annually by 8.56 billion cubic meters and investment in an additional 469[1] treatment facilities per year is required to meet United Nations (UN) goals[2]. These are the findings of independent research commissioned by ABB ahead of World Water Day (WWD) on March 22, 2023.

As the UN prepares to report on progress made against its Sustainable Development Goals (SDG), ABB's research focuses on SDG 6.3 which

aims to improve water quality by halving the proportion of untreated wastewater globally, increasing recycling, and minimizing the release of hazardous materials. The UN says 2.2 billion people lack access to safely managed drinking water, while more than 4.2 billion people lack safely managed sanitation.

However, treating wastewater is energy intensive, with the industry consuming up to three percent of the world's total energy output[3] and contributing to over 1.5 percent of global greenhouse gas emissions[4].

"This research proves more needs to be done to help support the UN goals and accelerate progress in tackling water scarcity," said Brandon Spencer, President of ABB Energy Industries. "But we need to ensure we are achieving these wastewater treatment targets in the most energy and resource efficient way possible to make it sustainable. This is where technology is key."

While increasing wastewater treatment capacity is a priority, the early integration of technology to drive efficiency at plants is also vital. ABB's automation, electrification and digital solutions are helping monitor, analyze and manage wastewater plant operations. In association with crucial measurement and control solutions, which collect and transmit a wealth of operational and diagnostic data, ABB systems help optimize resource efficiency and reduce energy consumption.

Development Economics, which has over 20 years' research experience, utilized the same data employed by the UN to assess what real-term measures are needed. Based on modelling using a 50-million-liter daily capacity wastewater treatment plant as the benchmark, a further 469 treatment facilities – the volume equivalent of 3.4 million Olympic swimming pools – is required each year.

The scale of the challenge linked to UN SDG 6.3 is highlighted in a report[5] from 2021 assessing the volumes of wastewater collected, treated, and reused. The research, which is used by the UN, concludes that 48 percent or 171.3 billion cubic meters of wastewater is uncollected or untreated annually. To meet SDG 6.3 – which targets halving the proportion of untreated wastewater by 2030 – these figures need to be reduced to 24 percent and 85.65 billion cubic meters.

In 2022, ABB's Energy Transition Equation report[6] analyzed how better use of wastewater could relieve pressure on water supplies through greater integration of automation and digital technologies:

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By applying a package of automation and digital solutions, water companies can reduce carbon emissions as well as deliver annual operational savings of up to \$1.2 million per plant

ABB's Process Automation business is a leader in automation, electrification and digitalization for the process and hybrid industries. We serve our customers with a broad portfolio of products, systems, and end-to-end solutions, including our # 1 distributed control system, software, and lifecycle services, industry-specific products as well as measurement and analytics, and marine offerings. As the global #2 in the market, we build on our deep domain expertise, diverse team, and global footprint, and are dedicated to helping our customers increase competitiveness, improve their return on investment and run safe, smart, and sustainable operations.

3. WSB and Bentley Systems Offer New Digital Construction Management Service Based on SYNCHRO

EXTON, Pa. and MINNEAPOLIS – March 15, 2023 – Bentley Systems, Incorporated (Nasdaq: BSY), the infrastructure engineering software company, announced a collaboration initiative with WSB to lead civil infrastructure owners and contractors to adopt and use infrastructure digital twins. WSB has launched a new digital construction management solution and advisory service, based on Bentley's SYNCHRO, to help the civil infrastructure market overcome challenges of adopting model-based digital workflows and leveraging the power of construction digital twins. WSB is the first firm to join the Bentley Digital Integrator Program for construction to provide programmatic go-to-market support and knowledge transfer to eligible engineering and project delivery firms and system integrators creating and curating digital twins for their clients' infrastructure assets.

Construction work is too often based on 2D drawings, spreadsheets, and document-based workflows resulting in errors, waste, and rework that cause most projects to be over budget and schedule. Bentley and WSB will lead firms in transforming construction by adopting technology and digital delivery.

Through a combination of industry-leading software, expertise, and innovation, Bentley and WSB's digital construction management initiative is helping to shape the way infrastructure projects are delivered. Key services include enabling a single source of truth by connecting project, contract, and document management to the future of design—a 3D/4D/5D constructable model—as well as the ability to create constructable models from current 2D plan sets, which allows the transition to a single source of truth for all stakeholders. This initiative is committed to putting the industry-leading model-

based construction management tool in the hands of those who build the work. WSB promotes advanced project delivery and knows how to apply the right technology and expertise to support their clients' aspirations for a digital future.

Together, Bentley and WSB are meeting the market where it is and providing the tools, training, education, and support required to make the digital leap. Project teams will realize the value of model-based digital delivery for better project efficiency and outcomes. Civil infrastructure owners and contractors will overcome barriers to technology adoption to drive efficiencies from preconstruction planning through construction execution. Skills will improve as more projects adopt model-based delivery, resulting in it becoming the common standard.

4. LANXESS expands Rhenodiv® production at Jhagadia site

Mumbai / Jhagadia, 13 March 2023 - Specialty chemicals company, LANXESS laid the foundation stone for its Business Unit Rhein Chemie's new and upcoming production line for Rhenodiv® - New Technology Release agents at its Jhagadia site. With this facility, the business unit will serve the growing demand of the Indian Tire & Rubber goods market.

The new production line will feature state-of-the-art equipment and technology, allowing LANXESS to produce high-quality technology tire release agents more efficiently. Currently, LANXESS has such a facility in Argentina. Once this facility becomes operational it will cater to the Indian Sub-continent & Asian markets.

The production of high-performance tires and molded elastomer products relies on the use of effective release agents. Process safety and low scrap rates are key for the efficient production of tires and molded elastomer articles. Rhenodiv® release agents are strictly water-based, solvent-free* and free of volatile organic compounds (VOCs) and therefore, environmentally friendly. LANXESS Rhein Chemie business unit has the solutions, market understanding, production knowledge and comprehensive service to support its customers at every stage of the process chain.

The laying of the foundation stone was done by Dr. Jens Hendrik Fischer, Global BU Head of Rhein Chemie, Dr. Holger Graf, Global Head of Production and Mr. Namitesh Roy Choudhury, Vice Chairman & Managing Director LANXESS India, along with Mr. U Parmeshwara Sriganesh, BU Head Rhein Chemie India region. The project is expected to be completed in the first quarter of 2024.

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5. SUEZ announces a new organization to deliver its strategy and appoints two new members to the Group's Executive Committee

Announced in September 2022, SUEZ's new strategy aims to make the Group the trusted partner for circular solutions in water and waste recycling & recovery. To reflect this new ambition, SUEZ is redefining its organisation around two major principles:

two operational divisions focusing on the Group's two core businesses, Water and Recycling & Recovery. This new structure will enable SUEZ to fully leverage its portfolio of solutions and improve expertise sharing and synergies between countries.

three cross-group units, Engineering & Construction, Digital Solutions, and Innovation. These units will contribute to offer SUEZ clients with truly differentiating offers, combining their unique expertise in engineering, procurement and construction with a recognised leadership in digitalization and in research and development.

The Group's new organisation will thus accelerate value creation for the benefit of our clients, all over the world.



Consequently, the Group welcomes two new members to its Executive Committee who will report to Sabrina Soussan, Chairman and CEO of SUEZ.

Yves Rannou is appointed as Chief Operating Officer Recycling & Recovery, Executive Vice-President, effective before Summer 2023. He will lead all the teams worldwide that are responsible for supporting local authorities and businesses in recycling and recovering their waste. In 2021, this division generated 45% of the Group's revenue. It comprises more than 23,000 employees working on behalf of clients in 7 countries.

Jörg Linsenmaier is appointed Executive Vice-President Engineering & Construction, effective May 2nd. He will lead all the engineering, procurement, and construction teams worldwide. His mission will be to deploy SUEZ's vast expertise in construction to deliver sustainable growth for the Group.

Following the appointment of Pierre Pauliac as Chief Operating Officer Water, Executive Vice-President, both nominations complete the membership of the Group's Executive Committee. Chaired by Sabrina Soussan, this now comprises the following directors:

Thomas Devedjian, Group Chief Financial Officer, Executive Vice-President

Laurent-Guillaume Guerra, Chief Human Resources Officer & Head of Health & Safety, Executive Vice-President

Frederick Jeske-Schoenhoven, Chief Strategy & Sustainability Officer, Executive Vice-President

Anne-Sophie Le Lay, Group General Counsel, Executive Vice-President

Jörg Linsenmaier, Executive Vice-President Engineering & Construction

Pierre Pauliac, Chief Operating Officer Water, Executive Vice-President

Yves Rannou, Chief Operating Officer Recycling & Recovery, Executive Vice-President

Full details of the Group's overall organisation will be announced in July, after completion of the information-consultation process of employee representatives.

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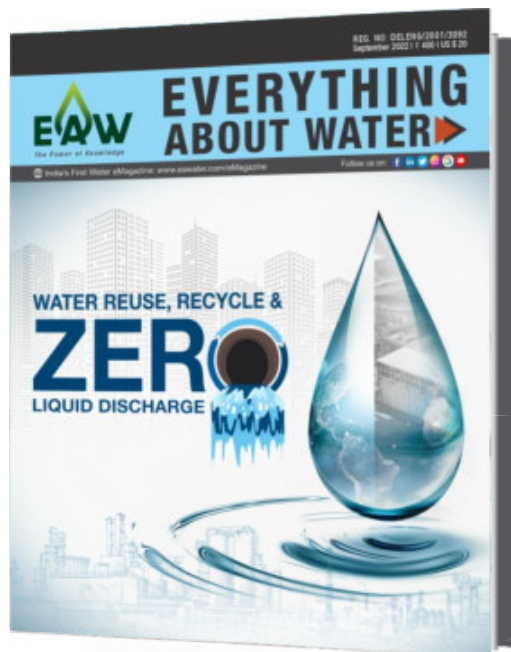
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IMPACT OF 3 R (REDUCE, REUSE, RECYCLE) ON WATER MANAGEMENT

By Dr. Anil Kumar Mishra, Bacteriologist, Quality Control Laboratory, Delhi Jal Board, Govt. of NCT Delhi



Water is an essential and vital component of life and required for performing different type of metabolic activities in all type of living organisms (microorganisms to higher plants and animals). Water is also important for environment and required for maintaining climate and other environmental components. In present scenario, water scarcity and contamination (physical, chemical and microbiological contaminants) are major problem in India and worldwide. In present scenario, due to rapid growth of population, urbanization, industrialization and agriculture activities, water resources are under stressed and gap between supply and demand (required for various activities like bathing, cooking drinking, sanitation, irrigation, industries etc.) increasing every year. Different national and international agencies are issuing directions/guidelines for conservation of water resources, avoid polluting water bodies/ ground water, sustainably use of water etc. Climate change also playing pivotal role for increasing stress on water resources, due to changes in various climatic conditions like temperature, humidity and other biotic and abiotic components of ecosystem. Worldwide, a significant number of population not getting sufficient quantity of potable and wholesome drinking water (as per norms laid down in various national and international guidelines/ standards), resulting their health related complexity are increasing due to different type of pollutants (Physical, Chemical, radiological, Microbiological etc).

In present scenario, three R's are viable solution for reducing stress on water resources upto maximum extent but if we add two more R's with reduce, reuse and recycle then it may be prove more viable approach for reducing stress on water resources. These two extra R's are:

1. **Respect water and**
2. **Reserve water resources.**

In India and worldwide, if we provide due regards to water and other resources, then never contaminate, waste or misuse the water and by adopting these principles (R's) we may overcome the problems caused due to water scarcity and pollution. Although, various government/private agencies issued/issuing different type of guidelines for implementation of above 3 R's (reduce, reuse, recycle) for reducing stress on water resources, so that consumers may get sufficient quantity of potable and wholesome drinking water as per their requirements/ per capita water supply as per norms laid down by various government and other related agencies. But I think, that due to lack/proper involvement of consumers participation in all the activities related to conservation of water, avoid polluting water, sustainably use of water resources etc, desired outcomes may not be achieved. Secondly, In India and worldwide, consumers not desirous to use treated waste water for any household purpose due to aesthetic or other reasons.

Water treatment plants located in different part of India and worldwide, adopting the principle of R's and establishing recycle treatment plant in many water treatment plants and other places for the reuse of waste water of WTPs and other sources, rejuvenation of water bodies, using treated waste water for irrigation of plants and trees in parks, greenery in road verges, thermal power plants, irrigation of crops etc. Various Govt. and other agencies started various schemes required for promotion of rain water harvesting and other such type of technologies which may improve the quality and quantity of surface as well as ground water. Rain water harvesting is viable tool for reducing stress on water resources. For promoting this tool, thematic parks, adopting various models related to rain water harvesting and other themes required for promotion of water conservation may be developed in different parts of India and worldwide. Such type of thematic park already developed at Bangalore in the name of "Sir M. Vishvesvariah rainwater harvesting theme park". After establishment of such type of parks, citizens may get different type of information related to rain water harvesting, importance of water for life and other useful information in single place i.e., under the umbrella of "Thematic parks". When citizens/consumers/students practically as well as theoretically get information in a single place they adopt it in better manner in their houses and surroundings; resulting underground water quality as well as quantity will improve drastically and consumers may get sufficient quantity of good quality of water for drinking and other purpose.

Although, various Govt. and non-government organizations have taken or taking initiatives by making rules, regulations and guidelines for promoting three R's but desired outcomes are still awaited. For attainment of better outcomes, policies related to awareness and promotion of all the aspects of 3 R's may be drafted and implemented at various levels of Governance (Central to Panchayat level) and its proper implementation at ground level may be ensured by providing incentives, awareness and other such type of activities to consumers. Different type of industries like hotel, hospitals, buildings etc. and consumers are aware about the reduce; reuse and recycle of water and its resources but due lack of

proper implementation at ground level, desired outcomes are still awaited. For better achievement of goals, proper policies related to awareness and promotion of all the aspects of 3 R's may be implemented at various level of govt. and ensure its proper implementation at ground level (consumers and other stakeholders) by providing incentives, awareness and other such type of activities. After proper implementation of three R's, sufficient quantity of good quality of water will be available for industries and consumers for various purposes; as water is backbone for industries, resulting profits of industries many also increase.

In present scenario, scientific principles and technologies are growing and our day-to-day activities become easier and faster as compared to earlier days and this fact is equally applicable for adoption of 3 R's in easier and simpler way by public and industries. Various level of Governments and other agencies (NGOs etc.) should give due attention in water and waste water treatment, its proper management and adopting various new, advanced and sophisticated technologies related to water and waste water treatment, conservation of water, rain water harvesting, rejuvenation of water bodies, recycle of used water, awareness among the students, consumers etc. through various platforms like trainings, conferences, media, seminars etc.

Training is an important tool for development of skill and competency in officers

and officials working in various fields related to water treatment, distribution, quality control (Physically, Chemically and Microbiologically), process control of WTP/STPs, quality surveillance monitoring system, disinfection system in various installation etc. Various regulatory norms like IS 10500:2012, ISO/IS 9001:2015, ISO/IEC 17025:2017, IS/ISO 17482:2020 etc. should be adopted by organizations working in these areas. So that they may ensure their workings and outcomes as per standard operating procedures (SOPs) laid down in above standards/ as per requirements. Regular trainings must be conducted by various organizations for all the stakeholders working in this field by internal/external faculties or in other national and international laboratories and organization.

In conclusion, I would like to suggest to all the stakeholders that every one respect water and its resources; as water is 100% natural and no substitute for it. Use it judicially and sustainably, so that our future generations may get sufficient quantity of potable and wholesome drinking water. If we may not maintain it properly, significant number of population may not get good quality of water in coming decades (as various organizations are issuing warnings time to time related to water, its uses, scarcity, deterioration of quality etc.). So for proper conservation and management of water, adopt various technologies required for reduction of NRW, Rain water harvesting, reduce, recycle, respect, Reserve and reuse of water etc.



About the Author



Dr. Anil Kumar Mishra is presently working as Bacteriologist in Delhi Jal Board, Govt. of NCT Delhi, since August 2007. He has qualified CSIR-UGC (NET) June 2002 for Lecturer-ship and ICAR (NET) 2004 and 2006 for Lecturer-ship. He also qualified UNERA fellowship of Australia government for advance studies in January and June 2006. He secured 11nd level prize in senior level comprehension certificate test on Right to Information Act-2005 in the year 2011 conducted by Govt. of NCT Delhi.

He is the recipient of Best Employee Award for the year 2019-2020 for Delhi Jal Board by Chief Minister of Delhi.

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I WATER SECURITY AND CLIMATE CHANGE

By Mangesh Dashrath Surve, Founder, Envicare



Water security is the big focus that cuts across all nations. There is hardly any country that is not facing issues related to water security. The freshwater requirements for various purposes like agriculture are adequate presently. However, the future looks bleak if sustainable methods do not get implemented. It threatens the very existence of our planet and our existence too.

When you mention water security, it means the availability, quality and accessibility of water resources for various purposes. It includes human survival and ecological as well as other productive requirements. Human dependency on the environment is undeniable. The fact is that freshwater available for use and consumption makes up only 0.5% of the water available on the earth. Our survival is heavily dependent on it. And climate change is impacting water security. This impact is from a quantity and quality point of view of water resources.

If you have a look around, the impact is very much noticeable. Climate changes impact on water security is getting reported majorly in the media. Global temperatures are rising to dangerous levels. It has majorly impacted the seasons, causing changes in precipitation patterns and triggering droughts in many regions. There are regular reports in the media on the increase in the regularity and strength of floods all over the globe.

Another concern concerning climate change is the rise in glaciers and snow caps melting in the north and south poles. The result of this melting is a harsh impact on the accessibility of freshwater resources in areas dependent on these sources. There will be a decline in water availability in the drier seasons in mountainous regions where melted water is heavily required.

Population increase around the cities has intensified the water wars. Increasing requirements in urban areas are leading to an impact on water sources. Urban pollution rise is indirectly impacting the water sources nearby as this polluted matter gets dumped there.

There is an increase in the pattern of climate change in the environment. There has been an increase in the frequency and intensity of natural disasters. These include droughts, hurricanes, typhoons, heavy rainfalls and storms. These natural disasters are impacting water management systems in a big way. These disasters are also increasing the chances of water-borne diseases affecting the population. There has been a rise in flood disasters by 134% since 2000.

Rising sea levels will increase the risk of saltwater interference in

coastal aquifers. What you see is freshwater source pollution and lessening accessibility of potable water. Groundwater impact will prove to be a costly affair in the future.

There is a visible impact of climate change on the quality of water. High temperatures combined with shifting precipitation patterns intensify the risk of water pollution. More rainfall will result in the pollutants getting washed into the rivers and lakes. It will make them polluted. The rising frequency of natural disasters means an increase in the hazard of water contamination. These disasters will release toxic chemicals from storage tanks and industrial areas into water sources.

There is an urgent need to address the challenge for the survival of our planet, ecology and humankind. Thus, there is a crucial need to improve water security and flexibility while dealing with climate change.

It also means an urgent need to implement integrated water resources management approaches which will keep in mind the quantity and quality of water resources. A sustainable management approach will allow us to deal with the crisis holistically without impacting the environment or the water's future. There is an additional need to defend the water sources from any and every possible contamination and distribute the water.

It is essential to invest in water infrastructure to deal with water security. It includes critically investing in dams, reservoirs and treatment plants. The benefit of investing in such infrastructure is to make sure there is a reduction in the risk of water scarcity. It will better the water quality, especially in areas where water resources are prone to get impacted by climate change.

The one major thing that will heighten the positive changes in water security is to create public awareness and education regarding its importance and ways for them to contribute to the change. It includes the promotion of sustainable water use practices. These practices include water conservation, waste reduction and protection of water resources from pollution. Simple methods like reducing water wastage at home and rainwater harvesting can help the situation positively.

Finally, it is necessary to understand that water security is the topmost topic that needs our attention. It has majorly affected the climate change that is seen all around us. There is a complete need to implement integrated water resources management methods. We must also implement water sources protection, investment in water infrastructure and increased public awareness and education.



About the Author



Mangesh Surve is a Chemical Engineer and has been leading ENVICARE for the last 22 years as its MD. With corporate offices in Pune, Dubai & Malaysia, he uses his knowledge to navigate the company in various related offerings. The innumerable awards in his kitty speak for his work. Envicare's team of committed engineers, managers, consultants & technicians are sought-after in India & internationally for their resourcefully sustainable technological & after-sales know-how. Their devoted R&D laboratory, AQUA Laboratories, runs actively on the ISO guidelines for water, wastewater & effluent testing.

In ENVICARE kitty, they have 750+ distinguished clientele, 1500+ installations, international business experience and successful recycling of over 5000+ million litres of wastewater from industrial & domestic activities. The ISO 9001: 2015 certification marks their commitment to quality consciousness and management.

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THE CIRCULAR WATER ECONOMY: THE INDUSTRIAL WATERSHED CYCLE

By Jim Lauria, Vice President, Sales and Marketing, Mazzei Injector Company, USA

Industry today has begun to think in circles—in a good way. Around the world, leaders in industries ranging from water to agriculture to technology have begun to see their business as part of circular economies, in which the products of one stage of production become the feedstock for the next stage, and recycling turns those connections into a cycle of use and reuse.

Water is most certainly part of a circular economy. Let's follow an imaginary gallon of fresh water from a reservoir that is treated to a high level of purity and delivered to an industrial site—for the sake of this issue of *Everything About Water*, a pharmaceutical plant producing cough syrup. Some is blended with the active ingredients and flavor agents to create the syrup. The rest is used as rinse water on the production line, then collected for filtration. Once filtered, it is reused in a cooling tower attached to the factory. At the bottom of the cooling tower, the water is captured and filtered again, then applied to the lawn outside the factory as irrigation water. The water not drawn up by the roots of the grass percolates into the soil, travels with the groundwater, and recharges the river, where the cycle begins again.

Industrial Watershed

The same thinking that allows our imaginary factory staff to use that gallon of water in three separate processes also guides the recognition that they are an integral part of two watersheds—the natural one that feeds the river that supplies and receives their water, as well as the industrial watershed on their facility grounds. In that industrial watershed, their management decisions impact the source, as well as the efficient use of valuable water within their business.

Like natural watersheds, industrial watersheds enjoy an interconnectedness among water supplies. They are circular, a continuum from source to sink and back again. Seeing themselves as part of an industrial watershed is leading progressive business leaders to better appreciate, and better manage, their water supplies.

Of course, circular economies are built on ensuring that resources are constantly being reused. Water transforms from precipitation to surface water to groundwater, bubbles back to the surface to feed springs or water courses, evaporates, then condenses back into rain or snow.

Water reuse in American power plants provided powerful testimony to the impact of building a circular system into industrial watersheds. According to a 2008 report by the Union of Concerned Scientists, freshwater withdrawal intensity among power plants in the American states of Virginia, North Carolina, Michigan and Missouri—where once-through cooling systems are the norm—were 41 to 55 times greater than in Utah, Nevada and California, where power companies had installed more recirculating systems.

Counting the cycles

Scientists who study natural ecosystems count every drop of water that cycles through. The same must be true for any water that gets pumped into the industrial watershed, falls from the sky, or released—all must be accounted for. Managers must analyze, treat, use and evaluate the efficiency and economic value of every drop. Then water in the industrial watershed must have its future uses assessed on that appraised value and the efficiency of various treatment options.

In industrial settings, the uses and specifications for ingredient water, service water and process water may overlap, or they may differ significantly. Understanding and managing for those overlaps or differences may allow for highly effective re-use either with or without treatment, which in turn improves both energy efficiency and water efficiency.

Analysis is key. Analyzing the contents and condition of water throughout its circular path through an industrial facility can help pinpoint how much treatment is necessary before it is piped to its next task or to discharge into the environment. For instance, water for a cooling tower does not need to be purified nearly as much as ingredient water that will be consumed by people. Later in the cycle, water being prepared for discharge must be brought to a high standard, and investments and efforts must be scaled accordingly.

The importance of the dissolved oxygen (DO) content of water also increases in an industrial watershed model. Increasing DO is often required in water that will be discharged to the environment. But lowering DO management is also important in many industrial applications, because dissolved oxygen can accelerate the corrosion of equipment in facilities such as power plants. Fortunately, re-aerating deoxygenated water can be a simple task. All that is required is some planning, and the commitment to understanding the chemistry of the water, how it will be used, and how we can manage it.

Stormwater can be the most variable factor in an industrial watershed. It can be a benefit when rain delivers new supplies of vital water, but can also pose the threat of flushing contaminants off-site. The lack of control means stormwater can connect the natural and industrial watersheds in unwanted ways.

Resilience

Resilience is a big word in industry today, and it shares a philosophical root with an industrial watershed outlook. Industry leaders are learning to flow with disruptions and unexpected events without crippling their business models. In short, thinking in terms of industrial watersheds is good business.

Watershed thinking is growing more vital every day. In many countries, consumers and lawmakers are more aggressively fighting the establishment of new industrial sites where they fear for water quality or scarcity. In addition to the consumption of process water, ingredient water is embedded in many products and exported.

At the same time, industrial managers are incorporating water in their thinking. In a 2013 poll of industry leaders, the Pacific Institute and VOX Global found that 57 percent said water issues affected their bottom line, and an equal number predicted water issues would affect their growth. In addition, 79 percent of the company leaders reported facing water challenges at the time.

Today, society evaluates businesses not just on their revenues and returns, but on their environmental footprint. Corporate social responsibility reports are becoming nearly as important as annual financial reports for many companies. Reducing water consumption, energy use and carbon emissions have become indicators of a company's values as well as the soundness of its approach to business.

Living, breathing

Aiding the industrial watershed perspective is a host of new tools that help managers understand, evaluate and treat water as it circulates. In many ways, these high-tech tools are rooted in an ancient way of thinking about watersheds. Five hundred years ago, Leonardo da Vinci envisioned water flowing through arteries in cities that breathed and excreted—descriptions of urban watersheds drawn in terms of pure, elegant anatomy. Today's industrial sites have sensor eyes and ears, electronic neural networks, SCADA brains, and state-of-the-art filtration and treatment systems that act as kidneys and livers. Today's technology brings an industrial watershed to life.

When we combine an industrial water management approach with the vision of two richly complex systems—the human body and the circular water economy—we see how water functions in an industrial watershed. We can envision how water varies in its value as it varies in its function, and how it may be treated to the most appropriate level to be effectively used and efficiently managed. We can look beyond the concept of water as a simple commodity and consider how to optimize the use of potable water, brackish water, process water, gray water, storm water and wastewater. Then we can use those many waters again, and ultimately cycle, recycle and efficiently manage them in a circular, regenerative pathway.



About the Author



Jim Lauria is the Vice President of Sales & Marketing for Mazzei Injector Company, a fluid design company that manufactures mixing and contacting systems for a wide range of water treatment applications. Since graduating with a Bachelor of Chemical Engineering degree from Manhattan College, he has traveled the world benchmarking and documenting the best global water management practices.

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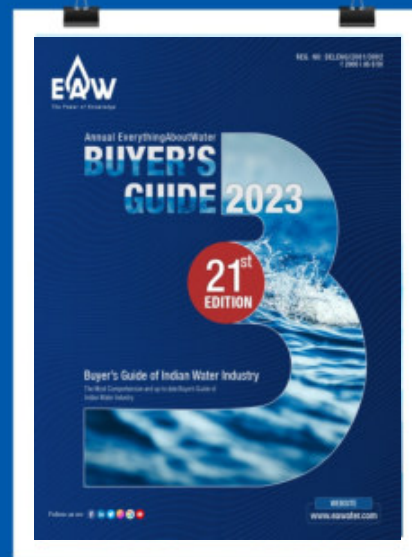
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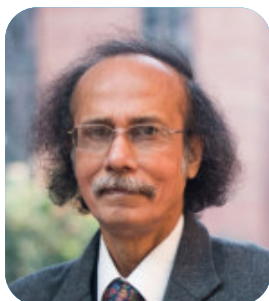
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SAFE REUSE OF TREATED WATER: A NEW FRAMEWORK

By SK Sarkar, Former Secretary, Ministry of Water Resources, Distinguished Fellow, TERI, New Delhi



Background

The concept of a circular economy in water sector is recent in India. In a linear economy the products are manufactured, used and disposed off. In contrast, in a circular economy, resources are used so that the new resources are less demanded, reduced, waste is avoided and life cycle of products increases. Waste of today then becomes raw material of tomorrow. Resource recovery from waste water facilitates benefits in many ways. For example, municipal waste water is an essential alternative source of nutrients in the economy. Biogas is a valuable byproduct of waste water treatment process.

In the water sector, safe reuse of treated water brings benefits such as water security, health benefits, environmental benefits, social benefits, economic benefits, innovation, increases capacity to implement waste related projects, and reduces climate emissions. For example, possible savings from reduced pumping of fresh water from aquifers help reduction of climate emissions in a country. Therefore, safe reuse of treated water has been recognized as an important component of water management in any country.

As per Ministry of Water Resources 2008 report, the available water resources in a year is about 1123 billion cubic meters (bcm), and it is estimated that by 2050 the water demand would be to the tune of 1447 bcm. In the industry and energy sector, the water demand is expected to grow to 193 bcm (2050) from 10 bcm in 2000. In domestic sector, the water demand in 2050 is expected to be 102 bcm compared to its demand of 42 bcm in 2000. In contrast, the water demand in agriculture sector will be very high, to the tune of 1072 bcm in 2050 compared to 541 bcm in 2000. The NITI Aayog report 2019 also stipulates that by 2030 the water demand in India will be twice the available supply of water resources. The issue is how to match this figure of demand and supply of water. In fact, safe reuse of treated water provides a water source in the economy that reduces the need to transfer water resources from increasing distances in the country.

The total volume of sewage generated by households in urban India was 72368 mld (26414 million cubic meter) in 2021. The available infrastructure capacity for treating sewage is 44% and approximately 15% of that capacity is not operational. Actual treatment of waste water is to the tune of 20235 mld. Out of this only a small portion is reused. The balance untreated water is released to tanks, lakes, ground water leading to contamination of water in the economy. India's efforts to separate industrial and municipal used water from wastewater will avoid health risks to both water users and end consumers.

India is a water stressed country: out of 766 districts 256 districts

are water stressed and in the coming years, India is moving towards a water scarce country. Globally India is ranked as the 13 most water stressed country. Ground water abstractions are also reaching unsustainable levels.

State initiative

Before the launching of National Framework on "Safe reuse of treated water" by the central Government in 2022 many state governments have taken initiatives for safe reuse of treated water, and they adopted policies for this purpose. For example, states such as Gujarat, Haryana, Karnataka, MP, Punjab, Rajasthan, Jharkhand have adopted policies for reuse of treated waste water. The most ambitious target of the state Gujarat is that the state will reuse 100% waste water by 2030. States such as Bihar, Uttarakhand, Karnataka, have also started reuse of water from sewage treatment plant for agriculture purpose. The National Framework for safe use of treated water have given a model Framework for state policy outlining role and responsibilities, setting water quality standards, indicating business models, financing safe water, safe reuse of treated water project, timeline for implementation, monitoring evaluation, capacity building, etc.

The Government of India has launched the National Framework for Safe Reuse of treated water in November 2022. The guiding principles for the framework are: adopting participatory planning process, allocation of treated used water based on social, environmental and economic benefits, encouraging mandatory reuse provision in the policy, establishing water quality standards for the purpose of end use, establishing price of treated used water, incentivization of the stakeholders, addressing issues related to existing uses of used water, etc. The vision for the Framework is "widespread and safe reuse of treated used water in India that reduces the pressure on scarce freshwater resources, reduced pollution of environment and risks to public health and achieves socio economic benefits by adopting sustainable circular economy approach.

The objective of the National Framework is to move India on a pathway of mainstreaming safe reuse of treated water by encouraging states to adopt the necessary framework as indicated above. This will help India to achieve Sustainable Development Goal 6.3.

Areas of reuse

Treated waste water in urban, rural and peri urban setting can be used in various ways. For example, this can be used in industry (for industrial states, power generation, and railways); in agriculture (including forestry, horticulture and aquaculture); in municipal uses

(landscaping parks, toilet flushing and firefighting); for construction activities etc.

The Framework identified 28 key institutions and stakeholders at the national and state levels which should be engaged in the implementation of the National and state Framework. The state Framework comprises of state committee on treated waste water, urban development department, SPCB, Agriculture department, water resources department, industries department, urban local bodies, Panchayati raj institutions. In addition the other stakeholders which have a clear role in implementation of the Framework include private sector (technology providers and operators), end users (industries, power plants, agriculture enterprises, Municipalities), agricultural universities and NGOs etc.

Pricing of treated waste water

The Framework also stipulated the determinants for price of treated waste water covering areas such as investment cost including conveyance, treatment, and distribution infrastructure; operation and maintenance cost of infrastructure; quality of water; type of end uses; prevailing price of alternating water source etc. It also given guidelines of business models and private sector engagement in this regard.

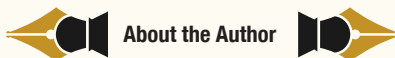
For example, in the public procurement model the implementing agency owns and operates the conveyance, treatment and treated used water distribution

infrastructure. In the public ownership model, the implementing agency provides either secondary treated water to a private entity who is responsible for achieving higher quality standards. In public private partnership model, the implementation agency will engage a private entity to attract public private investment after leveraging its efficiency and providing quality treatment facility. The model could be designed-built-operate, designed-financed-built-operate and transfer, hybrid annuity models, BOT (imposing user charges).

Concluding remarks

The National Framework of safe reuse of treated water is a laudable Framework of the central government. The features of this Framework should be adopted by the states. In case of those states which are already implementing their policies, they may like to review their existing policies to suit the need of the national framework. The states which are yet to formulate such policy should adopt the central framework for sustainable water management in the states.

Water is an essential input for economic growth of the country. In India water crises is an issue being debated at various levels. With reuse of treated waste water, India will be able to save water enabling the country to achieve Sustainable Development Goals of the United Nations in water sector by 2030.



About the Author

Dr S K Sarkar is Distinguished Fellow and Senior Director at TERI. He heads the Natural Resources and Climate Programme and is currently associated with TERI since September 2014. During 1998 till 2003 Dr Sarkar worked as Senior Fellow, TERI, and during 2005-2007 as Director, Division of Regulatory Studies and Governance in TERI. He is a Doctorate in Economics (1991) from the State University of New York. Dr Sarkar is an IAS officer (retired). He is a former Secretary to the Government of India (Gol) in the Ministry of Water Resources. He served other Ministries including Finance Ministry in the Gol, and worked in various capacities with Government of West Bengal. He worked as District Magistrate, Murshidabad and Member Secretary, West Bengal Pollution Control Board under State Environment Department during 2003-05 and formulated policies on plastic waste management. He also worked as consultant with the ADB and with the World Bank/ PPIAF (Public Private Infrastructure Advisory Facility). Dr Sarkar has got several publications to his credit, has authored and edited books on infrastructure issue and has presented a number of important papers in several conferences. He taught a course on "Public Policy" in the Kabul University (2007), Afghanistan, and also at TERI University.

To know more about the contributor of this case study, you can write to us. Your feedback is welcome and should be sent at:

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AUGMENTING TRADITIONAL WATER SUPPLY THROUGH WATER REUSE AND RECYCLING-RESIDENTIAL & COMMERCIAL BUILDINGS

By Mandarr Kkamthe, Senior Product Manager–Water at Asian Contec Ltd. (Stanlay)



The aim of this write-up is to highlight the potential for water reuse and recycling in the building sector of cities. The data seeks to overview the main ways water can be reused in this sector and seeks to provide an overview of the steps needed to ensure that water is used in ways that ensure human health.

In Indian capital cities, and many other cities around the world, commercial and residential buildings are responsible for over 70 per cent of all fresh potable water use. Whilst residential buildings use the bulk of this potable water, commercial, retail and office buildings are also significant consumers. The potential for water reuse and recycling is significant. To help give a sense of just how significant, consider the fact that over 50 per cent of the water being used for commercial buildings (cooling towers, toilet flushing and gardens/landscape) and residential buildings (toilet flushing, laundry and gardens) does not need to be water of drinking quality.

Strategy #1 – Rainwater Harvesting:

Currently most rain which falls on the world's coastal cities and towns simply flows out to sea without being used. Harvesting and storing rainwater in water tanks enables that water to be re-used in cooling towers, hot water systems, toilets, laundries and for watering gardens and landscapes. There is increasing demand for harvesting roof-water from larger buildings, such as community halls, schools and commercial premises.

The onsite collection and storage of rainwater for domestic or

commercial purposes has many benefits as it:

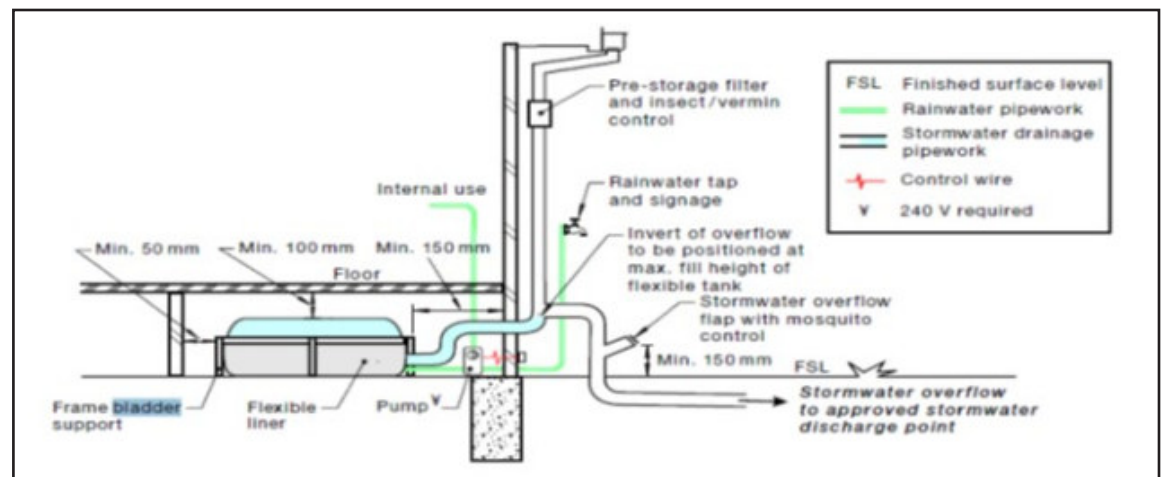
- reduced use (up to 50 per cent in urban areas) of mains water, which not only delivers financial savings to the would be consumer, but also:
- reduces community infrastructure costs (e.g. dams)
- provides cost effective onsite storm water detention
- protects environmental flows in rivers and streams, through stabilised or even reduced demand on catchments.

There are three broad categories of systems that can be installed to collect rainwater:

1. above ground tanks: usually the cheapest option, these can take the form of standard round tanks, or the slimline and modular systems (storage walls) that require less space.

2. underground tanks: while the catchment potential of these is greater than above ground tanks, the need for excavation generally makes them more expensive. Underground tanks can also capture water through infiltration

3. bladders: these flexible sacs are well suited to sub-floor spaces, requiring as little as 750mm height clearance. Bladder installation is more technically complicated than above or underground tanks, and is ideal in situations with limited space (e.g. renovations).



Strategy #2 – Greywater Treatment and Reuse:

Greywater is wastewater from showers, baths, spas, hand basins, washing machines, laundry troughs. Importantly, it does not include wastewater from toilets (known as 'blackwater'), and generally excludes kitchen and dishwasher water due to the associated health risks posed by pathogens.

There are many ways to collect, store and distribute greywater:

- Simple diversion: Simple diversion products can divert greywater to a sub-surface garden irrigation system under the action of gravity. These products consist of a tee junction, rubber socket and valve, and may also include overflow devices. Simple diversion is better suited to residential buildings than to commercial buildings.

- Sedimentation tanks and irrigation fields: Greywater can be stored in a sedimentation tank for several days in order to allow solids to settle to the bottom of the tank. The relatively clean water in the top of the tank can then be transferred to the garden while the sediment at the bottom must be periodically removed.

- diverter valves, filtration and storage: When greywater cannot reach the garden under the action of gravity, a system may be used that consists of a diverter valve, a small storage cell, a pump and a daily automatic release of the water. Greywater from shower and bath water can be diverted for toilet flushing.

Greywater can be used for garden watering. Appropriately treated greywater can also be re-used indoors for toilet flushing and clothes washing, both of which are significant consumers of water.⁴⁰ Large-scale treated greywater can be used for a number of applications, although this does vary from state to state, depending on specific state requirements. Some applications for greywater include:

- residential garden watering, car washing, toilet flushing and clothes washing
- irrigation for urban recreational and open space, and agriculture and horticulture
- fire protection and firefighting systems
- industrial uses, including cooling water.

Greywater is thus a valuable resource. Taking advantage of this 'waste product' delivers a range of benefits, including:

- Personal financial savings through reduced water charges
- Community financial benefit through reduced need for infrastructure (e.g. new dams)
- A 'restriction free' supply of water that can be used on gardens
- Reduced demands upon waste infrastructure (i.e. sewage treatment), delivering improved system longevity and efficiency

Capturing greywater:

There are many ways to collect, store and distribute greywater:

- Simple diversion: Simple diversion products can divert greywater to a sub-surface garden irrigation system under the action of gravity. These products consist of a tee junction, rubber socket and valve, and may also include overflow devices. Simple diversion is better suited to residential buildings than to commercial buildings.

- Sedimentation tanks and irrigation fields: Greywater can be stored in a sedimentation tank and for a few days in order to allow solids to settle to the bottom of the tank. The relatively clean water in the top of the tank can then be transferred to the garden while the sediment at the bottom must be periodically removed

-Diverter valves, filtration and storage: There are many systems that can be

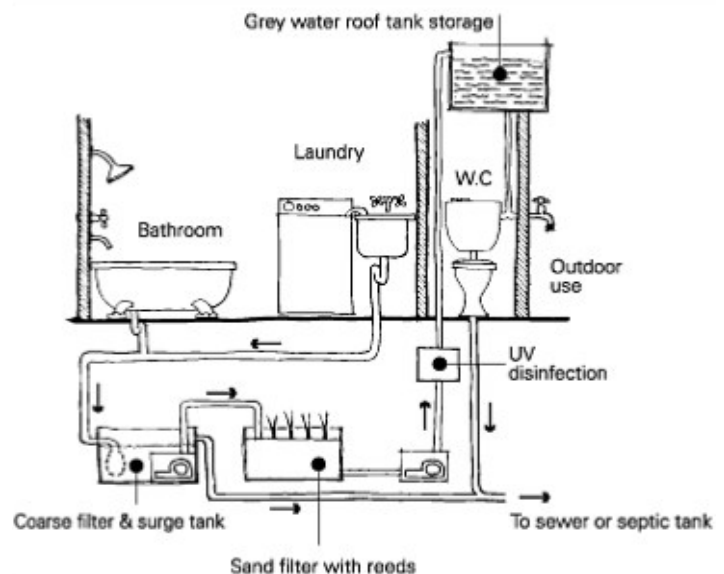
used when greywater cannot reach the garden under the action of gravity. One such system consists of a diverter valve, a small storage cell, a pump and a daily automatic release of the water. Another system consists of diversion, a storage tank, a pump, a filter, a float switch, an auto-electric controller and a daily automatic release of the water. Greywater from shower and bath water can be diverted for toilet flushing.

Treating greywater

There are several processes available for treating greywater, including sand filtration, aeration, electro flotation, pressure filtration and biological treatment.⁴⁴ Tertiary treatment is generally more costly than secondary treatment.

- Treating greywater for outdoor use: For outdoor use, greywater is usually required to be secondary treated; it is best not to handle primary treated water. Several types of greywater treatment systems available for outdoor water reuse. Currently, the most common type of system is the aerated wastewater treatment system. These systems work by first allowing solids to settle to the bottom of a tank, then aerating the cleaner water in order to assist bacterial breakdown of organic matter. There are also treatment systems that treat all household wastewater (greywater and blackwater) using a combination of plants, animals, fungi, bacteria, algae and other microbes, as well as rocks and other minerals, while using little energy and no chemicals.

- Treating greywater for indoor use: For indoor use, greywater is required to be tertiary treated. The most common process is chlorine disinfection but it is also the most environmentally hazardous. Safer alternatives include ultraviolet disinfection, ozone disinfection and microfiltration. All disinfection systems require regular maintenance. Several packaged on-site greywater treatment systems are available for indoor water reuse. These systems often perform similar processes to those for outdoor water use with an additional disinfection or microfiltration stage and continuously monitor the water quality and system performance. These systems vary considerably variation in their cost, water treatment quality and energy consumption. Homemade systems can also be built with council approval.



Strategy #3 – Blackwater Treatment and Reuse:

Blackwater is water from the toilet. Blackwater reuse is much less common than greywater reuse because the permitted uses for treated blackwater are understandably more restricted than those for greywater. Provided that appropriate

treatment is undertaken, uses include:

- Residential garden watering, car washing, and toilet flushing
- Irrigation for urban recreational and open space, and agriculture and horticulture
- Fire protection and firefighting systems and
- Industrial uses, such as water for cooling towers

Treating blackwater

Blackwater requires biological or chemical treatment and disinfection before being used. Treating blackwater to a certain class is generally more costly than treating greywater to that class. Until recently, treating blackwater for residential or small commercial buildings was difficult due to space limitations and the risk of treatment failure. New innovations in advanced membrane and other treatment technologies may provide opportunities for low cost and safe blackwater use.

Some new products include:

- “wastewater recycling units, which act on raw sewage and separate gross solids and fine solids through continuous deflection separation, followed by submerged aerated filters, a fine sand filter, UV disinfection and chlorine addition. Sewage [blackwater] is transformed into water up to Class A standard.
- those that can treat a range of effluents, including greywater, sewage and other wastewaters, using flat sheet membrane panels (that are aerated) within an activated sludge treatment tank. Screening and de-gritting must occur prior to use of the unit. These units produce water to a standard for toilet flushing, wash-down and irrigation
- using a simulated soil matrix (worm farm) to break down sewage and household organic waste, or an on-site, in-ground tank containing a fully aerobic, humic biological filtration matrix, which also incorporates extensive vermiculture (worm) activity for the accelerated decomposition of organics. The cleaned water from these biological filtration matrix systems can then be re-used on site, or the effluent can be exported to a pressurised reticulation network.



About the Author



Mandarr Kkamthe is Senior Product Manager-Water at Asian Contec Ltd. (Stanlay) with Industry Expert- Water. He has been working in the water sector for 12 very fruitful years. He was previously associated with organizations like JUSCO, Suez Environnement, Vishvaraj Environment Pvt. Ltd., Siemens, GE, etc. During this time, he achieved much in terms of expanding program offerings and enhancing the quality of existing Systems. He is an expert in developing and implementing a strategy for program teams, as well as developing robust mitigation plans. He has demonstrated ability to liaise with different engineering teams to increase system awareness. He has In-depth knowledge of developing new programs to support the strategic direction of the organization.

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LIVING BREAKWATER “PROTECTION POW”

By Arch. Maram Abbas, Ambassador, International “Jacques Rougerie Foundation”, Paris, France

The sea level rise isn't just the ecological problem but also its an architecture and economical problem. That effected on the shape and functional of waterfronts of coastal cities. I have made a huge research and case studies on sea level rise and its impacts on eastern Mediterranean waterfronts. In this article I will discuss about this problem and the strategy and implementation that I proposed “living breakwater_ protection bow” which is urban, economic, and environmental solution.

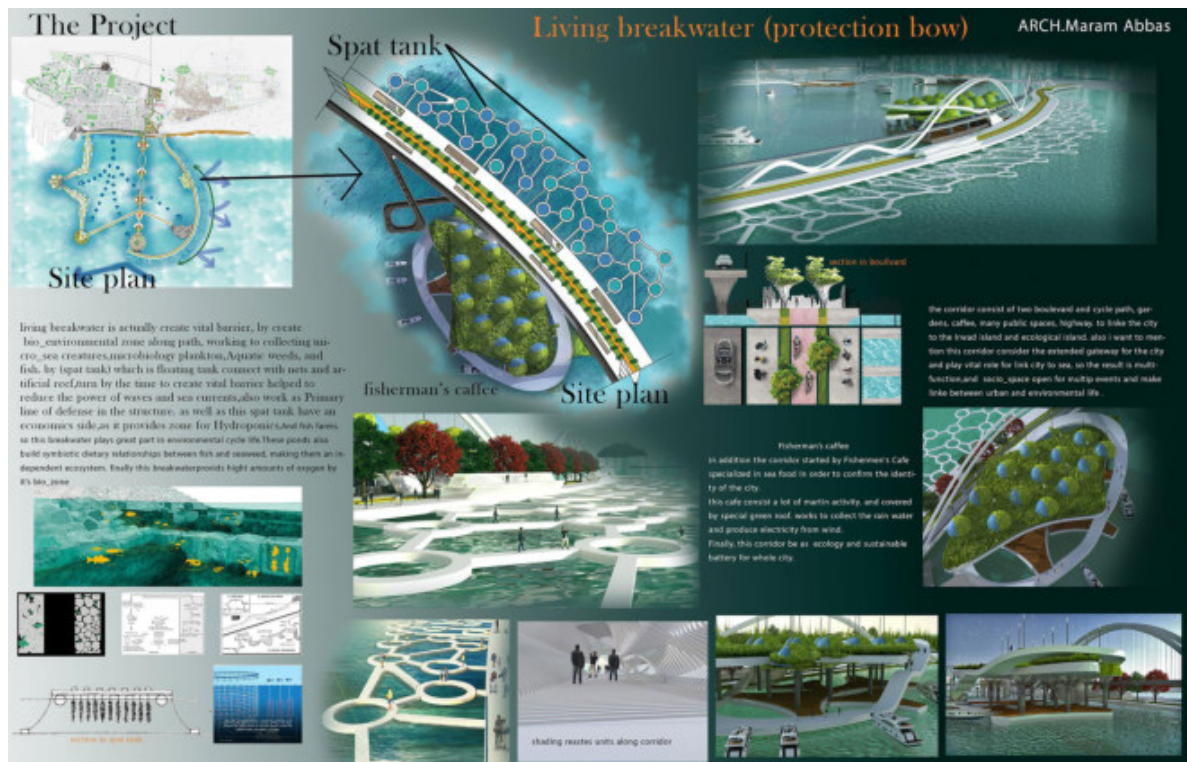
Why the sea level rise is very critical problem, and what the solutions have been proposed?

As maps predict, the sea level will rise 20 feet over its level. Many cities around the world like Miami, Shanghai, and Manhattan will be covered totally by water. In general, if the sea levels continued to rise, the specialists predicted that it would be upward of 7_36 feet by 2050 and 9_69 feet by 2080. Four millions of people are expected to be affected if the sea level rises only by 3 feet. But before all, the people who live on islands are most threatened with sinking. Which it should be absolutely consider that the sea level rise isn't linear but it's logistic regression. Also Human beings' misuse of fresh water can lead to the salinization of groundwater. the significant increase in constructing water dams on coastal rivers led to a gradual shortage in the abundance of fresh water that flows to the sea. As well as, rivers' dryness, which was the reason to flow the salt water into the sea along with the fresh water by river canals. The unbalance between coming fresh water and the sea level has made huge damage to the entire surrounding soil. So, the estuaries are considered a critical point in any study of waterfronts. Plus, the invasive attrition of

underground water, which is produced because of the difference between levels of underground water and seawater, brought the saltwater to the sea's freshwater. This harms the soil and the plants. Undoubtedly, this kind of sea level rise is considered the most dangerous, because it happens under the ground, and can't be seen. So, the flooding, the salinization of groundwater, infrastructure harm, and housing damage threaten to lose cultural heritage in coastal areas and cause a change in the amount and frequency of rain and storm. All of these are the consequences of sea level rise, and we have to consider them when undertaking a study of waterfronts planning.

Many studies and strategies have been developed by architects, planner, and geographers. To rehabilitate cities to make them sustainable and secured from sea level rise, whether by short- or long-term effective studies. Which is could “aquitecture”. The aquitecture is an architectural adaptation typology used to mitigate and manage flooding. With this typology, water and architectural design can unite to produce dynamic and reliable mitigation solutions. Its applications vary from a small range of floating houses and buildings to a wide range of overall urban planning for shorelines and waterfronts. As well as, developing strategies to rehabilitate coastal cities and their infrastructure. As a result, a new shape of waterfronts was activated to serve citizens by forming a new way of three living systems (houses, neighborhoods, and skyscrapers), and it's redirected to serve new functions such as constructing protected areas. This way shall be a part of the whole system which is meant by designing buildings to develop new electronic systems that contribute to solving problems. In conclusion, the main subjects of aquitecture are resilience, sustainability, and dynamics.

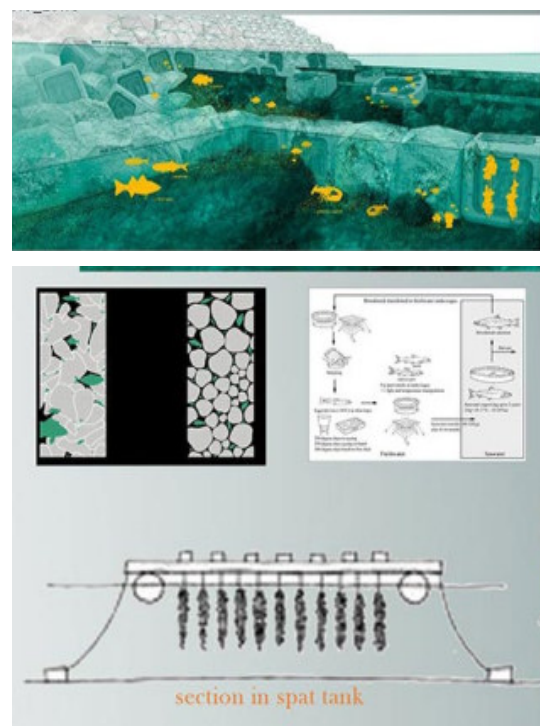
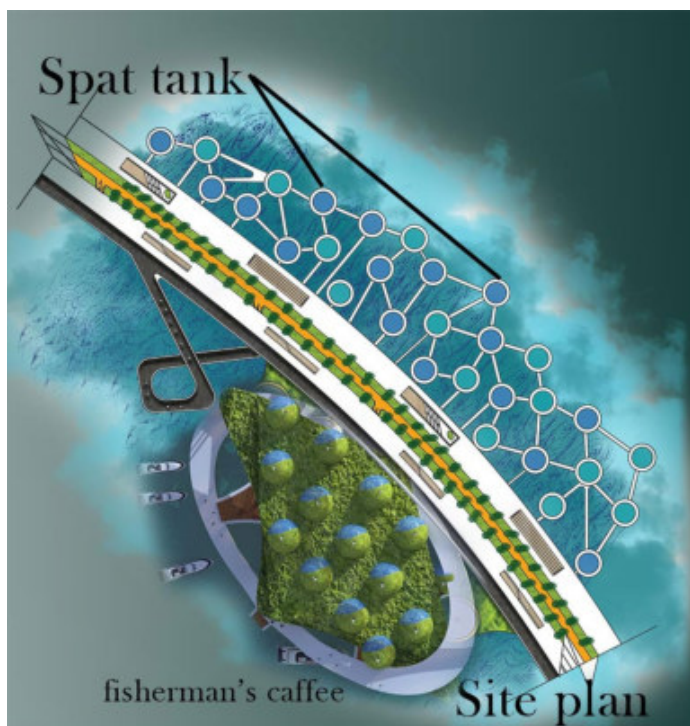
“living breakwater_ protection bow” Tartous case study:





The living breakwater is actually creating vital barrier, by create bio_environmental zone along path, working to collecting micro_sea creatures, microbiology plankton, Aquatic weeds, and fish. by (spat tank) which is floating tank connect with nets and artificial reef, turn by the time to create vital barrier helped to reduce the power of waves and sea currents, also work as Primary line of defense in the structure. as well as this spat tank have an economics side, as it provides zone for Hydroponics, And fish farms. so this breakwater plays great part in environmental cycle life.

These ponds also build symbiotic dietary relationships between fish and seaweed, making them an independent ecosystem. finally, this breakwater provides hight amounts of oxygen by its bio_zone

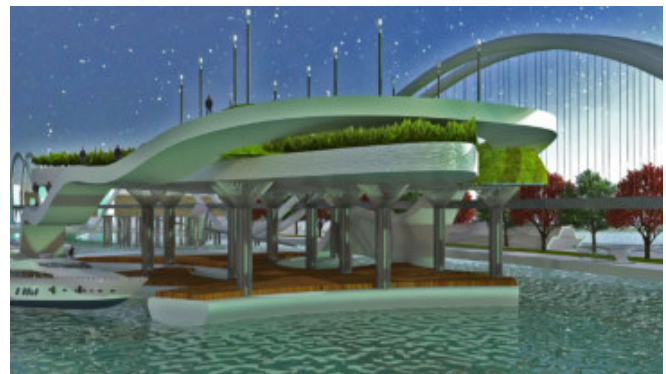
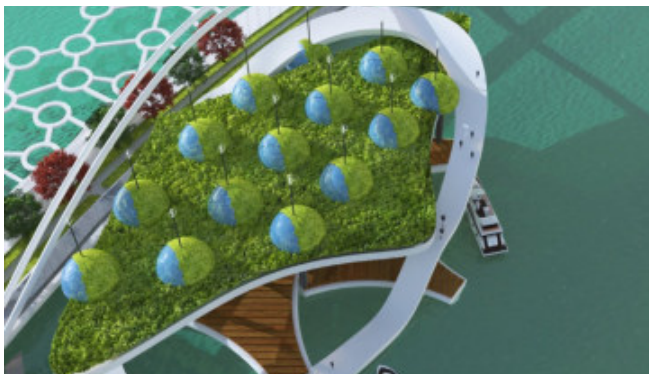
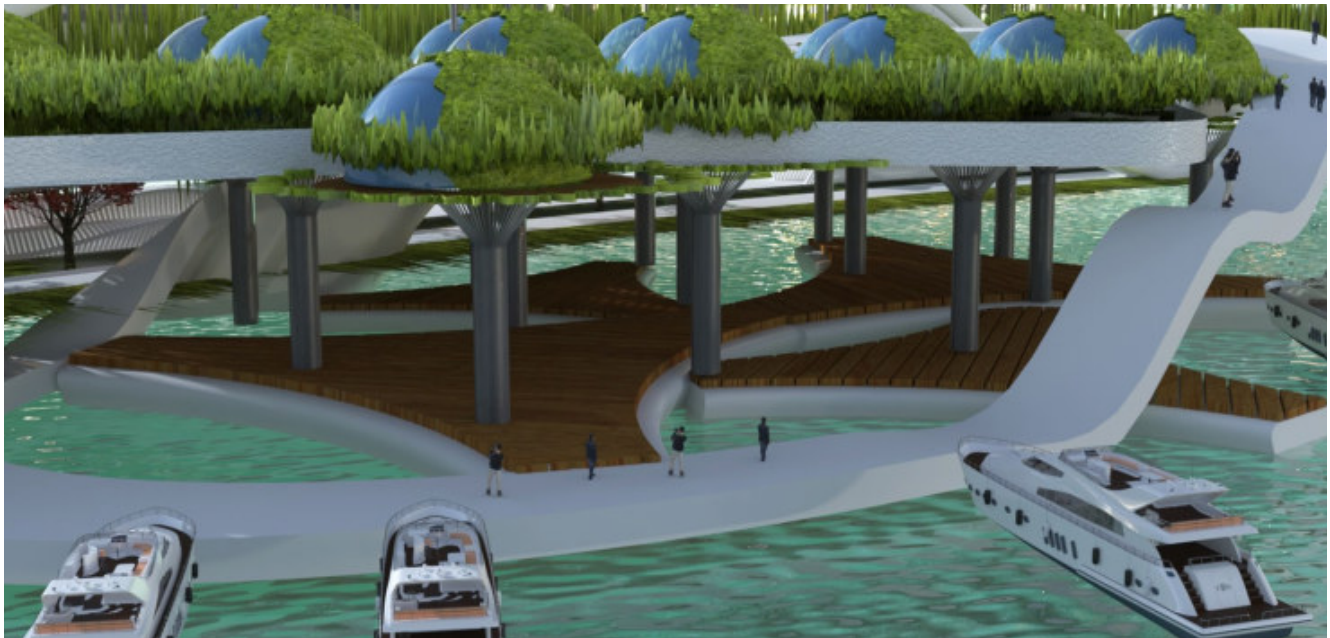


the corridor consists of two boulevard and cycle path, gardens, fisherman cafe, many public spaces, highway. to link the city with Irwad island and ecological island. also, I want to mention this corridor consider the extended gateway for the city and play vital role for link city with sea, so the result is multifunction, and socio_space open for multiple events and make link between urban and environmental life.



in addition, the corridor started by Fishermen's Cafe specialized in sea food in order to confirm the identity of the city. this cafe consists a lot of martin activity. and covered by special green roof. works to collect the rain water and produce electricity from wind.

Finally, this corridor be as ecology and sustainable battery for whole city.



About the Author



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HOW TO MONITOR THE WATER FLOW OF FISH LADDERS

By Christoph Sommer, Managing Director, SOMMER GmbH, Austria



SOMMER Messtechnik develops and manufactures monitoring equipment for the environmental industry. The product range includes discharge sensors, data loggers and data transmission devices. During the past 15 years SOMMER has invested great efforts to bring the tracer dilution methods for discharge measurement to a new level. In cooperation with universities and governmental agencies, a user-friendly measurement kit for easy application has been developed.

In recent decades restoration of channelled waterways has become popular as a means of restoring fish populations. At the same time, pressure on aqueous ecosystems is growing due to the increasing demand on hydro power as a carbon-neutral electricity source. As more and more rivers are being dammed, barrier-free fish migration has gotten a pressing issue and consequently sustaining minimum water flows.

The design of a hydro power plant must contain a suitable pathway for fish migration, which is typically realized as a fish ladder. Upon completion, the water flow must be monitored and must comply with the provisions determined by the responsible authorities.

How the classic tracer method for flow monitoring is applied to a fish ladder

Many hydraulic engineering constructions with their geometrically shaped obstructions often provide favourable conditions for discharge measurements. Once a channel cross-section is known

and invariable, water level and flow velocity can be determined precisely. Both current meters and electromagnetic flowmeters are suitable for this purpose, as are non-contact methods that simultaneously measure water level and flow velocity simultaneously.

For a number of other constructions, however, all these monitoring methods fail. One example is fish ladders, which often have to be retrofitted and implemented in the smallest possible space. Characteristic for such constructions are their high turbulence and rapidly changing channel cross sections, which exclude instrumental measuring methods from the very start.

The solution for such situations is offered by the classic, proven tracer method. The simple handling of this method, which is often also known as the salt dilution method, will be illustrated here by means of an example.

On a water channel in the Walgau region of Vorarlberg/Austria, a local energy supplier operates a small hydropower plant that was built as early as the mid-19th century. In the course of an ecological upgrade, the plant was extended with a fish ladder in 2017. After the plant was put into operation and the gate of the new ladder was opened, the required flow rate had to be verified. Due to the compact design, which does not have longer flow sections with constant flow conditions, it is not possible to determine the flow rate based on the water level and flow velocity. In contrast, this design predestines the use of the tracer method - frequent shifts



in direction and changes in cross-section guarantee very high turbulence and thus excellent mixing of the tracer with the water.

The mobile and easy-to-use TQ-S measuring system from Sommer Messtechnik GmbH in Koblach/Austria was used for the tracer test. This system is based on the salt dilution method and consists of two conductivity measuring probes, continuously sending measured values to the control and evaluation software "TQCommander" via Bluetooth®. Sommer Messtechnik recommends the use of two conductivity probes positioned at different points in the channel. Only in this way a homogeneous mixing of the salt can be verified.

For correct flow measurements, the conductivity probes must be calibrated. For this, the TQ-S measuring system includes a calibration kit with a precisely determined calibration solution and all necessary utensils. The user-friendly software guides the user through the individual steps and generates the calibration curves, which can be validated directly on site.

After calibration, the probes were placed at the bottom of the fish ladder - suspended from a provisional pipe.

Now, for the actual tracer experiment, a sufficient amount of salt must be dissolved in a portable container. For this purpose, the volume of water flowing over the fish ladder was roughly estimated and salt was weighed according to the common specification of 2-3 kg per cubic meter per second. The weight determined in this

way was then transferred to the software and the salt was dissolved in several liters of water. The actual tracer test could then be started by injecting the salt solution just downstream of the inlet to the fish ladder. From this moment on, the software records and graphs the measured conductivities so that it can be immediately observed when the salt cloud passes the probes. As soon as the concentration peak has been recorded and the conductivity has again reached the value of the incoming water, the flow rate can be read directly - in the present experiment this was 207 liters per second. As the recorded, well coinciding conductivity curves showed, the mixing was complete on the available, very short flow distance.

As this example shows, the classic tracer method still proves its worth and is sometimes the only choice under difficult flow conditions. In combination with modern hardware and software, as available with the TQ-S measuring system, flow measurements can be carried out quickly, inexpensively and without complications.

The primary advantage of the applied tracer method is, that mapping of a cross-sectional profile is unnecessary – a task which can be very cumbersome. This renders the tracer method superior to others when monitoring rivers of all sizes with undefined cross-sections.

Besides the TQ-Tracer kit, the broad product portfolio of SOMMER includes innovative radar sensors for non-contact determination of flow rates of natural rivers and open canals, non-contact flow meters for waste water and process water, as well as individual level and flow velocity sensors.



About the Author



Christoph Sommer is the Managing Director of SOMMER GmbH, Austria. SOMMER Messtechnik develops and sells sensors and environmental monitoring equipment including system solutions for data recording, data transmission and analysis of the captured data. With more than 30 years of experience SOMMER is a true measurement specialist and reliable partner in hydrography, meteorology, industry and water management, sewage and for geotechnical applications.

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AN INTEGRATIVE EVALUATION ON WATER QUALITY PARAMETERS: HYPOTHESIS AND REQUIREMENTS WITH LATEST DEVELOPMENTS

By Abhijeet Das, Research Scholar, Department of Civil Engineering, C.V. Raman Global University and Dr. Bhagirathi Tripathy, Assistant Professor, Department of Civil Engineering, Indira Gandhi Institute of Technology (I.G.I.T) Sarang, Dhenkanal, Odisha, India.

Abstract - Water is the furthestmost significant component in the terrestrial foundation and regulating the climate. It is one of the chemicals that affects life the most significantly. Typically, the characteristics of water's physical, biological, chemical, and constitution are utilised to define it. Groundwater resources are being depleted and are becoming significantly and diversely contaminated as a result of rapid economic development and the unrestrained use of chemical pesticides and fertilisers in agriculture. In-place sewage systems, landfill leachate, wastewater treatment plant effluent, leaking sewers, hydraulic fracturing, gas stations, or excessive fertiliser use in agriculture are the usual causes of ground water adulteration. Pollution can also be brought on by natural contaminants like fluoride and arsenic. Use of tainted groundwater exposes the entire public to illness or injury. Poor water quality can lead to a range of negative effects, including subpar goods, low earnings and serious risks to human health. This document provides detailed information on underground water quality characteristics, including pH, temperature, biological oxygen demand, dissolved oxygen, alkalinity, chemical oxygen demand, nitrite, hardness, ammonia, nitrate, sulphate and phosphate.

Keywords: Water Quality Index (WQI), Dissolved Oxygen (D.O.), Biochemical Oxygen Demand (BOD), Alkalinity, Eutrophication, Heavy metal.

1. Introduction

The lack of access to clean water is a global issue that affects all countries. The strong human desire to improve living standards has inevitably resulted in water pollution, with cumulative efforts and activities establishing as heavy industrial development and incessant urbanization, leading to progressive pollution of aquatic system [1-4]. When it comes to drinking, irrigation of crops, waste disposal, transportation, recreation, irrigation of crops, and industrial production, humans are utterly dependent on renewable resources of freshwater. The quality and quantity of water that can be used to placate human necessities are already threatened in many parts of the biosphere due to rising water usage, growing population, climate change and a rising water usage, the gap between freshwater availability and demand will worsen over the next century. About 80% contamination of Indian water resources, according to estimates by WHO, is caused by inhabited refuse. Water system management issues could have a substantial impact on the supply of drinking water [5-6]. Industrial waste is the main basis of water contamination. When wastewater from various industries is disposed of in the water without being properly treated [2]. Water's biological, physical and chemical properties have been changed in such a way that they are no longer useful for the intended application [7].

A change in the underlying sediments' and aquifer's chemical make-up also affects the variation in water quality. Surface sources like canals, lakes, dams, and rivers provide around one-third of the world's drinking water needs. Water is used in some way or another by an organism's chemical and physiological processes. In numerous aspects of existence, water is crucial. In order to research numerous physicochemical water characteristics including B.O.D. (biochemical oxygen demand), WQI (water quality index), D.O. (dissolved oxygen), Eutrophication, heavy metal, alkalinity, etc., water

samples from rivers and lakes provide an appropriate platform. Many scientists have occasionally studied the physicochemical properties of water bodies. The physicochemical features will also aid in the continuation of eco-biological impact research, the detection of pollution sources and the beginning of remedial action procedures for polluted water bodies [8-10]. Numerous scholars in India have studied the physicochemical and biological properties of reservoirs and rivers. Since a variety of physical and chemical elements can combine to affect primary production levels, which in turn affect total biomass and trophy structure across the aquatic food web, water quality must be taken into account when evaluating wetland habitat. In the current review work, certain parameters for evaluating the quality of water have been pre-sented together with earlier research on the subject by academics and scientists.

2. Analysis of Water Quality

Before using water for drinking, residential, industrial or agricultural purposes, it must first be test-ed. Different biological, physical and chemical factors must be used to test water. The only factors considered when selecting water testing parameters are the envisioned use of the water and the level to which its purity and quality are required. [11-14]. Different kinds of microbiological, dissolving, suspended, floating, and bacteriological pollutants are present in water. Physical tests should be conducted to evaluate the substance's odor, colour, temperature, pH, TDS, turbidity and further physical characteristics. Chemical tests should be conducted to evaluate the substance's COD, BOD, alkalinity, hardness, DO and other characteristics [15]. Water must be verified for heavy metal trace, organic and metal contaminants like pesticide scum in order to obtain more and more pure, high-quality water. It goes without saying that potable water must satisfy all of the required parameters during tests and contain the necessary amount of minerals [16-17]. Only in wealthy nations are all these requirements properly checked because there are very few organic and heavy metal pesticide contaminants in water, necessitating extremely analytical equipment and skilled labor. To monitor the water quality, a variety of physical-chemical parameters must be used.

2.1 Temperature Measurement

Using a digital thermometer, the temperature is determined by dipping the thermometer in the sample and recording the result [18]. Temperature is the degree of heat or cold in an aquatic organism's body, whether it is in water or on land. Despite having cold blood, fish experience body temperature changes in response to their environment. These changes have an impact on the fish's physiology and metabolism as well as its production. The micro biota's rate of metabolic activity as well as their rate of respiration both increase with temperature because of the rise in oxygen demand. It also results in increased ammonia levels in water and decreased oxygen solubility. However, with prolonged ice cover, chemicals such as carbon dioxide, methane and hydrogen sulfide can build up to dangerous levels and affect the health of fish. (Fig. 1 and 2).

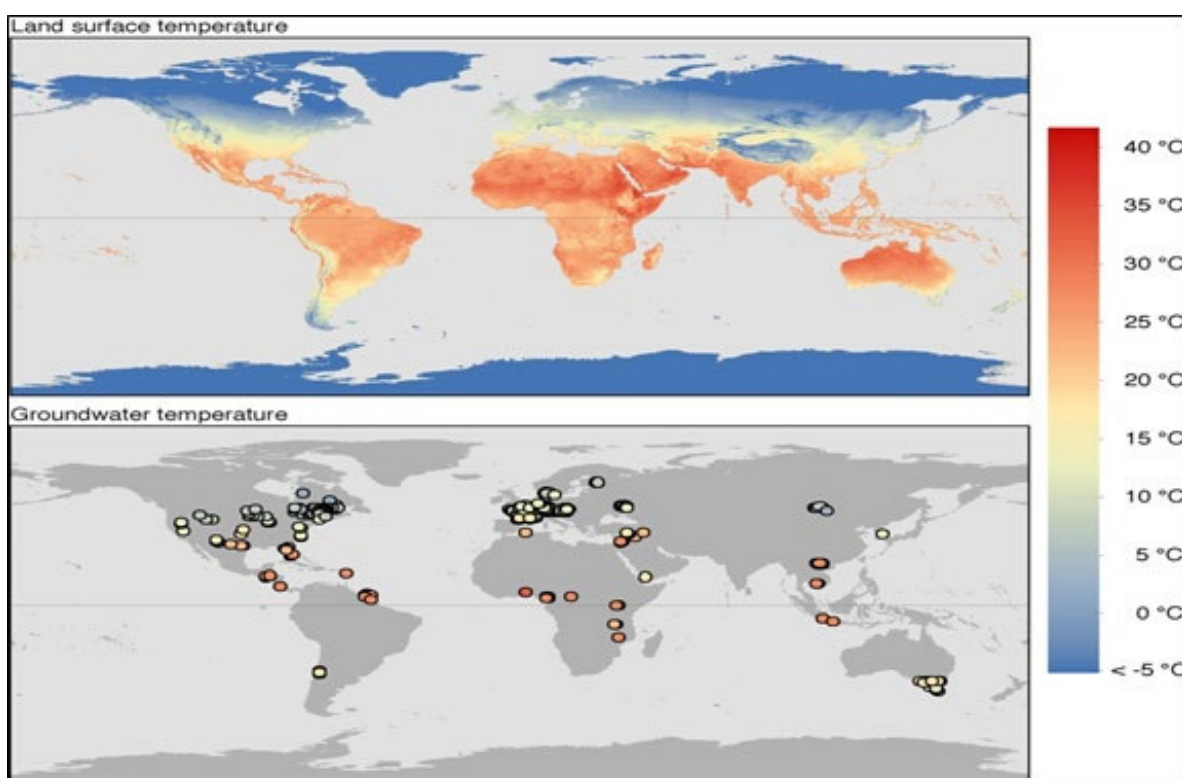


Fig. 1. Global map of temperature of shallow groundwater and land surface (GWT). LST is calculated using the daily MODIS products MOD11A1 and MYD11A1 averaged over a 10-year period (01/2005–12/2014). With regard to seasonal fluctuations in cloud cover, the bias in favor of cloud-free days was rectified. The same time frame saw the collection of (mul-ti)annual mean GWTs at depths of up to 60 m [19]

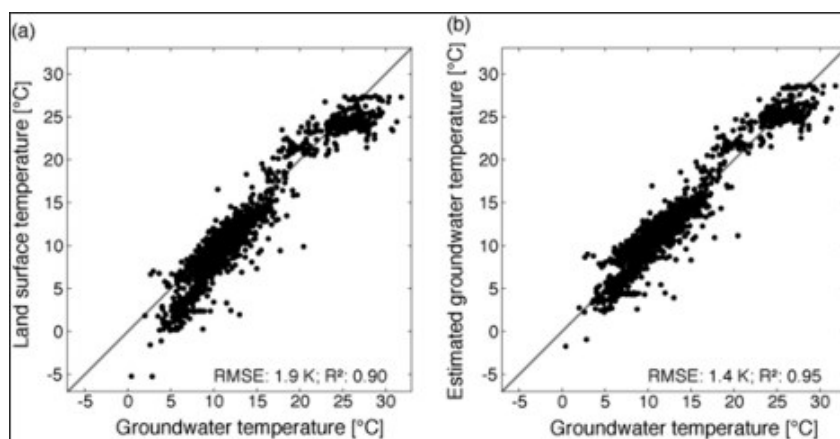


Fig. 2. Relationship between (a) and temperature of land surface (LST) and groundwater temperature (GWT) and (b) estimated and measured GWT. The equality line is shown in dark grey [19]

2.2 pH Measurement

The pH of water is a significant factor in determining its acceptability for a variety of uses, bathing, cooking, including drinking, agriculture and washing, among others. According to the BIS, water's pH should not overlie on either side of range 6.50-8.50. With a pH of 7, pure water is considered to be neutral. Acidic water is that which has a pH below 7.0, and basic or alkaline water is that which has a pH over 7.0 [20].

2.3 DO Measurement

Determining the amount of dissolved oxygen in a river is crucial since aquatic life there depends on it and needs at least 4ppm of DO to survive [8, 18, 21]. DO tests are carried out to confirm this. The Digital Dissolve Oxygen Meter is used to measure the DO test at the location of the sample collec-tion. When measuring DO on-site, the results are correct, but if DO is measured later, the results will alter due to changes in the atmosphere and temperature [10, 14].

2.4 BOD Measurement

The BOD is a measurement of how much total dissolved oxygen is used by microorganisms during the biodegradation of organic materials, such as sewage or food particles. Rural ponds may have an excessive amount of phosphate, cow waste, and domestic sewage from non-point sources, which all contribute to a high organic load and a higher BOD level [22].

2.5 COD Measurement

Chemical oxygen demand, which is typically combined with biological oxygen demand, is a measure of the amount of organics in water (BOD). The COD is a measurement of the amount of organic mat-ter in a sample that can be oxidized by a potent chemical oxidant.

[23–26]. The COD is frequently employed as a gauge of the organic and inorganic materials' susceptibility to oxidation in water bodies, industrial plant effluents and sewage discharges [27]. As a result, the COD is an accurate indicator for determining the degree of water pollution (Fig. 3). As organic and inorganic matter concentrations rise, so does the COD of water [28–29]. According to Garg [30], the COD concentration in Ramsagar reservoir ranged from 3.600 to 17.400 mg/l.

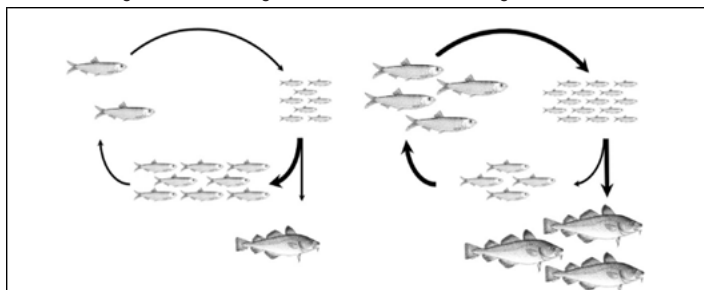


Fig. 3. Distribution of the stage of population of sprat in the two possible community conditions that give birth to the COD Allee effect. Right: Staffing to big size classes of sprat is strong with the presence of COD and high predation, especially on minor sprat, as a result of decreased intra-specific competition. Left: In absence of COD and low predation, individuals amass in the trivial-adult stage (stunted population). As a result, the remaining sprats grow quickly and produce a lot of progenies (arrows), which (mainly young) cod can eat. Even though cod target all sprat size classes, only the flow of biomass illustrating predation on young sprat is depicted because this interaction is what ultimately results in the other community states [31]

2.6 Carbon-di-Oxide Measurement

Unrestricted carbon dioxide, an exceedingly soluble gas in water generated by animal respiration, serves as nature's primary source of carbon. It can exist in water as dissolved or bound bicarbonate or carbonates in coral reef habitats, the earth's crust, and limestone. The pH of any system, especially those with inadequate buffering, is reduced when carbon dioxide is dissolved in water. This pH decrease can be harmful to aquatic life [32].

2.7 Alkalinity Measurement

Alkalinity, a measurement of the inclusive concentration of bases in pond water that includes dissolved calcium, magnesium, and other compounds as well as, bicarbonates, hydroxides, borates, phosphates, and carbonates, is the volume of water to engross variations in pH. Alkalinity is primarily increased by lime leaching from cement ponds or calcareous rocks, photosynthesis, sulfate reduction, and de-nitrification and it is primarily decreased or consumed by sulfide, respiration, and nitrification [33], as well as to a lesser extent by evaporation and decomposing organic matter. However, in case of insufficient alkalinity, even minor bit of acid might source a large pH change.

2.8 Nitrite-N (NO₂-N) Measurement

An intermediate in the transformation of NH₄⁺ or NH₃ into NO₃, nitrite, that is a by-product of oxidized NH₃ or NH₄⁺. Nitrification, which is carried out by the system's naturally occurring highly chemo-autotrophic bacteria, aerobic, gram-negative, completes this process. Due to the rapid nature of the dialogue, large nitrite amounts are not frequently seen. The "brown blood illness" is a condition where high amounts of the substance do, however, result in hypoxia brought on by the hemoglobin in fish blood becoming inactive [34]. Boyd [35] asserts that less than 0.3 mg/l of nitrite is the ideal level for aquaculture. The concentration of nitrite at cage stations was greater than the standard permitted value due to the influence from fish waste and more feed, according to re-search [36–42] that found the concentration of nitrite-N lied in the range of 0.001–0.28 mg/l in cage culture systems. It has been discovered that a higher less dissolved oxygen, more ammonia and pH can make it more poisonous.

2.9 Nitrate-N (NO₃-N) Determination

Nitrate is created via the process of nitrification, which is the oxidation of NO₂ to NO₃ by aerobic bacteria. De-nitrification of nitrate that aquatic plants cannot directly absorb occurs in anaerobic sediments [43]. According to Boyd [35], the ideal nitrate content for aquaculture is between 0.2 to 10 mg/l. Sewage and other pollutants high in nitrates can also contaminate surface water. Drinking water with higher nitrate content is harmful [44]. The Environmental Protection Agency (EPA) has determined that 10.00 mg/l of nitrate is the maximum contamination level (MCL) for water to be used for drinking purpose [45]. The concentration of nitrate in receiving waters is significantly impacted by runoff from farming operations and waste disposal sites. The usage of fertilizers on farms may have contributed to receiving streams' elevated nitrate levels through leaching and surface runoff during heavy rains. [29].

2.10 Ammonia (NH₃) Determination

Ammonia is a consequence of the protein metabolism that fish harvest, as well as the breakdown of bacterial of biological waste like dead planktons, food scraps and manure. Both ionized or unionized and ammonia are referred to as "total ammonia," yet only the unionized form (NH₃) is extremely toxic [31].

2.11 TSS Measurement

Total suspended solids, also known as non-filterable solids, are those solids that are retained by a filter with 1-micron holes. By running a known volume of sewage sample through a glass fiber filter equipment and weighing the dry residue that remains, their amount may be calculated [46].

2.12 Total Dissolved Solids (TDS) Measurement

Total dissolved solids, also known as filterable solids, are those solids that are not retained by a filter with 1-micron holes. By running a known amount of sewage sample through a glass fibre filter equipment and weighing the dry residue that remains after boiling the filtrate sewage, their quantity may be calculated.

2.13 Measurement of Turbidity

As soon as you can after the sample is taken, determine the turbidity. Before examination, gently stir all samples to achieve a representative measurement. If sample preservation is not possible, start the analysis right away. If storage is necessary, refrigerate or cool to 4°C to reduce the amount of microbial degradation of solids. For the best outcomes, test the turbidity right away without changing the pH or temperature of the original sample. A digital turbidity meter is used to measure turbidity. This was calibrated using a standard NTU [46].

2.14 Heavy Metals Measurement

Each sample of acid-digested water weighed 100 cm³ and was placed in a beaker. The beaker was then placed in a 70°C oven to condense the water to 50 cm³. Using an atomic absorption spectrometer, the concentrations of Co, Cu, Cr, Cd, Zn, Pb and Ni in each sample of water were measured (AAS: AAS: LABINDIA: AA- 7000) Prior to analysis, AAS required phase of acid digestion, which was accomplished by exposing the samples to concentrated HNO₃ [29]. Samples are digested using the methods endorsed by the American Public Health Association (APHA). The suggestions in the instruction manual were used to determine the instrument settings (10).

2.15 Index of Water Quality (WQI) Measurement

The WQI is premeditated in three steps. Each criterion was given a weight (Wi) in the first phase based on its relative significance to the overall quality of water intended for consumption. Nitrate has been given a maximum weight of 5 due to its significant role in determining the water quality [48]. The relative weight is computed using Eq. 1 in the second step.

$$W_i = \frac{w_i}{\sum_{i=1}^n w_i} \quad (1)$$

Where n is the number of parameters, relative weight is denoted by W_i and w_i represents the weight of each parameter. The parameter's calculated W_i values are provided in Table 1.

In the third stage, by dividing each parameter's concentration in each water sample by the relevant standard, according to the BIS specifications, and multiplying the result by 100, a quality rating scale (q_i) is obtained for each parameter (Eq.2)

$$q_i = \left(\frac{C_i - C_{io}}{S_i - C_{io}} \right) \times 100 \quad (2)$$

Where S_i is the BIS-recommended standard for Indian drinking water in mg/l for each chemical parameter and C_i is the concentration of each chemical parameter in every single water sample in mg/l. The parameter's optimal value in clear water is C_{io} . With pH, q_i is equal to $(C_i - 7)/(S_i - 7)100$ and C_{io} is equal to 7. For the remaining parameters, the optimal value is 0.

Table 1. Chemical parameters and their relative weight [49]

Chemical indicators	Weight	Indian Standard	Relative weight (W_i)
Magnesium	2.00	30.00	0.091
Total hardness	2.00	300.00	0.091
Calcium	2.00	75.00	0.091
TDS	4.00	500.00	0.182
Chloride	3.00	250.00	0.136
pH	4.00	6.50-8.50	0.182
Nitrate	5.00	45.00	0.227

Each parameter's sub index (SI_i), which is utilized to calculate the WQI in accordance with Equations 3 and 4, is first determined in order to calculate the WQI.

$$SI_i = W_i \times q_i \quad (3)$$

$$WQI = \sum_{i=1}^n SI_i \quad (4)$$

The i th parameter's subindex is SI_i . The estimated WQI values are classified into five categories in Table 2.

Table 2. Classification of water quality based on WQI value [49]

Water Quality Index	Quality of Water
>300.00	Unsuitable
200.00-300.00	Very poor
100.00-200.00	Poor
50.00-100.00	Good
<50.00	Excellent

The five categories range from "good water" to "unfit for drinking water", according to the computed WQI values (Table 2). The WQI has an inter-seasonal range of 28 to 267, with 24% of water-bodies rated outstanding in the pre- and post-monsoon seasons and 18% rated excellent during the monsoon season. Approximately 62%, 58% and 60% of water bodies are in good quality during the monsoon, pre-monsoon and post-monsoon seasons, respectively. 14%, 16% and 12% of water bodies were found to be poor water bodies in the respective seasons. The remaining 6%, 2% and 4% of water bodies were very poor water bodies in aforesaid seasons. 16% and 48% of water bodies are in excellent and good water bodies throughout the monsoon and post-monsoon seasons. Limits for the physicochemical properties of lake water in India are shown in Table 3.

Table 3. Physical and chemical features of Indian lake water [50]

Sr.	Parameter	BIS Specification
1	PH	6.50-8.50
2	Color	5 Hazena max
3	Appearance	Clear
4	Turbidity	5 NTU max
5	Alkalinity	200 mg/L max
6	EC	lacking mention
7	Chloride	250 mg/L max
8	Fluoride	1 mg/L max
9	Sulfate	200 mg/L max
10	Phosphate	lacking mention
11	Ca H	75 mg/L max
12	T H	300 mg/L max
13	TDS	500 mg/L max
14	Mg H	30 mg/L
15	FRC	0.25 mg/L
16	Silica	lacking mention
17	COD	lacking mention
18	Hydrazine	lacking mention
19	DO	lacking mention
20	BOD	lacking mention
21	NO ₃	50 g/L
22	SO ₃	lacking mention

3 Physicochemical Review of Some Water Samples from India

The study of physical-chemical parameters is crucial to obtaining a precise understanding of the water quality, and it allows us to compare the results of various chemical and physical parameter values with reference values (Table 3). Here is a brief summary of some previous research studies. Pulp and paper sector effluents are one of India's most polluting industries, according to Tripathi [51]. Small and large pulp and paper mills use several procedures that produce effluents with drastically varying physical-chemical characteristics due to their disparate production capacities and raw material sources. To diminish the impact of various pollutants on the environment, before being released into the drainage channel, such contaminated effluents must undergo sufficient treatment. Based on the findings presented here, it can be stated that the effluent emitted from both paper industries is extremely contaminated and exceeds the limits set by Indian regulatory agency norms. Furthermore, it is claimed that the pollutants produced at various stages of the paper manufacturing process can be reduced either by replacement of some current bleaching and pulping techniques with ECF (Elemental Chlorine Free bleaching), biopulping, TCF (Total Chlorine Free bleaching), bio-bleaching, and ozone bleaching, or by treating the effluent with physical, biological or chemical methods. This monitoring research of pulp and paper mill effluent collected from wood-based and agro-based sources resulted in the creation of a data bank that may be used to successfully anticipate their toxicity and implement appropriate management. Agarwal's [52] research shows that the water in the Bihar River can perform as a good habitat, provides educational data, and aids in understanding water features.

The pH value suggests that the alkaline water in May have resulted from the high temperature, which suggests that CO₂ is soluble in the water. The Bihar River's Baba Ghat's water quality metrics, including alkalinity, total hardness, chloride ion, pH, BOD, COD are all well within the acceptable range, according to the analysis. Consequently, appropriate methods should be developed. According to research by Vyas [53], the majority of fresh water bodies worldwide are becoming contaminated by human waste, industrial waste, sewage, agricultural waste, and religious practices like idol immersion. The Central Pollution Control Board [54] has created a thorough set of regulations regarding the act of immersing idols in oceans, lakes and rivers (Guidelines for Idol Immersion, CPCB, 2006). These regulations outline and define the function of state pollution control boards in evaluating the water quality of aquatic bodies and categorizing them according to specific physiochemical parameters. If these recommendations are followed and put into practices, the quality of the river's water after idol immersion could significantly improve. Tamot [55] asserts that the most crucial metric for determining the water quality is DO, which was discovered to be Nil at seven places despite being necessary for all aquatic creatures' metabolism. Ganai and Parveen [56] came to the conclusion that water temperature and water chemistry are the primary influences on phytoplankton dispersal, chloride, transparency, dissolved oxygen, alkalinity, TDS and CO₂. Hardness and Conductivity, on the other hand, have less of an impact on the distribution of phytoplankton groups. Rani Lake water displays low high COD, BOD, DO, hardness, turbidity, alkalinity, chloride, TDS, nitrate and phosphate during 2008 and 2009, according to Mishra [57]. These parameters' values were discovered to be over the allowable limit (IS: 10500). A higher pH number implies that the water is slightly alkaline.

The results unambiguously show that sewage discharge and other anthropogenic activities have caused this lake to become contaminated and eutrophic in character. The amount of oxygen utilized during aerobic processes of organic material degradation brought on by microorganisms is measured by biological oxygen demand. Therefore, the BOD provides details on the proportion of an organic substance in a sample of water that can be converted biologically. As a result, it is necessary to take into account how susceptible certain materials are to oxygen oxidation. The pre- during, and post-immersion activities yielded the ranges of 1.4-35, 4-55, and 3.3-38 mg/L. At Site-7, the immersion period produced the highest BOD value (Majnu Ka Tila). Analysis was also done on the COD, which is frequently used to estimate indirectly how many organic chemicals are present in water. COD is a helpful indicator of water quality because the majority of its applications estimate

the volume of organic contaminants present in wastewater or surface water (such as lakes and rivers). As indicated by a number of researchers [58-61], the value of COD in conjugation with BOD is beneficial in determining the hazardous circumstances and existence of physiologically resistant organic compounds.

4 Conclusions and Recommendations

The water quality of rivers and lakes has declined as a result of all the aforementioned effects. It provides a hint for municipal authorities to create effective management plans. The main factors influencing temperature variation are atmospheric temperature and weather. The industrial effluents that were released may have contributed to the pH decrease in Indian water bodies. This outcome is consistent with prior scientists' reports. The decrease in water volume due to rapid evaporation at high temperatures, high loadings of organic compounds, chlorides, detergent and other pollutants are all responsible for the increase in hardness. Low levels of DO as a result of wastewater discharge from enterprises that were discharging some biological wastes that demanded a lot of oxygen. An important factor that is frequently used to estimate the pollutant load of waste water is biological oxygen demand. The purpose of the BOD test is to quantify the quantity of carbonaceous matter that is biochemically oxidized. Values of BOD were caused by a faster rate of organic matter decomposition with turbidity, at a higher temperature and slower water current. A test called chemical oxygen demand is used to gauge how polluting household and industrial waste. This provides important information regarding the possibility for pollution from home sewage and industrial effluents. Many aquatic zones in India have high COD value, which shows that industrial effluents released by industrial units are mostly to blame for the pollution there. Therefore, it is crucial to check the water's purity using the several criteria listed above before utilizing it.

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DESTRUCTION OF PFAS CONTAMINATED WASTEWATER RESIDUALS AND BIOSOLIDS USING SUPERCRITICAL WATER OXIDATION

By Sudhakar Viswanathan, 374Water

Lifestyle and societal practices have brought us to a point in time where pollutants are a major threat to limited fresh water sources around the world. Common approaches to wastewater treatment separate liquid from solid waste - with a byproduct of the process being organic residuals and biosolids, or “sewage sludge,” as they are more commonly referred to. Depending on their composition, some biosolids are beneficially reused at agricultural or reclamation sites, where they provide nutrients and soil structure improvements. However, a large proportion of biosolids are disposed of in landfills or incinerated.

Sewage, residuals and biosolids can all be primary sources of a wide range of contaminants that should be eliminated during the wastewater treatment. This includes pathogens, inorganic chemicals, microplastics, per- and polyfluoroalkyl substances, also known as PFAS or “forever chemicals,” and other contaminants of emerging concern (CECS). PFAS are man-made chemicals that have accumulated over time, never fully breaking down. As such, they have been increasingly present in the environment and human bodies since the 1940s. Today, PFAS can be found in food packaging, household products like nonstick pans and water-repellent fabrics and even water, soil, and wildlife. A 2018 study estimated that 110 million Americans could have PFAS in their water.

The widespread presence of PFAS in water and other environmental media is a threat to human health. The two species of PFAS most commonly found in water - PFOA and PFOS - have been found to cause tumors, reproductive, developmental, liver, kidney, and immunological effects in laboratory animals. Exposed populations consistently experience increased cholesterol levels and more limited findings have pointed to low infant birth weights, immune system effects, thyroid hormone disruption (for PFOS) and cancer (for PFOA).

Incinerating and landfilling PFAS contaminated wastewater residuals only transfers the pollutants from one environmental compartment to another. The risk to human health and environment still exists. Anaerobic digestion is a common waste management approach that offers a means to process waste that would otherwise be sent to landfills or combustion facilities. A major byproduct of anaerobic digestion is methane, which accounts for 50-75% of the biogas produced during the process. Although biogas serves as a renewable fuel source, it is still a potent greenhouse gas with one of the highest Global Warming Potential (GWP).

There is a growing demand for new innovative technologies that transform wastewater residuals and biosolids to useful byproducts like water, energy, and minerals while destroying contaminants of emerging concern like PFAS, microplastics, and pharmaceuticals. One such technology is supercritical water oxidation (SCWO).

THE FUTURE IS NOW

Supercritical water oxidation (SCWO) offers a unique value proposition the water and wastewater industry, as researchers and professionals have come to realize in

recent decades. SCWO is a physical-thermal process that can treat a wide range of organic wastes, in particular wet wastes, and slurries such as wastewater residuals and biosolids, food waste, agricultural wastes, and recalcitrant organic wastes from a variety of chemical processing industries.

SCWO is a truly transformative technology that taps into the unique properties of water above its critical point: 374°C and 221 bar (705 °F and 3200 psi). In these conditions in the presence of oxygen, organics are rapidly converted to water, inert minerals, gasses, and reusable heat. In many cases, SCWO can eliminate more than 99.9 percent of organic compounds.

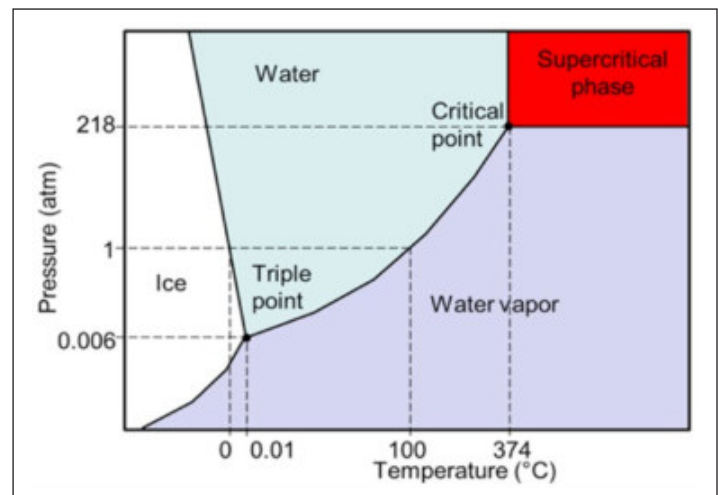


Figure 1: Water phase diagram showing the supercritical water region (not to scale)

SCWO has received increased attention as concerns over the ubiquity of emerging contaminants increase and governments promulgate regulations to manage them. The ability to truly eliminate nearly all traces of contaminants in residuals and biosolids is a groundbreaking feat. However, since its introduction, commercial development of SCWO has been slow due to technical challenges inherent to the approach. The complex nature of a high-pressure, high-temperature process can lead to corrosion, plugging and fouling. These logistical issues have driven a need for change to critical design elements of SCWO processors - including experimenting with changes to the reactor material, shape, and size. What's more, the pure oxygen used in older generation SCWO processes must be handled and stored safely, creating a need for expensive safety design and control processes to avoid hazards.

With energy being a byproduct of the SCWO process, early attempts to commercialize SCWO were also sidelined by unrealistic expectations that SCWO could produce

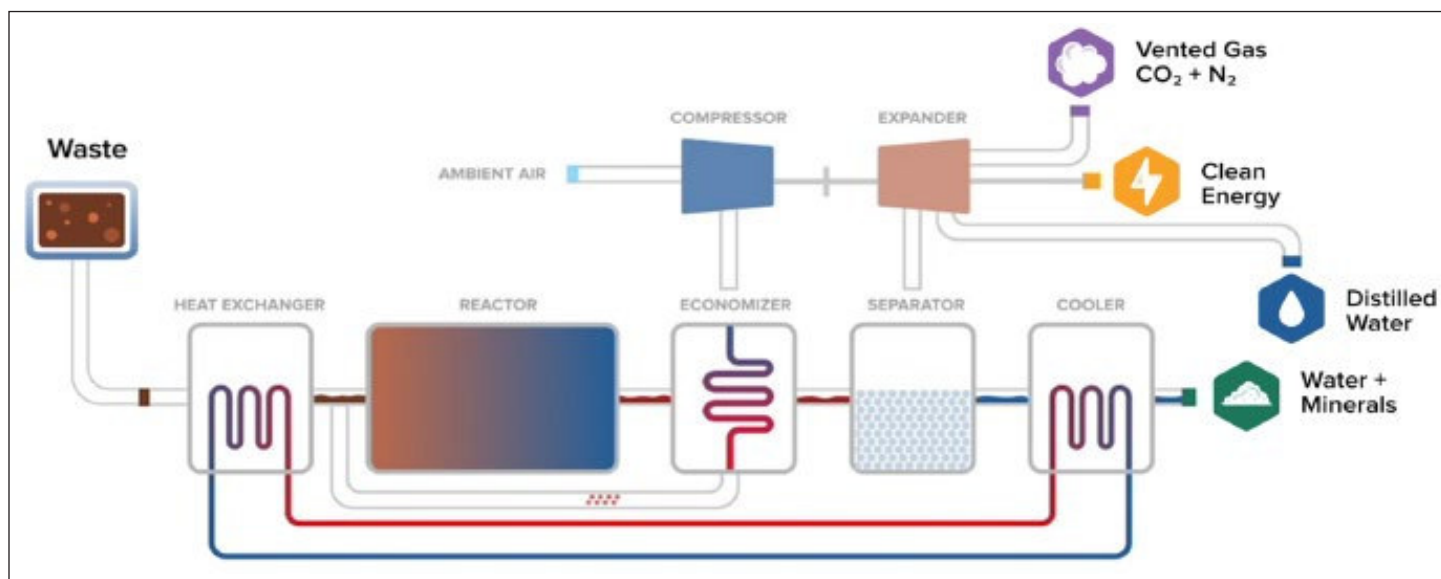


Figure 2: AirSCWO™ process flow diagram

power at a competitive retail electricity rate (approximately \$0.03-0.05 per kWh). This goal proved to be unreachable, making SCWO adoption and commercialization that much more difficult.

PIONEERING A NEW ERA WITH AIRSCWO™

374Water, of Durham, NC, USA, offers a commercial SCWO technology that treats wastewater residuals and biosolids contaminated with PFAS. The patented SCWO technology is at the center of the world's first self-sustaining, continuous flow SCWO system, called AirSCWO™. AirSCWO™ is proven to effectively process slurries and sludges. It was labeled "the third generation of SCWO" during an aqueous film forming foam (AFFF) and PFAS destruction study performed by the U.S. EPA PFAS Innovation Technology Team (PITT).

The systems are prefabricated, compact and modular and intended for decentralized installation. They are designed to operate continuously, 24x7 operation. The units can be set up to operate in parallel at existing wastewater plants, with options to configure the system to meet various throughput requirements.

AirSCWO™ successfully treated PFAS contaminated, lime-stabilized sludge from a small-scale facility in Maine. The sludge contained PFAS. The influent concentration of PFOS and PFOA were 110,000 ng/l and less than 6200 ng/l, respectively.

AirSCWO™ sharply reduced these concentrations to 0.65 ng/l and 3.15 ng/L, a >99.9 percent destruction removal efficiency.

AirSCWO™ addresses waste and wastewater management challenges plaguing communities across the globe and tackles prior hurdles which prevented SCWO technologies from widespread adoption and commercialization. This includes pending U.S. patents that allow the system to preheat waste slurry more moderately before mixing with supercritical water and air. This allows air to serve as the oxidant, a much safer alternative than pure oxygen and chemicals. Further, internal mixing brings waste to supercritical conditions rapidly, minimizing corrosion and risks of waste charring and plugging. With AirSCWO™, all organics found in the sludge mineralize to H₂O, CO₂, and inorganics with the heat of the oxidation process recovered to heat influent waste. The system also features a multi-stream tubular reactor configuration, which enables efficient and sustainable treatment while helping overcome corrosion and plugging.

By harnessing energy embedded in the waste stream undergoing treatment and simultaneously enabling recovery of clean water and minerals from numerous sludges and biosolid sources, AirSCWO™ is paving the way for a new era in sustainable waste management and resource recovery. The process is fast, clean and the units serve as net energy producers leveraging a unique, proprietary energy recovery unit ("Expander").



About the Author



Sudhakar Viswanathan has over 20 years of water and wastewater industry experience, with extensive expertise in biosolids and bioenergy products, processes, and projects. Author of a book and numerous papers/publications related to biosolids, bioenergy, water, and waste. Currently responsible for developing partners to grow Supercritical Water Oxidation solutions and expand the biosolids and bioenergy market for 374Water.

SURFACE WATER BIO REMEDIATION USING NOVEL NON-INVASIVE TECHNIQUE FOR INTEGRATED WASTE WATER MANAGEMENT

By Riddhish Soni¹, Jenil Shah² Prayag Pate³ Tejeswin Jagadesh⁴ Divyang Soni⁵ Jagadesh Reddy⁶ Anurag Wasnik⁷ Nirmal Chittora⁸
Dr. Faruk Kaz⁹ Ashok Samrat¹⁰ Lokesh Kumar¹¹, Aumsat Technologies

Introduction

Lakes, ponds and reservoirs ensure a sustainable balance to the environment and its surrounding locality. By acting as a nutrient sink, providing drinking water, lowering climatic vulnerability, enhancing flood protection capabilities and acting as a source of groundwater recharge, these natural resources play a vital role to mankind. Recent anthropogenic activities have led to changes in the physical, chemical & biological characteristics of water quality eventually leading to soil degradation, increase in health problems, eutrophication and a sharp decline in fauna.

In this study we evaluate the application of nature-based bioremediation solution for the Upparpally lake, Hyderabad along with its validation-verification using satellite-based imaging spectroscopy.

Upparpally Lake

Upparpally lake situated in Attapur area of Hyderabad is a cesspool with two sewage inlets draining garbage, sewage over a volume of 1.5 lac cubic meters of water spread across 12.32 acres of land. Recently the Greater Hyderabad Municipal Corporation (GHMC) had been receiving complaints from the local residents regarding the increase in debris & foul odour as a result of untreated sludge and slurry. In order to identify and mitigate the deteriorating water quality of the lake, a preliminary study was carried out by the GHMC ground action team.

After a detailed analysis, the ground action team identified problems of debris accumulation, increase in algae and hyacinth leading to foul odour and finally increase in CDOM and detrital material as a result of untreated sewage from STP.



Image 1: Upparpally Lake, Hyderabad

Date of Sample	pH	TSS	Turbidity	COD	BOD	Ammonia
Pre-Treatment Analysis						
28.05.2022	6.89	980mg/L	164 NTU	33000mg/L	12900mg/L	750mg/L

Bioremediation

With the lake quality deteriorating fast, GHMC invited proposals for the condition assessment of Upparpally lake using bioremediation techniques and one such contract was awarded to Magnatree Ventures Private Limited to manufacture sewage digesting enzymes for sewage water treatment.

After initial sample collection, lab testing and preliminary analysis, nature based probiotic enzymes were prepared using cow dung and enriched nutrient concussions. This diluted solution was mixed with lake water using drone-based spraying and the results were observed over a period of 4 months.



Image 2: Initial conditions on 24th June 2022



Image 3: Drone Spraying probiotic solution

Validation and Verification

Laboratory samples certified by NABL certified water testing observatories and satellite imaging spectroscopy generated by Aumsat Technologies LLP was used to as a source of validation and verification.



Image 4a: 15th June 2022



Image 4b: 15th July 2022

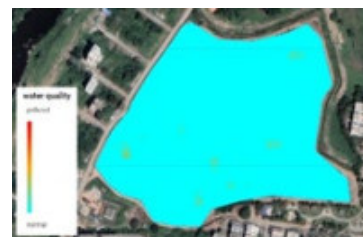


Image 4c: 15th August 2022

Date	pH	TSS	Turbidity
Before Treatment 28.05.2022			

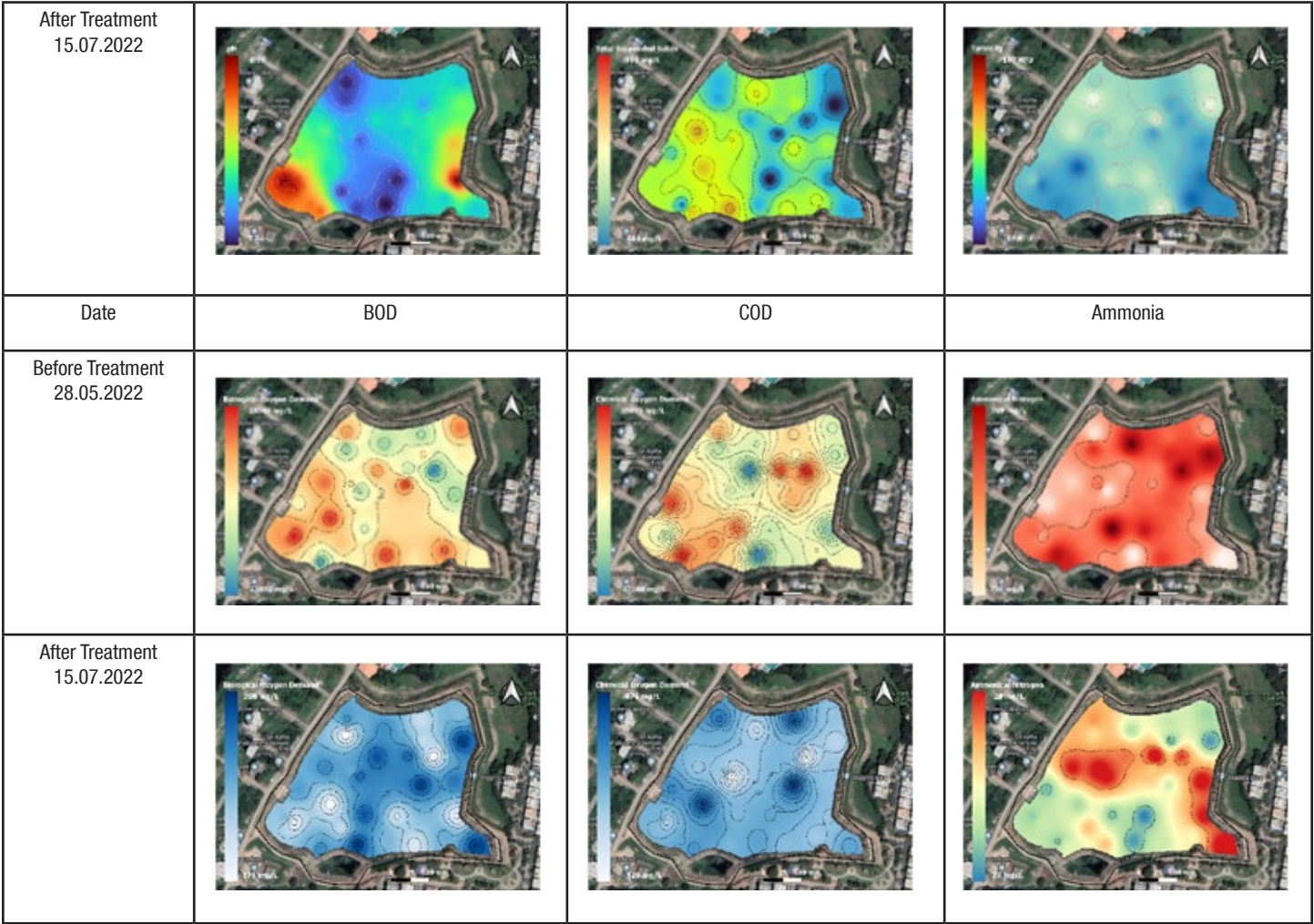


Image 5: Water Quality Data

Results

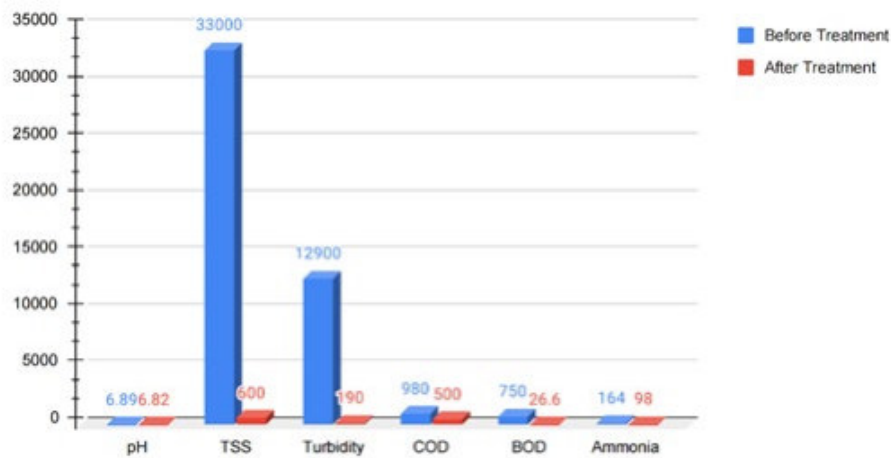


Table 1: Data Analysis

As observed from the results of Table 1, the bioremediation has demonstrated an effective solution for waste water treatment. The Chemical Oxygen Demand reduction from 33000 mg/L to 600 mg/L is an indicator that the residual organic chemicals had been converted as gases by the action of enzymes. Furthermore, the reduction in Biological Oxygen Demand, Total Suspended Sediments and Ammoniacal Nitrogen attributes to the reactions caused by the Probiotic Enzymes.

Conclusion

Population, urbanization, and water scarcity are on the rise again and Climate Change continues to affect millions of people today. Public investment in water management requires much greater support and increased investment in water infrastructure.



Image 6a: Before Treatment



Image 6b: After Treatment



About the Author



Riddhish Soni: Ex-ISRO Scientist and part of Chandrayaan 2 Mission. He comes with 9 years' experience in Space Application Industry.

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Lokesh Kumar: Commissioner GHMC Hyderabad with more than two decades of experience.

To share your feedback or enquire about the author, write to us at deepak.chaudhary@eawater.com

INDONESIA'S MENINTING DAM PROJECT SUPPORTS WATER ACCESS IN PROMISING TOURISM DESTINATION

By Aude Camus, Senior Product Marketing Manager, Reality Modeling at Bentley Systems



PT Hutama Karya decided to revolutionize their surveying and data collection by fully digitizing their processes. Image courtesy of PT Hutama Karya.

PT Hutama Karya (Persero) Uses Digital Monitoring Software to Promote Safety and Sustainability in Key National Infrastructure Project

Within the archipelagic nation of Indonesia, the island with the greatest international tourism profile is the lush and paradisaical Bali. But just to its east in the chain of the Lesser Sunda Islands, the island of Lombok is also growing a reputation as a tourist attraction.

Lombok is known for its hiking opportunities, including trails along Mount Rinjani, Indonesia's second-highest volcano. Additionally, Mandalika, a resort area on the island's southern coast, was named in 2020 as one of Indonesia's five "super-priority destinations"—sites that the Indonesian Tourism and Creative Economy Ministry is working to promote as international tourism hubs. Recently, Mandalika has attracted high-profile events, including the 2022 Indonesian motorcycle Grand Prix, which served as the second round in the international Moto Grand Prix Championship.

However, while the tourism possibilities in Lombok offer a promising avenue for Indonesia's economic development, island locals are facing a serious daily threat to their way of life, one

that is also holding back the area's tourism potential. During the 21st century, Lombok and the larger Indonesian province of West Nusa Tenggara have experienced growing water scarcity during dry seasons, with limited water available for drinking and sanitation. This scarcity also encroaches on Lombok's vital agriculture practices; the island is one of the top rice producers in Indonesia, and farming is the most common profession among locals.

To provide balance in water availability between Lombok's rainy and dry seasons, Indonesia's Directorate of General Water Resources tapped PT Hutama Karya (Persero), a state-owned enterprise that executes infrastructure projects, to engineer a dam in the West Lombok Regency. This district stretches along most of the southwestern coast of Lombok. The Indonesian government has honed in on the Meninting Dam as a linchpin for the development of the country's infrastructure and economy, officially naming it a National Strategic Project for the Acceleration of Economic Growth in Indonesia.

"It will significantly support the agricultural sector of the locals, and also support economic growth by making a new destination for the tourism sector," said Christy Vania, an engineer at PT Hutama Karya who is focused on building information modeling.

Safety Measures

Work on the USD 95.15 million Meninting Dam began in 2019 and should last into 2023. When completed, the dam will be 79 meters high with a water capacity of 12 million cubic meters. It will irrigate more than 1,500 hectares of agricultural property and ensure the availability of clean water to nearby Lombok residents and tourists. Additionally, the dam will provide an additional 0.8 megawatts of clean, hydroelectric power to the community.

However, to achieve this vision, PT Hutama Karya's engineers had to navigate tricky terrain. Parts of the site chosen for the dam were difficult to access, with thick trees and shrubbery and steep conditions. The undeveloped site presented an unknown degree of hazards for surveyors and construction workers. When the team attempted to survey the property using traditional methods, the data collection process was drawn-out and dangerous.

Considering these challenges, PT Hutama Karya decided to revolutionize their surveying and data collection by fully digitizing their processes. The team used a drone with a flying distance of 7 to 8 kilometers to capture images and data from the site's hardest-to-reach areas. The drone's findings were then processed using Bentley's 3D reality modeling and real-time visualization software to chart maps and monitor ongoing conditions at the site, identifying any new potential work hazards over time. This methodology cut the time required for data collection and monitoring by half and contributed significantly to worker safety. In total, project engineers saved an estimated USD 2.1 million in fees by avoiding potential work-related accidents.

"Because the terrain is very steep, there is a high potential for landslides. But we can say we had around 1,200,000 safe resource hours without lost time or injury," Vania said.

For the construction phase of the project, these digital visualization tools were folded into PT Hutama Karya's GIS dashboard, which also integrated BIM capabilities. Post-construction, these tools will also be useful so that Indonesia's Directorate of General Water Resources can monitor the dam's performance and upkeep.

Vania believes that the safety and cost benefits evident from PT Hutama Karya's innovations on the Meninting Dam will undoubtedly be carried forward into the organization's future projects, and digital surveyance will become a best practice.

Sustainable Priorities

Another one of PT Hutama Karya's priorities for the Meninting Dam was to keep the project's development as sustainable as possible. For instance, during construction, the company took steps to reduce the impact of tree cutting. Where trees had to be removed in the dense forest area, steps were taken to use displaced soil in another area of the project. That soil was also used to plant new trees.

PT Hutama Karya's venture into digital project management also helped to keep sustainability front and center. In a region where clean water is already precious, it was important to ensure that construction activities did not result in further contamination of the Meninting watershed. Through digital monitoring, project managers noticed that river water around the dam's construction was becoming dirty with excavated soil and heaps, creating a potential environmental risk for people

who live within a 3-kilometer radius of the dam. Project managers were then able to reduce the pollution and avoid creating ill effects for the civilians they hoped to serve with this key infrastructure project.

Spotlight on Fariz Harwanto and Christy Vania

Engineers with PT Hutama Karaya (Persero) Oversee Key National Projects for Indonesia's Development

In 2016, Indonesia implemented a sweeping plan to progress national development through key infrastructure projects. The nation's government convened the new Committee for Acceleration of Priority Infrastructure Delivery, which identified around 245 urgent projects, including new roads, dams, airports, power plants, and irrigation networks.

These strategic projects will not be completed overnight. However, work has already advanced on several high-priority projects under the guardianship of engineers with the state-owned enterprise PT. Hutama Karaya (Persero). One of these engineers is Christy Vania, a self-described building information modeling enthusiast who works out of PT Hutama Karaya's Jakarta headquarters. Vania has been responsible for overseeing streamlined BIM implementation from the project level to the corporate level, including major efforts such as the Trans Sumatera Toll Road and the ongoing Meninting Dam project in West Lombok.

"We [implement] best practices for the projects we manage, but also, we keep looking for something new to develop in BIM technology," Vania said.

One of the individual project managers who has worked together with Vania is Fariz Harwanto, the current site engineering manager for the Meninting Dam on the island of Lombok. This location is a point of passion for Harwanto, who cut his teeth as an engineer by assisting with the coordination of temporary shelters and schools for Lombok earthquake survivors in 2018. Now, he looks forward to seeing the completed Meninting Dam improve everyday life for people in the area.

"I'm very interested in how the dam will help the local community in farming, with water, and as a tourism area," Harwanto said.

The two engineers agree that it is a prime moment to be an engineer in Indonesia, as the country is gaining momentum to address so many key infrastructure issues. Harwanto is excited to welcome budding young engineers to the engineering field as it continues to grow to meet Indonesia's needs.

"I would tell them to prepare to learn," he said. "[It takes] problem solving. How can we get to work when the land acquisition has not been completed? How do you make our method work with current conditions?"

With so many experts needed to move Indonesia's strategic development forward, opportunities are opening for people who may have been shut out of the engineering field in the past, Vania said. In fact, she said that the field needs new voices more than ever as it strives to meet ambitious national goals.

"For women, the engineering field is very open today," Vania said.



About the Author



Aude Camus is the senior product marketing manager for reality modeling, roads, and bridges with Bentley Systems. Graduated from SKEMA Business School in France, she has nearly 15 years of experience in selling and marketing engineering and geospatial software.

To share your feedback or enquire about the author, write to us at deepak.chaudhary@eawater.com

MULTI-TECH APPROACH TO ACHIEVE MLD

CASE STUDY: TEXTILE INDUSTRY IN MEXICO

By Alain Mokbel, Dupont



Introduction

In Yucatán, Mexico, a fabric and apparel manufacturer is looking to improve their sustainability goals to be able to reduce the amount of water used per kilogram of textile produced.

In order to achieve this goal, the factory has implemented a project to achieve Minimal Liquid Discharge (MLD) to maximize wastewater recovery for reuse and eliminate water discharge to the environment.

Vertical Knits is committed to increasing their positive impact on our planet, one person, one shirt and one community at a time. As they have grown, so has their commitment to reduce the environmental footprint on our planet. Their vision is to elevate their employees, customers, suppliers and the community to become innovators, leaders and contributors of an inclusive society and a healthy environment.

Their comprehensive approach towards reducing their environmental impact means looking at all aspects of the business, how they intersect and how they can integrate new solutions to create meaningful and sustained change, such as adopting energy-efficient processes and controls, reducing the energy and water use and improving the waste and water recycling.

The Challenge

The region's textile industry has been employing Minimal Liquid Discharge (MLD) using reverse osmosis (RO) followed

by evaporation for more than a decade to meet local zero liquid discharge (ZLD) requirements. Using a hybrid MLD-ZLD process lowers the cost of traditional thermal ZLD by up to 60%, but the costs are still more than wastewater management costs of other textile factories around the world where ZLD is not required.

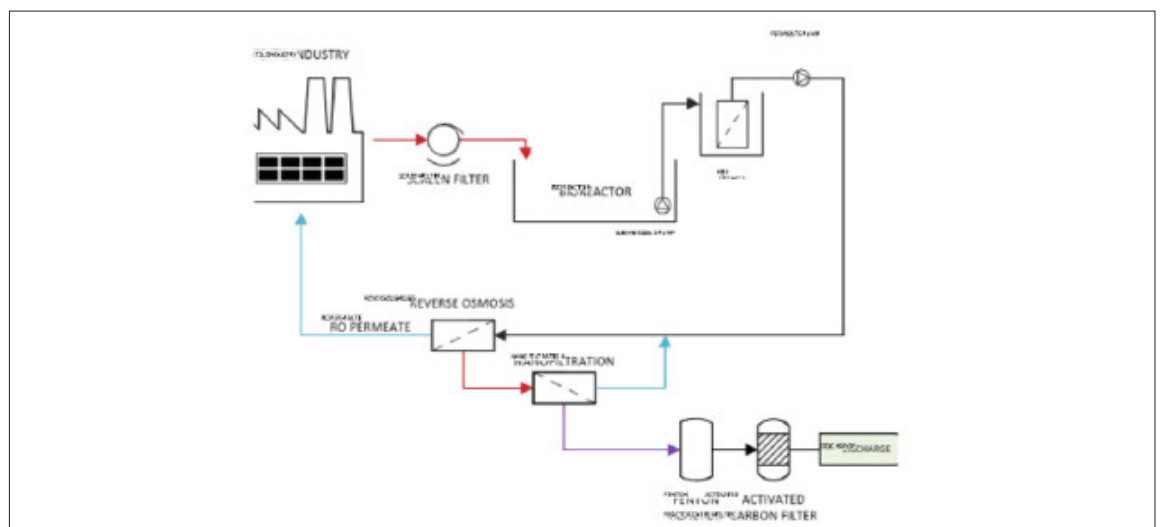
To remain competitive in the world's textile market, wastewater treatment costs must be further reduced. Innovative membrane technology to push the MLD process more and reduce the volume of water needing thermal treatment is needed to achieve this cost benefit.

The Solution

In order to achieve their sustainability goals and remain competitive in the market, the end-user implemented a membrane-based, multi-tech solution that consists of treating the wastewater first through membrane bio reactor (MBR) process using MEMCOR®B40N MBR modules. The permeate is then collected and fed to a reverse osmosis (RO) system that uses a combination of FilmTec™ Fortilife™ CR100, XC70, and XC80 elements to achieve a recovery of 85%.

The RO concentrate is then fed to a nano filtration (NF) system using FilmTec™ Fortilife™ XC-N to increase overall water recovery. The permeate of the RO system is reused within the process, whereas the permeate of the NF system is recycled to the feed of the RO system. The process train has an overall water recovery of 93%.

Process Flow Diagram



Fast Facts

Location:

Yucatán, Mexico

Commissioning:

2019

Application:

Minimum Liquid Discharge

Water Type:

Wastewater

Capacity:

1000m³/day

Contractor/End User:

Vertical Knits

Technologies:

MBR, Reverse Osmosis,
Nano filtration

Products:

MEMCOR®B40NMBR,
FilmTec™ Fortilife™
CR100, FilmTec™
Fortilife™ XC70, FilmTec™
Fortilife™ XC80, FilmTec™
Fortilife™ XC-N



MBR



Nano filtration system



Reverse Osmosis system



About the Author



Alain Mokbel is Lead - Engngineer, Technical Service at DuPont Water Solutions. He is a Chemical Engineer with over 15 years of experience in water treatment and project management.

To share your feedback or enquire about the author, write to us at deepak.chaudhary@eawater.com

HOW TO EVALUATE AND SELECT AN OZONE GENERATOR – Part 1

Awareness of ozone and its applications in India have increased. With more stringent rules with respect to the environment, Consultants have begun to look to alternate technologies and have found ozone providing solutions to many of their problems. As this technology is relatively new, it becomes very important for Consultants and prospective users to be aware of the intricacies associated with this technology. We will have a series of five parts Ozone page content to try and cover all the valid points one must consider while going in for an ozone system.

Ozone is an effective technology as long as it is applied well. For a successful Ozone application, four vital aspects are to be borne in mind. They have to be understood, analyzed and then the decision can be taken. The three aspects to be considered are:

1. The Ozone generation technology – Ozone can be generated from air through UV technology or Corona discharge technology, but also directly from water using electrolytic membranes. The selection of technology will greatly affect the success of the application. The Ozone generation technology also determines the Ozone concentration produced by the Ozone generator.
2. The running costs of an Ozone generator- The running costs of an Ozone generator depends on the choice of feed gas, the type of cooling and hardware design which also affects the maintenance costs over time.
3. Safety Aspects – Never neglect this aspect. Though ozone is a safe gas when handled well, the equipment uses high power, and needs to have interlocks for protection. The life span of the equipment and maintenance requirement depends upon this factor. Operational safety should also be ensured.

In most cases, clients and consultants are often in the dark as to how they go about evaluating ozone systems and the criteria to select the equipment for their applications.

The article will attempt to simplify the process of selections so that the user and the consultant make an informed decision to arrive at the selection.

1. CONSIDERING THE OZONE TECHNOLOGY

Ozone can be produced in over a 100 ways. There are more than 700 patented ways of ozone production. But commercially four most popular methods are being used.

- a) The UV method of ozone production
- b) The plate types corona Ozone production
- c) The tube types corona Ozone production
- d) Electrolytic (PEM) water based Ozone production

THE UV METHOD OF OZONE GENERATION

To understand this, we need to define the role of Ozone.

The role of Ozone

The main purpose of Ozonation is of dual nature. Ozone is expected to perform **both Oxidation and disinfection**. (Oxidation to remove organic and inorganic contaminants and disinfection to kill bacteria etc). Irrespective of the amount of ozone generated per hour, a minimum concentration of at least 1% is required for both oxidation and disinfection. UV ozone generators cannot generate Ozone at this concentration to perform simultaneous oxidation and disinfection. Ozone concentration greatly affects mixing efficiency.

The concentration of Ozone

Corona discharge Ozone Generators can produce Ozone at a concentration ranging from 1 to 16% w/w compared to 0.1 to 0.001% w/w by UV ozone. This as mentioned is 10 to 1000 times less when compared to CD ozone generators. **The amount of air required for UV Ozone generators is 10 times more than that required for CD units with consequent low Ozone concentrations.**

The solubility of Ozone in water is only partial and is governed by Henry's Law (the solubility of the gas in water is directly proportional to its partial pressure in the gas phase). Consideration of Henry's Law led to the obvious conclusion that the higher the Ozone concentration the greater will be the solubility of ozone in water.

The more ozone is dissolved in water **the more effective it is as a disinfectant**. It is therefore very clear that Ozone generated through UV radiation, not much of Ozone is available in the water for both Oxidation and disinfection. The following table explains: continued Next month

ISSUED IN PUBLIC INTEREST BY V.BARATHARAJ

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THE GREAT STINK AND THE BIRTH OF MODERN SEWAGE SYSTEM

The smell of human waste and industrial effluent hung over Victorian London. For centuries the river Thames had been used as a dumping ground for the capital's waste and as the population grew, so did the problem. The hot summer of 1858 elevated the stench to an unbearable level and resulted in an episode known as 'The Great Stink'. The hot weather exposed the rotting human effluent and industrial waste polluting the water of the Thames. Water-borne diseases like cholera and typhoid fever swept through the population. It was believed that the smell itself, or "miasma", spread these plagues, and those who could afford to fled the stinking city.

Such was the overpowering smell from the Thames, the curtains of the Houses of Parliament were soaked in chloride of lime in a vain effort to block out the smell. It is no surprise that a bill was rushed through Parliament and became law in just 18 days, to provide more money to construct a massive new sewer scheme for London.

THE SOLUTION :

Joseph William Bazalgette was the Chief Engineer of the Metropolitan Board of Works, and had been hired specifically to take charge of the new sewers. The cost would be enormous. Parliament initially offered £2.5 million, somewhere between £240 million and over a billion pounds in today's values.

Bazalgette carefully reviewed 137 different proposals to handle the poo problem. Bazalgette's plan was for an extensive underground system of sewers, joining up the patchwork of existing municipal drains. The new system would funnel the waste far downstream of the main city of London, eventually dumping it into the Thames Estuary at high tide.

The plan involved building 1,100 miles of drains under London's streets, to feed into 82 miles of new brick-lined sewers, and carry the effluent to six "intercepting sewers". Many of these had once been open streams, and "lost rivers" like the Fleet were brick-lined and covered over to become huge, hidden flows of waste.

At the time they were built, these pumping stations used the biggest steam engines in the world to pipe the effluent up to the mouth of the Thames. The whole project was colossal in scope: it required 318 million bricks and 670,000 cubic metres of concrete. Thousands of labourers were needed to dig out the tunnels by hand, and the demand for workers drove up bricklayers' wages by 20%.

Bazalgette insisted on the use of the relatively new Portland cement, an extremely strong substance that is also water-resistant. This is one of the factors that has helped the Victorian sewer system survive to this day.

Although the system was officially opened by Edward, Prince of Wales in 1865 (and several of the largest sewer channels named after members of the Royal Family), the whole project was not completed until 1875. By then, it could carry 2 billion litres of waste every day, enough to keep running even as the population of London exploded. By the time Bazalgette died in 1891, there were 5.5 million people living and defecating in inner London, over double the number when he first designed the sewers in the 1850s.

SEWAGE TREATMENT PLANT

In 1878, soon after Bazalgette's sewers were finally finished, the worst disaster in the history of the River Thames took place. The Princess Alice, a steamboat that took day-trippers up and down the Thames, crashed into a coal-carrying ship, the Bywell Castle. The Princess Alice sank in four minutes, and over 600 passengers were pitched into the Thames — just downstream of Bazalgette's two pumping stations. Just an hour before the disaster, they had pumped 75 million gallons of raw sewage into the river, making the water black and poisonous. Of the 130 survivors pulled out of the Thames, several died from having ingested the liquid waste. The tragedy encouraged the development of sewage treatment plants, to help reduce the amount of pure effluent dumped into the Thames.

The Victorian brick-lined tunnels are still the basis of London's sewer system even today, thanks to Joseph Bazalgette's foresight. Alternative proposals for the Metropolitan sewers proposed narrow-bore pipes, which would have been big enough to carry away the waste of the population of London in the 1850s. By contrast, Bazalgette insisted not only on large tunnels, but doubled their proposed size to accommodate the growth of the city.

More people live in London than ever before, and during periods of heavy rainfall, the combined waste and water still gets dumped straight into the Thames. Major emissions from "combined sewer overflows" happen about 50 times a year. That's why a brand-new super-sewer, the Thames Tideway, is being dug under London. Seven metres wide, this giant tunnel will run for 25 kilometres and intercept sewage that would otherwise pollute the river. Bazalgette would be proud.

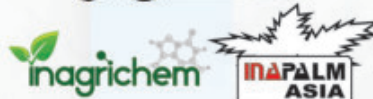
SOURCES: THE MUSEUM OF LONDON





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TENDERS

Ownership: Corporations/ Associations / thers

Tender Value: N.A.

Location: West Bengal - India

Closing Date: 20-5-2023

Pollution Abatement Works for River Ganga at Kolkata Municipal Corporation (Rehabilitation of Existing 50 MLD STP at Keorapukur and other allied Works at Kolkata) in West Bengal State.

Ownership: State Government

Tender Value: N.A.

Location: Tamil Nadu - India

Closing Date: 18-5-2023

Construction of Sewage Treatment Plant of capacity 15.43 MLD on dbo basis for ugss to added areas namely vadavalli and veerakeralam area wards 16 to 19 (zone v) of coimbatore corporation in coimbatore district, and (2) construction of Sewage Treatment Plant of capacity 19.49 MLD on dbo basis for ugss to added areas namely kavundampalayam and thudiyalur area wards 1(part), 2 to 9 & 43(part) (zone vii) of coimbatore corporation in coimbatore district (re-bidding)

Ownership: State Government

Tender Value: N.A.

Location: Tamil Nadu - India

Closing Date: 18-5-2023

Construction of Sewage Treatment Plant of capacity 15.43 mld on DBO basis for UGSS to Added Areas namely Vadavalli and Veerakeralam Area Wards 16 to 19 (Zone V) of Coimbatore Corporation
1 Construction of Sewage Treatment Plant of capacity 19.49 MLD on DBO basis for UGSS to Added Areas namely Kavundampalayam

Ownership: Corporations /Associations / Others

Tender Value: N.A.

Location: Gujarat - India

Closing Date: 8-5-2023

Request for Qualification and Proposal for appointment of Technical Expert to conduct treatability study of API Industries and Design Build Finance Operate & Transfer (DBFOT) PPP Model to set up Common effluent Treatment

Plant (CETP) & MEE - ATFD - CSTP at Bulk Drug park Industrial Estate.

Request for Qualification and Proposal for appointment of Technical Expert for Design Build Finance Operate and Transfer (DBFOT) PPP Model to set up Common Steam Plant Turbine power Generation & Steam distribution NetWork at Bulk Drug park Industrial Estate.

Request for Qualification and Proposal for appointment of Technical Expert for Design Build Finance Operate and Transfer (DBFOT) PPP Model to set up Common solvent Recovery Plant at Bulk Drug park Industrial Estate.

Ownership: State Government

Tender Value: INR 33,207,000.00

Location: Tamil Nadu - India

Closing Date: 3-5-2023

Supplying and Erection of 1.20 MLD Sewage Treatment Plant using Rotating Biological Contactor Technology (RBC) to 1800 Slum tenements (Ground + 4 Floors) at Perianaickenpalayam.

Ownership: State Government

Tender Value: N.A.

Location: Uttar Pradesh - India

Closing Date: 1-5-2023

Survey. Investigation. Design. Build, Operate and Transfer 90 MLD Capacity Sewage Treatment Plant (STP) and 20 KLD Fecal Sludge Co .Treatment Facility at existing Rajapur STP campus along with associate infrastructure including Interception. Diversion and Construction of Drain Tapping of 07 Nos. Drains, Interceptor Trunk Sewer line (4200 Mtr - Open cut trenchless method). Construction of 02 Nos. Sewage Pumping Station (SPS) 11 No. at Rajapur STP Campus- 74 MLD/ 56 MLD Capacity (Ultimate Year/ Mid Year) & 1 No. at Mumfordganj SPS Campus -59 MLD/ 39 MLD Capacity (Ultimate Year/Mid Year)! and 01 No. effluent Pumping Station 90 MLD with allied works including Rising Mains (3450 MU - Open cut / trenchless method) & effluent Gravity Pipe Line (300 MU - Open cut / trenchless method) and effluent Rising main (250 Mtr) with Operation and Maintenance period of 15 Years at

Ownership: State Government

Tender Value: INR 2,151,318.00

Location: Madhya Pradesh - India

Closing Date: 1-5-2023

Work contract for routine maintenance of system and equipments of wt Plant, pt Plant and pump house, clarified water and filter water pump house, cw pump house, raw water pump house, dozing system (hp, lp dozing pumps) etc. of 210 mw atps

Ownership: State Government

Tender Value: N.A.

Location: Tamil Nadu - India

Closing Date: 27-4-2023

Conducting Consultancy Studies for Rehabilitation and Revamping works including preparation of Detailed Project Report DPR, process designs and detailed estimates, preparation of bid documents for 300 MLD Water Treatment Plant at Puzhal and 14 MLD

Ownership: Corporations/ Associations/ Others

Tender Value: INR 339,385.00

Location: West Bengal - India

Closing Date: 26-4-2023

Renovation of flocculator motor with allied accessories for clariflocculator no-1 at WTP-i, grww

Ownership: Corporations/ Associations/ Others

Tender Value: N.A.

Location: West Bengal - India

Closing Date: 26-4-2023

Implementation of Grey water management on Baganchra, Charpanpara, Bara Kulia IMIS Village at Baganchra G.P. under Santipur Block under District

Ownership: Corporations/ Associations/ Others

Tender Value: N.A.

Location: West Bengal - India

Closing Date: 24-4-2023

Surveying, investigation, Planning, Designing, Construction and commissioning of 72.87 ML Collector well, 48.72 MLD infiltration gallery, foot way bridge, with pumping station on turnkey basis at DAMRA for Jamuria area within AMC under AMRUT 2.0.

Ownership: Corporations/ Associations/ Others

Tender Value: N.A.

Location: West Bengal - India

Closing Date: 24-4-2023

Surveying, investigation, planning, designing, construction & commissioning of collector well with a storage capacity for 5 minutes detention



TENDERS

time for the demand of 72.87 ml at ultimate year, 48.72 MLD capacity infiltration gallery, foot way bridge, with pumping station of 16 hours operation, supply & installation of suitable capacity transformer, construction of substation building, supplying & laying of 2 nos. m.s. pipe line from collector well to ms manifold line at the starting point of foot way bridge on the river bank and supply & laying of di pipe (k-9) from manifold line to the existing ground level reservoir with necessary valves and accessories, boundary wall (if required), approach road, drain, necessary civil, electrical (according to indian electricity rules), mechanical & all other allied works at damra.

Ownership: State Government
Tender Value: N.A.
Location: Maharashtra – India
Closing Date: 24-4-2023

Fabrication, Pre-despatch inspection, supply, installation/ commissioning and warranty of 750 LPH capacity UltraFiltration Water Treatment facilities at 3 railway platforms

Ownership: Education & Research Institutes
Tender Value: N.A.
Location: Goa - India
Closing Date: 24-4-2023

supply of water Purification system with inbuilt water cooler (q3) Qty 4

Ownership: Central Government/Public Sector
Tender Value: INR 670,000.00
Location: Uttar Pradesh - India
Closing Date: 22-4-2023

Supply Installation and Commissioning of STP Pump Set at Hal Factory.

Ownership: State Government
Tender Value: N.A.
Location: Madhya Pradesh - India
Closing Date: 21-4-2023

Various Civil Maintenance Work in filter Plant, Tank No. 2 and Ganesh Mandir Tank

Ownership: Central Government/Public Sector
Tender Value: N.A.
Location: Kerala - India
Closing Date: 21-4-2023

Annual maintenance services for water Purification and conditioning system (version 2) - potable water Purification system Reverse Osmosis or UV based; 5 to 7; package-3 water Purifier conditioning system maintenance involving basic servicing p Qty 22

Ownership: Corporations/ Associations/ Others
Tender Value: INR 42,735,157.00
Location: West Bengal – India
Closing Date: 20-4-2023

Repairing, renovation and overhauling of 15 MGD Bansberia Water Treatment Plant Under AMRUT within Bansberia Municipal area.

Ownership: Education & Research Institutes
Tender Value: N.A.
Location: Kerala - India
Closing Date: 20-4-2023

Supply of one number of water cooler with inbuilt Purifier for the institute of management in kerala (imk) , karyavattom.

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EVENT CALENDAR



MARCH 2023

India Smart Utility Week (ISUW) 2023

Wed, 01 - Sat, 04 Mar 2023
Lalit Hotel, New Delhi
<http://www.isuw.in>

Watertech China

Thu, 09 - Sat, 11 Mar 2023
Guangzhou, China
<http://expo.watertechgd.com>

New England Water Well Expo

Fri, 10 - Sat, 11 Mar 2023
Marlborough, USA
www.newwassociaation.org

Netherlands Aqua Trade Fair

Tue, 21 - Thu, 23 Mar 2023

Gorinchem, Netherlands
expotobi.com/aqua-nederland-vakbeurs

Oman Sustainability Week (OSW)

Sun, 12 - Thu, 16 Mar 2023
Muscat, Oman
www.omansustainabilityweek.com/

Watercon Conference

Mon, 20 - Thu, 23 Mar 2023
Springfield, USA
www.isawwa.org/mpage/Microsite_Registration

Water Korea

Tue, 21 - Thu, 23 Mar 2023
Goyang-si, South Korea
<http://waterkorea.kr>

Water Philippines Expo & Conference

Wed, 22 - Fri, 24 Mar 2023
Pasay, Philippines
www.waterphilippinesexpo.com/

Waptema Water Expo

March 3 - 5, 2023
Netaji Subhash Place, Pitampura,
New Delhi
waptema.in/

Water India

Mon, 27 - 29 Mar 2023
New Delhi, India
www.waterindia.com/

KRWA Conference & Exhibition

Tue, 28 - Thu, 30 Mar 2023
USA
www.krwa.net

Canadian Underwater Conference and Exhibition (CUCE)

Sun, 26 - Tue, 28 Mar 2023
Halifax, Canada
www.underwaterconference.ca

APRIL 2023

Smart Water Systems

Mon, 17 - Tue, 18 Apr 2023
London, UK
www.smartwater.com/

CIFA Water Infrastructure Summit

April 11-14, 2023

Washington, D.C., USA
www.cifanet.org/summit

Water Expo

14-16 April 2023
DC Ground, Yerwada, Pune, India
tradeshows.tradeindia.com/watere-xpo-pune

WQA Convention and Exposition

18 April, 2023 to 20 April, 2023
Las Vegas, United States
www.wqa.org/convention/

Texas Water

Tue, 11 - Fri, 14 Apr 2023
Houston, USA
www.txwater.org

IE Expo China

April 19-21, 2023
Shanghai, China
www.ie-expo.com

SDARWS Rural Water Expo

April 26-27, 2023
Rapid City, SD, USA
<https://www.sdarws.com/expo.html>

Beijing International Irrigation Technology Expo

April 26-28, 2023
CNCC, Beijing, China
expotobi.com/irrigation-technology-expo

MAY 2023

World Utilities Congress

May 08-10, 2023
ADNEC, Abu Dhabi, UAE
www.worldutilitiescongress.com

AZ Water Conference & Exhibition

Tue, 09 - Thu, 11 May 2023
Phoenix, USA
www.azwater.org

Ozwater 2022

10 May, 2023 to 12 May, 2023
Brisbane Convention & Exhibition Centre
Australia
www.ozwater.org/

Watrex Expo

Mon, 15 - Wed, 17 May 2023
Cairo, Egypt
waterexpo.com

Trenchless Asia

17 May, 2023 to 18 May, 2023
Kuala Lumpur Convention Centre, Malaysia
www.trenchlessasia.com/

Water and Plumb Skills Expo

18 May 2023 - 19 May 2023
Pragati Maidan, New Delhi, Delhi
www.plumbskillsexpo.com

Water Expo - Bangalore

18 May 2023 - 20 May 2023
BIEC, Bangalore, India
waterindia.net

Water Management Show

May 11-13, 2023
ICCB, Dhaka, Bangladesh
10times.com/water-management-show

E-World Energy & Water Exhibition

May 23-25, 2023
E-World Energy & Water Exhibition
www.e-world-essen.com

JUNE 2023

Watertech Africa

01 - 03 Jun 2023
Kenyatta International Convention Centre, Nairobi, Kenya
expogr.com/watertech

Aquatech China

05 - 07 Jun 2023
National Convention & Exhibition Center, Shanghai, China
www.aquatechtrade.com/china

World Environment Expo

05 - 07 Jun 2023
Pragati Maidan, New Delhi, India
worldenvironment.in

Algeria Electricity & Water Expo

05 - 07 Jun 2023
Algiers, Algeria
expotobi.com/algeria-electricity-water-expo

Power & Water Nigeria Exhibition & Conference

20 - 22 Jun 2023
Lagos, Nigeria
pnwnigeria.com

African Smart Cities Summit

28 Jun 2023
Gallagher Convention Centre, Johannesburg, South Africa
10times.com/asc-summit

EVENT CALENDAR



JULY 2023

European Water And Wastewater Management Conference And Exhibition

04 - 05 Jul 2023

The Point at Lancashire County Cricket Club, Manchester, UK
ewwmconference.com

IFAT Africa

05 - 07 Jul 2023

Gallagher Convention Centre, Johannesburg, South Africa
www.ifat-africa.com

INDO WATER

05 - 07 Jul 2023

Jakarta Convention Center, Jakarta, Indonesia
indowater.com

West Africa Water Expo

11 - 13 Jul 2023

Landmark Centre, Lagos, Nigeria
elanexpo.net/waweexpo

Delhi Water Expo

13 - 15 Jul 2023

Pragati Maidan, New Delhi, India
www.waterex.biz

Milwaukee Air and Water Show

22 - 23 Jul 2023

Milwaukee Lakefront, Milwaukee, USA
mkeairwatershow.com

AUGUST 2023

18th EverythingAboutWater Expo 2023

Thu, 03 - Sat, 05 Aug 2023

Pragati Maidan, New Delhi
www.eawaterexpo.com

The Water Expo

Wed, 23 - Thu, 24 Aug 2023

Miami, USA
www.thewaterexpo.com/

SEPTEMBER 2023

Water Indonesia

Wed, 13 - Sat, 16 Sep 2023

Jakarta, Indonesia
www.waterindonesiaexpo.com/

THAI WATER

Wed, 30 Aug - Fri, 01 Sep 2023

Bangkok, Thailand
www.thai-water.com

SR Onshore Wind Conference

Wed, 06 Sep 2023

Glasgow, UK
www.scottishrenewables.com

Gat Wat

Wed, 06 - Thu, 07 Sep 2023

Cologne, Germany
www.gat-wat.de

WasteEcoExpo

Tue, 12 Sep 2023

Krasnogorsk, Russia
en.waste-tech.ru

Taiwan International Water Week

Wed, 20 - Fri, 22 Sep 2023

Taipei, Taiwan
www.taiwanintlwaterweek.com

WCW Conference & Exhibition

Mon, 25 - Thu, 28 Sep 2023

Saskatoon, Canada
www.wcwwa.ca/page/AnnualConf

OCTOBER 2023

Wetex

Mon, 02 - Wed, 04 Oct 2023

Dubai, UAE
www.wetex.ae

IFAT India

Wed, 18 - Fri, 20 Oct 2023

Mumbai, India
www.ifat-india.com

Pak Water & Energy Expo

Wed, 25 - Fri, 27 Oct 2023

Lahore, Pakistan
pakwaterexpo.com

AWT Convention and Exposition

Wed, 04 - Sat, 07 Oct 2023

Grand Rapids, USA
www.awt.org/events/annual-convention

Envitech

Tue, 10 - Fri, 13 Oct 2023

Brno, Czech Republic
<http://envitech.co.in>

VietWater

Wed, 11 - Fri, 13 Oct 2023

Ho Chi Minh, Vietnam
www.vietwater.com/en

Water In Industry

Tue, 31 Oct 2023

Moscow, Russia
www.aquatechtrade.com/news/industrial-water

NOVEMBER 2023

Water Loss Forum

01 - 03 Nov 2023

Lut fiKirdar International Convention & Exhibition Center, Istanbul, Turkey
www.waterlossforum.org

Aquatech Amsterdam

06 - 09 Nov 2023

RAI, Amsterdam, Netherlands
www.aquatechtrade.com/amsterdam/

The International Water Conference

12 - 16 Nov 2023

San Antonio Marriott Rivercenter, San Antonio, USA
iwconf.org

Smart City Expo - Dubai

14 - 15 Nov 2023

The Ritz-Carlton, Dubai, Dubai, UAE
10times.com/smart-cities-nh

WETEX and Dubai Solar Show

15 - 17 Nov 2023

Dubai World Trade Centre, Dubai, UAE
www.wetex.ae

Myanwater

16 - 18 Nov 2023

Myanmar Expo, Yangon, Myanmar
myanwater.com

Sand Water Rv Expo

17 - 18 Nov 2023

Lake Havasu State Park, Lake Havasu, USA
sandandwaterexpo.com

Cairo Water Week

29 Oct - 02 Nov 2023

Cairo, Egypt

DECEMBER 2023

Water Bangladesh International Expo

07 - 09 Dec 2023

International Convention City Bashundhara (ICCB), Dhaka, Bangladesh
www.water-exhibition.com

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Date: 11-14 April 2023
Venue: Houston, Texas
Website: www.txwater.org

Texas Water 2023

Texas Water is the joint annual conference of the Texas Section American Water Works Association and the Water Environment Association of Texas.

The conference is celebrating it's 27th year as the Largest Regional Water Conference in the U.S.© and caters to professionals in the wastewater and water industry, including water quality engineers, treatment plant technicians, scientists, government officials, regulatory agency personnel, manufacturers and their agents, libraries, universities and groups and individuals concerned with protecting public health and the environment.

Texas Water's location rotates around various cities in Texas each year and includes technical sessions, exhibits, competitions, networking opportunities and much, much more!
 We hope you'll join us in Houston for Texas Water™ 2023!



Rural Water Expo

SDARWS Rural Water Expo aims to provide the highest quality services that meet the needs of and supports the collective efforts of our water and wastewater membership. It will cover areas like Drinking water security strategies and tools, Emerging drinking water treatment technologies and optimization of current technology, Workforce, operator certification, and/or technical assistance initiatives, Source water protection and sustainability of water supplies, etc.

Discussions about rural water began in South Dakota in the late 1960s. By 1972 Butte-Meade Sanitary Water District and Rapid Valley Water Service Company were established and a number of systems were organizing. Lincoln County



Rural Water, south of Sioux Falls, was under construction at the time.

Rural water enthusiasts met in Madison, South Dakota, on October 11, 1972. A decision was made to hold a statewide meeting in Pierre on November 30. A letter of invitation went out to 17 systems. The following systems were represented at the November 30, 1972, meeting at the King's Inn in Pierre: Aurora-Brule, Big Sioux, Brookings-Deuel, Minnehaha, Rapid Valley, Sioux, TC & G, and Tripp County.

Date: 26-27 April 2023
Venue: Ramkota Hotel, Rapid City, SD
Website: www.sdarws.com

Water in Mining Global Summit

Our industry is uniting once again for the annual Water in Mining Global Summit, 25-27 2023. We look forward to welcoming familiar and new members of the Water in Mining Community in Toronto to address how the mining industry approaches water management in the age of critical minerals.

Bringing you 3 days of unrivalled content aimed to strengthen your knowledge of water management strategy. This event is unmissable to mining professionals dedicated to water treatment, stewardship and strategy.



You will leave the event invigorated and inspired to from the myriad of site-specific case studies, new innovations and treatment approaches.

Maximize your attendance by participating in the Innovation Implementation pre-conference workshop and networking Gala Dinner.

Date: 25-27 April 2023
Venue: Toronto, Canada
Website: waterinmining.net



18th Everything About Water & Waste Expo 2023

18th EverythingAboutWater & Waste Expo 2023 is one of the most unique & comprehensive annual events in India showcasing the latest technologies & solutions in the water sector. Also, recognized as South Asia's largest water event during recent times, this is a perfect gateway for stakeholders from across the globe to penetrate into the vast & dynamic ecosystem of the Indian Water & Waste management industry to share business opportunities, network & explore innovative water solutions.

The 18th EverythingAboutWater & Waste Expo 2023 will offer unparalleled business opportunities to both national as well as international players from the water industry to learn, explore the future trends in the Indian water market

Date: 24-26 August 2023
Venue: Pragati Maidan, New Delhi, India
Website: www.eawaterexpo.com

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