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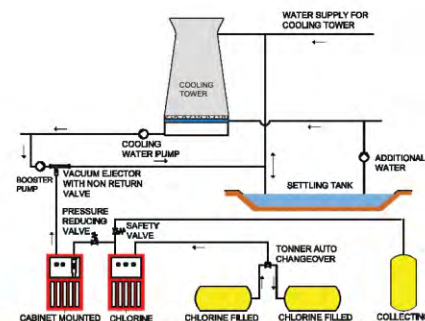
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The Need of the Hour: Drinking Water Technologies & Water Disinfection



Majority parts of India are water sufficient naturally, but we have not been able to use the resource wisely on a large scale and direct it to the water scarce regions. Even in water rich regions, safe drinking water has been an issue ever since. Nearly 76 million people in India do not have access to safe drinking water, as polluted rivers and poor storage infrastructure over the years has created a water deficit which may become unmanageable in the future. Unfortunately, millions of Indians across the country are not equipped with such facilities to test whether the water consumed and used by them is safe enough or not. The dual problems of not having access to water, or having access to unsafe water have resulted in safe and hygienic water, a basic amenity becoming a luxury.

Access to safe drinking water has been a grave problem for India, especially in rural areas where lack of usable water has resulted in decades old sanitation and health problems. In many villages, we find that consumers want their cattle to drink safe drinking water (even more than themselves or their family). They believe that good water will improve the cattle's productivity and life, which will positively contribute to their economic development. Today the situation is much better than it was 10 years ago but even today it is estimated that 37.7 million people in India get affected by water borne diseases which means approximately 73 million working days.

After the Covid we have to learn that it is vital that everyone has access to safe drinking water, to help the immunity of the masses and also, so that the citizens do not face other health issues related to contaminated water. In cities, the focus on clean water was there since a long time now, but in villages which now have operational water vending machines, a clear and well accepted contribution of the safe drinking water on good health, livelihood and wellbeing has been observed. Cases of cholera and other water-borne diseases have come down. Absence from work (agriculture or labour) has reduced. Need for people to go to the nearest towns for health treatment has reduced.

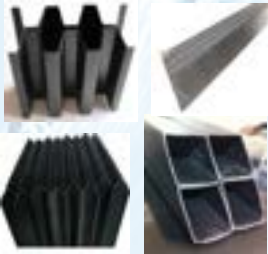
The Ministry of Drinking Water and Sanitation (MDWS) and the Government of India are planning to implement a uniform drinking water quality monitoring policy for systematic evaluation of all drinking water sources on Pan India basis. This policy when in effect will help in identifying the chemical and microbiological contaminants of water bodies and help in improving the quality and regularly monitoring it. As India moves forward on its commitment for 100% drinking water access under the United Nations Millenium Development Goals, this has had immense contribution in improving the quality of living in many small cities and villages. All of us can feel good and happy about that...

thanks & regards,
Deepak Chaudhary
Editorial Incharge

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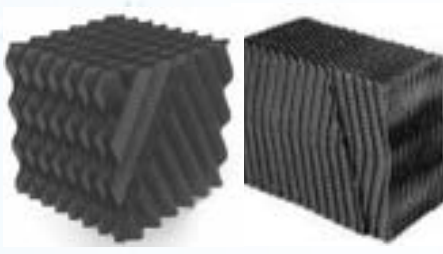
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DROPLETS SNIPPETS

Danfoss announces intent to acquire German compressor manufacturer BOCK GmbH to strengthen expertise in CO2 and natural refrigerants technology

Danfoss has announced the intent to acquire compressor manufacturer BOCK GmbH, headquartered in Frickenhausen, Baden-Württemberg, Germany, from NORD Holding GmbH. By acquiring BOCK GmbH, Danfoss takes a proactive approach to further the development and use of low-GWP refrigerants to help abate global warming and to ensure the competitiveness of the industry. With the acquisition, Danfoss adds the world's largest portfolios of semi-hermetic compressors for natural refrigerants such as CO2 (R744), hydrocarbons, and other low-GWP refrigerants to its already strong portfolio of oil-free centrifugal compressors, inverter-scroll, reciprocating and screw compressors, and condensing units.

Sulzer launches next pump generation for desalination

Global pump specialist Sulzer has expanded its portfolio of high-performance products for the desalination sector. The



MSN-RO high pressure pump range combines proven features from existing Sulzer designs with multiple enhancements to optimize both capital and operating costs. In addition, the AHLSTAR range of charge pumps has been extended with increased capacities suitable for modern large-scale desalination projects.

Almost half the world's population lives in regions with significant water shortages.[1] As demand increases, desalination using reverse osmosis (RO) technology is playing an ever-more important role in the delivery of fresh water for agricultural, domestic and industrial applications. The design of RO plants has advanced significantly in recent years, as owners seek to increase output, improve availability and reduce operating costs.

Vitens and NX Filtration start pilot for testing IJssel river water as potential source for drinking water

Vitens, the largest drinking water utility in the Netherlands, is starting a pilot program with NX Filtration, the global provider of breakthrough direct nanofiltration (dNF) technology for pure and affordable water. In the pilot program, Vitens will use NX Filtration's dNF membrane technology to produce drinking or industrial process water from the Dutch IJssel river. The pilot program of Vitens is expected to run from October 2022 to Fall 2024.



Today, groundwater is Vitens' primary source for high quality and reliable drinking water production. As a response to growing demand for water in combination with increasing periods of droughts as a result of climate change, Vitens is looking for alternatives for its traditional groundwater sources and to alternatives to supply industries. This led Vitens to start testing new technologies for additional surface water sources in order to safeguard its water supplies to households and industries for the future.

Doeke Schippers, strategic advisor at Vitens comments: "We have already worked with NX Filtration's direct nanofiltration membranes in small scale testing environments. Based on these results we are now ramping-up to a multi-year testing program for the treatment of surface water from the IJssel river. This will provide valuable inputs to develop alternative sources for drinking water supply that will enable our customers to continue to benefit from healthy, safe and affordable drinking water in the future."

Erik Roesink, founder and CTO at NX Filtration comments: "NX Filtration is honored to cooperate with Vitens in this innovative journey. Our direct nanofiltration technology has already proved its value in large projects ranging from Indonesia to Sweden and Canada, demonstrating consistent high performance combined with very low energy and chemicals consumption compared to alternative technologies. In the Netherlands we are currently involved in various pilot projects on drinking water production and wastewater reuse, through which we seek to also bring these benefits to the Dutch water market."



STL becomes the world's first optical manufacturer to be 'Zero Liquid Discharge' certified

STL, one of the industry's leading integrators of digital networks today announced that 100% of its Indian manufacturing facilities are now Zero Liquid Discharge (ZLD) certified by Deutsch Quality Systems (DQS India). This is a great milestone for STL in its UN SDG goal of attaining 'Water Positivity by 2030'.



While India only has 4% of the world's freshwater reserves at present, the demand will rise by over 70% by 2025, stressing water supply chains like never before. For STL, water management is a top priority in its materiality matrix. This has led STL to develop water-resilient communities and undertake rainwater harvesting and technology interventions to optimise water demand and adherence to stringent ZLD protocols.

At STL, the water management process is carried out through Sewage (STP), Effluent Treatment (ETP) and Multi-effective Evaporator (MEE) plants. The ZLD process involves an in-depth understanding of the liquid waste profiles and in-plant modifications to minimise water usage. The wastewater is chemically treated to remove chlorine and solid particles. It then undergoes three-tiered centrifugation to remove salt and suspended particles, making it fit for reuse in boilers and scrubbers. The entire process is digitally monitored using a Supervisory Control and Data Acquisition (SCADA) architecture and shift dashboards.

STL has replicated this ZLD framework successfully for all six manufacturing plants across Aurangabad and Silvassa, in Maharashtra, India. All these combined initiatives have helped STL recycle 145,000+ cubic meters of wastewater from manufacturing in FY22 across its manufacturing facilities.

Commenting on the achievement, Akanksha Sharma, Global ESG Head, STL, said, "Water conservation and re-usage is top of the agendas of the companies committing to sustainable business practices. The ZLD certification for all our manufacturing locations in India depicts our conviction that with the right technical innovation, intent, and ecological foresight, it is possible to conserve water and put it to re-usage while operating sustainably."

DROPLETS SNIPPETS

Pumps are a critical equipment category for the desalination industry. They make up a significant part of the capital investment of facilities, while the energy they consume accounts for 60 to 70 percent of the final cost of the water produced. In addition, today's rising energy costs are putting pump efficiency into even sharper focus. Sulzer has continued to meet market requirements by designing pumps that consume less energy, reducing costs and improving sustainability for operators.

MSN-RO: next generation efficiency.

The MSN-RO high-efficiency pump is designed for modern, large-scale desalination applications with large, independent RO trains with capacities up to 35'000 m3/d. The multistage axial split casing pump is based on existing Sulzer designs that have a proven track record in the sector. Its hydraulic section, lubrication system and balancing devices come from the MBN-RO pump. Its axial split casing, designed to simplify maintenance, is derived from the MSD-RO range.

The MSN-RO also incorporates several significant enhancements, designed to improve operating efficiency while reducing capital costs. The diffuser and discharge volute have new high-efficiency designs, optimized through extensive computational fluid dynamics (CFD) analysis. The renewable stationary wear parts within the pump are manufactured from polyetheretherketone (PEEK) engineering polymer, with minimal clearances for the highest efficiency.

The primary bearings of the MSN-RO are also made from PEEK, and are water lubricated. This approach significantly simplifies the operation and maintenance of the pump, by removing the requirement for forced oil lubrication and cooling system, which also eliminates the potential risk of lubricants contaminating process water.

Global Water Drinks Leaders To Meet At Evian

Leaders from the world's largest water drinks companies and directors of independent water producers will meet in Evian-les-Bains from 8 to 10 November for the 19th Global Water Drinks Congress, which has become the main international forum for businesses to discuss trends and issues affecting the market's future.

With the theme of 'Packed with purpose', to reflect the benefits of hydration and convenience, while recognising the challenges for social responsibility and sustainability,

DROPLETS SNIPPETS

programme highlights include:

- Global market insights from IRI, Kantar, KPMG and Rabobank
- Leadership perspectives from Danone, Coca-Cola, Niagara and the former CEO of Nestlé Waters
- Sustainability developments with Consumer Goods Forum and PepsiCo
- International updates from Gerolsteiner, Mahou San Miguel and Spritzer
- US innovation with Bossa Nova, Flow, Icelandic Glacial and Sanzo plus other pioneers from Chile, Switzerland and the United Kingdom
- A tour of the Evian production site and the Global Water Drinks Awards at a Gala Industry Dinner.

There will also be extensive opportunities for networking and a series of key issue round tables.

“In keeping with the theme, it's hard to imagine a programme that could be more packed with purpose,” commented Richard Hall, Chairman of specialist industry consultants and event organisers Zenith Global. “Delegates will have a chance to review all the key trends, update on the latest innovations discuss the most important issues and see one of the world's most iconic filling operations in just 48 hours. They should return with full confidence in knowing all they need for their next phase of business planning.”

This year's Global Water Drinks Congress is sponsored by Platinum Sponsor Lajthiza, Gold Sponsor Sidel, Silver Sponsor ICE Water Management and Bronze Sponsors AF Compressors and CCL Label.

PM lays foundation stone and dedicates to the nation projects worth around Rs. 5860 crores in Rajkot, Gujarat

The Prime Minister, Shri Narendra Modi laid the foundation stone and dedicated projects worth around Rs. 5860 crores in Rajkot, Gujarat on 19th October. The Prime Minister also inaugurated the India Urban Housing Conclave 2022. The Prime Minister dedicated over 1100 houses constructed under the Light House Project. Other projects being dedicated by the Prime Minister include a water supply project: Morbi-Bulk pipeline project from Brahmani-2 Dam to Narmada Canal Pumping Station, a regional Science Centre, flyover bridges and other projects related to road connectivity.

The Prime Minister laid the foundation stone of six laning of the existing four-lane of Rajkot-Gondal-Jetpur section of NH27 in Gujarat. He also laid the foundation stone of GIDC industrial estates worth around Rs 2950 crore at various locations in Morbi, Rajkot, Botad, Jamnagar and Kutch. Other projects whose foundation stones are being laid include the AMUL-fed dairy plant at Gadhka, the construction of an indoor sports complex in Rajkot, two water supply projects and other projects in the roads and railways sector.

Advent International and LANXESS announce future global business structure and designated management team members for envisaged High Performance Engineering Materials joint venture

Following the announcement of Calum MacLean as CEO-designate, Advent International (“Advent”) and



LANXESS AG (“LANXESS”) announce the envisaged global business structure and designated extended management team of the envisaged High Performance Engineering Materials joint venture (“JV”).

Upon closing of the transaction, the JV will be organized into three global business divisions: Performance Materials (comprising DEM Performance Polymers and HPM Engineering Plastics), Specialty Materials (comprising DEM Specialties and HPM TepeX), and Intermediates (comprising HPM Intermediates and DEM Polymer & Films). This structure will take into consideration the specific market characteristics and management requirements of each of the previous HPM and DEM businesses. These three divisions will be supported by a number of central functions, the exact structure of which will be communicated at a later stage. The JV expects to establish a small head office around Düsseldorf (Germany), and will be supported by the existing Geleen (DEM, The Netherlands) and Dormagen (HPM, Germany) locations.

Upon closing of the transaction, the JV Shareholders' Committee composition will include Ronald Ayles (Managing Partner, Advent), Matthias Zachert (CEO, LANXESS), and Roeland Polet (currently President, DEM), representing all parties to the transaction. Further members of the Shareholders' Committee will be nominated at a later stage.

Calum MacLean, the CEO-designate of the JV, said, “Preparation for 'day one' of this exciting High Performance Engineering Materials joint venture is taking shape. The preparation of an integrated face to the



market of the combined businesses and the appointment of the first designated senior executives is a major step to hitting the ground running on completion. Likewise, the envisaged Shareholders' Committee brings a wealth of experience from Advent and the heritage DSM and LANXESS organizations."

Background on the Transaction



On 31st May 2022, Advent and LANXESS announced the joint, Advent controlled, acquisition of DSM Engineering Materials, alongside its combination with LANXESS High-Performance Materials (subject to competition clearance), to establish a leading global engineering materials company with sales of around EUR 3 billion. The joint venture will benefit from the strong long-term partnership of all involved parties, as well as from their vast experience and common understanding of establishing and growing a highly innovative engineering materials business. The new company will be one of the leading suppliers to the attractive and growing automotive, electronics, electrical and consumer goods segments, with a particular focus on environmentally friendly and sustainable products. The highly complementary combination both in terms of regional footprint and product range will bring together well-invested assets, skilled employees with a strong

DROPLETS SNIPPETS

Alfa Laval inaugurates India Customer Center marking its 85th year in India

Alfa Laval – a world leader in heat transfer, separation, and fluid handling inaugurated its new sales and service office, the India Customer Center today. An opening ceremony was held on 19th October welcoming hundreds of employees and key customers to the world-class infrastructure. The ceremony was led by Thomas Moller, President of the Energy Division and Executive Vice President, of Alfa Laval Group Management, and Sergio Hicke, Alfa Laval Cluster President for India, Middle East, and S&E Africa.

The modern inspiring workplace reflects Alfa Laval's identity and its commitment to the customers, people, and planet. The 1 lakh sq. ft. facility is located at Dapodi, Pune which is situated on the same campus where the company has three manufacturing units. The new center, with a seating capacity of 550, has been designed in line with the sustainability goals of the company. The dynamic workplace will give the employees, customers, and visitors an outstanding experience.

The Customer Center will not only be the sales and service office for India, but will also be a hub of engineering and supply projects across the globe for Alfa Laval which is present in more than 100 countries.



cultural fit, and a comprehensive innovation pipeline, therefore creating a strong foundation for sustainable long-term growth, as well as opportunities for employees and customers.

Once established, Advent will hold a minimum share of 60% in the new JV, with the remaining stake being held by LANXESS. The transaction is subject to merger clearances and is expected to close in H1 2023. LANXESS and DSM are currently working on completing the respective carve-outs and preparing business integration for day 1. The designated leadership team and the envisaged business structure has been appointed and respectively decided by Advent, with full support of LANXESS.

NX Filtration part of ACCIONA-led initiative to eliminate emerging pollutants from water sources

NX Filtration, the global provider of breakthrough direct nanofiltration technology for pure and affordable water, announces its participation in the European innovation project LIFE PRISTINE, led by ACCIONA S.A. The project's objective is to eliminate emerging contaminants in the integral water cycle, one of the essential measures to promote alternative water resources in the face of water scarcity, which affects more than 2.8 billion people worldwide.

- The LIFE PRISTINE project has a budget of 4 million euros and is coordinated by ACCIONA, the Spanish sustainable infrastructure solutions group. Next to ACCIONA and NX Filtration, project partners include Eurecat, Xylem Services, the Regional Entity for Wastewater Sanitation and Treatment of the Murcia Region (ESAMUR) and the water utility provider Bilbao Bizkaia Water Consortium (CABB).
- The LIFE PRISTINE project combines water treatment processes, including NX Filtration's hollow fiber nanofiltration membranes, with artificial intelligence-based digital tools to develop a solution that removes emerging pollutants in the integrated water cycle. The integrated and versatile PRISTINE solution will be demonstrated in a representative full-scale operational environment.

Many forums have alerted on the urgent need to take steps to protect water resources, mainly through a reduction in water consumption but also by promoting alternative resources and reuse. These new resources are essential to guarantee water supplies for the future. One of the challenges to overcome fostering the reuse of water is the elimination of emerging pollutants and microplastics. These substances of anthropogenic origin are difficult to eliminate by using existing treatment systems and they may end up in seas and rivers, or even enter the food chain. Their presence may create hazards, which is why there is increasing emphasis on regulating the use of these substances and developing solutions to remove them from the environment.

LIFE PRISTINE is a sustainable alternative to ensure the elimination of emerging pollutants (+80%) in the end-to-end water cycle. It goes beyond the limits set by Directive 2020/2184/CE on Water for Human Consumption and the new European Regulation on minimum requirements for water reuse (Regulation (UE) 2020/741). LIFE PRISTINE focuses on emerging pollutants of the PFAS type (Per- and Polyfluoroalkyl substances, used e.g. in flame retardants), pesticides, pharmaceutical and personal care products, toxins microplastics and genes of microorganisms that are resistant to antibiotics. The project will help to strengthen the existing legislation and promote the reuse of water with the highest quality and safety standards.

The PRISTINE solution involves processes of adsorption, nanofiltration and advanced oxidation using virtual sensors, process modelling and decision-making support tools. It will be capable of eliminating emerging pollutants efficiently (+80%, -30% OpEx) from water sources and wastewater effluent. The PRISTINE project will be demonstrated in a representative operating environment on a real scale: treating the secondary effluent of a treatment plant in Murcia and supporting drinking water pre-treatment in the Bilbao Bizkaia Advanced Water Treatment Centre (CATABB). The LIFE21-ENV-ES-LIFE PRISTINE project (with project number 101074430) is funded by the European Union under the LIFE-2021-SAP-ENV call. The views and opinions expressed are solely those of the authors and do not necessarily reflect



those of the European Union or the European Executive Agency for Climate, Infrastructure and Environment (CINEA). Neither the European Union nor the granting authority can be held responsible for them.

FUKUI COMPUTER Partners with Bentley Systems to Promote Digital Transformation in Japan's Infrastructure Field

FUKUI COMPUTER, Inc (Head Office: Sakai City, Fukui Prefecture; President: Tadashi Sugita), the CAD vendor for the construction industry, has entered into a strategic partnership with Bentley Systems (Head Office: Exton, Pennsylvania, USA; CEO: Greg Bentley), the infrastructure engineering software company, to accelerate the adoption of digital workflows in the Japanese construction industry and support the promotion of digital transformation (DX) in the infrastructure field.

In Japan, there are concerns about the increasing shortage of labor in the infrastructure field, which is impacting the ability to take measures to mitigate aging infrastructure. This situation is further aggravated by the intensification and frequent occurrence of natural disasters. To help combat this, FUKUI COMPUTER will leverage the Bentley iTwin platform to augment its cloud-based data sharing service CIMPHONY Plus with 3D/4D visualization, simulation, and digital twin capabilities. The company will launch a digital solution that supports the entire infrastructure lifecycle, spanning project management, design, construction, and maintenance. FUKUI COMPUTER will also launch TREND ROAD Designer for road design, a new 3D application that will leverage Bentley's OpenRoads Designer, an industry standard for road concept, design, construction, and operations.

By entering into this strategic partnership, FUKUI COMPUTER will provide solutions for digital transformation (DX) in the infrastructure field promoted by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), leveraging Bentley's cutting-edge digital technology. The partnership aims to contribute to the improvement of productivity in the construction industry by introducing and utilizing 3D and digital twin solutions in the design, construction, and maintenance management sectors



under the i-Construction and BIM/CIM strategy promoted by MLIT.

Carsten Gerke, senior vice president of strategic channels with Bentley Systems, said, "Collaborating with FUKUI COMPUTER benefits all parties. End users will benefit from cutting-edge, world-class digital technology and trusted local expertise. Bentley will address the demanding Japanese infrastructure market and i-Construction regulations through the market leader in Japan, while FUKUI COMPUTER will provide the most innovative digital twin solutions to dramatically improve the construction industry in Japan."

Tadashi Sugita, president of FUKUI COMPUTER, said, "The strategic partnership with Bentley Systems will allow us to introduce cutting-edge digital technology to the ICT field in the construction industry in Japan. As a software company being trusted by the construction companies who support the infrastructure in local communities, we



will strive to contribute to society by providing useful products and valuable support services.”

Inauguration of biological wastewater treatment plant at LANXESS

LANXESS has commissioned a new wastewater treatment plant at its Belgium



Kallo/Antwerp site. The special chemicals company invested around EUR 12 million in the plant, which has a treatment capacity of around 260,000 litres of wastewater per hour.

LANXESS thoroughly modernized and expanded the existing water treatment plant to comply with the stricter environmental legislation. It was a challenging job because the plant had to remain operational throughout the renovation. The wastewater treatment plant not only processes the wastewater from the LANXESS plants on the site, for the production rubber chemicals and glass fiber, but also that from two neighboring companies.

Investing in sustainability

“The renewal and improvement of the wastewater treatment plant enables us to meet the highest environmental standards. We take responsibility for our local sites and this includes investing in sustainable and innovative processes that protect the environment,” said Anno Borkowsky, board member of LANXESS, in his welcome speech.

“Using energy, raw materials and water sparingly and efficiently is in the DNA of the chemical sector. As the largest chemical cluster in Europe, it is our responsibility to also be an innovation leader in cutting-edge environmental and climate technology. With this investment, LANXESS is putting its money where its mouth is in challenging economic conditions. It illustrates the chemical sector's ongoing commitment to a better environment and additional water savings. Compared to 10 years ago, chemical and pharmaceutical companies already consume almost a quarter less drinking water. Together with Flemish minister Zuhal Demir, we are working on a sectoral Blue Deal to save even more water,” said Yves Verschuere, managing director of essenscia, the Belgian sector federation of the chemical industry and life sciences.

Social commitment

“Today, the precipitation deficit in Flanders is greater than during the historically dry summer of 1976. Water managers, water companies, governments, citizens and companies are taking measures to mitigate the effects of the current drought period, but it is clear that we need to arm ourselves in a sustainable way against periods of drought. This investment by LANXESS demonstrates a social commitment to daring and willingness to invest in such measures in economically challenging times, in order to make their company, but also the sector, future-proof,” said Carina Van Cauter, Governor of the province of East Flanders.

Bacteria do the work

The installation is home to bacteria that process and purify the wastewater. The





different wastewater streams are mixed and end up in aeration towers. The water is fed with activated sludge, in which the bacteria reside. The environment of the biological wastewater treatment plant is constantly monitored, for example to ensure balanced acidity and the right temperature.

The bacteria are finally separated and returned to the purification process, the purified water is fed into the Scheldt. The plant operates day and night. An independent laboratory analyzes water samples daily for quality control. Substantial improvement of environmental protection standards at port sites

The project is part of an investment program in the mid double-digit million euro range with which LANXESS has significantly improved environmental standards at its sites in the port of Antwerp in recent years. At the Lillo site, LANXESS commissioned a plant to reduce nitrous oxide emissions in 2021. This will reduce the emission of CO₂

equivalents by 150,000 tons annually. In the autumn 2022, construction will start on a second plant that will eliminate another 300,000 tons of CO₂ equivalent annually.

Ocean Exchange Selects Semi-finalists for 2022 Awards: Receives record number of applications from around the world

Ocean Exchange, a leader in supporting the acceleration of innovative solutions for healthy oceans and the sustainable blue economy, announces the selection of semi-finalists vying for the prestigious 2022 Neptune Award, Wallenius Wilhelmsen Orcelle® Award, and Ocean Exchange Innovation Award for Transportation and Logistics Hubs (Transportation Hub Award). Each of these three awards carries prize money of \$100,000 and will be conferred at the organization's upcoming event, which takes place October 23-25 in Fort Lauderdale, Florida.

The Ocean Exchange Solutions Review Team will now review the applications submitted by the semi-finalists and choose the ultimate 24 finalists who will travel to Florida to present their solution at the event. Delegates representing business, academia, government, and non-profits will select the three monetary winners based on their presentations there.

Solutions being developed by the semi-finalists address an array of industry and technology categories spanning aquaculture and marine habitat to energy and vessel/port operations, and data/robotics to digitalization, emissions reduction, plastics use reduction/recycling, and clean water.

Countries represented include Australia, Bulgaria, Canada, Ireland, Israel, the Netherlands, Portugal, Singapore, South Africa, Spain, Tanzania, United Arab Emirates, United Kingdom and the United States.

"Ocean Exchange is proud to announce that our Solutions Review Team has chosen 51 companies from around the world as semi-finalists. This record number of applicants—an increase of 35% over previous events—reflects not only the



expansion of our awards program with this year's addition of the Ocean Exchange Transportation Hub Innovation Award, but also the tremendous interest in technologies and solutions that will help protect the priceless resource that our oceans and the Blue Economy represent. We are proud to be at the forefront of this effort, backed by the invaluable support of sponsors and leading industry experts from around the globe," said Millicent Pitts, Chief Executive Officer and Executive Director of the Ocean Exchange.

The Neptune Award 2022 will be given to the solution that advances our understanding of the ocean and helps minimize our impact on these resources, even while using them for human benefit, resulting in more resilient bodies of water including healthy marine life and coastlines.

Wallenius Wilhelmsen's 2022 Orcele Award reflects the company's statement of purpose, "sustainable logistics for a world in motion," and its view of sustainability as a broad theme that assigns equal importance to environmental and social aspects. Accordingly, the 2022 Orcele Award will go to the solution that creates most sustainable value for its business in regard to social, community or environmental issues, whether on land or at sea.

The Transportation Hub Award will be given to the solution that advances ocean-, inland-, and air- ports and other logistics hubs, seeking innovations that make ports/hubs more sustainable with technologies that support clean water and air, conservation of precious natural resources near ports/hubs, efficient road/rail/warehousing supporting the ports, and state-of-the-art sustainable port-hub land management.

"This year's event marks the 11th anniversary of the Ocean Exchange awards program. Since the beginning, we have always been focused on searching for and rewarding Solutions Inspiring Action. These are innovative, proactive and globally scalable solutions with working prototypes that can leap across industries, economies and cultures—innovations that generate economic growth and increased productivity, while reducing the use of nature's resources and waste. It is so encouraging to see that our approach has been embraced by so many promising young companies around the world," added Ms. Pitts.

Bentley Systems and Genesys International Collaborate to Provide 3D Mapping Capabilities for Major Cities across India

Bentley Systems, Incorporated (Nasdaq: BSY), the infrastructure engineering software company, and Genesys International, a pioneer in advanced mapping and geospatial content services, today announced that Genesys' 3D City Digital Twin Solution for Urban India – the first city digital twin project launched by any Indian company – will be powered by OpenCities 365, Bentley's infrastructure digital twin solution for cities and campuses. This massive mapping and surveying project has begun and will capture most of urban India.

Genesys previously partnered with Bentley to successfully pilot an earlier digital twin solution that enabled the smart inventory management of telecom infrastructure using Bentley's OpenTower iQ software. The robust solution provided operators with accurate and up-to-date information on planning and installing 5G towers, which saved time as well as the cost of conducting labor-intensive tower inspections.

"The Genesys 3D City Digital Twin Solution for Urban India, powered by Bentley's OpenCities 365, will enable us to create and curate city-scale digital twins that empower government and private entities across India to improve their execution, efficiency, and strategizing capabilities using the 3D data," said Sajid Malik, chairman and managing director at Genesys International. "This extraordinary solution enables capturing the as-built assets from the field and bringing them to the office in a reality model. We are impressed with the technical capabilities of Bentley's digital cities portfolio and see it as a key differentiator that will help proactively improve our existing digital capabilities through a continued partnership between Bentley and Genesys International."

Once a 3D digital twin for each of the cities is ready, engineering and application data layers can be added based on an end-user's requirements. These 3D city digital twins will enable local governments to improve public services, including urban governance, disaster management, emergency response, and tourism. Additionally, it will help governments deliver more resilient and sustainable environments for their citizens through enhanced urban development, optimized road, rail, utility, and water network upgrades, location-based services, and other smart city initiatives. On the private corporate front, processes followed in verticals such as telecommunications and broadband infrastructure, city gas distribution, e-commerce, construction, autonomous navigation, renewable energy and various other verticals will be served and modernized by these 3D



digital twins. The openness of Bentley applications provides Genesys further benefit because the software can connect with other asset management systems, such as third-party geospatial information systems, to capture and read that data.

Kaushik Chakraborty, Bentley's vice president, regional executive, Asia Pacific, said, "We are extremely happy to contribute to this massive mapping project of national importance with our technology and services. The 3D cities digital twin project will enable our public agencies, service providers, and citizens to deliver or avail services, plan and execute projects, make informed decisions, and improve their quality of life."

Chakraborty added, "The initiative will also drive the adoption of digital technology in the infrastructure segment. The output from this project will serve as the foundation for initiatives that we can launch to sustain the economy and environment."



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FEATURES

- ✓ Fritz Filter is the world's first microfiltration system that is NOT pressure-driven.
- ✓ It is designed to treat high volumes of water.
- ✓ The self-cleaning filtration system is capable of filtering up to a 10-micron range
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Case Study Invitation

FOR DECEMBER 2022 EDITION



The 14th Annual Case Study Issue is a collector's issue where we cover the best case studies on water & waste water management from the leading industries across the globe. This exclusive annual edition has a combined circulation of over 1,00,000 global end-users industries, municipal & water experts and water professionals.

Brief Guidelines for Content Submission:

- ▶ **Exclusive Content:** It should be an exclusive Article/Case Study which has not appeared in any other publication before.
- ▶ **Suggested Topics:** The November issue's articles should be focused on the theme of Automation and Instrumentation and how it impacts the water industry.
- ▶ For December's issue, we are inviting the success stories & case studies from all over the world. the case study should be focused on water/ waste water management. Topic options range from: Water Purification, Water Treatment, Sewage/ Waste water Treatment, Water Supply, Drinking Water, Membranes, Pipes, Valves, Pumps, Boilers, Chillers, Cooling Towers, Membranes, Drives, Water Meters, RO Systems, Ozone, UV, Desalination, Filtration, Chemicals, Irrigation, Dewatering, Water Testing, Water Conservation, Groundwater, Rainwater Harvesting, Storm Water, Well Water, Swimming Pools, Municipal Water, etc.
- ▶ **Word limit is:** 1000 to 1500 words. Please highlight the important things of your articles/case studies separately
- ▶ High resolution photographs, infographics, graphs, charts etc to support the case study.
- ▶ **Other requirements:** Short profile & pictures of authors. The photographs should be in high resolution & fit for printing.
- ▶ **Preferred Format:** MS Word
- ▶ Final approval on selected case studies will be given by the editorial board prior to publication
- ▶ The submission is "totally free-of-charge" and carries no financial commitment from your end.

IMPORTANT: THERE SHOULD NOT BE ANY MARKETING OR PROMOTION OF YOUR PRODUCTS IN THE CASE STUDIES OR ARTICLES. THE SOLE PURPOSE OF THIS INVITATION IS TO SPREAD AWARENESS & INCREASE THE KNOWLEDGE OF OUR READERS ON THE LATEST DEVELOPMENTS & THE BEST PRACTICES ON CRITICAL ISSUES OF WATER & WASTE WATER TREATMENT.

CLOSING DATE for December Issue is 15th December 2022.

Draft of articles and case study & other material to be sent at: **deepak.chaudhary@eawater.com**



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MEET THE INDUSTRY LEADER

Nivedita Bose

**Marketing Manager For South Asia
Pacific Region In Residential And
Commercial Segment, Dupont
Water Solutions**

Q. What is your take on the drinking water challenges and current situation in India?

Earth is referred as 'the water planet'. Rightfully so, since 70% of our earth constitutes of water, nevertheless only 3% is non saline fresh water. According to the U.S. Geological Survey, most of that three percent is inaccessible to human beings. With a population of 1.35 billion, 54% of India is water stressed. According to the latest assessment by the National Institution for Transforming India (NITI), nearly 70 percent of our country's fresh water is contaminated. Apart from the effects of pressures of an increasing population and rapid industrialization, climate change too is creating additional stress on water resources. With passing time, India is facing water crisis and it is estimated that by 2030, India's water demand will be twice the available supply, implying not only severe water scarcity for a large percentage of population but also eventual loss in the country's GDP.

Q. How can DuPont help in these challenges?

97% of the available water on earth is saline water, held by oceans. It is only 3% that is available as fresh water. In the scenario of consistent increase in stress on water, DuPont Water Solutions (DWS) has been actively working to bring innovative solutions to enable desalination plants operate on more efficient and cost-effective scenario, thereby making water available to masses.

Our residential water business portfolio, FilmTec™ and TapTec™ reverse osmosis solutions, have been enabling key brand owners achieve drinking water purification goals by effective TDS removal while minimizing water wastage and improving water recovery. In DuPont we are focused to deliver superior water purification performance through our innovation in membrane technology.

DuPont's RO, UF, and NF technologies are used to produce purified drinking water. DuPont's WAVE modeling software is used extensively to select the optimal RO membranes to ensure energy-efficient nitrate removal and deliver millions of gallons of drinking water.

Q. How are you helping the industries in their water requirements?

DuPont Water Solutions, with a strong legacy of innovation and customer centric approach is committed towards solving intractable water challenges. Our innovative and state-of-the art membrane science and ion exchange solutions enables our customers optimize water needs through purification, conservation, and reuse. Our collaborative approach places customer challenges at the heart of our innovation and aims to meet both our customers' and DuPont's sustainability goals - optimizing water more efficiently, using less energy, and reducing the carbon impact of wastewater.

DWS Technologies like FilmTec™, Amberchrom™, Amberlite™, Hypershell™ and many more are used in the industrial sector to fulfill industrial water requirements. For eg., DuPont™ AmberLite™ high-performance resins deliver the required quality water in power plants improving the power plant reliability and protect the equipment.

The value of working with us goes beyond benefitting from our product portfolios, however. We provide training, support, and services, and bring our local expertise to global markets, making knowledge more available for partners across the water value chain

Q. What is necessary in the long term to ensure that potable water reaches every person in the country?

I believe all of us need to truly inculcate the mantra of three R's (Reduce, Recycle and Re-use) in our day-to-day life and be mindful of the present and future situation of stress on water resource. Each of us need to do our part in this mission.

Optimum usage of water is the key to reduce wastage. Effective wastewater management and to turn this into resource for reuse needs to be the prime focus.

There are initiatives like Jal Jeevan Mission by the government of India with an aim to provide potable water in adequate quantity, of prescribed quality on regular and long-term basis. Community based water management should be institutionalized and strengthened.

Enabling a circular economy and focusing on water stewardship is surely going to pay off in the long term.

Q. What are the CSR Projects done by Dupont in Drinking water area?

In DuPont we aim to lead global collaboration and work with all stakeholders of the eco-system to create a more water-optimized world. We are actively engaging with various NGOs to work towards growing awareness regarding drinking water.

DuPont has collaborated with Coca Cola to sponsor clean drinking water to Hanoi city. We have also partnered with Kusini Water and the US Embassy in South Africa, donating technology and expertise to community-based purification project at Renelwe Primary School in South Africa.

In summer of 2020 during the spike of COVID-19 in Vietnam, DWS partnered with the Tan A Dai Thanh Group to send 150 water purifiers with FilmTec RO filters to five dedicated COVID-19 treatment hospitals in Hanoi and Ho Chi Minh City. In October, DWS partnered with Australian Water Association and number of other charities based in Australia and Vietnam, as well as the Vietnam Government to deploy water treatment systems into areas hardest hit by the storms and tropical cyclones.

In November 2021, City Water Optimisation Index, sponsored by DuPont, was launched, which measures how well cities around the world are safeguarding the reliability, accessibility, and sustainability of water resources. The Index can serve as a measurement tool for city leaders, policymakers, and regulators to make resource, investment, and policy decisions toward increased access to safe, affordable, and reliable water

Q. How do you see the future of India's water sector?

India has emerged as the fastest-growing major economy in the world and is expected to be one of the top five economic powers globally over the next 10-15 years. Such growth will of course call for growing water needs. Therefore, the future of water sector in India is promising and scope of substantial investments in this sector is foreseen.

ABOUT THE AUTHOR

Nivedita Bose is a Marketing Manager for South Asia Pacific region in Residential and Commercial Segment for DuPont Water Solutions. She has an overall work experience of 11 years and hold a master's degree from National Institute of Technology (NIT) Rourkela in Chemical Sciences.

In her current role, she supports DuPont Water Solutions with Go to Market Strategy, Innovations and growth initiatives.

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

SHIELD OF AUTOMATIC WATER FILTRATION & DISINFECTION UNIT FOR THE APARTMENTS/COLONIES AGAINST WATER-BORNE DISEASE



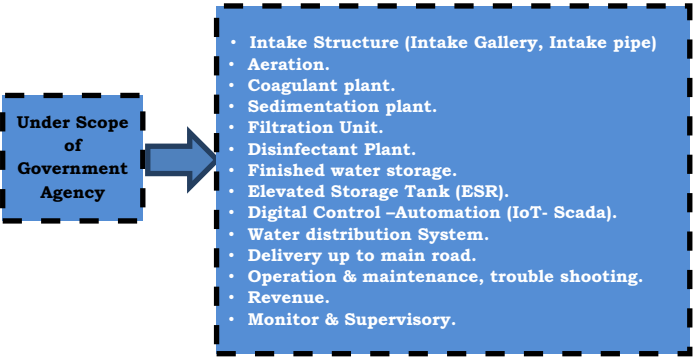
By Dilip Yewalekar and Manisha Kinge, Jain Irrigation

People are more vigilant and cautious about health related to water quality at home, in the office, in the hotel, and in travel. Although Municipal Corporations/Water Supply Agencies are adopting various steps to purify water and attempting to deliver water at the gate of the community in potable form, it cannot be guaranteed, because during the transit contamination of water could take place. That's why water purification, RO & desalination units are in more demand in the world and are procured by an individual to have safe potable water for drinking and to avoid the risk of the spread of water born disease. Awareness & marketing campaigns of water purifiers & RO units in Television, Newspapers, magazines, and media are in full swing.

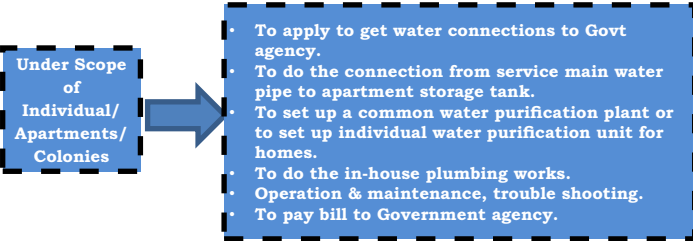
Everybody is aware of the community water supply system (city water supply) is under the control of a municipal corporation or local government, and the scope of work is limited to bringing water up to the main road. And for getting water connections, an individual or society (Apartment) needs to apply to them. Central & State Governments are continuously following up to implement various water supply schemes (Amrut Yojana, Jal Jivan Mission) in the countries to provide potable water to communities in rural to metro and to sort out drinking water issue which was lying since many decades.

Structure of Water Supply System under scope of Government Agency

The structure of the Government water supply scheme is briefed as under to get clarity. Water Supply System comprises of following principal components.



Structure of Water Supply System under scope of Individual / Apartment / Colonies



Drawbacks of conventional Water Purifications units.

- It has been seen that many apartments/colonies have set up either very expensive water purifications (RO) plants or conventional type and finally resulted in mesh and found beyond repairable. Some of the drawbacks are observed:
1. More than 50% of water just wasted during the process of purification.
 2. Consistency water quality is not possible to maintain or control.
 3. Frequent Replacement of cartridges resulted in an increase in cost.
 4. Depends on the service agency and every year maintenance contract needs to be renewed and fetch additional cost.
 5. Consume more electrical power an average of 5 hp (3.75 KW) and more electrical bills.
 6. Operation & Maintenance cost is more.
 7. Entire system is noisy.

Why filtration & chlorination System is a must?

Raw water contains physical, chemical, and biological impurities to treat these impurities various actions are needed.

Impurities	Types of impurities	Action proposed
Physical	Silt, Clay, Sand, heavy & Solid particles, and Suspended particles.	Screen filter
Chemical	Total hardness, TDS, TSS, pH, EC, Chlorides, Sulphates, Magnesium, Iron, Carbonates-Bicarbonates.	Chemical injector
Biological	Algae, Protozoa, Bacteria, Fungi.	Chlorine

Automatic Filtration & Disinfection Unit

To replace the conventional type of purification plant, enumerating configurations and new generations of equipment at affordable cost and with minimal operation and



maintenance cost. It is a supplementary filtration and treatment unit essential to be installed once the water reaches the gate of the apartment and thereby ensuring double filtration & treatment of water before reaching the individual home. The principal components involved are shown in the sketch.

1. Primary Screen filter(Automatic Cleaning).
2. Auto-control motor pumpset.
3. Smart Clean filter (Automatic Cleaning).
4. Chlorine Injector (Proportionate).
5. Chlorine Storage Tank.
6. Controller (microprocessor).
7. Safety devices.

Smart Clean filter works on the unique concept of online and effective cleaning. It has built-in suction nozzles that suck the dirt accumulated on the surface of the screen and work automatically.

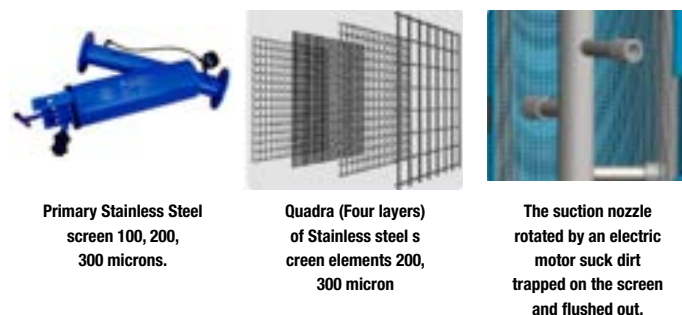
Raw water is flowing 'in-to-out' of the screen filter element so that the dirt particle gets trapped on the surface of the screen element and it helps to clean/ flush out easily by suction tubes. The automatic cleaning mechanism works when the pressure difference between 'in-to-out' reaches 0.6 bar. Automatic cleaning/flushing is done by suction nozzles, rotating around the surface of the screen element and it sucks dirt particles from the screen element and flushed out. Nozzles are rotated by an electrical motor or hydraulic pressure differential mechanism.

A smart clean filter is eco-friendly and utilizes a minimum volume of water for cleaning thereby saving precious water resources also maintaining the record of filtration and water quality.

- Carbon steel construction with pre-treatment of sandblasting of SA 2.5 grade. In this method oil, grease, dirt, mill scale, rust corrosion, oxides, paint, or other foreign matter is completely removed from the surface. It helps to do the electrostatic polyester powder coating internal and external surfaces of thickness 150-200 microns to protect the body from the environment and weather.
- Robot-operated high-quality MIG welding is used to manufacture Smart Clean filter units.
- Maximum working pressure 10-16 kg/cm² and meeting quality control as per ISO 9912.
- Strong and Robust Quadra (four) layer stainless steel 316 L screen of filtration level to 100 microns are used as the screen element.
- Automatic back washing mechanism (motorized or hydraulic) is used to perform automatic back washing with respect to pressure differential or time base or periodic interval.
- It is available in various capacities and sizes.
- It is available in horizontal and vertical options as per the available space

Disinfection

Disinfection destroys pathogenic bacteria and is essential to prevent the spread of



waterborne disease. Typically, it is a final process in drinking-water treatment, it is accomplished by applying either chlorine or chlorine compounds, ozone, or ultraviolet radiation to clarified water. Simple and economical way is using Liquid Chlorine.

Chlorination

The addition of chlorine or chlorine compounds to drinking water is called chlorination. Chlorine compounds may be applied in liquid and solid forms—for instance, liquid sodium hypochlorite or calcium hypochlorite in tablet or granular form. Taste or odour problems are minimized with proper dosages of chlorine at the treatment plant, and a residual concentration can be maintained throughout the distribution system to ensure a safe level at the points of use.

Chlorine Injector

A proportionate Chlorine injector is used to inject liquid chlorine into the system in a range of 2 to 200 ppm to maintain the purity of water. The rate of chlorine injection is adjusted or set in the controller.

Sr.	HEAD	CONVENTIONAL SYSTEM	AUTOMATIC FILTRATION/DISINFECTION
1	Wastage of water during the process	More than 50 % of water is wasted during the process of purification which is priced.	No water wastage during the process.
2	Wastage of water during cleaning, and backwashing.	More than 10% of water is wasted during cleaning and backwashing.	Less than 10 liters of water is wasted during cleaning and backwashing.
3	Cleaning & backwashing.	In many places, it is done manually.	Automatic cleaning/back washing based on pressure differential, time base, or interval base.
4	Spares- replacement	Frequent (every 3 to 6 months) replacement of cartridges and media resulted in cost.	All parts are sturdy and made from good quality materials, can replace once in 5 years if required.
5	Power cost	It requires higher electrical power (@ 7.5-10 hp).	It requires less electrical power to operate (@ 50-7.5 hp).
6	Control & Manpower	Manual control. Need manpower. The increased cost of manpower.	All control is automatic. Simple to operate and no need of manpower.
7	O & M cost	O & M cost more.	O & M cost is low.
8	Noise level	Substantial more.	Very low and negligible.
9	Capex	Higher Capex and extra CAPEX for housing & infrastructure. (approx. Rs 25+ lac)	Low Capex and housing & infrastructure costs an optional. (approx. Rs 10+ lac).
10	Opex	High. Frequent replacement of cartridges, media etc. More electrical bill.	Low. No need to replace it frequently. Low electrical bill.
11	AMC	(AMC) Annual maintenance Contracts need to be signed and paid.	No need for (AMC) Annual maintenance contract. Services on-call basis.
12	Efficiency	Working Efficiency @ 50%	Working efficiency 90%.

Comparison – Conventional and Automatic Filtration/Treatment Conclusion: Potable Water!

The water that is fit for drinking safe and agreeable is called potable water.

- It should be free from bacteria.
- It should be colour-less and crystal clear.
- It should be tasty, odour free, and cool.
- It should be free from objectionable matters.
- It should not corrode pipes, equipment, and utensils.
- It should have dissolved oxygen.

Even the ancients, Sanskrit writings from as early as 2000 BC tell how to purify foul water by boiling and filtering. But it was not followed until the mid-19th century,

many people died because of water-borne disease (cholera), and it was not until the end of that same century that the German bacteriologist Robert Koch proved the germ theory of disease, establishing a scientific basis for the treatment and sanitation of drinking water. At the end of the 19th century and the beginning of the 20th, the main goal was the elimination of deadly waterborne diseases. The treatment of public drinking water to remove pathogenic, or disease-causing, microorganisms began about that time. Treatment methods included sand filtration as well as the use of chlorine for disinfection.

Now it is necessary to focus on a cluster of houses, apartments, and colonies, to switch over from the conventional type of Filtration and Treatment to advanced Automatic Filtration and Disinfection unit to shield (safeguard) the community against deadly water-borne diseases.

ABOUT THE AUTHORS

Dilip Yewalekar is the Senior Vice President of Jain Irrigation Systems Ltd. He has over 36 years of experience. He has done M.Tech- Civil- Structural Engg, PG Diploma in Piping Engg, AMIE, UK, ASAE, USA. He is a Google scholar, Member of ICID.

He also has Fellowship of World Bank and Mashav, Israel and is a Faculty at Govt College of Engg, Jalgaon. He is also a faculty at Micro Irrigation Course of ICID & CWC, Govt of India. He has been awarded the EEF Global Water Leadership Award – Global Water foundations. Strategic Leader in Micro Irrigation – ABSA Award, Professional Excellence Individual Award – Aqua foundations and Best Innovative Article in Sabujeema International Magazine. He has 70+ papers/publications at national/international conference/magazines/books to his name.

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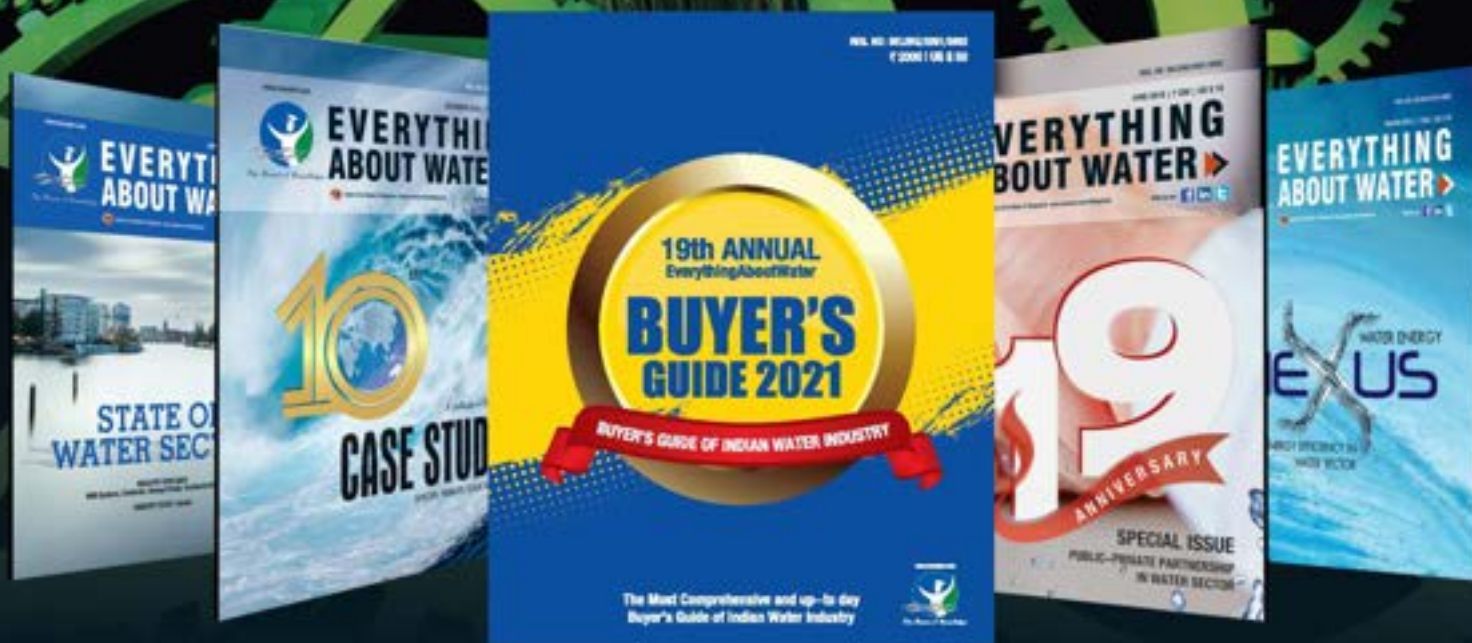
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MONITORING OF WATER PURIFICATION PROCESS BASED ON IOT

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



Water is essentially to human life and the health of the environment. To establish a good quality of water, it is required a monitoring system which developed based wireless sensor network and IoT. Wireless sensor network used to measure water quality by sensing the change of pH, TDS of water after the purification process. The status of system will send to Web with IP defined address in order to monitor the status of system numerically and graphically.

According World Health Organization many people around the world suffered from the quality of drinking water, so that the company of water race to gives good quality water with suitable cost. Many techniques have been investigated to enhance the quality of drinking water, however water filtering is the process of removing harmful chemicals, biological contains, suspended solids, and gases from water, and main water purification methods are:

A – Boiling: Boiling water is the cheapest and safest technique of water purification. In this way, clean water should be brought to boil and left boiling for 1-3 minutes. Boiled water should be covered and left to cool before drinking.

B – Filtration: Filtration is one of the sufficient ways of purifying water and when using the suitable filters, it's effective in remove water of the compounds. This method uses both chemical and physical processes to purify water and make it safe for human use.

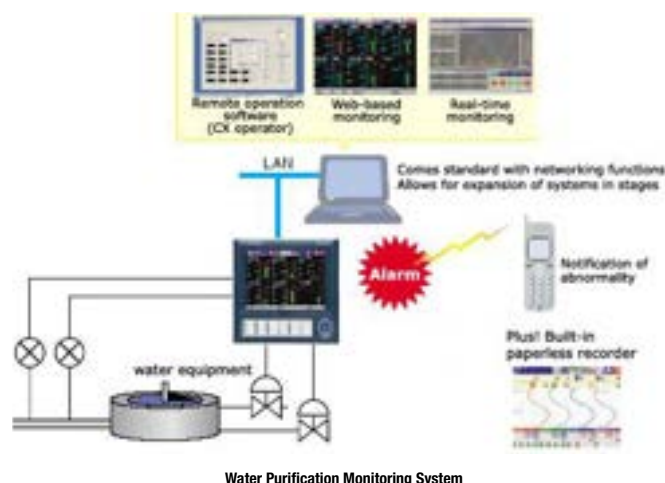
C – Distillation: Distillation is a water purification way that used heat to collect pure water in the form of vapor. This technique is effective by the scientific reality that water has a lower boiling degree than other contaminants and elements found in water that causing disease. Water is subjected to a heat source until it reaches its boiling degree. It is then left at the boiling degree until it vaporizes. This vapor is directed into a condenser to cool. Upon cooling, vapor is reversed into liquid water which is clean and safe for drinking.

D – Chlorination: Chlorine is a powerful chemical method that has been in use for many years to enhanced water for home purification. Chlorine is an effective water purification method that kills germs, parasites that causing disease that found in ground or tap water.

Water Purification Monitoring

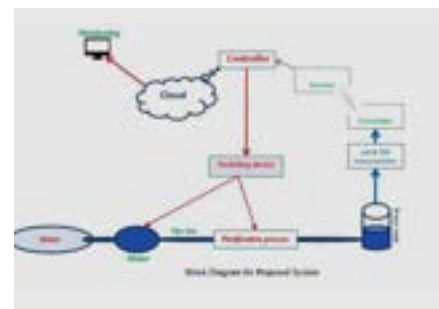
A monitoring device for a drinking water purification system consist of a microcontrollers that controls the overall process of the purification system, LCD indicating circuit that tell the information to maintenance person, a detecting means that analyses data for determining the healthy condition of the filtration elements, a warning means that produces message or sound for warning consumers about the unhealthy condition of the water filtration elements, and a power switching devices means switch off electricity supply to the water pump of the purification system. In process, the filtration elements will be sensed by impurities after being used for a

period of time. If the filtration elements are clogged, the monitoring device will make a sound to warn of such condition of the filtration elements and will immediately switch off power supply or reduce of speed of the pump in order to stopping water supplement if the filtration elements are not replaced after a certain period of time. The monitoring of water purification process described in Figure



Proposed Work

In this paper, water purification station based wireless sensor network has been designed by controlling and WEB Monitoring System, by measure and monitor the quality of water and also send the status of purification station to maintenance persons how's have the authentication to access to WEB, however when sensing elements read a change goes beyond critical values of both pH and TDS, the suggested system switch off the motor that supplied the purification unit and send a message told maintenance persons that one or both of the measured values goes far from its acceptance range, and the purification needed to have a suitable maintenance by defining two nodes of sensing elements one of them considered be a transmitter while the other considered to be a receiver , the receiving node connecting directly to Wi-Fi module use to connect the system with internet . When the system connected to internet the Wi-Fi module send the data to a global database system in order to process data and make a decision about the quality of water, and display the status of the purification system on a corresponding defined IP address Web. Finally, the



proposed work described as shown in Figure:

System Requirement

The system consists of two microcontrollers, one of them is used to interface the sensing element and sending the measured values which acts as transmitting node, while the other microcontroller is used to receive the measured values by interfacing

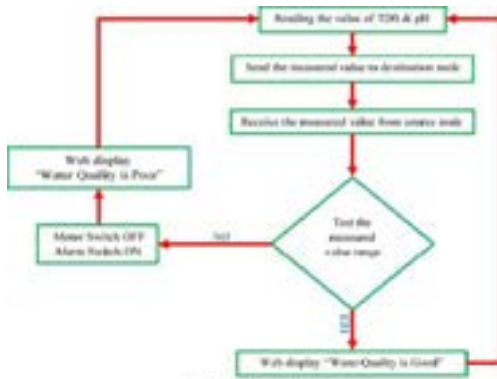
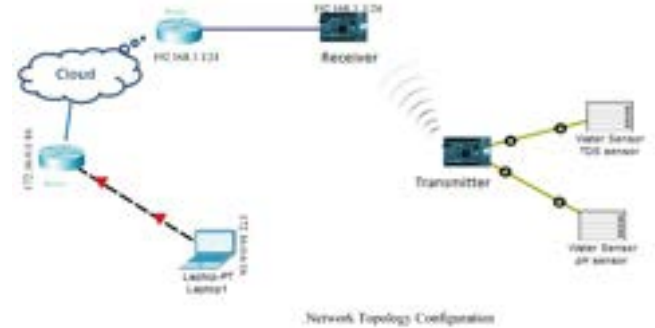


Figure 3: Decision Making System

another node and sending the status of purification system to global database server in order to suggest the water quality, the server send the status of the system to a secure web, that tell the status of purification system to maintenance person, however a monitoring means that display measured value and the switching on/off of the purification process according of the measured value that readied from the sensors, in order to determining a good water condition result from purification system, a warning has been established by produces message and graphical figures

deals to the unhealthy condition of the water filtration elements. The power switching devices used to switch OFF electricity supply from the motor that pump water to the purification system. In process, the filtration elements will be sensed by impurities after being used for a period of time. Finally, the implementation required building up WEB with static secure address using HTML programming web according to the following network topology which is shown in Figure



Network Topology Configuration

Conclusion

The investigated system can monitor quality of water automatically without intervention of human, and it is considered to be low in cost. This system is used to keep the water is being pure by measuring both pH and TDS using wireless sensor networks nodes and monitoring the status of purification system by internet using secured Web at home, offices etc. according that the water quality monitoring become more economical, convenient and fast.

ABOUT THE AUTHOR

Mandarr Kkamthe is Senior Product Manager-Water at Asian Contec Ltd. (Stanlay). 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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DRINKING WATER DISINFECTION: NEED OF THE HOUR

By Dr. Pooja Nikhanj, Microbiologist, Punjab Agricultural University



Water is one of the most abundant and vital resources on the Earth's surface. It is vital to life; every living being on the earth needs water for their survival and growth. Human beings depend on water for drinking, as well as industrial and agricultural production. Today, because of the increasing population, industrialization, and transition to a modern consumer society, contamination of water resources frequently occurs. Therefore, water has to be treated using different processes before being supplied to consumers. Therefore, the objective of any water treatment process is to remove contaminants from the water and to make it fit for the intended use. Water treatment includes biological, chemical and physical processes to remove contaminants from the water. Disinfection is an essential part of the water treatment process that destructs and inactivates waterborne pathogens, thus protecting human health. Therefore, it is indispensable in the drinking water treatment process as it protects human health by killing harmful pathogens. Disinfection has been widely used as the standard treatment of wastewater, swimming pools and drinking water. The most common disinfection methods used in water treatment include physical disinfection (e.g., ultraviolet radiation (UVR) and chemical disinfection (e.g., chloramine, chlorine, ozone, chlorine, and dioxide). However, a large proportion of the public has significant concerns about disinfectants due to their reliability, efficiency, toxic by-product formation and costs. Many different water disinfection techniques are commonly used worldwide that have different efficiencies, drawbacks, and advantages. The selection of the best water disinfection process is very crucial before designing and implementing any water treatment plant. Multi-criteria decision-making methods can be used to help decision-makers to evaluate problems systematically and clearly. By using these methods, the decision-makers can easily scale and examine the issues based on their criteria.

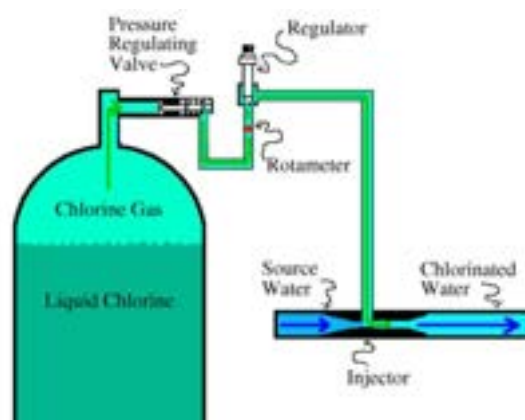
Water disinfectant methods

Disinfection is a crucial step that ensures that water safety for drinking. It is commonly the last step in the drinking water treatment procedure for killing or inactivating disease-causing microorganisms that can cause human illness. The disinfection process either inactivates or kills pathogens (bacteria, fungi, parasites, etc.) in a municipal water supply. Currently, there are many disinfectant technologies used for treating the municipal water supply. Generally, there are three types of disinfection techniques used in water treatment, namely chemical, radiation, and heat. Most commonly used methods are radiation and chemical methods. Some of them are explained below:

Ultraviolet radiation

Ultraviolet radiation is one of the most widely used tertiary treatments for the disinfection of effluent in water treatment plants. At present, UVR is a widely used disinfectant in water treatment due to its capacity to inactivate a variety of disease-causing microorganisms. This type of disinfectant is non-residual and does not form any harmful products in the water. In this method, water is exposed to shortwave radiation to kill any microorganisms contained within it. UVR disables the growth and replication of microorganisms by directly affecting its deoxyribonucleic acid. UVR is an effective disinfectant, and it does not influence the quality of water. This is because UVR is a physical means of removing bacteria, that is, no chemical agent is added to

the water for disinfection, and the water does not undergo any chemical change. As a result, the smell, taste and pH are not changed, as the only target is the bacteria. In addition to drinking water treatment, this technique can also be applied in the disinfection of treated wastewater. UVR has been used in the disinfection of municipal water supply for more than 75 years. The main advantage of using UVR



disinfectant in the drinking water supply is that it disinfects the water without using chemicals (no need to handle toxic chemicals). The other advantage of using UVR is that it is an incredibly rapid process (immediate disinfection), cost-effective and straight forward to maintain. On the contrary, the lack of residual disinfection is the main disadvantage of using UVR. Since UVR is a form of physical disinfection, it does not form any harmful by-products.

Chlorination

The primary objective of disinfection in any water supply system is to remove pathogens that cause waterborne diseases. Chlorination (CL) is a successful method of achieving this objective and is the most commonly applied disinfection technique used on the water supply in the majority of countries. In this technique, chlorine is added into the water in the form of chlorine or chlorine by-products. In this process, the added chlorine or chlorine by-product reacts with water to form hypochlorous acid and hypochlorite ions. Chlorine is a strong oxidizing water disinfectant. It is cheap and effective even at low concentrations, and it forms a residual (no post-treatment is required). The primary preferred standpoint of this method is that chlorine lasts longer in water as residual chlorine; therefore, it is disinfectant action continues during storage and distribution. Because of its low cost and strong disinfection capability, CL is a widely used disinfection technology around the world. However, the disadvantages of CL such as the unpleasant odor and taste, ineffectiveness against protozoa eggs and cysts, the formation of trihalomethanes and more than 400 other types of CL by-products have prompted the introduction of other disinfection techniques. The other problem associated with CL is that there is no fixed rule on the quantity that is required. However, the amount needed depends

on the water quality and the disinfection requirement. Furthermore, a water treatment plant that uses chlorine gas as the disinfectant requires highly skilled engineers, operators, and maintenance and repair infrastructures. However, a treatment plant that uses diluted chlorine is relatively cost-effective and straight forward. Nevertheless, the worldwide applicability of this method can be ascribed to its convenience and to its exceedingly acceptable performance as a disinfectant, which has been built up by many years of usage.

Chloramination

Monochloramine is formed by dosing chlorine and ammonia and reacts under well-controlled conditions. This process is generically called chloramination (CM). The process of CM should be performed under well-controlled conditions to prevent the formation of by-products and strong tastes. The efficiency of mono-chloramine in reducing microorganisms is low as compared to CL, and it is predominantly used to provide a disinfectant residual during the distribution of treated water. The advantage of using CM as a type of disinfection is that it does not form harmful by-products such as trihalomethanes under the presence of organic matter. Moreover, the taste threshold is typically much higher than for chlorine alone. Thus, using CM in disinfecting drinking water can significantly reduce customer complaints relating to chlorine tastes. Due to this reason, the use of CM disinfectant is becoming increasingly popular in most developed countries as it provides residual disinfectant in distribution lines. The residue of chloramine protects the water from recontamination. On the other hand, the CM method has some disadvantages. Some of its drawbacks include that it requires skilled personnel, is dependent on chemical access, is less efficient in pathogen removal than other methods and it is harmful to fish farming enterprises.

Ozonation

Ozone (O₃) is generated onsite by passing dry oxygen or air through a system of high-voltage electrodes. Ozone is a powerful oxidizing agent that is extensively applied in the water supply to achieve water quality and disinfection improvement. Due to its high oxidizing capacity, it is now one of the most effective disinfection techniques used for water treatment. Ozone is a popular disinfection alternative used instead of chlorine. In comparison to chlorine, it is a highly effective disinfectant that readily oxidizes chemical residuals, pesticides, various microbes and organic matter in short contact times and low concentrations. Ozonation (OZ) is a more effective disinfectant compared with chlorine dioxide (CD) and chlorine. It requires less concentration and contact time than CD, chloramine, and CL to achieve the required disinfection. This method is primarily effective against cysts and spores. OZ is the only chemical disinfectant that can inactivate *Cryptosporidium* and *Giardia*. Its most significant advantage is that it does not produce unwanted by-products since ozone becomes oxygen. Therefore, its use in water treatment has increased in popularity in recent years. The drawback of OZ is that its concentration in water decays rapidly in

comparison to other methods. Therefore, when using this method, it is likely that there could be recontamination in the distribution system. Furthermore, OZ is very expensive, especially in terms of operational and capital costs (CC). It requires a highly skilled workforce for maintenance, onsite generation, high energy input and post-treatment to remove organic carbon formed during the oxidation process. Ozone also reacts with bromide and organic matter to produce by-products such as ketones, aldehydes and bromate.

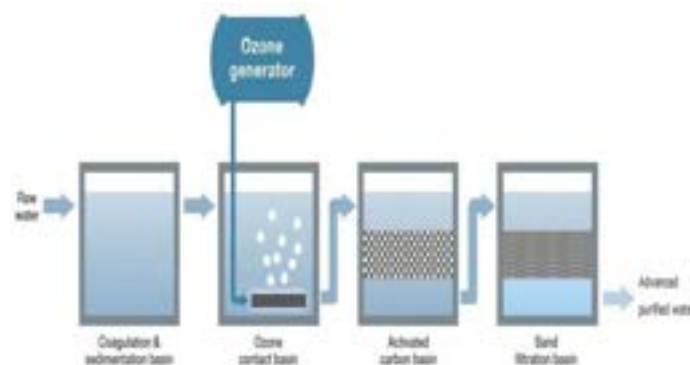
Chlorine dioxide

Chlorine dioxide (ClO₂) is one of the methods used in drinking water treatment for disinfectant, especially for algae control. Moreover, the CD also removes odor, taste, iron, and manganese from the drinking water. As CD is unstable, it is sensitive to pressure, temperature and light. Thus, it is highly explosive in the air if its concentrations are 4% and above. Therefore, CD is usually generated and used onsite to avoid problems of bulk storage and distribution.

Pathogen removal efficiency Water treated using different techniques must be disinfected until the final quality of water meets the World Health Organization (WHO) standards for drinking water supply. This criterion evaluates both the ability of the disinfectant technique to remove pathogens and other undesirable contaminants in the treated water. The effectiveness of a specific disinfection method can be evaluated based on experience from full-scale treatment plant studies. Removal efficiency has been used as a criterion for selection of best alternative by many studies.

Safety risk

In selecting the best out of many disinfection techniques, the safety of workers in different processes should be taken into account. This is because, during operation or maintenance, accidents could happen involving workers. Safety for workers is one of the criteria used in the evaluation of different water treatment processes.



ABOUT THE AUTHOR

Dr. Pooja is a Microbiologist in Punjab Agricultural University since 2018. She was an INSPIRE National fellowship holder from DST, New Delhi during her PhD and also qualified the ASRB-NET. She was awarded with two Gold medals for her excellence in academics during PhD and M Sc degree. She is currently working on Postharvest management of Horticultural crops along with quality analysis of water, waste water and all types of fresh and processed food products. She is handling researches on Fresh cut fruits and vegetables shelf life extension by the use of disinfection treatments, edible coatings and Modified atmosphere packaging techniques. She is also involved in the use of horticultural wastes for the production of valuable products by fermentation processes. She has published more than 20 publications including research papers, book chapters, review articles and popular articles on various aspects of fermentation, fresh cuts and value added products development.

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REVISITING THE BIOLOGICAL WATER SAFETY POLICY NORMS

Dr. Sandeep Singh Shekhawat, Assistant Professor, School of Life and Basic



Disinfection is the last step of water treatment system to remove the microbial pathogens. The purpose of the disinfection is to limit the infectious (disease causing) agents in water and to control their spread in the environment. It is an essential practice to provide safe drinking water for protection of human health from water-borne pathogens. Among different disinfectants, Chlorine, Ultra-Violet irradiation, and Ozone are most commonly used at households and community levels. Globally, chlorination is the most practised disinfection strategy for water treatment due to its highly potential oxidizing capacity and low cost. In 1974, J. J. Rook first time discovered the formation of trihalomethanes as by-products of chlorine disinfection in drinking water. Some of the disinfection by-products (DBPs) in high concentrations may increase the risk of cancer and other health problems. However, the formation of DBPs is associated with different factors like chlorine dose, and the presence of natural organic matter in water. Survival of chlorine tolerant/resistant pathogens in treated water has recently fuelled the question over the human health safety by chlorine disinfection. These limitations of chlorine disinfection have opened doors for the use of UV disinfection due to their minimum formation tendency of DBPs and their high efficacy against the chlorine tolerant/resistant pathogens *Cryptosporidium* and *Giardia*. These pathogens are known for water-borne outbreaks in USA and other countries. The average prevalence of *Cryptosporidium* is 4.3% in developed nations and 10.4% in developing nations, while *Giardia* is the most prevalent (33%) of the enteric parasites in developing nations. In India, around 37 million population is affected yearly by waterborne diseases; including 1.5 million estimated child deaths due to diarrhoea alone.

UV disinfection has increasingly been replacing the use of chlorine for water treatment due to its broad range of microbial inactivation including bacteria, viruses, and protozoan. The UV light inactivates the microbes by targeting their nucleic acids (DNA and RNA) through dimerization of pyrimidine-pyrimidine resulting in blocking of the replicating ability. However, it does not ensure a complete microbial security in treated water. Emerging microbial contaminations such as antibiotic resistant bacteria, opportunistic pathogens and antibiotic resistant genes are becoming a great challenge to the present disinfection practices, although, no regulatory standards for these pollutants exist and hence the limitations of individual disinfectants are unfortunately ignored. An award-winning scientist Karl G. Linden from University of Colorado Boulder research group has received the Clarke Prize for Excellence in Water Research from the National Water Research Institute for his work with UV technology. He has developed different UV disinfection units and types of lamps to reduce the cost and their applicability for low-income nations. A high capital cost of UV irradiation units may also put extra economic burden on such nations. Moreover, a less than 4 log reduction of microbial counts may lead to a higher microbial regrowth post UV disinfection thereby compromising on the overall disinfection efficacy, and hence the current concern is to evolve scientific water policy norms to ensure microbial safety. Recent studies have reported that microbial regrowth post disinfection could be a big issue for developing microbial indicator norms. The pathogenic indicators such as

coliforms or *E. coli* counts have certain recommended norms, but the revegetation of cells is grossly ignored. The culturable coliform counts may be found as zero immediately after disinfection but this may not be true after some time post disinfection. The current norms of the indicator organisms should not solely be dependent on immediately reduction of bacterial counts post disinfection simply due to absence of culturable counts but should also account the microbial regrowth post disinfection. Professor A. B. Gupta's research group at Malaviya National Institute of Technology Jaipur has been working in the field of different disinfection practices and their efficacies with a special focus on post disinfection microbial regrowth. We have suggested that Effective Reduction (ER), which includes the regrowth potential of disinfected bacteria in addition to the immediate culturable counts may be a better parameter for ensuring human health safety. A minimum period of 6 h post disinfection is recommended for chlorination to account for the microbial regrowth, however it may differ with the type of disinfectant being used. UV disinfection is an effective strategy, however high microbial regrowth potential post disinfection is a serious concern for the present policy norms. It is suggested to revisit the microbial indicator norms and include effective reduction (ER) of these indicators/pathogens for the safe application of any disinfectant. In fact, none of the standalone disinfectants guarantees adequate microbial safety of treated water. Therefore, it is suggested to devise a suitable hybrid disinfection strategy that curbs the microbial regrowth as well as eliminates the pathogens of emerging concern. The low- or middle-income nations need to focus for the water disinfection strategies of having low economic input. The extensive investigations over the sequential use of two or more disinfectants or hybrid strategies may be better approach for the development of disinfection technology. A low-cost disinfection strategy fits with current challenges can get a global popularity and is specially benefitted to low or middle-income nations to improve their economic growth.

Further Reading:

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ABOUT THE AUTHOR

Sandeep Singh Shekhawat earned his PhD from MNIT Jaipur in the year 2021. Presently He is working as an assistant Professor in the school of Life and Basic Sciences at Jaipur National University, Jaipur. He has more than 8 years of teachings and research experiences. His research interests are emerging microbial water pollutants, disinfection technologies, antibiotic resistant bacteria/genes. He has published 10 research papers in the reputed peer review journals. Currently he is developing hybrid disinfection technology for the removal of emerging microbial pollutants.

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THE “THIRD SOURCE” OF WATER

By Santosh Hegde, Transwater System Pvt. Ltd.



We all are witnessing a continuous and consistent quest going on in the society to explore avenues and alternatives to identify a source of water which can fulfil the demand for clean, safe and high-quality water for various applications and usages.

In line with this we at **BOSON® Whitewater {by Transwater System Pvt. Ltd.}** are talking about the “Third Source” of water in the following article. A source which not only satisfies the need of the industries & institutions only but also enables residential, commercial and institutional establishments to achieve practically a “Zero Liquid Discharge” status sustainably and economically.

Highlighting the fact that 'ZLD' is not limited only to the industries with hazardous effluents but applicable to any individual / Institution who use water in any form. This implies it's the responsibility of every human being. Also, ZLD in all scenarios does not mean one should install a thermal/Eqvt unit to evaporate and condense wastewater separating the salts.

ZLD can be achieved by adopting the most optimized recovery solutions and striking the required balance catering to all requirements of water and wastewater for any establishment, be it residential or commercial or industrial.

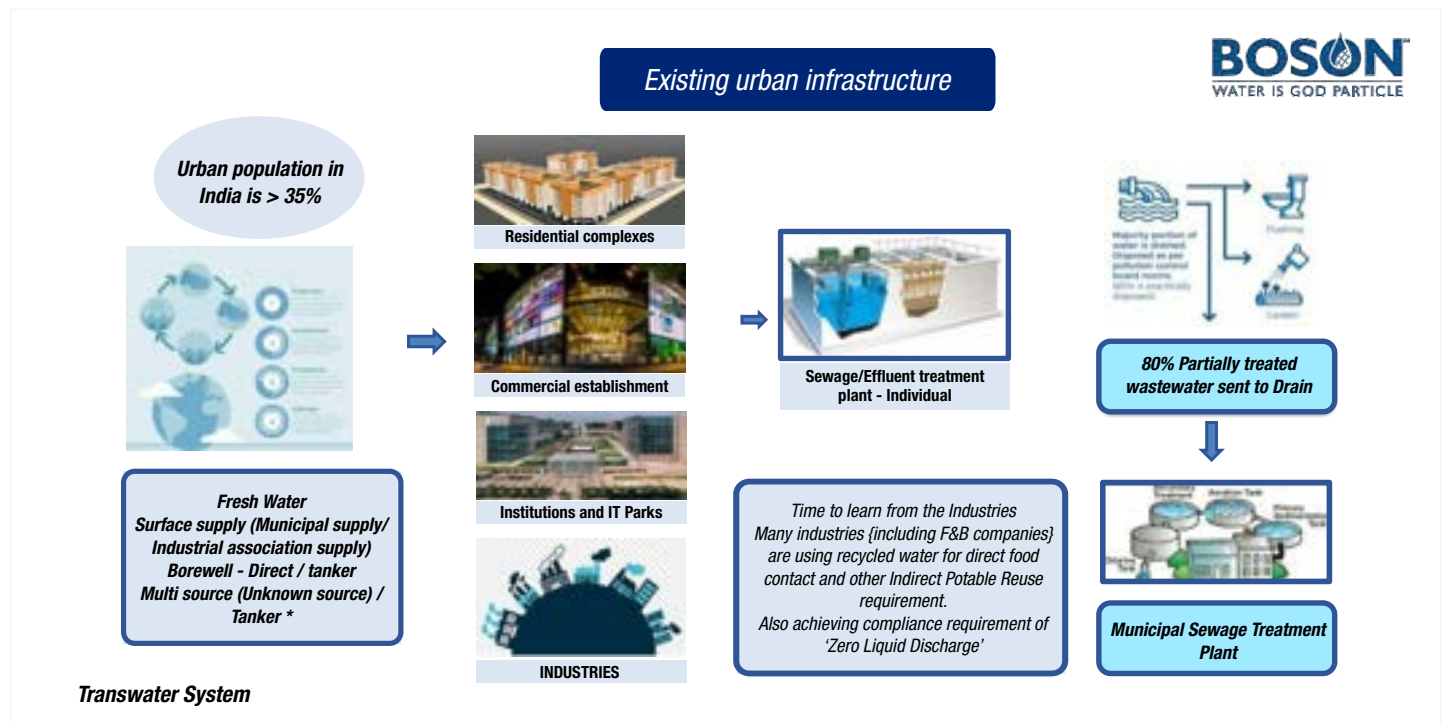
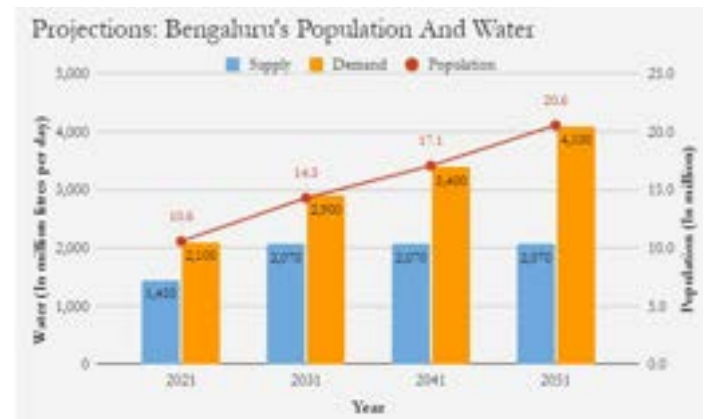
Our core vision is to create abundance of this high-quality water and provide easy access to the user communities across the society. With this prologue, let us now understand the solution in detail.

Urban water infrastructure in majority of the cities in our country is dependent on Surface water source nearby. Above representative image provides a gist of the network.

Classic example:

Bangalore city feeds from the Cauvery River which is 90-100 Km away with more than 65 sub stations to pump water to the city. This involves huge pumping cost and depletion of the source for more appropriate usages such as agriculture.

To provide a fair idea to the readers Bangalore city's water treatment infrastructure is set up for 1,450 MLD (Million Litres a day) – This is excluding the borewell water and tanker water supplies. Further, saddest part is > 25% of this goes unaccounted (Data as per BWSSB records). Most of the other larger cities of our country are being



operated in the similar fashion. Below is the projected increase in water demand in the coming years.

If we take a closer look on the above picture, we can clearly see that 'Treated Sewage' from the STPs (Sewage Treatment Plants) of the apartments, commercial complexes and institutions is again let to the Municipal Sewage Treatment plant. Have we ever wondered why and what is the logic/reason behind treating the already treated Sewage water?

The answer is, we are not able to find a way/application to reuse this 'Treated water' as a replacement to Fresh water there by saving the fresh water and reducing unwanted, unnecessary and illogical excess load on our Municipal STPs. At the same time handling the excess treated STP water is equally a Herculean task for the apartments/commercial establishments.

With **BOSON® Whitewater {by Transwater System Pvt. Ltd.}** we exactly address this issue as precisely as an incision made by a scalpel during a critical surgery and save our society from seeing the 'Day 0'. We are parallelly enabling commercial, institutional and residential establishments to achieve '**SUSTAINABLE ZERO LIQUID DISCHARGE**' model in true sense.

Efficient Water Management with BOSON® Whitewater:

Following section intends to provide clarity on the holistic picture of the solution. Decentralized STPs installed at apartments / commercial establishments treat the sewage to meet the qualities prescribed the regulatory authorities for usage in irrigation or inland discharge. This treated STP water is tapped and further treated in advanced multistage stage treatment process using BOSON® Whitewater system to convert it to high quality water which consistently satisfies norms such as IS 456 (Construction) or IS 10500 (Drinking water standards). This ensures the suitability of recovered water for all the industrial and institutional usage. This also qualifies the water for Indirect / Direct potable reuse.

The high-quality BOSON® Whitewater is then supplied to the industries/institutions near to the residential complexes / source of treated STP by means of tankers.

What's in it for STP owners / Residential complexes?

- Peace of mind from handling excess treated STP water
- Readily available high-quality water at their premises for any higher secondary usage – Vehicle wash, floor wash, toilet flush and even for reuse for domestic consumption – PS Cities in Australia, California, Texas, Singapore, Namibia, South Africa, Kuwait, Belgium and the United Kingdom and many more have already adopted this method in centralized manner.
- Fulfilling the social responsibility of saving fresh water by enabling industries to use the recovered water and become a sustainable & environment friendly housing society in true sense.
- Achieve Zero Liquid Discharge Status

What's in it for the Buyer / Industries / Institutions?

- Very high-quality water (Ready to use) for manufacturing processes.
- Freedom from extraction and treatment of borewell water – Fresh water saving
- Trouble free and ensured business continuity w.r.t water and water quality – (Multi source / Tanker water qualities are inconsistent which hamper production process quite often)
- No seasonal fluctuations in water quality

Further, if cities move towards Indirect Potable Reuse (IPR) / Direct Potable Reuse (DPR) norms by using advance technologies to recover potable water from the waste water. Developed Cities in other parts of the world mentioned above plan their water management based on the Waste water going out of the city as its more predictable

and not based on Rain which is coming in to the citylike cities have already adopted this concept to become sustainable.

When such technologies are employed, the technology should have the capability to digitally measure, monitor and CONTROL systems to ensure best quality of water comes out of tertiary treatment.

In the similar lines we create Safe potable grade high quality water with our multi stage, IOT enabled, fully automatic BOSON® Whitewater Systems. Currently we are generating 40+ crore litres of high-quality potable grade water which is being used by residential complexes, industries, commercial complexes for various applications.

Few Challenges:

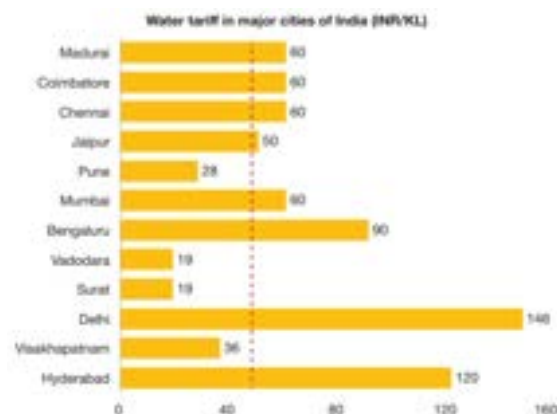
Direct and Indirect Potable reuse of Tertiary treated water comes with a huge mindset barrier to handle. As a society we are still gripping to understand and come to terms in reuse of secondary treated water for Gardening and flushing. Looking at reuse of STP treated water for potable reuse looks like impossible task in hand for government and private players trying to solve the impending water crisis.

How can we overcome Challenges?

Few key market factors which can help overcome mindset barrier to reuse STP water for potable reuse. –

- FIRST** of all, we need to understand the fact that Total water available on our planet is fixed. Water can't be created. Either naturally/with the use of technologies. It can only be managed.
- The source of water which is supplying the water to our apartments / complexes through tankers is unknown. There are more than few instances when these unknown waters have showed substantial Fecal coliform counts, pesticides, carcinogenic contaminants etc.
- The Water pricing is a critical area which directly depends on unstable supply and demand and varying at different seasons. Reference: PWC report – Closing the Water loop.

Logical thinking and assessing technology benefits begins only when the other sources of water is costlier. Imagine the "WHITEWATER – Potable water recovered from STP water" is almost the cost of tanker water people buy and Whitewater comes with the benefit of each batch Water Report(A small slip which indicates the water quality for the water in the tanker) also periodic detailed test reports by NABL Accredited Laboratories in line with the WHO/BIS standards for drinking water quality.



D. Few regions have faced the doomsday for short periods of time and when we are pushed to this, we have to look at alternatives. However, this cannot be actionable item to implement. Government sectors, NGO, Social Organizations and Private organizations can have more measurement and can create awareness campaigns to prevent such disasters from happening.

Planning for doomsday of not having water for supply can still be beneficial than be completely clueless on what to do on such massive natural scenario's occur.

E. Government norms enforcing for Zero Discharge from apartments
Our country works on penalties and fear. Government enforcement helps in implementation of such water reuse norms like DPR / IPR. However, this measure helps in some way but is not a citizen inclusive mechanism for quick success of such water reuse programs. Large citizens forum come against such initiative as government also does not have the framework to enable such activities. Norms should have inclusive of citizens and we have to ponder on how can we make norms that can be called the citizens' initiative.

F. Flexibility for people to choose to use or not to use the water and making it commercially viable.

Enabling and giving people the option to reuse treated waste water for potable application is the best method to start the process of Reusing water for potable application. However, this can be enabled by Government or Private sector at the cost of spending time and effort to map the industry requiring high quality water and the apartment which is producing waste water. Private player can enable setup of Tertiary treatment plants at apartment complexes and government can play the role of enabling Industries to purchase the treated Tertiary water. Industries should commercially benefit from purchasing this tertiary treated water and apartments should benefit from the sales of waste water together with private player to have a commercial case to keep it sustainable. Over time, when generator of waste water is fed with data on quality of water being produced inhouse will eventually decide to use the water for primary application. Once such entity solving this is Trans water system Pvt Ltd. In Bangalore.

SUMMARY

The visible way forward for cities and industries of India to become sustainable in terms of water is recovery of high-quality water from waste water. This would make our country water abundant. We are used to hearing the word water scarcity and if our mindset changes from scarcity to "abundance" we have better infrastructure for the city.

We at BOSON® strongly believe that WATER is a GOD particle. Thus working and aligning ourselves towards UN's SDG goals creating "The Third Source" of water and manage this precious resource sustainably. We strive for consistent access to safe water and making it viable for the population. Adopting Circular Economy in its true sense and implementing it efficiently. Our goal is to prevent our societies from seeing the "DAY ZERO"

ABOUT THE AUTHOR

Santosh Hegde is a Water/wastewater professional with a passion for Environment. He is a Chemical engineer with specialization in environment and post graduation in management. He has 16+ years of experience in water and wastewater treatment and recycling solutions.

Transwater System Pvt. Ltd. – BOSON® Whitewater recently won the MISSION PAANI award by CNBC TV18 (Top 4 in India) and have also been called Water Warriors by publication like Times of India, HAR EK BOOND (Republic TV), BetterIndia. They are also the winners of India-Pitch-Pilot-Scale-Start-up Challenge 2022 under Amruth 2.0. They have been providing solutions for water/wastewater treatment since 2008.

They are convinced and strongly believe that the only way for cities of India to sustain in terms of water is to reuse every drop of waste water generated from the city and create a "Third Source" of Safe drinking Water for all.

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



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DISRUPTING WATER DISINFECTION: EMERGING TECHNOLOGY TO CREATE A SAFER WATER SUPPLY

By Vikram Gulecha, Co-founder (Strategy & Alliances), Oceo Water

Quality of life is, in part, dependent on a safe water supply. Every year millions of people, most of them children, die from diseases associated with inadequate water supply, sanitation, and hygiene. A significant percentage of the mortality and severe illness is attributable to harmful waterborne bacteria, particularly *Vibrio cholerae*, *E. coli*, and *Staphylococcus*.

In India alone, the U.N. estimates over 100,000 children die from diarrheal disease each year. Without easy access to safe and affordable drinking water, the health and livelihoods of many families remain in peril.

And there is an economic consequence to this shortage. It is estimated that waterborne diseases have an economic burden of about USD 600 million/year in India, most felt in drought- and flood-prone areas (Source: JMP 2017).

When families do not have a safe and reliable water source, preferably direct to their home, then it is often women and children that are responsible for collecting water. School attendance in India decreases when children are required to spend hours collecting water. A 22% increase in school dropout rates has been reported in drought-affected states. Close to 54% of rural women – as well as some adolescent girls – spend an estimated 35 minutes getting water every day, equivalent to the loss of 27 days' wages annually (Source: Analysis of the Situation of Children, Adolescents and Women in India 2016).

As part of U.N. Sustainable Development Goal #6 (Clean Water and Sanitation), a target has been set to achieve universal and equitable access to safe and affordable drinking water for all by 2030. To complement the long-term development of piping infrastructure and municipal water systems in India, the need to provide immediate safe water solutions against deadly bacteria – whether at-home or away-from-home – is critical to improving the quality of life for such families impacted by lack of easy access.



Conventional Wisdom Regarding Water Disinfection

The prevailing theory over the last 50+ years is that chlorine-based compounds are universally safe and effective, and any side effects are “acceptable risks” relative to the effects of water-borne pathogens. Today, that wisdom is only partly correct.

While chlorine-based solutions have been used for over 50 years in India, there is significant evidence showing that chlorine-based disinfection agents react with pathogens and create carcinogenic by-products called trihalomethanes, including chloroform. These chlorine disinfection by-products have been linked to various cancers and some birth defects.

Also, while chlorine-based solutions effectively kill bacteria, their efficacy is limited over long periods of time; hence, algae/bacteria film often appears, requiring re-application of water disinfectant.

Hence, it may be presumptuous to consider these “acceptable risks” any longer acceptable in the face of emerging technology.

An affordable, effective, yet safe water disinfection solution that keeps drinking water clean has not been readily available in the Indian market – until now.

Emerging Technology – SV36

For almost 20 years, formula SV36 (brand name Silverdyn in Mexico) has been the exclusive emergency relief water treatment option approved and used by the government of Mexico, replacing chlorine tablets.

SV36 consists of a silver-based stable suspension that forms a non-toxic, non-chemical, and non-hazardous product. In as little as 30 minutes, this silver-based solution effectively kills a broad spectrum of waterborne bacteria, including *E. coli*, *Pseudomonas*, *Shigella*, *Salmonella*, *Vibrio cholerae*, and *Legionella* (lab tests also have shown SV36 to be effective against MRSA, a bacteria strain that is highly resistant to antibiotics).

When used as directed, SV36 will disinfect water without any taste, odor, color, or toxic effects. SV36 is engineered and manufactured using proprietary processes that keep silver particles in suspension for increased absorption and efficiency. The result is a shelf-stable concentrated liquid that is lethal to bacteria and other



COFEPRIS is similar to CDSO.
CONAGUA is the National Water Commission.
Silverdyn is the brand name used in Mexico.

biological contaminants but harmless to humans and the environment. One 30-ml bottle can treat up to 1200 liters of contaminated water.

SV36 is manufactured using proprietary engineering that results in a true colloidal silver suspension, lethal to bacteria but harmless to humans, animals, and the environment. Rigorous testing by laboratories such as Pasteur Institute and Noguchi Memorial Institute (WHO Collaborative Centers) has shown the product to be extremely effective in killing a broad spectrum of bacteria.

History of Silver as a Bactericide

Historically, silver has been used by fighting forces for wound care for a very long time. Since the 19th century, battlefield medicine practitioners have embraced its use, including silver sutures, surgical instruments, and both liquid and powdered wound treatments. In WWI, US surgeons wrapped wounds in silver leaf to prevent infection. To this day, most severe burns are treated with silver sulfadiazine, and there is not an operating room in major hospitals without a silver product in use.

The highly electrically conductive nature of silver is at the heart of its effectiveness against bacteria. These properties make metallic silver fatally disruptive to the electro-chemical functioning of simple bacteria. The mechanism for this disruption, often referred to as the oligodynamic effect, occurs when silver ions (Ag+) bond with a wide range of bacterial building blocks, including key enzymes, proteins, and DNA. Because silver is not consumed in disinfection, it remains active in the water, thus protecting against recontamination and inhibiting biofilm formation. COFEPRIS has determined that SV36 is 99.999% effective at concentrations as low as 90 parts per trillion.

NO.	TECHNOLOGY	USA	FRANCE	SINGAPORE	VIETNAM
		3 drops / Liter	Treated Earthenware Jars	3 drops / Liter	3 drops / Liter
1	Kill Rates After 30 Minutes	99.999%	99.9999%	99.99%	100.00%
2	<i>Escherichia coli</i>	99.999%	99.9999%		
3	<i>Pseudomonas aeruginosa</i>	99.999%		99.98%	
4	<i>Shigella flexneri</i>	99.999%			
5	<i>Salmonella arizonae</i>	99.999%			
6	<i>Salmonella Typhimurium</i>		99.9999%	99.99%	100.00%
7	<i>Vibrio cholerae</i>		99.9999%		100.00%
8	<i>Legionella pneumophila</i>			99.99%	

Several academic studies have validated the harmful health side effects associated with chlorine disinfection. Because there are no harmful health side effects associated with disinfection with silver-based solutions, SV36 is an extremely effective solution and better alternative to ensure a safer water supply. The table below illustrates kill rates from various independent testing laboratories.

In addition to everyday use, SV36 can be used for various applications to improve community health and hygiene:

- Humanitarian relief after earthquakes (government officials can distribute bottles to communities)
- Long-term water storage for drinking and washing (adding drops to home storage vessels keeps water safe from re-contamination)
- Support infant-feeding programs (mixing infant formula with SV36-treated water ensures retention of formula nutrients)

SUMMARY

Silver-based solutions represent an emerging technology that effectively kills a broad spectrum of waterborne bacteria. Because there is no harmful health side effects associated with its disinfection process, this solution represents a safer, more effective alternative to chlorine-based solutions.

The product is currently available for sale in Mexico, where the Government of Mexico (COFEPRIS - Mexico Health Authority) is the largest buyer and SV36 has been their exclusive emergency relief water treatment option. With recent product registrations by NAFDAC and Ghana Food & Drug Board, SV36 is sold in West Africa too. SV36 is expanding to serve the needs in the Indian market.

ABOUT THE AUTHOR

Vikram Gulecha is the Co-founder (Strategy & Alliances) at OCEO WATER. Oceo Water digital solutions have the power to engage with consumers more closely than ever before, save billions through operational efficiencies, improve service levels and reliability, and map water quality data for social good.

Under his leadership, the team is building a decentralized, proactively managed system and can potentially provide the backbone for the water network of the country. In the near future, the team aims to make consumers, stakeholders and regulators view water as more advanced than energy.

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PATHOGEN REMOVAL AND HIGH LOG REDUCTION VALUE CREDITING FOR REVERSE OSMOSIS SYSTEMS USING CONTINUOUS STRONTIUM MONITORING



By Troy Pittenger, Research and Development Director, Cooper Environmental

Public potable water supplies are being stressed by growing population, cyclical droughts, and climate change. One way to sustainably augment the potable water supply is to recycle (reuse) wastewater. This is performed by using a tertiary wastewater treatment facility followed by advanced water purification (AWP) which includes; Reverse Osmosis (RO), UV/advanced oxidation and free chlorine disinfection. RO is the core technology of AWP providing a physical barrier to waterborne pathogens and dissolved constituents. Reliable and safe potable reuse requires continuous demonstration of pathogen removal. Since monitoring pathogens directly is prohibitively time consuming, removal is typically demonstrated using total organic carbon (TOC) and electrical conductivity (EC) as a surrogate. TOC and EC offer a maximum achievable log reduction value (LRV) of approximately 2 and 1.5, respectively. Where under controlled conditions measuring actual pathogens, RO systems provide at least a 4-log reduction. Prior research studies¹ show that strontium, a naturally occurring constituent, has a 3.0 – 3.5 LRV for RO systems. Strontium's higher LRV allows RO systems to receive more accurate treatment credits and allows increased sensitivity to RO membrane breaches.

This application evaluates the feasibility of demonstrating continuous RO pathogen removal by measuring strontium using Cooper Environmental's Xact 920, continuous multi-metals monitor based-on energy dispersive X-ray fluorescence (XRF).

Data presented in this paper was collected over a two-month demonstration in 2021, with the Xact 920 configured to provide continuous 1-hr strontium measurements. The Xact 920 was installed at a pilot AWP facility capable of treating 100,000 gallons per day. The pilot plant was equipped with a 2-stage primary (PRO) and closed circuit secondary (CCRO) RO system which together achieves greater than 90% recovery. One Xact 920 was installed with an automatic switching manifold, allowing switching between four sample locations including; PRO Feed, PRO permeate, CCRO Feed (PRO Brine) and CCRO Permeate. Measuring these four locations allows LRV calculations (Equation 1) for both the primary and secondary RO systems. Figure 1 show the AWP RO treatment process and the Xact 920 sample locations. The Xact 920's

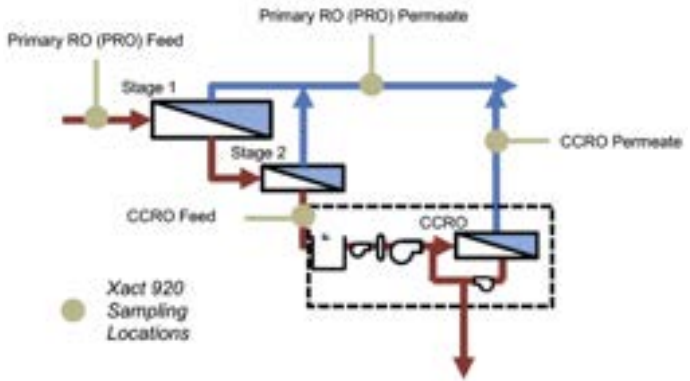


Figure 1 : AWP RO treatment process and Xact 920 sample locations²

performance was evaluated based on adequate sensitivity (detection limit), mass balance of the PRO system, and comparing the Xact 920 to U.S. EPA's Method 200.8, an inductively coupled plasma mass spectrometry (ICP-MS) based method, for total strontium concentration and LRV.

The Xact 920's 99% confidence level detection limit (DL) for all four streams was calculated. For the two permeate streams standard EPA calculations were performed. However, due to the high native strontium concentrations in the two feed streams, XRF spectral detection limits were calculated and propagated to concentration using the measured pre concentration parameters. Table 1 shows the Xact 920's DLs along with the average concentration and standard deviation for all four sample streams collected during the study. The closest Xact 920 DL is over four standard deviations from the average concentration. Meaning greater than 99.99% of all strontium measurements will be greater than the Xact 920's DLs. This demonstrates the Xact 920 has adequate sensitivity for this application.

Table 1 : Summary of Xact 920 strontium DLs compared to the average measured total strontium for all four samples

Sample ID	Xact 920 DL (ppb)	Xact Measured strontium concentration (ppb)		
		N	Average	Standard deviation
PRO feed	4.6	92	669	39
PRO permeate	0.22	116	0.69	0.11
CCRO feed	6.8	80	2664	142
CCRO permeate	0.48	223	2.68	0.38

$$LRV = \text{Log}(C_f) - \text{Log}(C_p)$$
 Equation 1

Where:
LRV = log removal value
C_f = strontium RO feed concentration
C_p = strontium RO permeate concentration

¹Trussell, R. S., et al. (2017). Realizing reverse osmosis potential for potable reuse: Demonstrating enhanced pathogen removal (report 196). Washington, DC: Department of the Interior Bureau of Reclamation.
²Idica, E., Seval, S. Online Strontium Meter for Potable Reuse RO LRV Crediting. 2021 WateReuse California Annual Conference, September 19th, 2021.

Strontium mass balance/recovery of the PRO system was calculated using Equation 2 on four separate days. The mass of the strontium on the permeate and brine streams should equal the mass on the feed. The average strontium recovery was $99\% \pm 3\%$, demonstrating the Xact 920 strontium measurements are in the expected range.

$$Sr \text{ mass recovery} = \frac{[(C_p \times F_p) + (C_b \times F_b)]}{(C_f \times F_f)} \times 100\% \quad \text{Equation 2}$$

Where:

C_p = strontium PRO permeate concentration

F_p = PRO permeate flow rate

C_b = strontium PRO brine concentration

F_b = PRO brine flow rate

C_f = strontium PRO feed concentration

F_f = PRO feed flow rate

The Xact 920 measurements were compared to laboratory results using EPA 200.8 for both concentration and LRV. Table 2 shows the average percent difference between the Xact 920 and EPA 200.8 for total strontium concentration, during three sampling campaigns. In addition, one inter-laboratory EPA 200.8 comparison was conducted on all four streams to evaluate the variability of EPA 200.8. The Xact 920 had excellent agreement with EPA 200.8 exhibiting similar percent differences as EPA 200.8 has with itself.

Table 2 : Xact 920 percent difference analysis to EPA 200.8 for total strontium – concentration

Average Percent Difference		
Stream ID	200.8 inter-laboratory comparison	200.8 & Xact 920
PRO feed	1.4%	8.6%
PRO permeate	16.9%	19.6%
CCRO feed	13.3%	9.2%
CCRO permeate	3.0%	10.5%

The same data used for percent difference analysis in total strontium concentration was also used to calculate the LRV for the PRO and CCRO systems. Table 3 summarizes the measured LRVs for the Xact 920 and EPA 200.8, while Table 4 shows the percent difference analysis for the LRV. The Xact 920 performance was equal to EPA 200.8, demonstrating the Xact 920 can be used for this application.

Table 3 : Summary of Xact 920 and EPA 200.8 LRV for the PRO and CCRO systems

System ID	Campaigns (n)	LRV			
		Avg. Xact 920	Stdev. Xact 920	Avg 200.8	Stdev. 200.8
PRO	3	2.97	0.04	2.93	0.11
CCRO		3.04	0.15	3.05	0.16

Table 4 : Table : Xact 920 percent difference analysis to EPA 200.8 for total strontium – LRV

LRV - Average Percent Difference		
Stream ID	200.8 inter-laboratory comparison	200.8 & Xact 920
PRO	2.3%	2.9%
CCRO	1.5%	1.3%

Lastly, a membrane breach was simulated on the CCRO system to evaluate if the Xact 920 could detect such an event. Figure 2 shows the Xact 920 and EPA 200.8 total strontium measurements over time during the breach event. The Xact 920 and EPA 200.8 track very closely during normal operation and under a simulated breach.

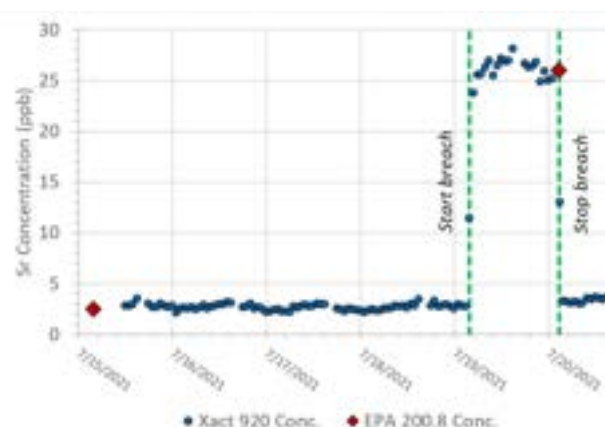


Figure 2 : Xact 920 and EPA 200.8 total strontium concentration results during a simulated breach of the CCRO system

This application demonstrates the Xact 920 can provide accurate, continuous, near real-time total strontium measurements to demonstrate adequate pathogen removal and high LRV crediting of RO systems.

ABOUT THE AUTHOR

Mr. Pittenger is currently the Research and Development Director at Cooper Environmental in Tigard, Oregon. He received his Bachelor degree in Environmental Chemistry from Oregon State University, USA in 2006.

Over the past 16 years, Mr. Pittenger has been actively involved in both the scientific and environmental fields. The majority of his efforts have been focused on aerosol generation, transport and characterization, and the instrumentation involve in these tasks. Over the past 5 years, Mr. Pittenger has shifted his focus to water quality measurements concentrating on the design, testing, and development of an automated sampling and analysis system for elemental analysis.

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UNCONVENTIONAL DISINFECTION IN CONVENTIONAL WTP IN EUTROPHICATION- A CASE STUDY AT HOSUR, INDIA

By Dr S Sundaramoorthy, Dr S Saktheeswaran, D. Srinivasan, T V Rajan

Abstract

The Millennium Development Goals (MDGs) enjoins upon India as the signatory nation to extend improved sanitation to 100% access for the population by 2025. It is an open-book that we would be lagging behind. A document by the Bill & Melinda Gates Foundation in 2018 mentions that “it is estimated that 78% of human faecal waste that is generated in India goes untreated into the environment (Ref. Madhu Krishna, Bill & Melinda Gates Foundation’s India initiative on Water, Sanitation and Hygiene, “Building long-term sanitation solutions”, Nov-19-2018). Leave alone, the magnitudes, the fact remains that it is not “completely out of the woods” So, much so, it is not uncommon to encounter sudden upsurge of these fecal pollutions especially in droughts and pre-monsoon seasons and the existing water treatment plants (WTP) are not able to take it and with the result, chlorination at entry, during treatment and after treatment is rampantly slapped. The problem becomes severe when the raw water source is suffering eutrophication by algal infestation. It is well known that disinfection by chlorination of such waters can result in carcinogenic by-products (DBPs). On the other hand, Hydroxyl radicals can react with not only bacteria but also extracellular biofilms and kill them. This is achieved by the high pH and carbonation system. One such demonstrated case study is that of the town of Hosur in Tamilnadu, India in 2004 and got over by this in-situ unconventional disinfection and is recounted here.

1. Physical Setting and the Problems encountered

The water source is the Pennaiar River which flows from upstream Bengaluru during the south-west monsoon months of July-September and the water is to be stored and drawn for the whole year. In summer this causes eutrophication due to stray sewage discharges upstream. The 23.5 MLD capacity water treatment plant (WTP) has cascade aeration, pre-chlorination, coagulation, flocculation, clarifier, rapid sand filter and post chlorination. But cannot deal with the dead and dying algae and additional problem is foaming obviously from phosphatic detergent usage. The conventional WTP of lime clariflocculation and rapid sand filtration with pre and post



Figs 1 to 3. Top-The vastness of Dam Middle-Algal mats around intake
Bottom-Foaming of the water

chlorination could not treat the water and the public en masse rejected the water and were preparing to migrate from this industrial hub virtually threatening the industries like TVS Motors, Ashok Leyland etc into their relocation elsewhere-a task not all that easy. The compounding issue was ground water could be located only beyond 300 meters depth and in interrupted yields. These challenges occur once a while and needs localized emergency solutions.

2. Raw Water and Treatment Options

The raw water quality at that time ranged as in Table-1. It may be seen that the raw water was definitely impacted negatively by the algal loads and decaying organics causing the phenomenal Fecal Coliform values of up to80,000 per 100 ml besides

Table-1
Variation of Surface Raw Water Quality in the Impoundment

Appearance	Greenish	Sodium as 'Na'	85 to 95
Appearance after 24 hours	Greenish	Potassium as 'K'	7 to 10
Odour	Algal	Total Dissolved Solids	630 to 670
Odour after 24 hours	Foul stench	Iron total as 'Fe'	0.24 to 0.52
Turbidity, NTU	13 to 20	Manganese as 'Mn'	Nil to trace
Total hardness as 'CaCO ₃ '	320 to 350	Ammonia as N	5.6 to 6.8
Calcium as 'CaCO ₃ '	180 to 210	BOD	14 to 18
Magnesium as 'CaCO ₃ '	81 to 85	COD	48 to 65
Iron total as 'Fe'	0.24 to 0.50	Chloride as Cl	150 to 170
Manganese as 'Mn'	Nil to trace	Sulphate as SO ₄	40 to 52
Alkalinity Phe / total CaCO ₃	0 / 380 - 450	Fecal coliform / 100 ml	40000 to 80000

Table-2
Options Considered for Instituting a quick Installation

NO.	TECHNOLOGY	ADVANTAGES	DISADVANTAGES
1	Prechlorination, SMBS, lime clariflocculation-rapid sand filtration, post chlorination	1. Prechlorination with ammonia causes chloramines formation 2. Chloramines are useless in disinfection and purpose lost 3. Chloramines and organics become dubious byproducts	1. Chlorine of decaying organisms may result in Trihalomethanes (THM) 2. Precise chlorine control impossible as algal mat densities not controllable 3. Leaks of chlorine gas may affect the effort by public who are already upset
2	Copper sulphate in impoundment	1. Elimination of fresh growth 2. Simple dosing from a row-boat	1. Cu residuals may carry over 2. The dosing will not be precise
3	Micro strainers before WTP	1. Micro strainers filter algae 2. D/S treatment can be easier 3. Chemical Toxicity is avoided	1. Micro strainers may be choked 2. Algal stench cannot be removed 3. Basic problem of foul odour remains
4	DAF before WTP	1. DAF can be float out algae 2. Scum can be put in filter press 3. Sludge cake can be composted	1. Algal stench cannot be removed 2. No guarantee of completeness 3. Dependence on Prechlorination
5	High lime, CO ₂ sand filter and post chlorination	1. High ph disinfects microbes 2. No danger of THMs 3. Removes colour, NH ₄ , Po ₄	1. Sludge is to be land filled 2. Need to store and use CO ₂ containers 3. Ambient ammonia to be monitored
6	Spin klin filters, UF before WTP	1. Can eliminate algae 2. Avoiding dosing of chemicals	1. Dependence on few vendors 2. Basic problem of foul odour remains

It may be seen that the options 1 to 4 pre-empt themselves due to the stated reasons. Option 6 would have been the best but dependency on a few vendors was not encouraging at that time. Thus option 5 though rudimentary, but, in essence locally appropriate was preferred. More importantly, this modified operation is nothing extraordinary and needs only pH controls at high-Lime and in recarbonation. These can be discontinued upon normalcy and restored back easily even when similar distress situations come up all of a sudden. Thus, it is the easiest retrofit possible in an existing conventional WTP as is the case in almost all places in India.

3. Treatment Process Evaluated

The existing and unconventional disinfections are in Figs.4 and 5. The high-Lime provides the comprehensive disinfection. It also demonstrates the stripping of NH₃ and precipitates PO₄. The high Lime carbonation route was chosen as this can be incorporated in any existing WTP and the WTP can be brought back to its required status if eutrophication sets later on.

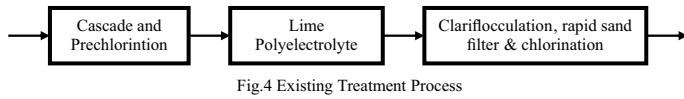


Fig.4 Existing Treatment Process

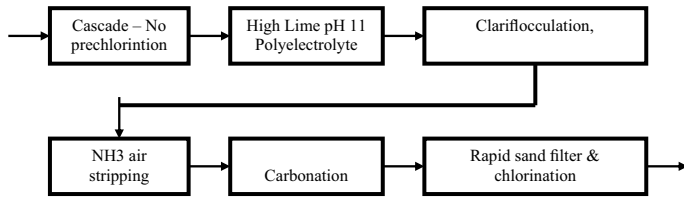


Fig.5 Modified Treatment Process

4. Photo Record of the Retrofit

Some photographic views of the modified process and retrofit of the WTP are



Fig.6 Modified WTP - Clockwise from top left, Cascade aeration, Lime dosing, High lime water clariflocculator with rapid sand filter in the background, CO₂ cylinders, NH₃ stripping sprays and the same tank in far ground dosed with CO₂ at the floor level by tubular diffusers.

The fine misty spraying nozzles of M/S Spraying Systems, USA were the only overseas fixtures but easily imported against Rupee payment. Most important, local contractors were able to erect these without any specialized training and do the O&M. It facilitated retaining multiple small time contractors to get segments of the works executed in tandem and thus fast-track the remedy to the drought stricken town

No.	Parameters	Raw	Final	Standards.	No.	Parameters	Raw	Final	Standards.
1	Appearance	Green		(UO)	14	Manganese as Mn	Nil	Nil	0.05 - 0.5
2	Odour	Algal		(UO)	15	Ammonia as NH ₃	14.96	Nil	Nil
3	Turbidity, NTU	13	1	1 - 10	16	Nitrite as NO ₂	nil	Nil	Nil
4	Tot Dis Solids	730	950	500 - 2000	17	Nitrate as NO ₃	1.7	1.7	45
5	pH	7.30	7.23	6.5 to 9.2	18	Chloride as Cl	145	140	200 - 1000
6	Phe Alk as CaCO ₃	0	0	ND	19	Fluoride as F	0.44	0.21	1.0 - 1.5
7	Tot Alk as CaCO ₃	400	630	200 - 600	20	Sulphate as SO ₄	48	45	200 - 400
8	Hardness as CaCO ₃	290	515	200 - 600	21	Phosphate as PO ₄	5.2	Nil	Nil
9	Calcium as Ca	80	200	75 - 200	22	Silica as SiO ₂	9.86	6.86	6.26
10	Magnesium as Mg	20	3	30 - 150	23	BOD	7	Nil	Nil
11	Sodium as Na	80	80	80	24	COD	48	15	Nil
12	Potassium as K	20	20	20	25	TOC	50.99	1.50	NM
13	Iron as Fe	0.24	Nil	0.1 - 1.0	26	Fecal coli/100 ml	50,000	Nil	Nil

5. Water Quality Improvements after Retrofit

The ammonia stripping was only a maximum of 11 kg / hr and not felt by the operating staff and auxiliary air spraying nozzles interposed between the ammonia spraying nozzles would dilute the stripped ammonia concentrations down to the ambient threshold of 25 ppm.

Table-1
Variation of Surface Raw Water Quality in the Impoundment

NO.	PARAMETERS	PRE-CHLORINATION	HIGH LIME - CARBONATION
1	Colour	Reverses on storage beyond 6 hours	Does not reverse even after a week
2	Odour	Repulsive decaying odour persists	Decaying odour is completely gone
3	Keeping quality	Worsens on storage of even a day	No deterioration even after a week
4	Fecal coliform	50 mg/l as Cl for elimination	200 mg/l as CaO for elimination
5	TDS	No appreciable increase	Increases by about 200 mg/l
6	Phosphate	No change	Is fully eliminated
7	Magnesium	No change	Is almost eliminated
8	Calcium	No change	Increase by about 130 mg/l
9	Handling	Hazardous	Relatively safer
10	Ambience	Disturbing due to chlorine escapes	Pleasant and fresh
11	Byproducts	Possibility of THM and carcinogens	No risk of THM and carcinogen
12	Heavy metals	Cannot be removed	Precipitated as oxides.

6. Relative Advantages over Pre-chlorination

The TDS increase is preventable by two-stage carbonation, first pH of 9 to 9.3 to precipitate Ca and then to neutral pH to precipitate CaCO₃ and Mg (OH)₂ already precipitated at pH of 11. The CaCO₃ has commercial value in industries. Another advantage is the simultaneous metal removals, as in Fig. 7, though not really needed

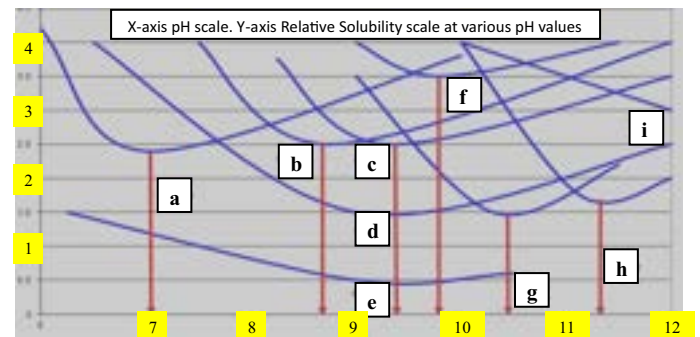


Fig.7. Relative Solubilities of Stated Heavy Metals at Incremented pH of Aqueous Solution.

a - Al(OH)₃; b - Cr(OH)₃; c - Al(OH)₃; d - Cu(OH)₂; e - Fe(OH)₃; f - Pb(OH)₂; g - Ni(OH)₂; h - Cd(OH)₂; i - Ag(OH)

The stated metals precipitate sequentially as hydroxides and do redissolve as only the metals can do so. This is a classical advantage of this high Lime-recarbonation water treatment. In the present case, the presence of these metals was almost non-existent, but then, the relevance to the treatment where metal removals pose problems is to be seen.

7. Public Acceptance

As with such WTP retrofit exercises, the public acceptance is the key as in Fig.8. The convincing of the local elected representative was the key in getting the project accepted by the public by local print media first convinced and they took it upon themselves to spread the message.



Fig. 8 Key Photo Records of HR at Site

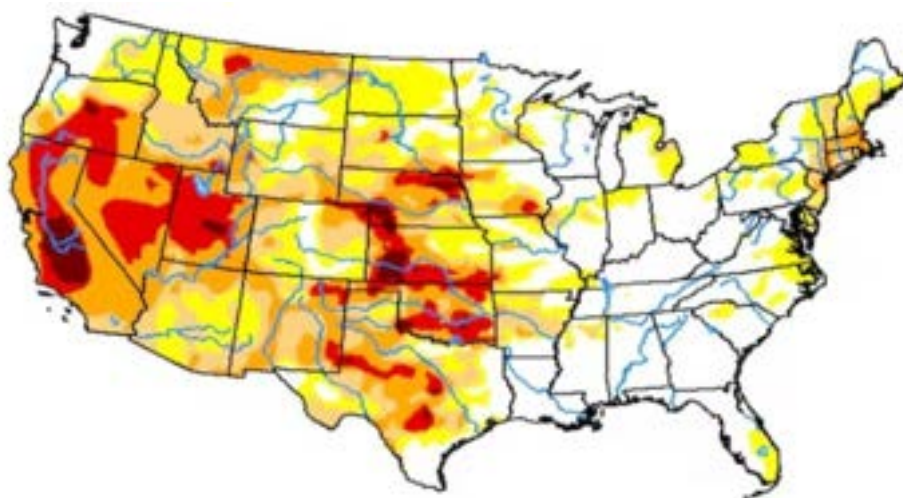
Top Left-officers of M/S TVS and Water Board; Middle-Lead Author, Right-The all in one office, dining, meetings, naps on coir cots under the Banyan Tree for the one month of the project. Bottom-Samples of raw & treated water and the elected representative inspecting the treated water

8. Cost Aspects

As of 2004-2005 the conventional treatment cost was Rs 4 / KI whereas the high Lime carbonation cost was Rs 15 / KI. Though this will be deterrent for the local authority, there was no economical alternative in dealing with this short-term emergency situation.

9. The 2022 Mega Drought of USA and its Pointer to India

With climate change taking its uncertain presence of late, a classical case study is the unprecedented drought impacting the western USA as of this September-2022 as in Fig. 9



Intensity:

-  None
-  D0 Abnormally Dry
-  D1 Moderate Drought
-  D2 Severe Drought
-  D3 Extreme Drought
-  D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>

Author:

David Smeral
Western Regional Climate Center



droughtmonitor.unl.edu

Fig. 9

Source-Water Online Journal, Guest Column, September 22, 2022
<https://theconversation.com/desalinating-seawater-sounds-easy-but-there-are-cheaper-and-more-sustainable-ways-to-meet-peoples-water-needs-184919>

ABOUT THE AUTHOR

Dr S. Sundaramoorthy was the project manager. Dr S Saktheeswaran, D Srinivasan, and T V Rajan were design engineer, electro-mechanical engineer and field chemist.

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It is reported “this drought could last until 2030 and the worst mega drought in 1,200 years and climate change is to blame” (National geographic, Alejandra Borunda, and February-15-2022). The pointer for India is in the case of US it only implies drought but here the pollution as in Hosur compounds the problems. The technology as narrated in this article needs to be grasped in this light and as locally adaptable and brought out.

10. Conclusions

It is said “When sorrows come, they come not single spies, but in battalions” (Shakespeare, Hamlet), Thus after a solid 420 years of that writing, it is now proving in the above drought of USA impacting the very lifestyles. India needs a water mapping and advisory on WTP especially due to significant human faeces generated in India going into the environment at various stages as in the abstract. Procrastination is the bane of progress because challenges which crop up during the progress do not have a ready-reckoner

Acknowledgements

The author is grateful to M/S Srinivasan Services Trust of M/S TVS who funded this retrofit project of unconventional disinfection. We acknowledge the confidence on us by the local authority who gave unstinted support, the local print media and the local elected representative for the trust placed on us. Specific mention has to be made of the District Collector who declared open the retrofit plant and mentioned that never before has so much (the war footing retrofit night and day work in one month at the WTP) been owed by so many (meaning the town population and the industries) to so few (meaning the authors and the team). There is the tale which mimics dedication in wartimes.



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HIDROING DEVELOPS SMART WATER SOLUTIONS FOR 144-YEAR-OLD WATER SUPPLY NETWORK IN ZAGREB, CROATIA: A CASE STUDY

By Sandra DiMatteo, Industry Marketing Director, Water Infrastructure, Bentley Systems



OpenFlows and OpenUtilities save 16 Months when Delivering One of the Largest Digital Twins in Eastern Europe

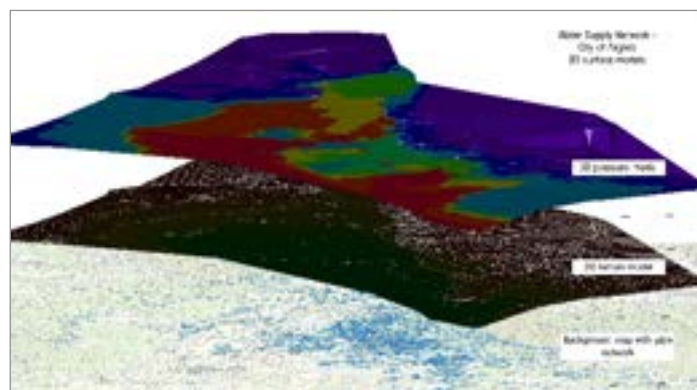
Modernizing One of the World's Oldest Water Supply Systems

Originally constructed in 1878, the 144-year-old Zagreb water supply system is one of the oldest functioning water networks in the world. At that time, the capacity of the constructed system was 53.2 liters per second via a 4-kilometer-long pipeline that provides water to 11,150 of the 30,000 inhabitants in Zagreb, the capital and largest city of Croatia. ViO Zagreb has been responsible for the city's public water supply since its inception, including construction and rehabilitation of the network infrastructure. The organization ensures reliable water distribution to the growing number of residents. To cover water services for now over 900,000 people across 800 square kilometers, the water supply network was expanded, spanning 3,500 kilometers with seven water sources, more than 400 components, and a daily water intake of 310,000 cubic meters.

Over the last two decades, water loss has grown significantly and sharply worsened after the occurrence of earthquakes in 2020. To resolve these losses and modernize the network, ViO Zagreb retained Hidroing to develop a detailed master plan and water loss program, digitalizing the system for optimal water distribution over the next 30 years of operation. "The project was developed to be used as a statistical and reporting tool, [where digital] protocols were developed for direct data analysis in activities of water loss reporting," said Igor Dundović, project manager at Hidroing.

Striving to Optimize Network Operations

The EUR 1 million project required Hidroing to develop a detailed hydraulic model based on an updated GIS model that enabled water loss analysis and detailed diagnosis of the supply system, including modeling of district meter area (DMA) zoning and numerous measurement points. "Our final goal was to



establish a hydraulic model with all GIS data to be used for conceptioneering by ViO Zagreb development sector, and as a digital twin for ViO Zagreb's operational sector," said Dundović.

However, Hidroing faced significant data collection challenges and difficulties measuring flow, pressure, and chlorine levels. To meet the owner's digital expectations, streamlining access to reliable network data and optimizing network operations, they realized that they needed an integrated technology solution to facilitate smart water management.

Bentley Applications Support Digital Twin Solution

After considering their options, Hidroing selected Bentley's OpenFlows and OpenUtilities applications for GIS development, 3D modeling, hydraulic modeling, and on-site operations and facility management. "As a big project with a big database, our company decided to use Bentley products for all tasks," said Dundović. They modeled 3,000 measurement points, 144 DMA zones with individual scenarios and water balance management, and 3,500 kilometers of pipeline, creating and calibrating a hydraulic model. Using Bentley applications, they linked water loss calculation input data, including pipe length, the number of service connections, flow, real water loss, and average pressure. They stored and reported this statistical network data through the GIS platform and transferred it directly to the hydraulic model, providing a single source of truth to extract data based on real-life changes in the system and resolve water loss.

Bentley's hydraulic modeling solution enabled them to combine all network analyses into a digital twin, simulating system operations and more than 150 scenarios, including scenarios for every DMA zone. The established model is one

of the largest digital twin models in Eastern Europe, facilitating smart water solutions.

A Digital Twin Industrializes Network Management

Using Bentley's advanced digital platforms, Hidroing established a digital twin to improve processes and development of the Zagreb water supply system. The integrated modeling and analysis solution enabled real-time processing of input data, eliminating time-consuming manual data manipulation and validation, accelerating model calibration and delivery by 16 months. Using OpenFlows and OpenUtilities, the team delivered a final model and digital twin, pinpointing 50 actions to reduce water loss. "Final delivery time was reduced from an

estimated 36 months to 20 months. This time reduction enabled faster digital twin implementation and an earlier start to the water loss reduction program," said Dundović. The digital twin solution brings direct savings in water loss and minimizes environmental impact by reducing water intake and electricity usage.

Bentley products helped us in reducing [resource] hours, which directly increased the speed of final product implementation and the usage of the hydraulic model for water loss reduction."

*—Igor Dundović,
Project Manager, Hidroing d.o.o.*

PROJECT SUMMARY

Organization: Hidroing d.o.o.

Solution: Water, Wastewater, and Stormwater Networks

Location: Zagreb, Croatia

Project Objectives:

- To combine all network analyses into a digital twin.
- To provide a single source of truth for improved decision-making and optimal water supply operations.

Project Playbook:

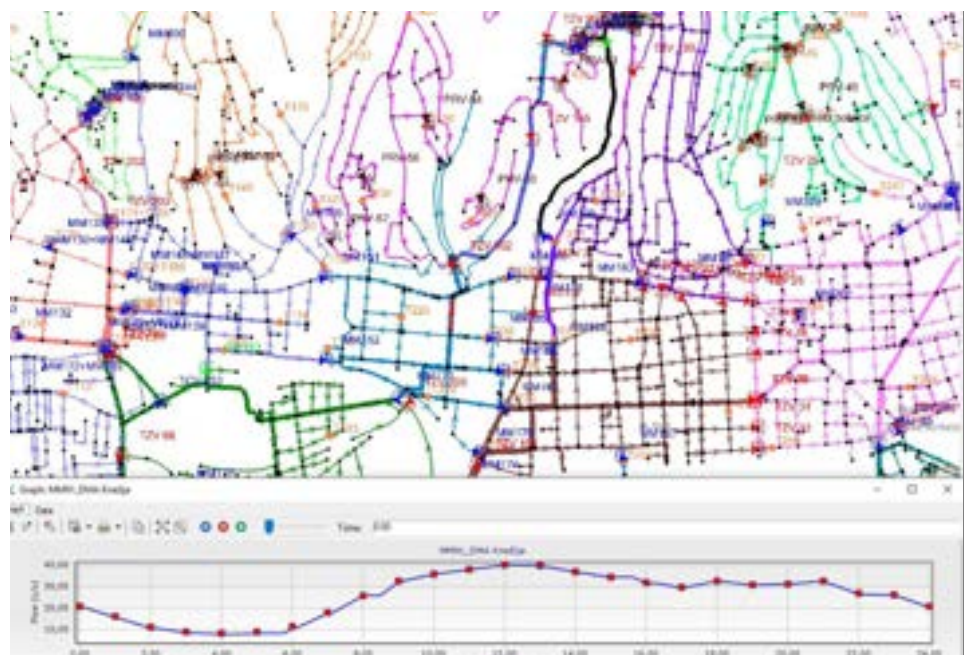
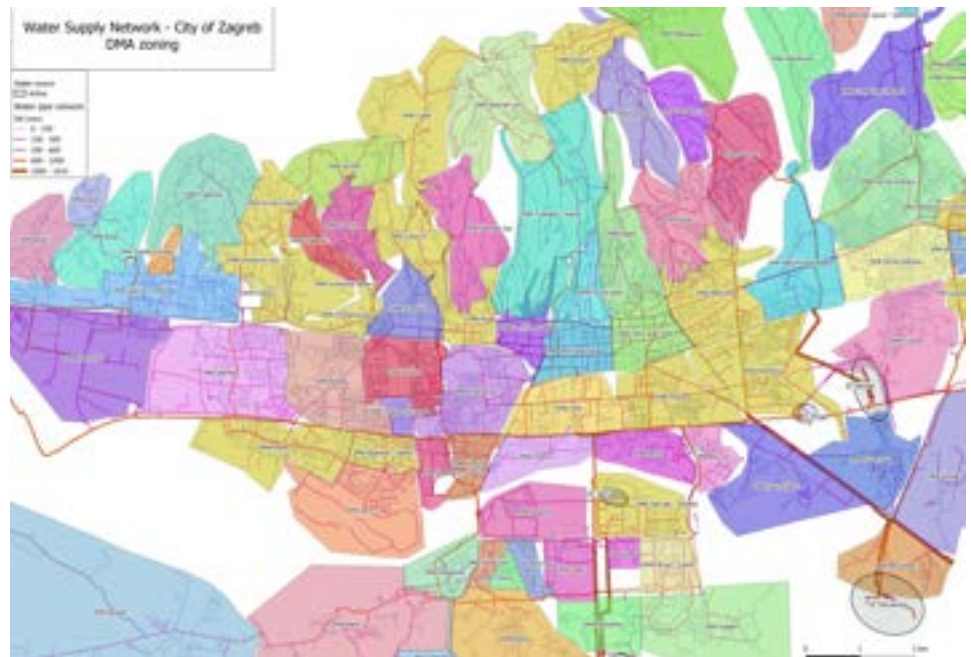
ContextCapture, MicroStation, OpenFlows HAMMER, OpenFlows WaterGEMS, OpenFlows WaterOPS, OpenUtilities

Fast Facts

- Recent earthquakes and significant water loss prompted ViO Zagreb to digitalize their water supply system for better network management.
- Hidroing was retained to develop a master plan and water loss program for the network's next 30 years of operations.
- Hidroing used Bentley applications to combine all network analysis into one of the largest digital twins in Eastern Europe.

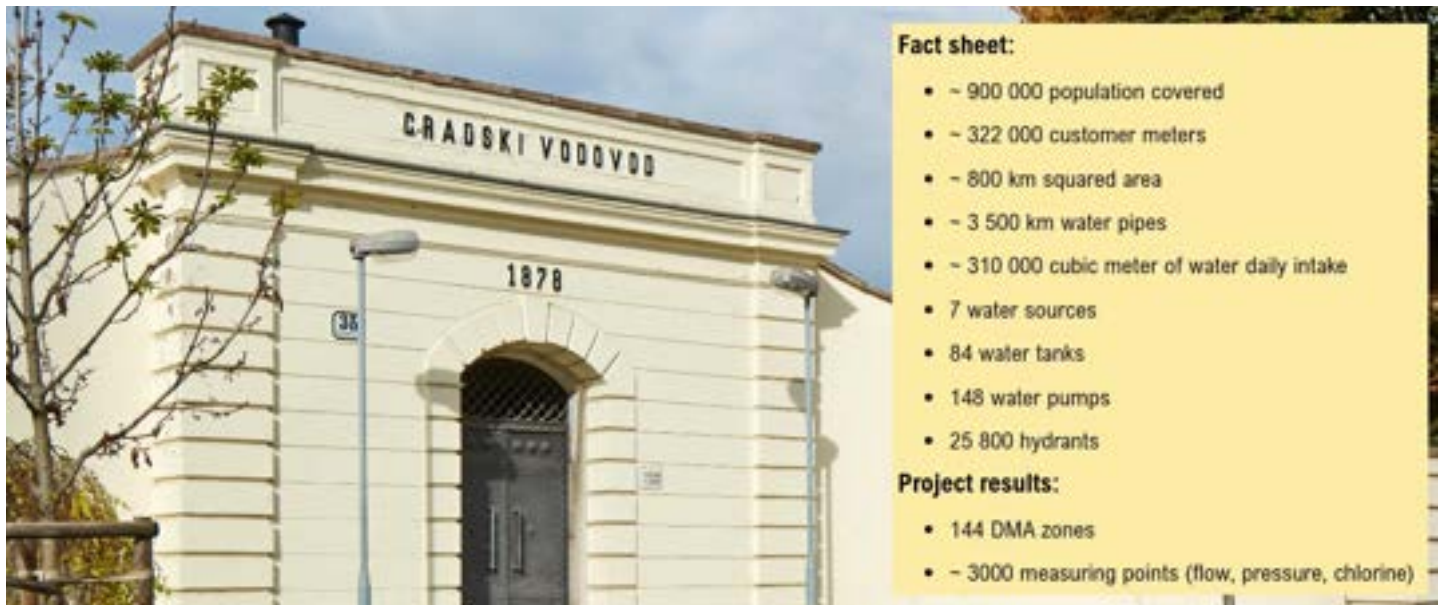
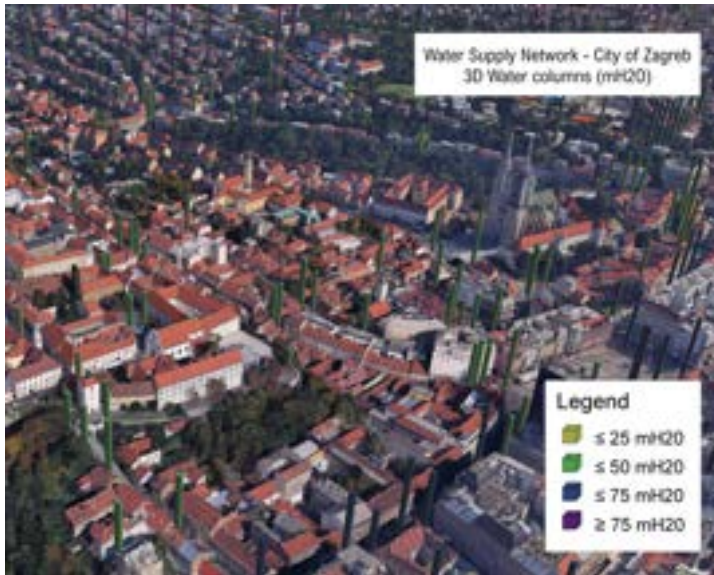
ROI

- Using OpenFlows and OpenUtilities, Hidroing modeled 3,000 measurement points and 3,500 kilometers of piping, creating a calibrated hydraulic model.
- Bentley's applications streamlined data integration between the GIS system and model, saving 16 months while delivering a network digital twin.
- The digital twin facilitates better decision-making and smart management for one of the world's oldest water supply systems.



Given the recent earthquakes and frequent ruptures of the Zagreb water pipes over the last few years, ViO Zagreb recognized the importance of digitalizing their water network and implementing smart water management processes. To meet the owner's technology expectations, Hidroing delivered a digital twin that can be used for ViOZagreb to make more informed decisions regarding their supply system's development, operations, and future planning, industrializing

network management of the capital city's water infrastructure. "After devastating earthquakes during March 2020 in the city of Zagreb, these kinds of projects are even more significant in a way that during development of master plans, water safety and distribution alternatives are now mandatory," said Dundović.



ABOUT THE AUTHOR

Sandra DiMatteo is the Industry Marketing Director, Water Infrastructure at Bentley Systems. She has more than 25 years of experience in reliability and asset performance management software, asset lifecycle information management, and is an expert in digital twin cloud solutions in the water and wastewater, energy and process industries. Sandra holds an honors degree in accounting and is a Certified Reliability Leader. She sits on the Reliability Leadership Institute Board of Advisors and founded the Ontario Chapter of the Society of Maintenance and Reliability Professionals.

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DIGITAL INSIGHTS DELIVER TANGIBLE WATER SAVINGS

By Michael Willer, Director of Water Research, Buckman

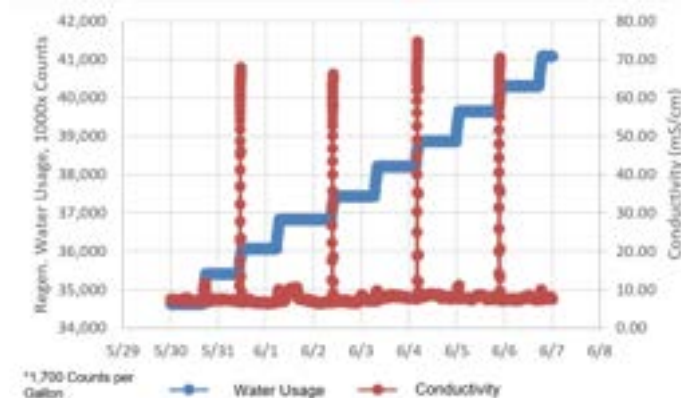
In today's economy, nearly every discussion about the business goals of a particular enterprise will touch on water in some manner. Businesses that consume water for utilities purposes, particularly in the Commercial and Institutional sectors, may be more concerned about water than ever before. Several factors are contributing to this increased attention to water, including corporate sustainability expectations, regulatory restrictions due to drought or conservation efforts, cost of fresh water and disposal, or efficiency initiatives to reuse water and reduce waste. Whatever the reason or combination of reasons, the result is increased attention to water use patterns and pressure to identify opportunities to use less water. At the same time, digital technologies have become pervasive in our world, and the cost has correspondingly decreased to such a point that it is now feasible to monitor potential sources of waste in a light industrial setting. With increased visibility to the water systems, the operational issues that arise in every system are becoming visible and no longer go undetected. The outcome is real insights into the root causes of these issues and recommendations to resolve them, which translates to tangible impact on the business goals of the enterprise.

In this article, a case study is presented in which a water softener was functioning as directed by the operators but with an unseen problem. In fact, if the operators were to be asked about the softener operation, they would have indicated that everything was functioning properly and no intervention was needed. Fortunately, this small chemical manufacturer in the US recently installed Buckman's Ackumen™ Boiler Management system, including a pretreatment monitoring module. It is common in the light industrial market for softeners to be used to pretreat the feedwater in order to remove hardness from the water before entering the boiler. Softeners are also a common source of problems due to maintenance issues, along with the need to keep brine tanks filled with salt. With the other priorities the operators have, the preventive maintenance of their water systems often fall to the wayside until bigger issues arise as a result. The Ackumen Boiler Management system helps fill this gap by monitoring the parameters relevant to proper softener operation and regeneration and alerting the operator only when an issue requires attention.

By monitoring water flow and conductivity during the regeneration cycles (Figure 1), it was readily apparent that the regeneration was occurring daily. Buckman's Remote Services Innovation team observed this pattern and assessed the need in light of the local water chemistry. With a relatively low hardness level in the makeup water, the team determined that the regeneration was happening too frequently. As a result, water and salt were clearly being wasted. In addition, it was observed that the conductivity was not increasing during regeneration of the alternate softener bed (every other day), indicating that it was not introducing sufficient brine. So even with frequent regenerations, the alternate softener bed was not regaining softening capacity. After sharing these findings with the Buckman sales rep and consulting with the customer, two additional consequences were attributed to the frequent regenerations. First, unnecessary load was being directed every day to the onsite wastewater system, thereby increasing the cost of waste treatment. And furthermore, due to the high frequency of brine usage, fines for chloride discharge

were being incurred from the municipality.

As a side note, the Ackumen Boiler Management system highlighted here is also capable of identifying other operational problems. Examples include undercycling the boiler, leading to increased water use and blowdown; regeneration line issues preventing flow of brine to the softener; low or empty brine tank; and other mechanical issues. Each one of these issues alone can result in operational problems of varying magnitude, and most are not immediately apparent when they



happen. Since boilers typically operate continuously, chances are high that problems will happen after hours or when operators are not nearby. The potential for these and other problems exists in every system, and having visibility to the system when they happen and an expert available to respond is extremely important.

For this small chemical manufacturer, a very modest investment in digital technologies, implemented in a system that was not seen as having any problems, delivered multiple benefits and reduced the total cost of operation. In this case, the operator likely set the regeneration frequency to daily just to “be safe” and ensure no hardness entered the boiler in order to prevent scaling and the associated costs. But while that objective was partially achieved, a problem was identified and additional unforeseen costs were introduced as a result of the decision. Without the visibility afforded by Ackumen Boiler Management and the Remote Services Innovation team, the source of these issues and resulting costs would have remained unidentified, and the additional costs of operating in this manner would have continued to multiply.

Implementation of a digital monitoring and control platform with remote visibility is an essential best practice in today's industrial environment. This is true for all of the core industrial water systems, including open cooling systems, closed loops, steam boilers, and reverse osmosis systems. Many decision makers are facing intense pressure to control or reduce operational expenses, which may cause them to make



decisions to forgo investment in such digital monitoring technologies, based on the belief that there will not be a sufficient return in savings to justify the expenditure. However, as the examples in this case study clearly show, the probability of seen and unseen issues occurring in any given water system is high, and these issues invariably lead to an increase in operational expenses. Perhaps most importantly for the light industrial sector, it is also imperative that the remote visibility provided by these platforms be paired with a team of remote water treatment experts who can

identify and respond to the issues observed. In many cases, as in the present case, it does not involve a system alarm. In contrast, the real value comes from a knowledgeable expert proactively identifying operational patterns or data correlations and an ability to understand the consequences. Without these best practices, business owners and operators will forever fall short of their business goals related to water usage, and they will continue to needlessly spend due to operational issues that can be avoided.

ABOUT THE AUTHOR

Michael Willer is the Director of Water R&D at Buckman. He holds a BA in Chemistry from Kalamazoo College, and a PhD in Inorganic Chemistry from Harvard University. He has 22 years of experience in chemical and digital product development in water treatment and cleaning/sanitizing in the industrial sector, including a commercially successful digital IoT platform in the water treatment market.

He was a founding board member of the Alliance for Advanced Sanitation, and has also served as a member of the Household and Commercial Products Association.

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A STUDY ON ENHANCED COAGULATION-DISINFECTION TREATMENTS IN STP EFFLUENTS



By Shital Gandhi, Pushkar Shukla, Vishal Makadia, Hiten Mehta
Aditya Birla Water Application and Product Development Centre, Grasim Industries Limited (Chemical Division), GIDC Vilayat, Tal. Vagra, Dist. Bharuch, Gujarat

Abstract. Looking towards current scenarios, environmental laws have become more stringent towards health, economy & pollution reduction. Sewage contributes 70% of total pollution load to water bodies and is major source of water deterioration. Consumption of polluted water adversely impact human health & aquatic life. Approx. 62000 MLD sewage is generated every year in our country and 920 installed STPs are operating. Due to scarcity of water it has become need of an hour to reuse or recycle wastewater using various treatment approaches. Conventional sewage treatment operations include coagulation, sedimentation, filtration and disinfection. Revised norms for disposing of STP effluent has been introduced by CPCB, New Delhi, 2021 in which standards for fecal coliforms, total suspended solids, total phosphorus, etc. has been modified. Therefore, tertiary treatment has become more critical step for any STP or waste water treatment plants. In the present study Poly Aluminium Chloride (PAC) based coagulant PAC 18 + variant was used as a cost effective & efficient coagulant followed by disinfection using chlorination. Optimum coagulant dose was determined by jar test analysis of 65 mg/l. Sodium hypochlorite, NaOCl was used for disinfection of bacterial load. Turbidity, TSS, TOC, total phosphorus, total nitrogen removal efficiency were 91%, 85%, 68%, 71% and 33 % while total coliform and heterotrophic bacteria removal efficiency under optimum condition was 83% and 91 %, respectively. For optimum dose of coagulant & disinfectant, 5-unit log 99.999% removal of coliforms and 3-unit log 99.9% reduction of heterotrophic bacteria was observed in treated sample as compared to untreated sample.

Keywords: PAC (Polyaluminium chloride), STP (sewage treatment plant), optimum, coagulation, disinfection

1. INTRODUCTION

Coagulation & flocculation (C-F) are important part of any water & wastewater treatment plants [6]. In potable water treatments, clarification of water using coagulants has been widely used since ancient times [2][4]. Use of alum as coagulant is mentioned around 77 AD [6]. In modern wastewater treatment plants, C-F are still essential components in primary treatment. Apart from alum many other polymerized coagulants are used consistently to produce treated water turbidity less than 0.1 NTU to guard against pathogen contamination. Commonly used inorganic coagulants are metal based on aluminum and iron. Aluminum based coagulants includes alum, aluminum chloride, aluminum chlorohydrate, poly aluminum chloride (PAC) and other PAC based variants, sodium aluminate and PAC in combination with organic polymers [2], [4], [5]. Iron based coagulants involves ferric sulphate, ferrous sulphate, ferric chloride, etc. Water Application and Product Development Centre (WAPDC) of Grasim Industries Ltd., Vilayat has successfully produced many waste water treatment products like coagulants for removal of oil, microalgae, colour, paper & pulp, etc. and has provided treatment solutions to many industries of different sectors.

PAC based coagulants have general formula $(Al_n(OH)_mCl_{(3n-m)})_x$ are

prepolymerised inorganic coagulants made by partial hydrolysis of aluminium chloride in controlled conditions. They are superior over alum as they function over wide range of pH and raw water temperature, less sensitive to low water temperature, low doses required as compared to alum, generates less residual Al concentration as compared to alum. Effectiveness of any metal-based coagulants arises principally due to its ability to form multi charged polynuclear complexes with enhanced adsorption characteristics. Nature of complex can be controlled by pH of the system. When PACs are added into water, they rapidly hydrolyze in uncontrolled fashion forming metal hydrolysis species followed by electrostatic - bridging effects and remove colloids either by sweep flocculation or charge neutralization [4], [5]. Moreover, PAC in presence of colloidal particles has rapid aggregation velocity and thus, forms the larger and heavier flocs; and therefore lower dose is required as compared with alum [10], [11]. PAC based variants are designed in such a manner that they are highly specific, best formulation for particular type of wastewater is case specific and needs to determine by jar testing. Factors affecting coagulation operations include: type of coagulant used, coagulant dosage, temperature, sequence of coagulant addition, final pH, type and dosage of flocculent used, intensity and duration of rapid mix stage, flocculation retention time, residual aluminum and sludge handling [5], [10], [12]. The main objective of this experiment is to study the effectiveness of PAC variant, PAC 18 + aided with disinfectant sodium hypochlorite for the removal of coliforms & other microorganisms to meet latest standard prescribed by Central Pollution Control Board (CPCB), New Delhi. Optimum dose of disinfectant was selected on the basis of maintaining free residual chlorine of approx. 1 mg/l in disinfected water to promote primary purpose of chlorination. Physicochemical & biological parameters like pH, turbidity, total dissolved solids (TDS), total suspended solids (TSS), total organic carbon (TOC), total phosphorus, total Kjeldahl nitrogen, total coliforms & total viable counts were determined before and after treatment.

2. Methodology:

2.1. Collection of water sample and experimental set up. In this study approx. 10 litres of wastewater sample was collected from the secondary treatment tank outlet point of STP unit in the premises of Grasim Industries Ltd. GIDC, Dist. Bharuch, and Gujarat. Poly aluminium chloride (PAC) variant PAC 18+ was chosen as coagulant and sodium hypochlorite, NaOCl as disinfectant to study their efficiencies for the removal of different parameters in the entire experiment. Coagulant and disinfectant were tested under three different conditions comparing with untreated sample taken as control. Therefore, four different experiments were conducted simultaneously and complete analysis was performed.

i) Untreated sample (control), ii) Coagulant treated sample, iii) Disinfectant treated sample iv) Coagulant and disinfectant treated sample.

2.2. Physicochemical and bacteriological properties of effluent. Physical parameters like turbidity (NTU), pH, total solids (total dissolved solids, TDS and total

suspended solids, TSS, mg/l), total organic carbon, (TOC, mg/l), total phosphorous(mg/l), total Kjeldahl nitrogen(mg/l), total viable counts(cfu/ml) and total coliforms (most probable number, MPN/100ml) were determined by Standard Methods for Examination of Water and Wastewaters [1].

Percentage removal for each parameter was calculated using formula:

$$\text{Removal (\%)} = \frac{C_i - C_f}{C_i} \times 100$$

Where C_i and C_f are initial and final concentrations for each parameter respectively. Initial parameters of samples were determined immediately on the same day of collection as shown in table 1.

Table-1 Characterization of raw sample

PARAMETERS	RESULT
Turbidity, NTU	57 ± 6
pH	7.8
TDS, mg/l	841 ± 3
TSS, mg/l	51 ± 2
TOC, mg/l	38 ± 3
Total Phosphorus, mg/l	14 ± 5
Total Kjeldahl Nitrogen, mg/l	27.5
Total Coliforms, mpn/100ml	54000
Total Viable Counts, cfu/ml after 24 hrs	4 x 10 ⁵
Total Viable Counts, cfu/ml after 48 hrs	5 x 10 ⁵

2.3. Preparation of coagulant & determination of optimum coagulant dose.

Coagulant PAC 18+ used in the study was available in liquid form. 1% solution of PAC 18+ was prepared and used as stock solution throughout the experiment. Coagulation-flocculation was carried out taking 200 ml sample in jar test apparatus (VELP- Scientifica, model: JLT4, Italy) in 500 ml beakers. The experiment was started by determining optimum pH ranges between 5.0 – 7.0. The sample was stirred at constant speed of 200 rpm for 1 minute along with addition of coagulant followed by slow stirring at 30 rpm for 15 minutes allowing flocs formation. Sedimentation time of 20 minutes was fixed for experiment (table.2). Coagulant was added in dosage varying from nil to 100 mg/l.

Table-2 Jar test parameters

STAGE	PROCESS	SPEED (rpm)	TIME(min)
1	Rapid mixing	200	1
2	Slow mixing (Flocculation)	30	15
3	Sedimentation	0	20

After settling, turbidity (NTU) was measured for each doses using HACH turbidimeter. Optimum dose was selected based on 90% reduction of initial turbidity of raw sample. Supernatant was withdrawn slowly from 2 cm below the surface using micropipette and sample was collected in screw capped clean plastic tubes for further analysis of all parameters.

2.4. Disinfectant dosing and determination of chlorine demand. Disinfection of untreated and coagulated sample was carried out by different doses of sodium hypochlorite ranging from nil to 5 mg/l. Disinfected samples were kept in dark with fixed contact time of 30 minutes. Residual chlorine was determined using standard method in terms of chlorine demand [1]. Optimum dose of chlorination was selected on the basis of maintaining free residual chlorine of minimum 1 mg/l in disinfected water. Chlorine demand was calculated using residual chlorine values.

Total residual chlorine – Free residual chlorine= Combined residual chlorine 2.5.

2.5 Enumeration of total viable count and total coliforms. After disinfection, total viable count of all samples were performed immediately to determine amount of heterotrophic bacteria present in sample. Serial dilutions of samples were made in pre-sterilised test tubes containing distilled water. From each dilution, 0.1 ml of aliquot was spread on respective pre-sterilised nutrient agar plates. Plates were further incubated at 37°C in BOD incubator for 24-48 hrs. Visible colonies were counted after incubation. Agar plates showing 30-300 colonies were selected for viable counts [1]. Colony forming units (cfu/ml) was calculated using formula:

$$\text{cfu/ml: no. of colonies} \times \text{dilution factor} / \text{aliquot vol. (ml)}$$

MPN test was also performed simultaneously of all the samples for determination of total coliforms using standard method. Each sample was inoculated in MacConkey's Broth in different dilutions followed by incubation at 37°C for 48 hrs. Turbidity, acid & gas production was observed due to lactose fermentation. Positive tubes from presumptive test of all samples were inoculated on Brilliant Green Bile Broth (BGLB) tubes and also streaked on Eosin Methylene Blue (EMB) agar plates for confirmatory and completed test of faecal coliforms. BGLB tubes showing turbidity were counted and superficial colony characteristics were studied on EMB agar plates by visual examination. Total coliforms were calculated from reference MPN table as given in standard method [1].

3. Result and discussion:

3.1. Efficiency of PAC 18+ as a coagulant. Analysis of sample with coagulant PAC 18+ was done with different doses using jar test and 65 mg/l was found to be optimum dose showing 90% reduction of initial turbidity. Characteristics features of chosen coagulant PAC18+ are shown in table 3.e

Table: 3. Characteristics of PAC 18 +

CHARACTERISTICS	OBSERVATION
Appearance	Pale yellow liquid
Al ₂ O ₃ (%)	17.04
Relative Basicity (%)	45.82
Chloride (%)	21.35
pH (5%)	3.88
Charge density(µeq/kg)	1296
Specific gravity	1.38

Dose optimization was done using jar test experiments. Dose showing minimum turbidity was selected as optimum dose. 65 mg/l of PAC 18+ was sufficient to remove turbidity up to 91% as shown in fig.1 (a.b). Further increase in dosage tends to increase turbidity. Over dose of coagulant leads to charge reversal and particles start restabilising. Higher than the optimum dose of coagulant thus results in less turbidity removal. [13].

Table 4. Dose optimization of PAC 18+

DOSE (ppm)	TURBIDITY (NTU)	REMOVAL EFFICIENCY (%)
60	6.18	89.16
65	5.02	91.19
70	5.15	90.96
75	5.5	90.35

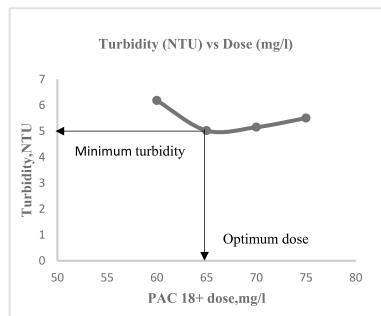


Fig.1 (a) Determination of optimum dose

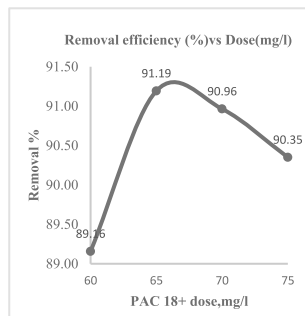


Fig.1 (b) Removal efficiency

3.2. Efficiency of Sodium hypochlorite as a disinfectant. Sodium hypochlorite, NaOCl was used in varying dosage in coagulated and uncoagulated sample. 3.5mg/l was selected as optimum dose giving free residual of 0.99mg/l generating chlorine demand of 2.8 mg/l (table 5, fig.2). Dose was effective to kill more than 90% of bacterial load including pathogens indicating that chlorine demand is satisfied. It constitutes an important safeguard against the risk of subsequent microbial contamination after treatment.

Dose of Chlorine(mg/l)	Free residual chlorine(mg/l)	Chlorine demand(mg/l)
3	0.28	2.72
3.5	0.99	2.80
4	1.27	3.10

Table 5. Determination of chlorine demand

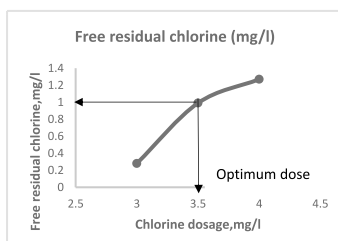


Fig.2 Determination of optimum chlorine dose

3.3. Comparative analysis of all physicochemical and biological parameters under different conditions. All physicochemical and biological parameters were analysed in treated and untreated sample shown in table 6.

Table 6. Comparative analysis of four different samples (Result: mean $\pm$ SD, n= 4)

No.	Parameters	Untreated	Disinfected treated	Coagulant treated	Coagulant + Disinfectant treated
1	Turbidity(NTU)	57 $\pm$ 6	56 $\pm$ 6	5 $\pm$ 1	6 $\pm$ 1
2	pH	7.8	7.82	7.52	7.56
3	TDS(ppm)	841 $\pm$ 3	840 $\pm$ 3	840 $\pm$ 1	842 $\pm$ 2
4	TSS(ppm)	51 $\pm$ 2	50 $\pm$ 1	9 $\pm$ 1	7 $\pm$ 1
5	TOC(ppm)	38 $\pm$ 3	33 $\pm$ 7	12 $\pm$ 1	11 $\pm$ 2
6	Total Phosphorus (ppm)	14 $\pm$ 5	12 $\pm$ 5	6 $\pm$ 3	4 $\pm$ 1
7	Total Kjeldahl Nitrogen(ppm)	27.5	25.5	18.5	22
8	Total Coliforms(mpn/100ml)	54000	4.5	4900	<1.8
9	Total Viable Counts(cfu/ml) after 24 hrs	4 $\times$ 10 ⁵	0.02 $\times$ 10 ⁵	0.6 $\times$ 10 ⁵	10 ²
10	Total Viable Counts(cfu/ml) after 48 hrs	5 $\times$ 10 ⁵	0.02 $\times$ 10 ⁵	0.6 $\times$ 10 ⁵	0.1 $\times$ 10 ³

3.3.1. Effect of coagulant on removal of total solids and total organic carbon. TSS was removed in 85% to 87 % range in coagulated water while there was no major difference in TDS removal (fig. 3 a,b and d). The reason may be PAC 18+ is polymeric in nature upon hydrolysis it imparts dissolved solids in terms of chlorides. TSS removal by PAC+ is within the prescribed limits as revised standards norms below 20 mg/l. Naturally, suspended particles are not easily sedimented by conventional settling therefore addition of coagulants combine these particles into formation of large particles and enhance the destabilization of dispersed particles making more dense flocs improving the settling capability [8], [12]. TOC represents

total organic carbon of system including DOM (dissolved organic matter) [12]. Addition of PAC consumes alkalinity generating slight acidic conditions (slight low pH in treated water) shows higher affinity for coagulation of organic carbon also favouring phosphorus removal. TOC was removed from 68% to 71% in coagulated as compared to uncoagulated water (fig. 3 c).

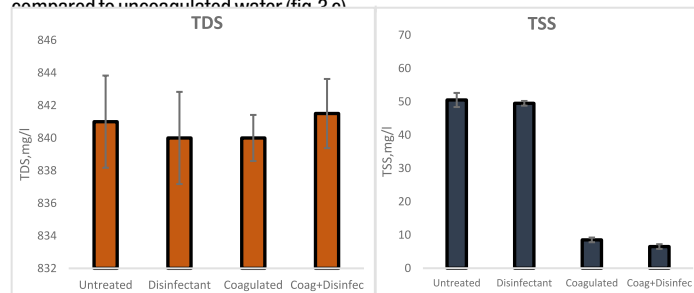


Fig.3(a) TDS at optimum dose of PAC 18 +

Fig.3(b) TSS at optimum dose of PAC 18 +

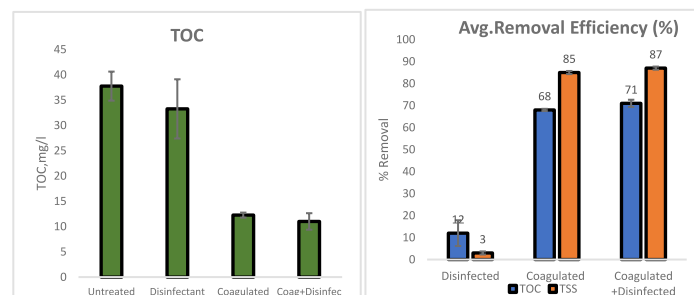


Fig.3 (c) TOC at optimum dose of PAC 18 +

Fig.3 (d) Removal efficiency of TOC and TSS

3.3.2. Effect of removal of phosphorus and nitrogen. The presence of phosphorus and nitrogen in the wastewater should be limited. Phosphorous can cause eutrophication of surface waters and nitrogen can reduce the levels of dissolved oxygen in water, stimulate algae growth, reduce the efficiency of disinfection (with chlorine) or affect the quality of the water for re-use [5]. Total phosphorus was removed by 57 % to 71% and total nitrogen was removed by 37 % to 62 % in coagulated water (fig. 4 a,b). Removal of phosphorus occurs by precipitation followed by adsorption on floc surface [12]. There occur interactions between metal (Al) and phosphorus at specific pH, where phosphorous gets precipitated as metal-phosphates [12].

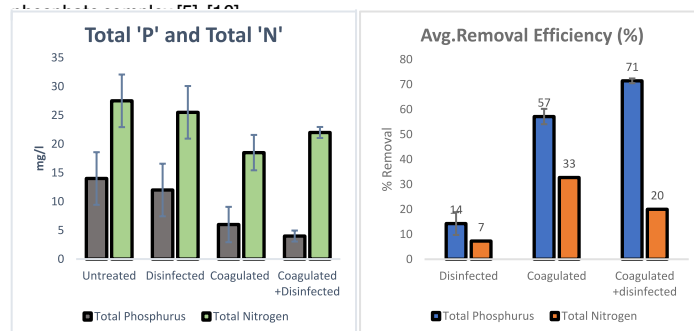


Fig.4 (a) 'P' and 'N' at optimum dose of PAC 18+

Fig.4(b) Removal efficiency of 'P' and 'N'

3.3.3. Effect of coagulant on removal of bacterial load. Bacterial load was determined in terms of total viable count. Heterotrophic bacteria present in the effluent was dosed with 3.5ppm NaOCl with 30 mins contact time & viable count was performed immediately. One-unit log reduction was found in coagulant treated water and three-unit log reduction was found in coagulated + disinfectant water as

compared to untreated sample (table 7, fig. 5 a). More than 99% removal of bacteria was observed when sample was coagulated + disinfected (fig. 5 b, c). Endogenous organisms were sensitive for both residual & combined chlorine. PAC 18 + coagulant destabilizes microbial particles by neutralizing (opposite charge attraction) or reducing their surface electric charge by trapping them in floc particle or creating bridges between them and allows particle to come in contact with one another. Chlorine based disinfectants act as oxidizing agents which oxidize proteins and nucleic acids in bacteria and kills them [9]. Moreover chlorine was less effective in killing Bacilli spp. as growth of Bacilli spp. was observed on Nutrient agar plates in presence of disinfectant. Resistant of Bacilli spp. against disinfection can be due to spore formation [9].

No.	Sample	CFU/ml after 24 hrs	CFU/ml after 48 hrs.	% Removal	Unit- log reduction
1	Untreated	4×10^5	56 ± 6	5 ± 1	6 ± 1
2	Coagulated	6×10^4	7.82	7.52	7.56
3	Disinfected	2×10^3	840 ± 3	840 ± 1	842 ± 2
4	Coagulated + disinfected	10^2	50 ± 1	9 ± 1	7 ± 1

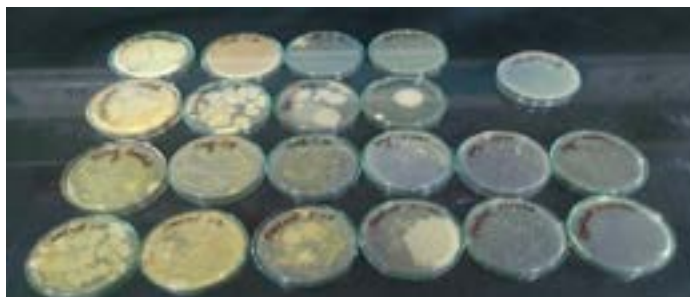


Fig.5(a) agar plates showing total viable

Nutrient showing counts

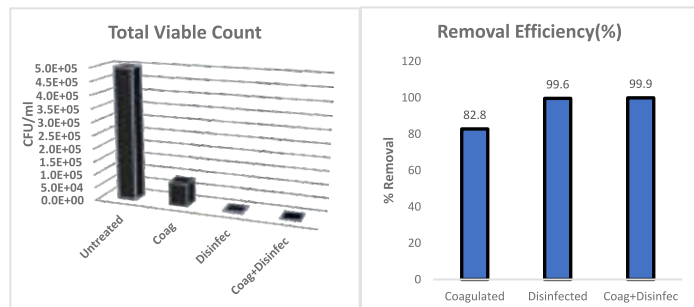


Fig.5 (b) Total viable count

Fig.5(c) Removal efficiency (%)

3.3.4 Effect of coagulant on removal of coliforms.

Total coliforms were removed by 91% when treated with PAC 18+ & were removed to 99.999 % when treated with PAC 18+ & NaOCl (table 9, fig. 6 a, b). Disinfection efficiency can be increased either by decreasing pH to 7 or increasing contact time. Above pH 8, HOCl dissociates to H^+ & OCl^- . HOCl is 100 times more effective than OCl^- and it is stable is pH is <8 [7], [9]. MPN test observations of different samples are shown in table 8. As evidenced from fig. 8 (a and b), colonies having greenish metallic sheen were observed on EMB agar plates which is absent in disinfected and

Table.9 Results of total coliforms at optimised PAC 18+ and chlorine dose.

No.	Sample	Result (MPN/100ml after 48 hrs.)	% Removal
1	Untreated	54000	0
2	Coagulant treated	4900	90.92
3	Disinfectant treated	4.5	99.99
4	Coagulant + Disinfectant treated	<1.8	99.999

coagulated + disinfected EMB plates (fig. 8 c) suggesting removal of fecal coliforms in treated sample. Though NaOCl was found to be effective in removing total & fecal coliforms (fig. 7 d) but less effective on inactivation of Gram positive bacteria, non-lactose fermenting pinkish colonies as observed from EMB agar plates (fig. 8 (c)). This can be attributed due to formation of resistant spores by Gram positive Bacilli spp. [9].

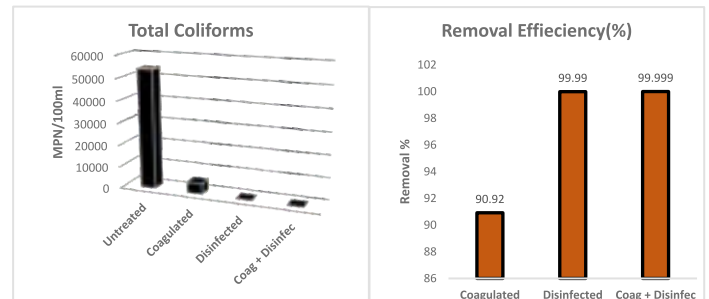


Fig.6(a) Total coliforms

Fig.6(b) Removal efficiency (%)

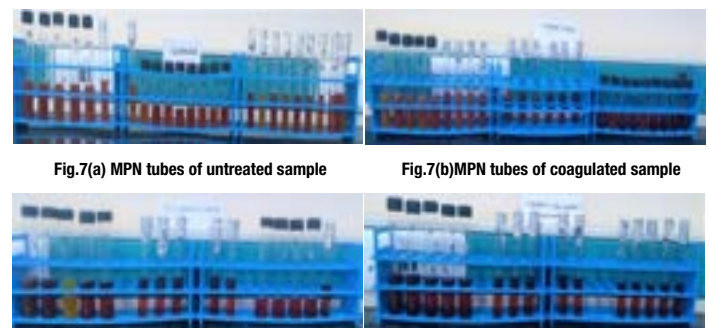


Fig.7(a) MPN tubes of untreated sample

Fig.7(b) MPN tubes of coagulated sample



Fig.7 (c) MPN tubes of disinfected sample

Fig.7 (d) MPN tubes of coag + disinfect sample

Fig. 7 MPN/100 ml presumptive test observations

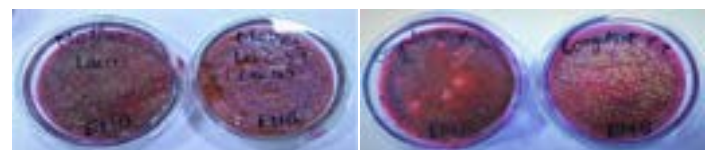


Fig.8 (a) Untreated sample on EMB plates

Fig.8 (b) Coagulated sample on EMB plates

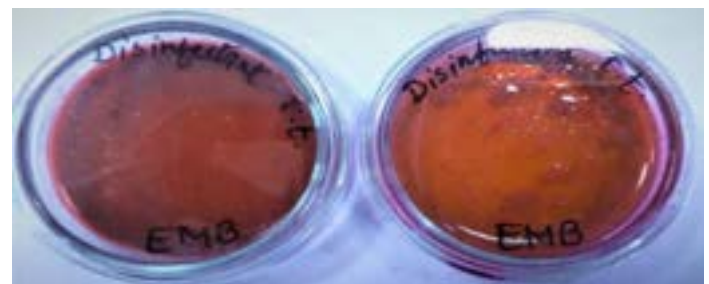


Fig.8 (c) Disinfected sample on EMB plates

Fig.8 (d) MPN/100 ml confirmatory test observations

4. Conclusion:

Present experimental studies on treatment of STP effluent using PAC variant, PAC 18+ shown good reduction of various parameters. It was also noted that selection of appropriate dose of coagulant and disinfectant also plays a major role in removal of parameters like TSS, phosphorus, bacteria, etc. From current study it was observed that the optimum dose of PAC 18+ was 65 mg/L wastewater. At optimum

dose of coagulant, TSS was reduced by 80%, TOC by 70%, Total 'P' and 'N' by 71% and 33% respectively. Disinfected + coagulated sample killed microorganisms by 99.99%. PAC has relatively higher cationic charge as compared with alum due to its polymeric nature showing enhanced surface activity and improved charge neutralizing capacity making them more effective at a comparatively lower dose than alum. Chlorine is potent oxidiser oxidizing vital molecules of microorganisms and kills them. Thus, it was revealed by series of studies that coagulation by PAC18+ along with chlorine works quite effectively in a synergistic manner in removal of coliforms and heterotrophic bacteria as compared to using only coagulant or only disinfectant in STP effluents. The treated wastewater quality followed latest guidelines by NGT, New Delhi, 2019.

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RECLASSIFIED GRAM-NEGATIVE PATHOGENS – FUTURE WORRIES FOR THE PHARMA INDUSTRY

As mentioned earlier most of these happen to be opportunistic gram-negative bacteria and many of them are recent classifications of potent future pathogens. They are not easily removed by conventional water treatment processes. Ozonation appears to me the only alternative. They all seem to require higher ozone doses and more than the normal contact time. Selected few were listed last month. Here with some more

1) *Aeromonas salmonicida* Gram Negative In the past, *Aeromonas* species were placed alongside *Vibrio* species and *Plesiomonas shigelloides* in the family *Vibrionaceae*. The major route of contamination is poor water quality. The bacterium's optimal growth temperature is between 22 and 25°C. The maximum temperature that it can grow at is 34.5°C. It is widely distributed in aquatic environments since their genus is made up of psychrophiles and mesophiles from soil and aquatic environments. *Aeromonas* species have the inherent capability to grow in water distribution systems, especially in biofilms, where they may be resistant to chlorination

2) *Acinetobacter ursingii* & *Acinetobacter lowffii* The species belonging to the *Acinetobacter* genus are widely distributed in nature since they are found frequently in soil, water, and dry environments. Due to their ability for long-term survival on inanimate surfaces, they are commonly isolated from the hospital environment. Since they are regularly recovered from urinary tract, their presence in water could be contamination through sewage or soil

10) *Roseomonas gilardii* Gram Negative The natural reservoir for *Roseomonas* infection is unknown although it has been isolated from water supplies. It may also exist as a commensal in humans. Not much has been reported about the disinfection of these species. We have studied the information, including the likely source, the habitat that would provide us some idea on ozone's effects on them. Not many studies have been reported on the effects of Chlorine/ozone on these bacteria.

Our inference will be based on the species and its susceptibility on ozone and its actions. Our Inference:

- 1) Most of them /all are Gram Negative
- 2) Many of them were previously classified as *Pseudomonas* species but now reclassified
- 3) Most of them find their way into water through soil contamination/sewage contamination
- 4) Most of them hide behind bio-fouling material to escape disinfectant action

- 5) All *Pseudomonas* species are chlorine resistant
- 6) All are opportunistic bacteria
- 7) All are causative organisms of hospital infection.

Likely ozone actions on these bacteria

Construction of Bacteria

Bacteria are microscopically small single-cell creatures and take up foodstuffs and release metabolic products, and multiply by division. The bacteria body is sealed by a relatively solid cell membrane. Their vital processes are controlled by a complex enzymatic system. Action of ozone on Bacteria. Ozone interferes with the metabolism of bacterium cells, most likely through inhibiting and blocking the operation of the enzymatic control system. A sufficient amount of ozone breaks through the cell membrane, and this leads to the destruction of the bacteria.

Gram Negative Bacteria are more susceptible to ozone than gram positive organisms. In Gram negative organisms, fatty acid alkyl chains and helical lipoproteins are present. In acid-fast bacteria, such as *Mycobacterium tuberculosis*, one third to one half of the capsule is formed of complex lipids and glycolipids. The high lipid content of the cell walls of these bacteria may explain their sensitivity, and eventual demise, subsequent to ozone exposure.

Ozone may also penetrate the cellular envelope, directly affecting cytoplasmic integrity, disrupting any one of numerous levels of its metabolic complexities. Solutions to Obtain pathogen free water

The inference ozone is a good solution for eradicating these bacteria

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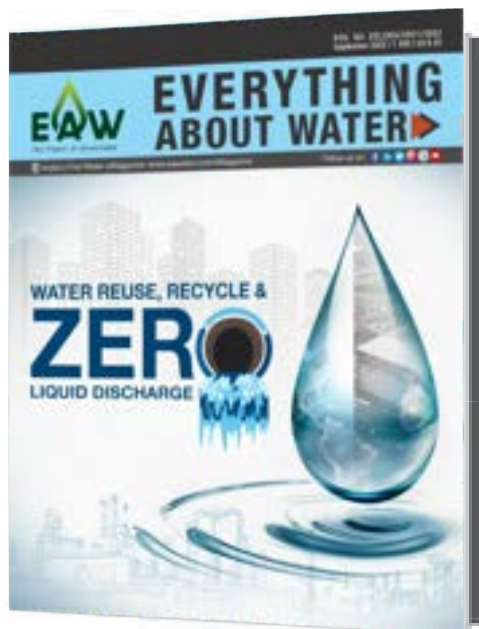
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FAMOUS QUOTES ON WATER

Water is the necessity of life. 70 percent of all humans is water. We are surrounded by it and thus, famous words have been said about it. Here are 15 Famous Quotes on Water, some are thought provoking and some are funny, just like the various forms of water.



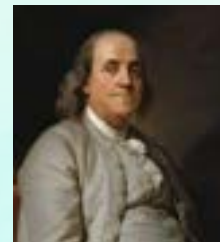
▶ **"In rivers, the water that you touch is the last of what has passed and the first of that which comes; so with present time."**
– Leonardo da Vinci

"Be like water making its way through cracks. Do not be assertive but adjust to the object and you shall find a way around or through it."
– Bruce Lee



▶ **"Where the waters do agree, it is quite wonderful the relief they give."**
– Jane Austen

"When the well's dry, we know the worth of water."
– Benjamin Franklin



▶ **"The earth, the air, the land, and the water are not an inheritance from our forefathers but on loan from our children. So we have to handover to them at least as it was handed over to us."**
– Gandhi

"Iron rusts from disuse; water loses its purity from stagnation... even so does inaction sap the vigor of the mind."
– Leonardo da Vinci

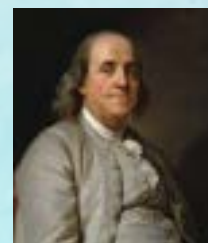


▶ **"To have faith is to trust yourself to the water. When you swim you don't grab hold of the water, because if you do you will sink and drown. Instead you relax, and float."**
– Alan Watts



▶ **"Thousands have lived without love, not one without water."**
– W. H. Auden

"In wine there is wisdom, in beer there is freedom, in water there is bacteria."
– Benjamin Franklin



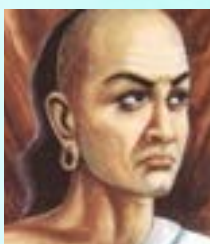
▶ **"If there is magic on this planet, it is contained in water."**
– Loren Eiseley

"There are only three things women needs in life: food, water, and compliments."
– Chris Rock



▶ **"You don't drown by falling into water. You only drown if you stay there."**
– Zig Ziglar

**"Rivers, ponds, lakes and streams - they all have different names, but they all contain water.
Just as religions do - they all contain truths."**
– Muhammad Ali



▶ **"O wise man! Give your wealth only to the worthy and never to others. The water of the sea received by the clouds is always sweet. "**
– Chanakya

TENDERS

OWNERSHIP:

Authority : Haryana Government
Name : Executive Engineer, M.C. Rohtak
Address : Executive Engineer, M.C. Rohtak
City : Chittoor
Location : Rohtak | Haryana | India
Bid Open Date : 26 Oct 2022
Doc Collection Date : 26 Oct 2022
Competition: Domestic Competitive Bidding
FTID : 22101925430
 Consultancy Of Solid Waste Treatment Plant Rohtak (To Extend Renewal Of Environment Clearance, Extension/ Renewal Of Consent To Operate Under Water And Air Act From The Concerned Deptt. Etc.)

OWNERSHIP:

Authority : Public Works Department
Name : Executive Engineer
Address : O/O The Executive Engineer Dws Division Udaipur Pincode 380001
Location : South Tripura | Tripura | India
Bid Open Date : 19 Nov 2022
Tender Value : ₹ 3.01 Crore
Doc Collection Date : 19 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019225020
 Kbn Under Cnstrn Of 0.65 Mgd Wtp In/C Allied Works S.H. 1.00 Lac Gallon Cap Rcc Oht Of 18.30 Mtr. Staging Height Along With Prvdng, Laying Of Clear Water Rising Main From Treatment Plant To The Oht, Testing Etc. Cmplt Under Jm Drng The Yr 22-23.

OWNERSHIP:

Authority : Public Health Engineering
Name : Xen
Address : Nowshera
Location : Rajouri | Jammu & Kashmir | India
Bid Open Date : 25 Oct 2022
Tender Value : ₹32.00 Lac
Doc Collection Date : 25 Oct 2022
Competition : Domestic Competitive Bidding
FTID : 221019228370
 Design, Provision And Construction Of 5000 Glns Per Hour Capacity Rapid Sand Water Treatment Plant Along With Pre Settling Tank Complete In All Respects And Trial Run For A Period Of 12 Months On

Right Side Of Nallah At Kali Dub Under Wss Droon (Langu)

OWNERSHIP:

Authority : Directorate Of Municipal Administration
Name : Chief Officer Karjat Municipal Council
Address : Karjat Municipal Council
Location : Raigad | Maharashtra | India
Bid Open Date : 04 Nov 2022
Tender Value : ₹ 81.56 Lac
Doc Collection Date : 04 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019250700
 Providing Manpower For Operation And Maintenance Of Head Works, Raw Water Pumping Station At Wanjarwadi And Water Treatment Plant At Dahivali.

OWNERSHIP:

Authority : Nagpur Metropolitan Region Development Authority
Name : Superintending Engineer, Nmrda
Address : The Office Of Superintending Engineer (Nmrda), Station Road, Sadar, Nagpur
Location : Nagpur | Maharashtra | India
Bid Open Date : 02 Nov 2022
Tender Value : ₹ 2.45 Crore
Doc Collection Date : 02 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019251420
 Providing Fixing Laying Installation Commissioning Works Of Fire Fighting Electrical Works, Sewer Line, Storm Water Drains, Water Pipe Line, Painting And Sewage Treatment Plant Works At Shantivan Chicholi Under Govt. Grant. liird Call

OWNERSHIP:

Authority :
Name : Chief Manager Admin
Address : Aigga Bhopal
Location : Bhopal | Madhya Pradesh | India
Bid Open Date : 02 Nov 2022
Doc Collection Date : 02 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019258720
 Maintenance Of Stp Sewage Treatment Plant

OWNERSHIP:

Authority : Karnataka State Tourism

Development Corporation
Address : Pincode 560001
City : Bangalore
Location : Bangalore | Karnataka | India
Bid Open Date : 14 Nov 2022
Doc Collection Date : 10 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019426620
 Tender For Operation And Maintenance Of Sewage Treatment Plant Installed At Nkkgh

OWNERSHIP:

Authority : Directorate Of Municipal Administration
Address : Pincode 581118
City : Savanur
Location : Savanur | Karnataka | India
Bid Open Date : 02 Nov 2022
Tender Value : ₹ 26.73 Lac
Doc Collection Date : 02 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019429840
 Providing The Man Services For Suranagi Water Treatment Plant, Jackwell Mevundi And Town Water Supply At Laxmeshwar On Outsource Basis

OWNERSHIP:

Authority : Indian Oil Corporation Limited
Address : Regional Contract Cell, Indian Oil Corporation Ltd(Md), 9 Th Floor Central Wing, Indian Oil Bhavan, Gariahat Road (South), Kolkata-700068, Pincode 732141
City : Englishbazar
Location : Englishbazar | West Bengal | India
Bid Open Date : 05 Nov 2022
Tender Value : ₹ 1.35 Crore
Doc Collection Date : 04 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 221019472610
 Design And Construction Of Shed Along With Effluent Treatment Plant And Pmcc Room For In-House Statutory Testing And Painting Cum Re Painting Unit At Indane Bottling Plant, Malda

OWNERSHIP:

Authority : Zilla Parishad
Address : Debkundu Gp Office, Pincode 742133

City : Murshidabad
Location : Murshidabad | West Bengal | India
Bid Open Date : 09 Nov 2022
Tender Value : ₹ 14.52 Lac
Doc Collection Date : 04 Nov 2022
Competition : Domestic Competitive Bidding
FTID : 2210194108740
 Water Treatment Plant At Hareknagar Dighipara Sansad No Xviii JI No 52 Under Debkundu Gp

OWNERSHIP:

Authority : Kandla Port Trust
Address : The Chief Executive Officer, Watco Ground Floor, Unnati Bhawan, H.B. Colony, Satyanagar, Bhubaneswar-751007, Odisha, India (0674) 2391444, Pincode 751001
City : Bhubaneswar
Location : Bhubaneswar | Orissa | India
Bid Open Date : 07 Dec 2022
Tender Value : ₹ 312.00 Crores
Doc Collection Date : 01 Dec 2022
Competition : Domestic Competitive Bidding
FTID : 2210194146540
 Construction Of 130mld Water Treatment Plant And Its Ancillary Structures For Improvement Of Water Supply To Bhubaneswar City On Engineering, Procurement And Construction (Epc) Contract Including Operation And Maintenance For A Period Of Five Years





Government of India
Ministry of Jal Shakti
Department of Water Resources,
River Development and Ganga Rejuvenation



7th INDIA WATER WEEK

Theme: Water Security for Sustainable Development with Equity

1 - 5 NOVEMBER 2022

Venue: India Expo Centre, Greater Noida

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India Water Week Secretariat, National Water Development Agency

Room No. 212, Second Floor, Palika Bhawan, Sector - 13, RK Puram, New Delhi-110066

Ph.: +91-11-24121759, 24122379, 24195734, **Email:** connect@indiawaterweek.in

Exhibition

India Expo Mart Ltd, Greater Noida

Email: exhibition1@indiaexpocentre.com | exhibition2@indiaexpocentre.com

Reach us at:



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www.indiawaterweek.in



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@indiawaterweek



EVENT CALENDAR



OCTOBER 2022

Pak Water & Energy Expo

Tue, 04 - Thu, 06 Oct 2022
Karachi, Pakistan
<https://pakwaterexpo.com/>

IGAD Water Forum

Tue, 25 - Thu, 27 Oct 2022
Entebbe, Uganda
<https://adibs.ae/>

Water Bangladesh International Expo

Thu, 13 - Sat, 15 Oct 2022
Dhaka, Bangladesh
<https://www.bangladeshwaterexpo.biz/>

IE expo China

19 October to 21 October
Shanghai New International Expo Centre (SNIEC)
China
<https://www.ie-expo.com/>

Pump and Valves Indonesia

19 October to 21 October
Jakarta International Expo, Kemayoran
Indonesia
<https://www.pump-valve-indonesia.net/>

LaoWater 2022

20 October to 22 October
National Convention Centre, Vientiane
Lao People's Democratic Republic
<http://www.laowater.org/>

INDO WATER

Wed, 05 - Fri, 07 Oct 2022
Jakarta, Indonesia
<https://indowater.com/>

Aquarama Trade Fair

Thu, 20 Oct 2022
Belgium
<https://www.aquarama.be/en/trade-fair/edition/2022/home>

Water Environment Federation Technical Exhibition & Conference (WEFTEC)

Sat, 08 - Wed, 12 Oct 2022
New Orleans, USA
<https://www.weftec.org/>

WWEM - Water, Wastewater and Environmental Monitoring Conference

Wed, 12 - Thu, 13 Oct 2022
Telford, UK
<https://www.ilmexhibitions.com/wem/>

Taiwan International Water Week

Thu, 13 - Sat, 15 Oct 2022
Taipei, Taiwan
<https://www.taiwanintlwaterweek.com/en/index.html>

Aquatech China

Sun, 09 - Tue, 11 Oct 2022
Shanghai, China
<https://www.aquatechtrade.com/china/>

Water Management Show

Thu, 20 - Sat, 22 Oct 2022
Dhaka, Bangladesh
<https://www.tradeindia.com/tradeshows/105725/water-management-show-2022.html>

Shanghai International Water Treatment Exhibition (Aquatech China)

Sun, 09 - Tue, 11 Oct 2022
China
<http://www.aquatechchina.com/>

Middle East Produced Water Management Conference and Expo

Mon, 17 - Tue, 18 Oct 2022
UAE
<https://middleeast.produced-water-management.com/>

Oceans Conference & Exposition

Mon, 17 - Fri, 21 Oct 2022
USA
<https://www.oceansconference.org>

Minnesota Water Resources Conference

Tue, 18 - Wed, 19 Oct 2022
Saint Paul, USA
<https://ccaps.umn.edu/minnesota-water-resources-conference>

Renewable Energy Show

Thu, 20 - Sat, 22 Oct 2022
Dhaka, Bangladesh
<https://renewableenergyindiaexpo.com/>

Cairo Water Week (CWW)

Sun, 16 - Wed, 19 Oct 2022
Cairo, Egypt
<https://www.cairowaterweek.org/>

Middle East Smart Water Utilities Exhibition and Conference

Wed, 12 - Thu, 13 Oct 2022

NOVEMBER 2022

Agro Bangladesh Expo (ABExpo)

Fri, 18 - Sun, 20 Nov 2022
Dhaka, Bangladesh
<https://www.cems-agroexpo.com/>

China International High-end Drinking Water Industry Expo

Fri, 11 - Sun, 13 Nov 2022
Beijing, China
<http://www.waterexpocn.com/en/>

[Kansai] Smart Energy Week

Wed, 16 - Fri, 18 Nov 2022
Japan
<https://www.cantonfair.net/event/13112-kansai-smart-energy-week>

National Drainage Show (NDS)

Wed, 23 - Thu, 24 Nov 2022
UK
<https://drainageshow.com/>

Water Loss Asia

Tue, 08 - Thu, 10 Nov 2022
Kuala Lumpur, Malaysia
<https://www.waterlossasia.com/>

Waste Expo Brasil

Tue, 08 - Thu, 10 Nov 2022
Brazil
<https://www.wasteexpo.com.br/>

Natural Disasters Expo California (NDE California)

Wed, 09 - Thu, 10 Nov 2022
USA
<https://www.ndecalifornia.com/>

World Congress and Expo on Recycling

Mon, 21 - Tue, 22 Nov 2022
Netherlands
<https://blackcycle-project.eu/19th-world-congress-and-expo-on-recycling/>

National Drainage Show (NDS)

Wed, 23 - Thu, 24 Nov 2022
UK
<https://drainageshow.com/>

Wuhan International Water Technology Expo (WTE)

Fri, 11 - Sun, 13 Nov 2022
China
<https://www.neventum.com/tradeshows/the-wuhan-international-pump-valve-pipeline-water-treatment-expo-wte>

Industrial Water

Tue, 22 - Thu, 24 Nov 2022
Germany
<https://www.usgs.gov/special-topics/water-science-school/science/industrial-water-use>

MyanWater 2022

3 November to 5 November
Myanmar Expo Hall
Myanmar
<http://www.myanwater.org/>

VietWater

9 November to 11 November
Saigon Exhibition & Convention Center
Viet Nam
<https://www.vietwater.com/en/>

CamWater 2022

16 November to 18 November
DIECC (Koh Pich), Phnom Penh
Cambodia
<http://www.camwaterexpo.com/>

Natural Disaster & Emergency Management Expo (NDEM)

Wed, 16 - Thu, 17 Nov 2022
USA
<https://www.ndemevent.com/en-us.html>

India Water Week (IWW)

Tue, 01 - Sat, 05 Nov 2022
Greater Noida, India
<https://www.indiawaterweek.in/>

World Congress and Expo on Recycling

Mon, 21 - Tue, 22 Nov 2022
Netherlands
<https://blackcycle-project.eu/19th-world-congress-and-expo-on-recycling/>

EVENT CALENDAR



recycling/

International Water Conference (IWC)

Sun, 06 - Thu, 10 Nov 2022
Orlando, USA
<https://eswp.com/water/overview/>

International Conference on Clean Water, Air & Soil

Fri, 11 - Sun, 13 Nov 2022
Malaysia
<https://inwascon.org.my/conferences/>

Water Loss Forum

Wed, 02 - Thu, 03 Nov 2022
Istanbul, Turkey
https://www.waterlossforum.org/en_US/home

DECEMBER 2022

Storm Expo Asia

Wed, 07 - Thu, 08 Dec 2022
Singapore
<https://www.thestormexpocalifornia.com/index.asp>

E-Waste World Conference & Expo

Wed, 30 Nov - Thu, 01 Dec 2022
Germany
<https://ewaste-expo.com/>

KISAN Agri Show

Wed, 14 - Sun, 18 Dec 2022
Pune, India
<https://krishijagran.com/events/kisan-agri-show-2022/>

Digital Water Summit

29 November to 2 December
Bilbao
Spain
<https://digitalwatersummit.org/>

Groundwater Week 2022

6 December to 8 December
Las Vegas, Nevada
USA
<https://groundwaterweek.com/>

AsiaWater 2022

7 December to 9 December
Kuala Lumpur Convention Centre
Malaysia
<https://www.asiawater.org/>

JANUARY 2023

Water Expo & Forum

Mon, 16 - Wed, 18 Jan 2023
Abu Dhabi, UAE
<https://www.worldfutureenergysummit.com/en-gb/water.html>

Iran International Water & Wastewater Exhibition (Water and Wastewater Exhibition)

Fri, 30 Dec 2022 - Mon, 02 Jan 2023
Tehran, Iran
<http://watex.ir/en>

NEWEA Annual Technical Exhibition & Conference

Mon, 23 - Wed, 25 Jan 2023
Boston, USA
<https://annualconference.newea.org/>

World Future Energy Summit

16 January, 2023 to 18 January, 2023
ADNEC, Abu Dhabi
United Arab Emirates
<https://www.worldfutureenergysummit.com/en-gb/water.html>

FEBRUARY 2023

Water & Wastewater Equipment, Treatment & Transport (WWETT Show)

Mon, 20 - Thu, 23 Feb 2023
Indianapolis, USA
<https://www.wwettshow.com/en/home.html>

WATER TODAY'S WATER EXPO

Thu, 23 - Sat, 25 Feb 2023
Chennai, India
<https://www.watertoday.org/>

Interaqua 2023

1 February, 2023 to 3 February, 2023
Tokyo Big Sight
Japan
<https://www.interaqua.jp/eng/index.html>

Water & Solid Waste Expo 2023

16-18 February 2023
Pragati Maidan, New Delhi
India
<https://watersolidwaste.com/>

World Water-Tech Innovation Summit 2023

21 February, 2023 to 23 February, 2023
London
United Kingdom
<https://worldwatertechinnovation.com/>

MARCH 2023

om/

Netherlands Aqua Trade Fair

Tue, 21 - Thu, 23 Mar 2023
Gorinchem, Netherlands
<https://expotobi.com/aqua-nederland-vakbeurs>

Oman Sustainability Week (OSW)

Sun, 12 - Thu, 16 Mar 2023
Muscat, Oman
<https://www.omansustainabilityweek.com/>

Water Philippines Expo & Conference

Wed, 22 - Fri, 24 Mar 2023
Pasay, Philippines
<https://www.waterphilippinesexpo.com/>

WAPTEMA WATER EXPO

March 3 - 5, 2023
Netaji Subhash Place, Pitampura,
New Delhi
<https://wapterma.in/>

Water India

Mon, 27 - Wed, 29 Mar 2023
New Delhi, India

APRIL 2023

<https://www.waterindia.com/>

Smart Water Systems

Mon, 17 - Tue, 18 Apr 2023
London, UK
<https://www.smartwater.com/>

WQA Convention and Exposition

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

Texas Water

Tue, 11 - Fri, 14 Apr 2023

Houston, USA

MAY 2023

<https://www.txwater.org/>

Ozwater 2022

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

Trenchless Asia

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

AUGUST 2023

The Water Expo

Wed, 23 - Thu, 24 Aug 2023
Miami, USA
<https://www.thewaterexpo.com/>

18th EverythingAboutWater Expo 2023

Thu, 24 - Sat, 26 Aug 2023
Pragati Maidan, New Delhi
India
www.eawaterexpo.com

SEPTEMBER 2023

Water Indonesia

Wed, 13 - Sat, 16 Sep 2023
Jakarta, Indonesia
<https://www.waterindonesiaexpo.com>

NOVEMBER 2023

om/

Aquatech Amsterdam

6 November, 2023 TO 9 November, 2023
RAI, Amsterdam
Netherlands
<https://www.aquatechtrade.com/amsterdam/>



NATURAL DISASTERS EXPO ASIA 2022

Natural Disaster Expo Asia 2022

Natural Disasters Expo Asia is transforming the Singapore Expo on the 7th & 8th of December 2022 into the ultimate event for the management and mitigation of natural disasters and will welcome experts around the globe to source the latest revolutionary solutions to calamity management and mitigation.

Climate change has become a significant topic in recent years, as the UN reports there are more than an 80% increase in climate-related disasters over the last four decades. The Natural Disasters Expo is

the central hub for any forward-thinking disaster risk management professional to ensure the technology and advancement is in place before any state of emergency.

With your FREE ticket secured for the show, you can expect yourself to connect with over 300 cutting-edge suppliers, 100 inspirational seminars, countless networking opportunities, innovation awards, and much more!

All under one roof, you'll be able to witness the latest products, innovations, solutions and systems, hear industry experts from the big names on the planet divulge their very own secrets to success, and enable you to gain in-depth knowledge in disaster mitigation and prevention.



Better still, they are divided into 4 zones in the expo, which include heat & fire, storm, flood and earthquake, all run alongside each other, to collectively form the largest event in the mitigation and prevention of disaster management.

So what are you waiting for?

Register for your free ticket now via
<https://bit.ly/PtnEverythingAbWaterMag>

Date: 07-08 December 2022

Venue: Singapore Expo

Website: <https://www.naturaldisastersshowasia.com/>

Shale Gas Water Management Marcellus & Utica 2022

American Business Conferences has held over 75 Summits around the world in the Oil & Gas space since 2010, with over 10,000 attendees.

Our established Oil & Gas Congress series stretches globally across the USA, Canada, South America, Asia and Europe.

Our speakers have come from almost every major unconventional E&P company operating in the Americas and Europe including: Apache Corporation, ENAP, Chesapeake, Anadarko, Shell, Plains Exploration & Production, ConocoPhillips, Statoil, PennWest Exploration, Chevron, Continental Resources, BHP Billiton, PetroBakken, Talisman Energy, BP, Pioneer Natural Resources, Cuadrilla Resources Ltd, Hess Corporation, Nexen Inc., Sinopec, El Paso Corporation, Seneca Resources, Range Resources, Tamboran Resources, Americas Petrogas, Shell, Antero Resources, Talisman Energy...



Our Sponsors and Exhibitors have included Halliburton, Hydrozonix, Golder Associates, New Wave Energy Services Group, Concord Produced Water Services LLC, Baker Hughes, Schlumberger, WorleyParsons, Weatherford, Core Laboratories, Inc., Calfrac Well Services and Nalco to name but a few.

We also work closely with the principal industry associations to ensure that our Initiatives are as relevant and up to date as possible, bringing you the latest news and information in a well-presented, enjoyable and professional networking format.

Date: 01-02 November 2022

Venue: Live In Pittsburgh & Online

Website: <https://www.shale-water-marcellus-utica.com/>



7th India Water Week – 2022

The Seventh India Water Week-2022 will be held from 1-5 November, 2022 at India Expo Centre, Greater Noida, National Capital Region (NCR) of Delhi with the theme "Water Security for sustainable development with equity." The event is a multi disciplinary international conference focusing on new approaches for long term water planning and management by incorporating principles of sustainability and equity evolved over the years by National and International Water experts and Organisations, with a concurrently running exhibition enriching the theme and showcasing the technologies and solutions available for the areas under deliberation of the conference.

Partners in Organisation

The 7th India Water Week (IWW) 2022 will be organized by the Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation in co-ordination with nodal Departments/Ministries of Drinking Water Supply and Sanitation; Agriculture; Environment, Forest and Climate Change; Rural Development; Urban Development; Power; New and Renewable Energy; Niti Aayog along with their associated expert organizations and Public Sector Units, key International Bodies, and Private and Public business houses.

Participation

The participation in the conference and exhibition is by paying fee as decided and published by the Organiser. Delegates/Exhibitors/Visitors who wish to attend the conference and exhibition can express interest through sign up/register online in the website which is free of cost. However, participation in the conference and exhibiting in the exhibition is subject to payment of fee, and visiting exhibition is free of cost for all.

Date: 01-05 November 2022

Venue: India Expo Centre, Greater Noida, India

Website: <https://indiawaterweek.in/>



EverythingAboutWater conference on Current Challenges and Futuristic Solutions for the Water Issues of Western India

Despite consisting of India's richest states, having access to global infrastructure, natural resources including massive coastline, a good economic condition and strong manufacturing sector, the western part of India has been dealing with water issues.

The problems are diverse, ranging from the water scarcity in Maratwada, Saurashtra and Kutchh areas to floods along Narmada River and major districts in Gujarat. The mega cities struggle to keep pace with upgradation of their water and sewage treatment plants and water supply issues and NRW remain a constant pain for the water bodies. The opportunity to take benefit of desalination plants is a ray of hope for many, but the operational and environmental costs and question on the long term sustainability still remains a concern.

EverythingAboutWater is bringing the think tanks of the water industry together on a common platform and discuss the challenges and sustainable solutions at the upcoming mega conference on the theme of "Current Challenges and Futuristic Solutions for the Water Issues of Western India" on 11th and 12th November in Mumbai India.

Date: 11 November 2022

Venue: Mumbai, India

Website:

<https://www.eawater.com/event/everythingaboutwater-conference-on-current-challenges-and-futuristic-solutions-for-the-water-issues-of-western-india/>





18th EverythingAboutWater Expo 2023

18th EverythingAboutWater 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 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



Advance training on Design and Operation/Maintenance of Ion Exchange, Reverse Osmosis /Ultra Filtration Water treatment Plant & MBR Technology

EverythingAboutWater is excited to offer this invaluable opportunity to gain unparalleled knowledge on water treatment design and operation. This advanced training program will be held on November 3 and 4, 2022, at the Hotel Hindustan International in Pune, Maharashtra. By participating in this program, professionals involved in all aspects of water treatment will be able to learn from the best, and enhance their skills and knowledge. This is an incredible opportunity, and we hope you will take advantage of it!

Learnings

- How to assess/ analyze the existing water treatment plant performance that they have, how to design or check the existing plant design and validate
- How to design clarifiers, sand and activated carbon filters, ion exchange cation/anion/mixed bed units and reverse osmosis units
- How to understand the exact sizing, designing and maintenance aspects of the wtp expansion needs
- How to improve the performance (saving on manpower and operation cost) of any ion exchange /reverse osmosis plant
- How to be aware the environmental facts of any water treatment plant
- Introduction to zero liquid discharge and effluent treatment methods for waste water
-

Date: 03-04 November 2022

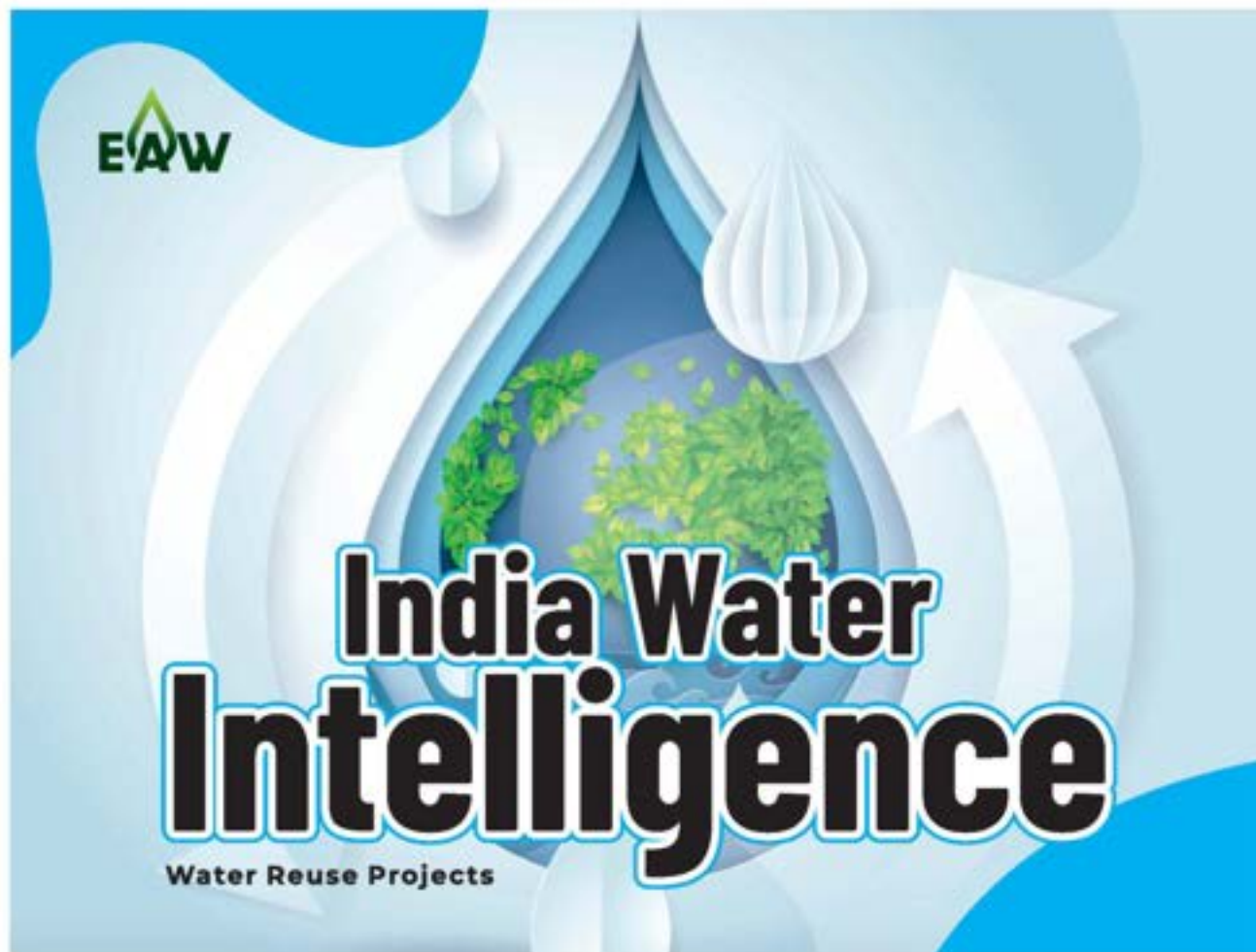
Venue: Hotel Hindustan International, Pune, Maharashtra

Website: www.eawater.com



India Water Intelligence

India's first monthly tracker on the municipal and industrial water markets,
in a easy-to-read e-magazine format, keeping you updated on the latest projects and trends



- Municipal water supply and sanitation projects
- Water and effluent treatment projects in large industries like power, steel, refinery, metals, cement, fertilizers...
- Advanced technology projects in wastewater recycling and desalination
- Information on funding under JNNURM, JICA, World Bank, ADB for water projects
- Projects under conceptualization, projects sanctioned, project planned, projects tendered, projects awarded...
- Regulatory changes and new guidelines being planned / notified contact details of relevant decision - makers and project incharges.

For more information and a complimentary copy,
please feel free to contact at Tel: +91 97188 24607, 98113 39374 | E-mail: editor@eawater.com

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