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EDITORIAL STREAM

FINDING THE PERFECT BALANCE

The success of water management lies between maintaining a balance of water treatment and waste water management. The availability of water is crucial and will be a deciding factor in future regarding the economic and social development. We cannot deny that in future there may be a threat of World War III around the issue of water availability and water will be a key political agenda in global politics. Increasingly, water is now seen as a strategic resource – one to be used with caution and managed with care. After all, water availability may be what will differentiate the haves and have-nots.

India is a water stressed state and here demand management is better option than augmenting water supply – it is less capita intensive and more environment friendly. Raw water costs have been increasing in the last few years in many parts of the country. In some areas, the price is as high as 60rupees per cubic meter. Further, in water scarce areas, industries have no option but to close down their operations if they are using outside water. Similarly, certain cities and municipalities have been dealing with water quantity and quality issues since many years.

One of the solutions to these problems is to have a better co-ordination between water treatment and waste water treatment projects. Few years back, the Government of India launched the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) with the aim of providing basic civic amenities like water supply, sewerage, urban transport, parks as to improve the quality of life for all especially the poor and the disadvantaged. The focus of the Mission was on infrastructure creation that has a direct link to provision of better services to the citizens. Launched on June 25, 2015 by Prime Minister Narendra Modi, AMRUT completed its mission period in March 2020. The second phase of the mission, the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) 2.0 scheme, which has been launched on 01 October, 2021 for the period of 05 years i.e. from the financial year 2021-22 to the financial year 2025-26, is designed to provide universal coverage of water supply through functional taps to all households in all the statutory towns in the country and coverage of sewerage/septage management in 500 cities covered in first phase of the AMRUT scheme.

Similarly on a micro level, many industries have realized that the waste water within their industry might be the cheapest and reliable source to fulfill their water needs. A natural evolution towards the solution is the concept of Zero Liquid Discharge, where industries completely reuse every drop of processed water and nothing is discharged outside the unit. Reusing water for bulk consumption needs is very important.

The water projects in India need to be proportinate as per the problems in different areas. Where in we focus on water treatment, we should also keep a balance at water conservation. One side where there is a need of sewage treatment, there should also be balance at the other side of ZLD. In this edition of our magazine, we seek the to highlight the requirement of this perfect balance in Water Projects in India.

thanks & regards,
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KARNATAKA CHIEF MINISTER LAUDS ALLSTATE INDIA FOR EFFORTS IN RAINWATER HARVESTING

Bengaluru / Mumbai, 5 January, 2023 : Allstate India, the strategic services arm of Allstate, a Fortune 100 US insurer, and an established hub for top talent in India, was felicitated in the presence of Honourable Basavaraj Bommai, Chief Minister of Karnataka, for its leadership in the Rainwater Harvesting (RWH) project driven by the NASSCOM (National Association of Software and Service Companies) GCC Karnataka chapter. The initiative helps provide clean drinking water to local school children and surrounding communities by setting up rainwater harvesting units in select government schools.

Speaking at the NASSCOM Corporate Social Responsibility (CSR) Partners' Felicitation Ceremony in Bengaluru on 06 Dec 2022, the Chief Minister thanked GCCs (Global Capability Centres) like Allstate India for partnering on this commendable venture and encouraged more organizations and individuals to join hands. Rainwater harvesting proves to be one of the most effective solutions especially now when global warming has made monsoon and rainfalls unpredictable and scarcer. Involvement in this project is part of Allstate India's commitment towards developing sustainable solutions to strengthen resource conservation and mitigate climate challenges.

Piloted in 2020 with the support of a few other GCCs in Karnataka, the project successfully covered 31 schools during the first two years and 38 schools in the third year (2022). Allstate India alone has installed rainwater harvesting units in 6 such schools across Bengaluru and Pune. So far, over 27 million litres of water have been harvested with more than 24,000 students and broader communities enjoying easy access to clean water. The aim is to cross over 50 schools in 2023 and reach more than 2,675 schools over the next five years. The Forward Foundation is the implementation partner for this project.

Chetan Garga, Managing Director and Senior Vice President, Allstate India, said "Water conservation is a key step in India's climate journey. It is due to this reason that we started the rainwater harvesting project, driven by NASSCOM, in government schools in Bengaluru. The effort is also designed to inculcate resource sensitivity among school children, the torch-bearers of tomorrow, besides dealing with water stress in the concerned schools and communities around them."

"The State Government has been extremely supportive, and we have received a lot of encouragement from the Chief Minister. The opportunity size is huge with potential to cover more than 2,600 schools in Urban Bengaluru alone. We are hopeful of bringing a visible change and becoming a catalyst for creating a positive impact on the larger society," Garga added.

LANXESS AND TOTALENERGIES TO COOPERATE ON SUSTAINABLE STYRENE

- Biocircular styrene based on tall oil
- Target 2050: Fully climate-neutral raw materials

Mumbai, January 7, 2023 - Specialty chemicals company LANXESS and French energy group TotalEnergies have entered into a cooperation on the supply of biocircular styrene. Unlike conventional styrene, the raw material used by TotalEnergies is based on tall oil, which is derived from a tree resin and is a by-product of pulp production. LANXESS uses the styrene to produce sustainable ion exchange resins. These products are applied primarily in the treatment of wastewater and chemical process flows as well as in the food industry.

The sustainable origin of the styrene is certified in accordance with the mass balance approach of the ISCC PLUS standard ("International Sustainability and Carbon Certification"). Under mass balance approach, the certified and non-certified materials are mixed physically, but kept separately on a book keeping basis. This method allows companies to document and track the sustainable materials through the complex production process and ensures the full tracibility through the entire supply chain. The ISCC PLUS certification of the styrene is an important requirement, as LANXESS offers its products in accordance with this certification standard as well and therefore relies on the same transparency for its raw materials.

"Our customers are increasingly asking for sustainable solutions, and raw materials with a low carbon footprint are a key lever here. By partnering with TotalEnergies, we can further expand the respective offering for our customers," says Marcel Beermann, Head of Global Procurement & Logistics at LANXESS.

"We are pleased to form this partnership with LANXESS, which demonstrates TotalEnergies' ability to offer sustainable products to its customers, helping them reduce their carbon footprint. This is a perfect illustration of the orientation taken by the Refining and Chemicals branch of TotalEnergies to develop lower carbon intensity products, in line with TotalEnergies' Climate Ambition to get to Net Zero emissions by 2050, together with society," declares Jean-François Renglet, Vice President Marketing Base Chemicals Division at Total Refining and Chemicals.

In addition to styrene, the specialty chemicals company already sources many other sustainable equivalents of fossil raw materials. Biocircular acrylonitrile is used for another type of ion exchange resins. The preservative Preventol is also available with various fatty acid mixtures based on sunflower oil. Prepolymers under the Adiprene Green brand contain starch-based polyether polyols. The intermediate Trimethylpropane Scopeblue consists of about half sustainable N-butylaldehyde. The composite Tepex Scopeblue is based on flax and polylactic acid. And the high-performance plastic Durethan Scopeblue uses biocircular cyclohexane and waste glass.

Goal: climate-neutral along the entire value chain

In August of last year, LANXESS announced its plan to make its upstream and downstream supply chains climate-neutral by 2050 (Scope 3). This includes indirectly generated emissions, particularly in purchased raw materials, but also in logistics and end products. For direct emissions in production (Scope 1) and energy sources (Scope 2), LANXESS had already set a target three years ago of being climate neutral by 2040. The renowned Science Based Targets Initiative (SBTi) had previously confirmed that LANXESS's climate targets are in line with the Paris Climate Agreement.
To achieve its Scope 3 targets, LANXESS has launched the Net Zero Value Chain Program. One pillar of the program is the increased sourcing of sustainable raw materials that are bio-based, originate from a recycling process or are produced with renewable energy. LANXESS is also pursuing plans for "green" logistics and a growing portfolio of climate-neutral products.

CURRENT EVENTS SURROUNDING THE INDUS WATERS TREATY HAVE CONSEQUENCES BEYOND INDIA AND PAKISTAN

India has delivered a message to Pakistan that it wants to modify the Indus Waters Treaty (IWT). The treaty was signed between the two countries in 1960, with the World Bank as guarantor, to regulate use of their shared rivers. As reported by The Wire, the demand from India is for Pakistan "to enter into inter-governmental negotiations within 90 days to rectify the material breach of IWT. This process would also update IWT to incorporate the lessons learned over the last 62 years."

This is the latest salvo in a long saga of lawfare in which India and Pakistan have been embroiled since 1988. The initial disagreement began when India started planning the Kishanganga hydropower project on a tributary of the Jhelum River. The Jhelum is one of the three western tributaries of the Indus whose waters are supposed to be for Pakistan's use under the treaty. India is allowed to build projects but not to limit water flow on these rivers – whereas it can do as it likes with the three eastern tributaries of the Indus.

Under the Indus Waters Treaty, India has to notify Pakistan in advance of the designs of any project it builds on the western tributaries, in case they impede water flow into Pakistan.

What is the Indus Waters Treaty?

Pakistan objected to the Kishanganga project because the design envisaged the diversion of water from one tributary of the Jhelum to another. Meanwhile, the Pakistani government had its own plans to build a hydropower plant on the Neelum river (as the Kishanganga is called in Pakistan) – the Neelum Jhelum Project (NJP). The displacement that would occur from the 330 megawatt Kishanganga project, while not reducing the overall flow of water into Pakistan, would limit the flow to the envisaged NJP.

Pakistan only approved the design of its own project in 1989 – a year after India had started its survey work on the Kishanganga project, construction began in 2007, and the Neelum Jhelum Project was completed in 2018. On the Indian side, work on tunnels began in 2004, while construction of the dam started in 2007. India agreed to Pakistan's demand of assembling a Court of Arbitration (CoA) – the one and only time such a court has been held – in 2010, and work on the Indian side was paused in 2011 until the CoA's decision in 2013.

Pakistan's contention in this case was that the NJP would be unable to function because India would channel water for its projects away from the river and then release it downstream of the NJP site. India countered that it was sticking to the terms of the IWT because it was not holding back any water from Pakistan, and that its projects predated the NJP.

In its 2013 decision, the CoA largely found against Pakistan's objections but asked

India to make some modifications to its dam designs.

Dispute resolution mechanisms of the Indus Water Treaty

When the IWT was signed in 1960, an Indus River Commission was established, with commissioners from India and Pakistan. The treaty has two dispute resolution mechanisms for situations when India and Pakistan cannot agree and the issue has to go beyond the commissioners: the appointment of a Neutral Expert and a Court of Arbitration. As the World Bank explains, "questions" are handled by the Commission; "differences" are to be resolved by a Neutral Expert; and "disputes" are to be referred to the Court of Arbitration, a seven-member arbitral tribunal.

During the CoA hearing, India had argued another point, that a CoA should only be created after an issue had first been dealt with by a Neutral Expert. The 2013 CoA verdict rejected this. It went further and said that a dispute obviously existed, and the court could not "accept that India's current position… that the Second Dispute is a matter for a neutral expert… even if India were now to request the appointment of such an expert". This is because India had insisted that no "difference" existed, and while a Neutral Expert was appointed to deal with "differences", only a CoA could deal with "disputes".

After the ruling, India completed the project, and it went online in 2018. Pakistan alleged that India had not followed the design specifications mandated by the 2013 ruling, and when India decided to commission the (much larger) 850 MW Ratle hydropower project in 2013 (the actual allocation of funds only happened in 2021) on the Chenab, Pakistan decided to request a Neutral Expert to deal with the issue in 2015. In 2016 it withdrew that request, and instead, on August 22, 2016 asked the World Bank to form a CoA to deal with the issue.

India responded on October 4, 2016 by requesting a Neutral Expert be appointed to deal with the dispute. This put the World Bank, as the guarantor of the treaty, in a quandary. The treaty explicitly states that a CoA, or other mediation efforts, do not apply to a "difference" that is currently being addressed by a Neutral Expert. Nonetheless, the IWT does not empower the World Bank to reject a request for a CoA if a Neutral Expert is not already examining the "difference", and none had been appointed.

The World Bank's role is strictly procedural, and it could not reject either request. And yet having two procedures underway on the same dispute seemed liable to act at cross purposes.

In a bid to manage the contradictions, the World Bank paused both mechanisms, initially until January 2017, and then for years. Throughout this time, India has argued that the creation of two processes endangered the treaty itself, and that a Neutral Expert should be appointed first.

No progress was made, especially as India-Pakistan relations have been in embroiled in hostility. On April 6, 2022, after numerous meetings and high-level talks, the World Bank decided to restart both conflict resolution processes, arguing that, while "concerns of the Parties that carrying out the two appointments concurrently poses practical and legal risks… the lack of success in finding an acceptable solution over the past five years is also a risk to the Treaty itself."

CENTRAL SEAL ON SILIGURI WATER PROJECTS

The Union ministry of housing and urban affairs has approved two important projects worth around Rs 785 crore for drinking water supply in Siliguri civic area. Hardeep S. Puri, the Union minister of housing & urban affairs, petroleum and natural gas, informed BJP Darjeeling MP Raju Bista in writing on Wednesday that the two projects was approved under the second edition of AMRUT (Atal Mission for Rejuvenation and Urban Transformation).

"Funds will be shared on a 70:30 basis and the state will pay the major share," a source added. The approval has prompted Siliguri Municipal Corporation — north Bengal's largest civic body — to float a tender for the project to resolve the city's ongoing drinking water crisis. For the past few months, the Trinamul-run board of the civic body and the state government had been pursuing approval of the Centre's drinking water scheme.

Senior officials in SMC said Siliguri desperately needs a new drinking water project to cater to the daily demand of around 80 million litres. Presently, only around 50 million litres can be supplied. Also, because of silt deposits and other technical glitches at the old plant that had been set up in the 1990s, water supply often gets completely disrupted, the officials pointed out.

DROPLETS
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Bentley Systems Announces Promotion of Brock Ballard to Chief Revenue Officer and Eric Boyer Joining as Investor Relations Officer

EXTON, Pa. – Jan. 9, 2023 – Bentley Systems, Incorporated (Nasdaq: BSY), the infrastructure engineering software company, today announced that Brock Ballard, previously vice president and regional executive, Americas, has been promoted to the role of Chief Revenue Officer, and that Eric Boyer has joined as Investor Relations Officer. Ballard succeeds newly retired Gus Bergsma who joined with Bentley Systems' acquisition of RAM International in 2005.

Prior to joining Bentley Systems in 2020, Ballard served in sales leadership positions with Dassault Systèmes, Autodesk, and Océ after earning a Bachelor of Arts in Communications and Information Sciences from the University of Alabama in 2001. He reports to Chief Operating Officer Nicholas Cumins, who said, "In addition to leading our Americas account teams to unprecedented ARR growth, Brock has driven our Enterprise 365 subscription program globally, to reach new levels of business partnership with many of the world's largest infrastructure engineering firms and owner-operators. Brock's energy, resourcefulness, and collegial leadership have been proven through business development opportunities with our accounts to advance infrastructure by going digital. While we will all miss Gus Bergsma, we congratulate him upon his long-earned retirement and thank him for his relentless focus on delivering success and establishing a high-performing account advancement organization, preparing Brock for success in 2023 and beyond."

Greg Bentley, Chief Executive Officer, said, "We could not have come nearly so far without Gus's indefatigable resolve and empathy for both infrastructure engineers, where he started professionally himself, and for our colleagues whose successful careers in sales he, in many cases, launched, and certainly exemplified. Gus has shown the way from cofounding a startup to achieving Bentley Systems' billion-dollar revenue milestone as a public company.

"And we now welcome Eric Boyer as our inaugural Investor Relations Officer, reporting directly to me. Eric combines a wealth of experience and strategic acumen to help us create a world-class investor relations function. I look forward to working very closely with Eric to extend and improve our outreach and communications with the investment community globally."

Boyer brings over 20 years of experience in investor relations and equity research, a deep knowledge of capital markets, and a strong network of relationships. During his tenure as senior vice president and head of investor relations at IHS Markit Ltd., which was a global information services leader, its market capitalization increased from $8 billion to $44 billion. He was also consistently recognized by Institutional Investor as a leading IR professional. Prior to Boyer's investor relations career, he spent more than a decade as a sell-side equity analyst at Wells Fargo and Deutsche Bank, where he covered various technology and related services sectors and was recognized by The Wall Street Journal's "Best on the Street" survey for his stock selections. He earned a Bachelor of Science in Business Logistics and International Business from Penn State University in 1999.

Badger Meter Enhances Smart Water Capabilities with Acquisition of Syrinix

Neuffen, Germany, January 16, 2023 – Badger Meter, Inc. (NYSE: BMI) announced the acquisition of Syrinix, Ltd., a privately held provider of intelligent water monitoring solutions, for £15 million, funded with available cash. Founded in 2010 and headquartered in the U.K., Syrinix specializes in high-frequency pressure monitoring and leak detection within water distribution and collection networks. Its remote network monitoring equipment and cloud-based software platform deliver data, customized alerts and insights that empower customers with real-time asset monitoring to reduce water loss and improve asset life. Kenneth C. Bockhorst, Chairman, President and Chief Executive Officer of Badger Meter, stated, "We are pleased to add the hardware-enabled software capabilities of Syrinix into our smart water solutions portfolio. Leveraging our industryleading ORION® Cellular endpoints and BEACON® Software as a Service, we continue to expand our comprehensive digital solutions to operationalize real-time data into actionable insights that improve efficiency, resiliency and sustainability. I look forward to working alongside the talented Syrinix team to further our aim to preserve the world's most precious resource."

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LANXESS increases prices for ion exchange resins and iron oxide adsorbers

Mumbai, January 19, 2022 – Specialty chemicals company LANXESS will globally increase its basic prices for all Lewatit ion exchange resins and Bayoxide iron oxide adsorbers for water treatment applications by approximately 10%. The price increase will be valid for all orders starting January 1, 2023. Customers will be informed individually.

The monthly variable surcharge introduced in the second quarter of 2022 will be retained and adjusted monthly on the basis of key input costs. It is intended to compensate for the drastic cost increases in raw materials, energy and transportation. The measures take account of the continuing high volatility in the markets.

The LANXESS Liquid Purification Technologies business unit is one of the world's leading global solution providers for water treatment and liquid purification. Ion exchange resins and iron oxide adsorbers are used in numerous industries and applications to purify water and other liquid media effectively.

Kozhikode corporation to go ahead with STP projects

The corporation denied media reports that it was dropping the project to set up sewage treatment plants(STP) at Kothi and Avikkal Thodu where there was intense opposition from residents against the project. Mayor Beena Philip refuted news reports and said that her statements were misconstrued by the visual media.

She added that she only said that as cases against the project were pending in courts and due to needless local protests, the STP projects can't be implemented underAmrut-1 and hence corporation was planning to implement them under Amrut-2.

She said corporation has conveyed its concerns about not being able to implement the project within the March 31,2023 deadline for projects that come under Amrut- 1 to the high-power steering committee headed by the chief secretary and the state-level technical committee headed by additional chief secretary. She said the projects will be shifted to Amrut-2 based on the directive of Amrut steering committee after the corporation council's approval.

Last month, Kozhikode Principal Munsiff Court had issued an interim injunction order, barring corporation from carrying out STP works at Avikkal Thodu by reclaiming land of the water channel at the proposed site. The court issued the order based on the petition moved by a resident that the proposed site was part of a canal and implementing the project will lead to severe environmental issues.

As of now, water is drawn from a canal of the Teesta, treated at the Fulbari plant in the southern end of Siliguri and distributed across the city through overhead reservoirs and pipelines. Under the new project, water will be directly drawn from the Teesta river at Gajoldoba, which is around 25km from here. "It is indeed a major development. The ministry has approved two projects worth Rs 785.27 crore," said Bista. According to sources, the water supply project which includes augmentation of water supply for the SMC area and rural areas en route, with a cost of Rs 511.08 crore, has been sanctioned. Another project of Rs 274.19 crore has been approved for sewerage and septage management, rejuvenation and augmentation of the existing waste stabilisation pond and allied works.

In phase I, infrastructure would be created to draw 211 million litres of water per day from the river Teesta, so that at least 138 million litres can be supplied to the treatment plant at Fulbari. The civic body sought expertise from Kolkata Metropolitan Development Authority to execute the project.

INDIA FAST-TRACKS ARUNACHAL DAMS; EXPEDITES STALLED PROJECTS FEARING 'WATER WAR' BY CHINA

Itanagar: India has started its largest hydropower project, worth 11,000 megawatts (MW), in Upper Subansiri, Arunachal Pradesh, in response to China's threat of "water wars."

India is moving three stalled projects forward for possible allocation to National Hydro Electric Power Corporation Pvt Ltd. (NHPC) in response to Chinese dams being built in the north-east, after recommendations from an appraisal committee and in-principal permission by the ministry of power. According to government sources quoted by TOI, a 60,000MW Chinese project on the Yarlung Zangbo (Brahmaputra) planned at Medog on the border with Arunachal Pradesh could be a cause for concern for a number of reasons, including environmental concerns, water scarcity if China decides to divert it, and floods that could affect thousands of people in Arunachal Pradesh and Assam if China suddenly releases water.

The Brahmaputra accounts for around 30 percent of India's freshwater resources and 40 percent of its whole hydropower potential. The Brahmaputra Basin is almost entirely under Chinese borders.

According to sources, the 2,000 MW Lower Subansiri project in India will be finished in the middle of this year. In addition to producing power, several hydroelectric projects are anticipated to help reduce water scarcity for up to a year in the event of a Chinese diversion and manage flooding in the event that China releases exceptionally high levels.

Given that 50 percent of the Brahmaputra River basin is in Chinese territory, the north-eastern hydroelectric projects are underway, especially in Arunachal Pradesh, which borders China. This is seen as a strategic move to counter the potential effects of

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Chinese flow diversion through the dams China is building.

On Medog, which is quite close to Arunachal Pradesh, China intends to construct this dam. Large-capacity dams are being constructed. Experts claim that China can utilise the Medog dam as a political tool, which could worry Bangladesh and India, according to the sources quoted by TOI.

This hydroelectric project is intended to reduce flood risks in Assam and Arunachal Pradesh as well as any water scarcity.

GOVERNMENT TO REVIVE 50 AIRPORTS, HELIPORTS, WATER AERODROMES, ADVANCED LANDING GROUNDS

The government on Wednesday said 50 additional airports, heliports, water aerodromes and advance landing grounds will be revived for improving regional air connectivity in the country.

The announcement was made by finance minister Nirmala Sitharaman while presenting the Union Budget for 2023-24. Over the past few years, the government has been taking various initiatives, especially the UDAN (Ude Desh ka Aam Naagrik) scheme, to boost the regional air connectivity.

“Fifty additional airports, heliports, water aerodromes and advance landing grounds will be revived for improving regional air connectivity," Sitharaman said in her Budget speech.
Besides, she said that 100 critical transport infrastructure projects, for last and first mile connectivity for ports, coal, steel, fertiliser, and food grains sectors have been identified.

"They will be taken up on priority with investment of Rs 75,000 crore, including Rs 15,000 crore from private sources," she added. UDAN flights have transported almost close to 1.15 crore people in the last six years.

In her first address to the joint sitting of Parliament on Tuesday, President Droupadi Murmu said the country's aviation sector is growing rapidly.

"Up to 2014, the number of airports in the country was 74, it has now increased to 147. Today India has become the third-largest aviation market in the world. The UDAN Yojana has played an important role in this regard," she had said.

DR JOSHI INAUGURATES WATER SUPPLY PROJECTS IN HARMADA

Jaipur: PHED Minister Dr Mahesh Joshi on Sunday inaugurated the Urban Water Conservation Scheme at Mansa Mata Temple in the Harmada area to provide Bisalpur water to locals of the area.

Under the scheme, construction of two high reservoirs of 1500 kiloliter (kl) and 700 kl capacity and two clean reservoirs of 1800 kl and 1400 kl capacity will be built and a 143 km long pipeline will be laid.

He also laid the foundation stone of a 2000 kl capacity high water reservoir and laying of 10.6 km pipeline for the supply of drinking water in the Bhatta Basti area. The work will be done for Rs. 8.17 cr. Officials informed that nearly 60,000 population of Harmada and Badrana areas will be benefited by this drinking water scheme.

ODISHA CABINET APPROVE VARIOUS PROJECTS INCLUDING 9 PIPED WATER PROJECTS WORTH ₹1,287 CRORE

In an effort to provide fresh water to more and more people, the Government of Odisha on Saturday approved nine piped water project supply projects in three districts of the state. The project was worth 1,287 crore which also included the tribal-dominated district of Malkangiri district.

The decision regarding the projects was taken in the cabinet meeting chaired by Chief Minister Naveen Patnaik. Two projects with an outlay of 254.66 crore will be implemented in Jajpur while three will be implemented in Nayagarh district with a budget of 393.93 crore. The number of people in both districts is pegged at around 4.45 lakh.

In a statement, the office of the Chief Minister informed that under the 'Jal Jeevan Mission,' four mega-projects worth 639.26 crore will be implemented in the Malkangiri district. The government said that the project will benefit a population of around 3 lakh people in 453 villages of the tribal-dominated district.

Among the other proposals approved by the Odisha cabinet include an increase in the grant for the employees of government-aided colleges, Development Commissioner Pradeep Kumar Jena said. The proposal will cost the government around 290 crore and will benefit 15,711 teachers and employees. The development commissioner added that the decision will be effective from 1 January 2022.

For the proper accommodation of cancer patients, the cabinet also allotted two acres of land for the construction of a facility by Bagchi-Sri Shankara Cancer Care Centre and Research Institute. "This will help cancer patients avail stay at affordable prices for a longer period of their treatment. The land will be free of premium in the close vicinity of the main hospital campus at Chandihata under Jatni tehsil in Khurda district," the statement from the government added.

190 MLD PLANT AT ALUVA NEED OF THE HOUR: KWA WRITES TO GOVERNMET

Even while the state government is sitting on the proposed 190 million litres per day (MLD) water treatment plant project at Aluva, top officials with KWA in the district have written to the government elaborating how important is the project to address the drinking water woes of the city and the suburbs.

In the letter, the officials state that unless the project is implemented in a time-bound manner, Kochi and suburbs, which are already facing acute shortage of potable water, will face a worse situation in the future.

The officials stress the need for allocating Rs 316 crore required for the project. They also point out that while implementing the Jal Jeevan Mission project, which intends to give drinking water connections to all households in grama panchayats, the demand will further go up.

"We expect that the government will consider the request favourably," KWA sources said.

29 SEWAGE TREATMENT PLANTS IN UP NOT COMPLYING WITH STANDARDS, SHOWS REPORT

Of the 111 operational sewage treatment plants (STPs) in Uttar Pradesh, 29 were not complying with the effluent discharge standards fixed by the Union Environment Ministry, shows a report available with the National Mission for Clean Ganga (NMCG), the apex body that implements the government's ambitious Namami Gange scheme.

The monthly progress report for Uttar Pradesh for the period September-October 2022 shows that these 29 non-complying STPs accounted for 15 per cent (532.18 million litre per day or MLD) of the total sewage treatment capacity (3,663.4 MLD) in the state and were located along the main stem of river Ganga and its tributaries. This is significant in view of the gap in sewage treatment capacity in the state.

As per the report, there were 119 STPs with a sewage treatment capacity of 3,663.4 MLD against the estimated sewage generation of 5,500 MLD in the state—leaving a sewage treatment capacity gap of 1,836.6 MLD.

However, of the 119 STPs in the state, only 111 were operational, shows the report. The report shows that out of the 111 operational STPs in the state, 29 were found "non-complying" with effluent discharge standards notified by the Union Ministry of Environment, Forest and Climate Change for STPs on October 13, 2017.

As per the environment ministry's standards, the pH value, which measures how acidic/basic water is, should be 6.5-9.0; BOD (Biochemical oxygen demand), which is a test to identify biological decomposable substances, should be less than 20mg/l; the TSS (Total Suspended Solids), which are the waterborne particles that exceed 2

microns in size, should be less than 50mg/l; and Fecal Coliform (FC) should be less than 1000 MPN (most probable number)/100 ml.

Out of the 29 non-complying STPs, seven were under Uttar Pradesh Jal Nigam (Rural), while 22 were under the state's urban development department and other agencies, shows the report, shared by the Uttar Pradesh government to the NMCG on November 21, 2022.

The seven non-complying STPs of UPJN-Rural accounted for a combined sewage treatment capacity of 188.5 MLD and were located along the main stem of river Ganga and its tributaries in different districts, including Kanpur, Hapur, Mathura and Bulandshahr. The remaining 22 non-complying STPs under UDD/others accounted for 343.68 MLD and were located across Firozabad, Chitrakoot, Varanasi, Lucknow, Ghaziabad, Meerut, Mathura and Greater Noida.

The non-compliance of the STPs in Uttar Pradesh is significant in view of the Centre's focus on Uttar Pradesh. Jal Shakti Minister Gajendra Singh Shekhawat himself has travelled several times to the state. The first meeting of the National Ganga Council was chaired by Prime Minister Narendra Modi in December 2019 at Kanpur. Besides, out of 177 sewerage treatment projects sanctioned under the Namami Gange scheme to date, a maximum of 59 projects have been sanctioned for Uttar Pradesh. Out of the total expenditure of Rs 11,707 crore incurred on sewerage projects under Namami Gange, a maximum of Rs 4,481 crore has been spent in UP

TREATING BLACK FOR BLUE: PERSPECTIVES ON MANAGING URBAN WASTEWATER IN INDIA

By Nitin Bassi, Saiba Gupta, and Kartikey Chaturvedi, Council on Energy, Environment and Water (CEEW)

Overview

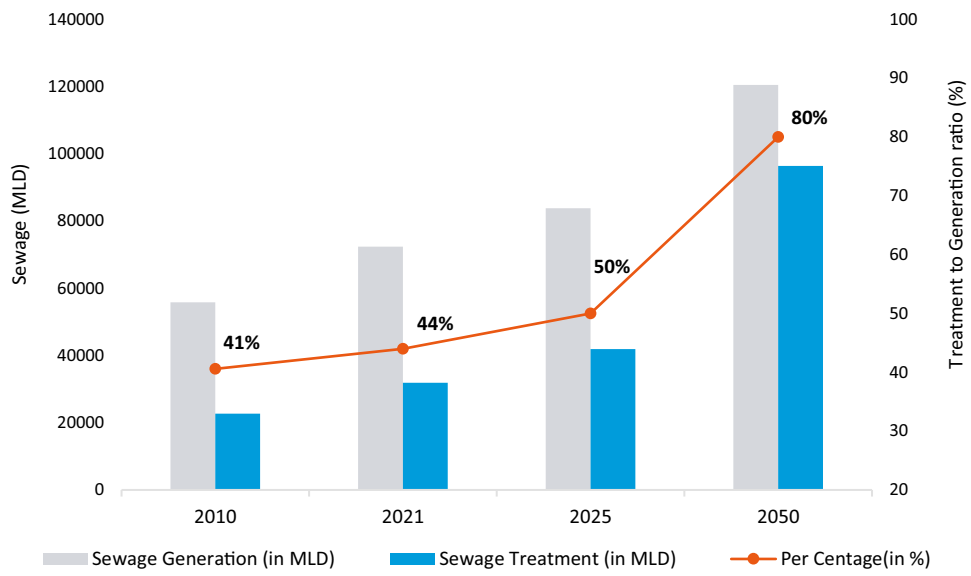
India has the capacity to treat only 44 per cent of the total sewage it generates per day. Out of the 72,368 million litres per day (MLD) of sewage we produce in urban centres, our installed treatment capacity is 31,841 MLD (CPCB, 2021). In class I (population above 1,00,000) and class II (50,000 to 99,999 population) cities, which represent a major share (72 per cent) of the total urban population, the actual treatment is lower than the installed capacity. Out of the estimated 38,254 MLD of sewage these cities produce, only 30 per cent is actually treated (CPCB, 2021). The untreated wastewater is then discharged into freshwater bodies such as rivers.

The discharge of partially treated or untreated wastewater is taking a heavy toll on river health, which is a critical source of fresh water. As per recent water quality monitoring reports from the Delhi Pollution Control Committee (DPCC), the stretch of Yamuna that passes through Delhi continues to be one of the most critically polluted in the country (DPCC, 2022). The river's water quality deteriorates substantially by the time it exits the city. The situation is no different for other rivers passing through urban areas, with the Central Pollution Control Board (CPCB) identifying 351 polluted stretches across India with Biological Oxygen Demand (an indicator of faecal contamination and organic pollution) above the prescribed limit of 3mg/l (CPCB, 2018).

Rapid and unplanned urbanisation, rise in industrial growth, and shifting consumption patterns have intensified India's water demand, far exceeding the available supply of fresh water. As per our analysis using the Central Water Commission (CWC) estimates on basin-wise water availability (CWC, 2021), 11 out of the 15 major river basins in India will experience water stress by 2025, with annual per capita renewable water availability below 1700 cubic metres. Hence, it is essential to explore alternative sources of water to address the demand and supply gap. Treated wastewater is a highly underutilised resource that offers an avenue to address the scarcity of fresh water and at the same time improve the water environment if managed properly.

Reuse potential of treated wastewater

In India, the reuse of treated wastewater holds immense potential considering the scale of wastewater generation, which is likely to increase exponentially over the years. Further, India has made substantial progress in strengthening its operational wastewater treatment capacity with an increase of over 40 per cent from 2014 to 2020 (CPCB, 2021). According to our analysis based on population projections, sewage generation is estimated to increase from 55,812 MLD in 2010 to 1,20,472 MLD in 2050. Further, given the enhancement in operational treatment capacity, the sewage treatment capacity as a percentage of total sewage generation will



Source: Authors' analysis, data from Niti Aayog Demographic Scenario 2025 (Niti Aayog, 2019) and CPCB (2021)
(Projected Sewage Generation = Urban population X 185 X 0.8)

Figure 1 In 2050, sewage treatment capacity in India is estimated to be 80% of sewage generation

rise from 41 per cent in 2010 to 80 per cent by 2050. This implies that about 96,378 MLD of treated wastewater will be available for reuse by 2050 (Figure 1). Hence, there is a significant opportunity for the reuse of treated wastewater across different sectors, especially for non-potable use.

many others do not meet the prescribed effluent water quality standards (CPCB, 2021). In some cases, STPs are underutilised since the sewerage network does not cover unauthorised colonies and sub-urban areas (CSE, 2014). Many urban utilities are unable to scale up wastewater treatment capacity as the capital and operating cost of infrastructure is high.

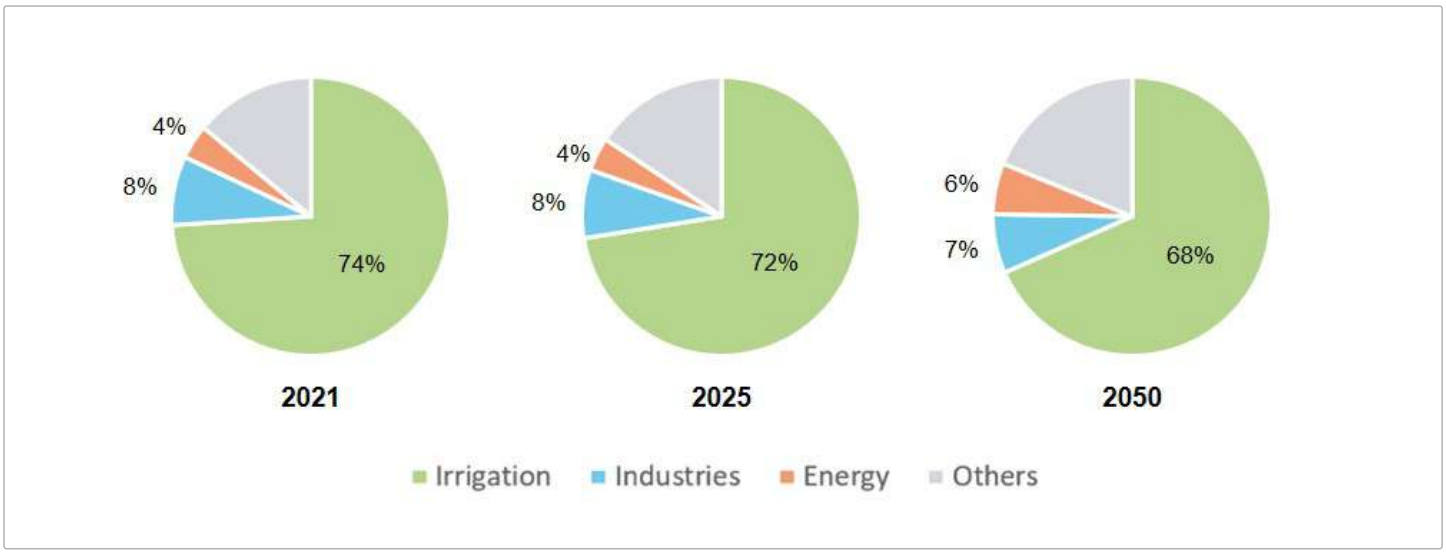


Figure 2 Potential opportunity to reuse treated wastewater, especially for irrigation

The amount of treated wastewater that can be readily made available for reuse across different sectors in India is presented in (Figure 2). This estimate is based on the actual wastewater treatment capacity installed in India, apportioned as per the ratio of (current and projected) water demand over the years in three major sectors – irrigation, industries, energy, and others.

The analysis suggests that the water demand for the irrigation sector, in proportion to the total water demand, will witness a gradual fall and that of the industrial and energy sector will steadily rise. Such changes in the future could be attributed to factors such as efforts towards improving water use efficiency in irrigation, and increasing water demand from the growing economic sub-sectors. Nevertheless, the agriculture sector retains its relative dominance, accounting for 68 per cent of total water demand in 2050. Thus, the reuse of treated wastewater for irrigation presents an opportunity to reduce pressure on groundwater extraction which is a major source of irrigation, and minimise fertiliser use on account of the inherent nutrient value of wastewater.

A number of Indian states have formulated state-level policies on the reuse of treated wastewater. States such as Rajasthan, Gujarat, and Haryana have prepared comprehensive policy documents that identify sectors for reuse, and define allocation mechanisms and pricing principles, with provisions for exploring public-private partnership models for wastewater treatment projects. Yet, there is a gap in terms of the effective implementation of the policies and mainstreaming of treated wastewater reuse.

Challenges in the reuse of treated wastewater

The current state of treatment and subsequent reuse of treated wastewater, even in the major urban agglomerations of the country, is inadequate. According to the CPCB, many sewage treatment plants (STPs) do not function at maximum capacity and

Nevertheless, some initiatives are being undertaken by local urban authorities to promote the reuse of treated wastewater. For example, as part of a project initiated by the water board in Delhi, artificial lakes are being constructed near existing STPs with the aim to recharge groundwater in the city. The water in the constructed lakes is sourced from the treated wastewater from the respective STPs. It is estimated that about 50 per cent of the treated wastewater in such artificial lakes would recharge groundwater and can be extracted through tube wells installed in the surrounding areas for irrigating nearby farms, and watering urban parks (DDA, 2022). Also, the authorities have set up a sludge treatment plant at one of the existing STPs to process the residual sludge from it and convert it into ash. The ash can be moulded into interlocking paver blocks for use in construction. However, such efforts are only a few examples of wastewater management in urban areas of India.

Way forward

There is no doubt, wastewater management in India requires a holistic shift from a 'use and throw – linear' to a 'use, treat, and reuse – circular' approach (Kim, et al., 2018). Strengthening governance plays a key role in mainstreaming the reuse of treated wastewater. But there need to be some targeted interventions to achieve this.

First, institutional synergy is needed between the centre and state for the effective implementation of wastewater treatment and mainstreaming its reuse. The existing state-level policies in India on reuse of treated wastewater do not define the treated wastewater reuse quality standards for specific uses. Hence, a comprehensive national framework is a crucial instrument for addressing such gaps, acting as an umbrella document for promotion of wastewater management and governance of its reuse.

Second, appropriate public-private partnership models need to be promoted to develop financially viable treated wastewater reuse projects (Bassi et al., 2022). For

this, approaches promoted under the National Mission for Clean Ganga to scale up wastewater treatment infrastructure and reuse should be looked at. Such projects can be made financially viable if the technology adoption is undertaken considering the market potential of the intended purpose for which treated wastewater would be reused.

Third, freshwater needs to be priced to create more demand for treated wastewater. In many Indian cities, domestic water is supplied for free or is highly subsidised. As a result, there is no demand for treated wastewater even in areas that experience water scarcity on a regular basis. Charging freshwater on a pro-rata or consumption basis will create institutional demand for treated wastewater, especially for irrigating gardens, meeting non-potable water demand in hotels and hospitals, for use in anti-smog guns, etc.

Fourth, an effective pricing mechanism for treated wastewater should be put in place based on the market potential of treated wastewater. It will help reduce/recover the wastewater treatment cost and thus contributes towards making such projects commercially viable.

Fifth, low-cost nature-based wastewater treatment technologies such as waste stabilisation ponds should be promoted. They do have a large land requirement in comparison to electromechanical technologies. This can be made available in small towns where the population density is low and there is a low demand for building new infrastructure. Also, being low in energy usage, such technologies have a low carbon footprint.

To conclude, there is a vast potential for making reuse of treated wastewater for non-potable purposes. For instance, a quick estimate based on the current wastewater treatment capacity and water demand for irrigation suggests that the amount of treated wastewater currently available for use in the agriculture sector is sufficient to irrigate 1.4 million hectares of land which is equal to about 9 times the area of Delhi. This land can further generate revenue from the agricultural produce obtained through irrigation using treated wastewater, along with additional benefits such as the economic value of nutrients recovered from wastewater and energy savings from reduced groundwater pumping. Hence there is immense un(der)tapped potential for reusing treated wastewater that can promote circularity in urban wastewater management.

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He played a key role in the establishment of the India-EU Water Partnership (IEWP) and its work priority areas. He was a Member of the Water Quality Task Force (River Ganga), set up by the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD & GR), Government of India (2017). He was also a Member of the Thematic Sub-group on Water Management for Climate-Smart Cities Assessment Framework 2.0, set up by the National Institute of Urban Affairs (NIUA) and Ministry of Housing and Urban Affairs, Government of India (2020-21).

He has about 90 publications to his credit. He has co-edited five books, two of which were published by Routledge UK, two by Springer Nature, Switzerland, and one by Sage Publications. He regularly reviews manuscripts for Water Policy, International Journal of Water Resources Development, Journal of Hydrology, and book proposals for Routledge, Sage, Springer, and Wiley.

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She has also been associated with the Sustainable Cities Integrated Approach Pilot in India, implemented by UNIDO and UN-Habitat. She worked on developing training modules and delivering capacity building workshops for ground functionaries and city officials from the water and solid waste management departments in five pilot cities. In the past, she has also worked on urban infrastructure projects around Chandigarh, as well as Development Plans of new towns in Maharashtra being developed by the Maharashtra State Road Development Corporation.

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BENEFITS OF NRW REDUCTION

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

Reducing Non-revenue Water

The maximum leakage occurs in the water distribution system and house service connections which is around 80% of the total leakages in the system while the remaining percentage covers the loss at source, transmission system, treatment plants and service reservoirs. NRW is usually taken as the measure of efficiency of a water supply system. The reduction of NRW is a crucial step to improve the financial health of water utilities and to save scarce water resources. The percentage of physical losses is influenced not only by the deterioration of piped network, but also by the total amount of water used, system pressure, and the degree of supply continuity. The percentage of administrative losses depends on the degree of effort exerted in identifying illegal connections and in repairing meters. To a large extent, the level of NRW is an indicator of how well a utility is managed. Continuous supply system may result in increase in NRW; however, installation of district flow meters, functioning of domestic meters on consumer connections will indicate areas where quantum of NRW is high and efforts to minimize NRW can be concentrated

Impacts of NRW

In many water utilities, there are high levels of NRW which leads to low levels of efficiency in terms of financial economy and redressal of complaints. When a utility's product (treated water) is lost, water collection, treatment and distribution costs per unit of volume increases, water sales in terms of volume and amount decreases, and to resolve this situation substantial capital expenditure programs are often promoted to meet the ever-increasing demand. In short, the utility enters a vicious cycle (Figure 1) that does not address the core problem. The challenge for these utilities is to turn this vicious cycle into a virtuous cycle (Figure 2), which will lead to low levels of NRW and therefore substantially improved efficiency.

Water Audit

For effective control of water losses, NRW of every DMA is to be determined by dividing operational zones. A city is divided into number of operational zones (OZs) which are further divided into number of sub zones called as District Metered Areas (DMAs). Each DMA is then critically studied for different demand patterns, leakages and unaccounted for water. Thus, the problem is divided into sub-problems and effective control measures are taken to provide effective solution for each sub problem to solve the problem in total. Water audit identifies how much water is lost and the loss of revenue against the same. The objective of water audit is to help the utility select and implement programs to reduce distribution system losses. Water audits should be performed annually to help managers to adjust priorities, monitor progress, identify new areas of system losses, and establish new maintenance goals. A water audit followed by leak detection program can help water utilities reduce water and revenue losses and make better use of water resources.

Computation of NRW by Step Test

Step test is generally used to compute NRW within DMA. This

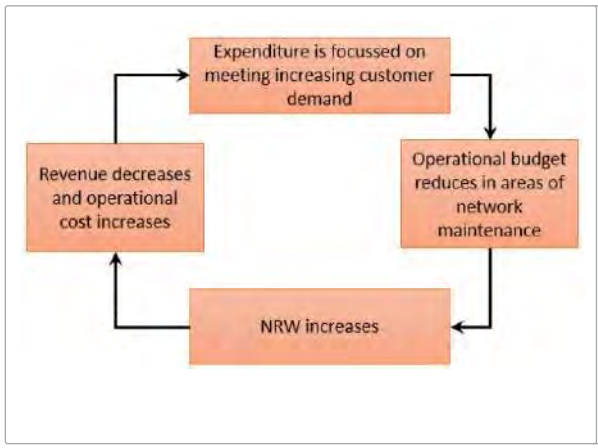

Fig 1. Vicious circle of NRW

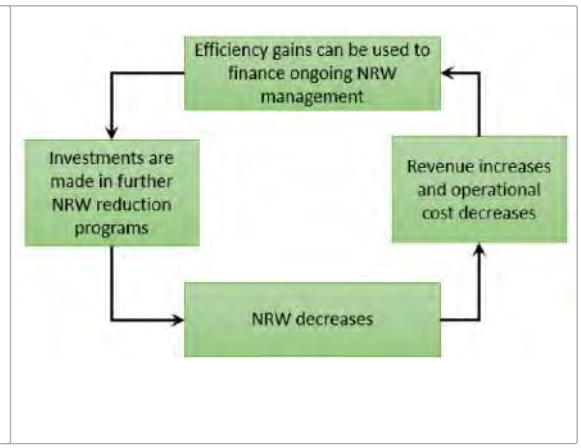

Fig 2. Virtuous circle of NRW

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technique, is usually undertaking during the night hours in order not to interrupt the regular supply of water to the customers. The minimum night flows are evaluated against expected and calculated legitimate usage within that DMA. If there is certainty that there is sufficient leakage for that DMA, Step Testing will be performed within that DMA to localize any leakage potential. After each section closure, re-evaluation of the recordable night flows is conducted to see if the amount of estimated leakage is found. This allows for quick and immediate decision making by the client in order to control the costs of the leakage survey. Estimated leakage potential within each isolated DMA and each subsection within that DMA will be known.

Methods For Reducing Unaccounted For Water (UFW)

1. By 100% Consumer Metering and Telescopic Tariff

100% Consumer metering and telescopic tariff based on volumetric measurement curbs wastage of water as excess and unnecessary consumption becomes costly for consumer. Thus, demand management is achieved which reduces NRW.

2. Leak Detection

The leak detection involves identification of actual leak points without carrying out any excavation. The main principle of these methods is to identify the location of each leak and magnitude of each leak's severity, expressed in liters per second, in buried pipes. The principle includes a generated noise from the point of leak in the buried pipelines.

Leak Repair Program

Bursts can be identified by the variation in minimum night flow over longer period, say 180 days. These variations in night consumption can be observed and then can be identified and repaired. Reported bursts are visible leaks and are also removed in reasonable time by ULB. However, small leakages do not come to surface and cause increase in NRW and contamination. These invisible leakages appear and are known as background leakages. Unreported bursts can also be detected. since it is not removed, the losses are continued and again another unreported burst occur. When both the unreported bursts are removed, NRW level is brought down.

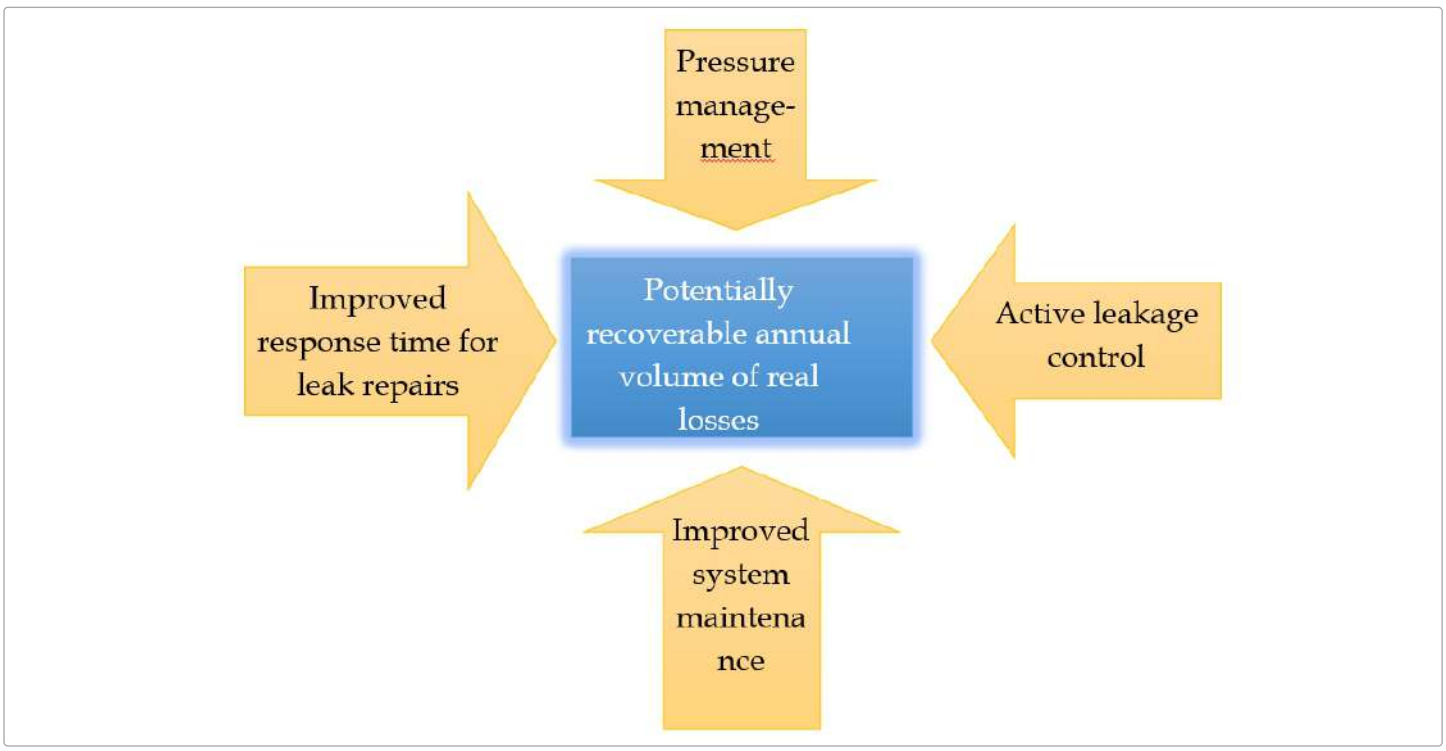
DMA Management

As soon as DMA is established initial values of NRW, net night flow (NNF) should be recorded. NRW values generally increases with time. Operator should fix the Intervention limit. When NRW reaches this limit, the task of NRW reduction is taken up. NRW is lowered to its base level. As time moves on, value of NRW again increases. Operator has to again bring NRW to its base level. If frequency of intervention increases rapidly, then the pipe replacement should be made.

Conclusion

General Benefits of NRW Reduction

- Revenue improvement through lower losses & improved billing.
- Pressure improvement in the project area.
- Improved levels of customer service.
- Better knowledge and understanding of Network.
- Water quality risk reduced by monitoring leaks in the DMA's.
- Operation of system meets best international best practices.
- Total accountability of water in supply.
- Better understanding of free water usage and slum usage.
- Improved forecasting of demand and cost - improved asset management.
- The equitable distribution of water or system optimization.
- Reduced operational cost.
- Illegal usage can be tracked.



Flowchart for reduction in real losses of water

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STATE OF WATER AND WASTEWATER TREATMENT IN INDIA

By Mangesh Dashrath, Founder, Envicare

The unique geography and geology of India have impacted its climate majorly. Northernmost India is affected by the renowned Himalayas, while the west is home to the expansively arid desert. Southern India is flatter with grass plains and the Deccan plateau. All of the geographical conditions influence water availability in these regions.

In 2019, the market for India's wastewater treatment plants was at USD 2.4 billion. It has the capability of reaching USD 4.3 billion by 2025. It would be due to the increasing demand for municipal water and sewage treatment plants across India. This is told by Amitabh Kant, the CEO of NITI Aayog.

Like most countries, the COVID-19 epidemic impacted India's economy negatively. It includes the operations of several end-user industries of the said market. It has resulted in a reduction in the outflow of industrial wastewater.

As per the valuation of the fiscal year 2021-2022, the total operation cost of the Swachh Bharat Mission-Urban 2.0 for its components is Rs. 1,41,600 crores or USD 18.998 billion).

The Financial Express has stated that India's water requirements will double the supply by 2030. It means resultant severe water scarcity in the country. This shortage for commercial & residential usage will ultimately increase the need for water treatment systems.

The Indian government aims to provide the whole population with safe & adequate drinking water by 2024-25. It will give a push to the municipal water treatment plants across India.

India is the third largest coal producer. And this production requires large amounts of water. So there is a need to push for extensive wastewater treatment in place.

The medium term will see fast-falling freshwater resources and increasing wastewater complications drive the demand for water & wastewater treatment technologies in India. Waste treatment technological advancements can provide an opportunity in the said market soon.

There is a need for wastewater treatment across the country in cities. The significant applications of technologies include preliminary, primary, secondary & tertiary treatment. The percentage of the rural population having access to safe and adequate drinking water within premises has increased.

The last few years have seen a stark rise in India's urban sewage capacity. This rise will push the country's innovative water treatment technology demand.

The abovementioned factors suggest the dominance of municipal water and wastewater treatment technologies in the predicted time frame.

The demand for freshwater for infrastructure development has risen with fast-paced urbanisation and industrialisation. The agricultural sectors are showing increased water needs. It means a focus on new-age technologies which not only save water but also help utilise it smartly.

With development, the waste will increase too. Wastewater generation and treatment have become more focused by the govt by putting stringent norms. It results in technological progress to deal with the situations.

The impact is astounding. When municipal wastewater is treated & later reused, it helps in environmental rehabilitation, along with coping with the increasing water needs from different sectors, said Mr Kant.

Implementation of various regulations related to water treatment has happened. However, a large population is still far away from access to safe water. The planning commission has budgeted USD 26.5 billion in the 2012-2017 plan. It is for providing safe water to all urban & rural Indians.

ABOUT THE AUTHOR

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

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

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SURFACE WATER QUALITY STATUS BASED ON A MODIFICATION OF CCME-WQI IN MAHANADI BASIN, ODISHA

By Abhijeet Das, Research Scholar, Department of Civil Engineering, C.V. Raman Global University

Abstract

Strong economic and cultural ties exist between the locals and the Mahanadi River in Odisha, India. It has enough fertile plains and slopes for farming, as well as suitable terrain for local fishing, recreation, hunting, domestic water supply and irrigation. Due to the abundant natural resources, it offers, it is crucial for both individuals and the state of Odisha. The investigation's objective was to examine the CCME water quality index using data from 19 sample locations. A one-year detection time is used (2021-2022). pH is somewhat alkaline in nature. The overall WQI readings, which ranged from 34.71 to 85.52, indicated that the water was of good quality and suitable for a variety of human purposes. The current study makes clear that TC was a major factor in the river's WQI change. A GIS spatial distribution map has been attempted to be used for drinking-related objectives. Our current study's findings on water quality indicate that the Mahanadi basin needs to implement suitable management policies, mitigation methods to reduce pollutant inflow, and conservation activities.

Keywords: Mahanadi River, CCME water quality index, GIS spatial distribution, Pollutant.

I. Introduction

Because they control the microclimate of every urban centre and thus have an impact on the lives of those who live nearby, rivers are regarded as ecological determinants of a city's wellbeing (Benjamin et al. 1996). Due to rising consumption for drinking, irrigation, and industrialization over the past few decades, it has turned into a need. In India, one of the major issues is a lack of water. Overuse of high-quality surface water for agriculture and drinking in many parts of the world makes it an unavoidably scarce resource in a variety of arid and semi-arid locations (Bouderbala et al. 2017). Elemental composition that are significantly influenced by geological formations and human activity determine how the quality of the water varies in a given place (Subramani et al. 2005). Any river system's environmental conditions rely on its nature and how exposed it is to different environmental influences. Therefore, surface water quality is influenced by human impacts including urban, commercial, and agricultural activity in addition to natural phenomena like rainfall inputs, eroding, and earth's crust content degradation (Papatheodorou et al. 2006). Due to development pressures and an increase in human population, rivers are more susceptible to solid waste dumping and sewage discharge, which puts pressure on the percolation and infiltration processes (Ravikumar et al. 2011). Over the past several decades, the community has increased significantly, because there hasn't been a corresponding rise in social facilities. As a result, metropolitan rivers and water reservoirs, notably, have become sinks for toxins (Iscen et al. 2008). Therefore, despite growing urbanisation and anthropogenic pressure on surface waters, periodic monitoring and assessment of their quality aid in the development of management plans to reduce it (Shuchun et al. 2010). Using a few well-chosen variables and techniques for weighting and aggregating them, the Water Quality Index (WQI) is the simplest and most straightforward way to express complicated data (Kachroud et al. 2019). It is amongst the most powerful order to better inform decision-makers and community members about the monitoring and treatment of rivers and streams (Naik and Purohit 2001). In peninsular India, the Mahanadi River is one of the principal east-flowing interstate rivers. Water from the river is used for domestic, industrial, and agricultural uses, thus the quality of the water is an issue for the use in the future. Comparing the current system of water purity, potability, and potential sources in the river water, the current work has been carried out by analysing physicochemical parameters and by estimating WQI. The findings could offer proof of water pollution in the watershed area.

II. Description of study area

The Mahanadi River basin 141,589 km2, or about 4.3%, of the country of India's total land area. It is located between the north latitudes of 19°21' and the east longitudes of 80°30' and 86°50'. The Hasdeo, Seonath, Mand, Ib, Bhadar, Jonk, Ong, and Tel are the principal tributaries that contributes. The river's water runoff is 50*109 m3/ year, with a peak flow of 44,740 m3/s. The Chhattisgarh state capital, Raipur, lies 6 km away from the river's source in Pharsiya village (Nagri town), where a pool's surface rises at a height of 442 m as it flows. Mahanadi enters Orissa after travelling 28 km from Chhattisgarh. The Ib River enters here near Bagra from the left. Furthermore, the river flows into the stony banks of the Hirakud reservoir, which is 10 km away from Sambalpur Town across the Mahanadi. Approximately 11 km upstream of Sonepur, the Ong River feeds into the Mahanadi from its right. Near Sonepur, the Tel, the second-largest tributary, enters the main river after making a gentle turn to the southeast. Approximately 6 kilometers (km) below the Satkosis Gorge's beginning is the water quality station in the settlement of Tikarpada. 11 kilometres to the west of Cuttack, the state capital, the river opens up once more below this canyon, turns left, and ultimately emerges into the Naraj delta. The study river is 851 km long overall, 357 km of which are in Chhattisgarh State and remaining km are in Orissa (Jain et al. 2007). Figure 1 depicts the study region with the necessary fundamental geographic information and stations.

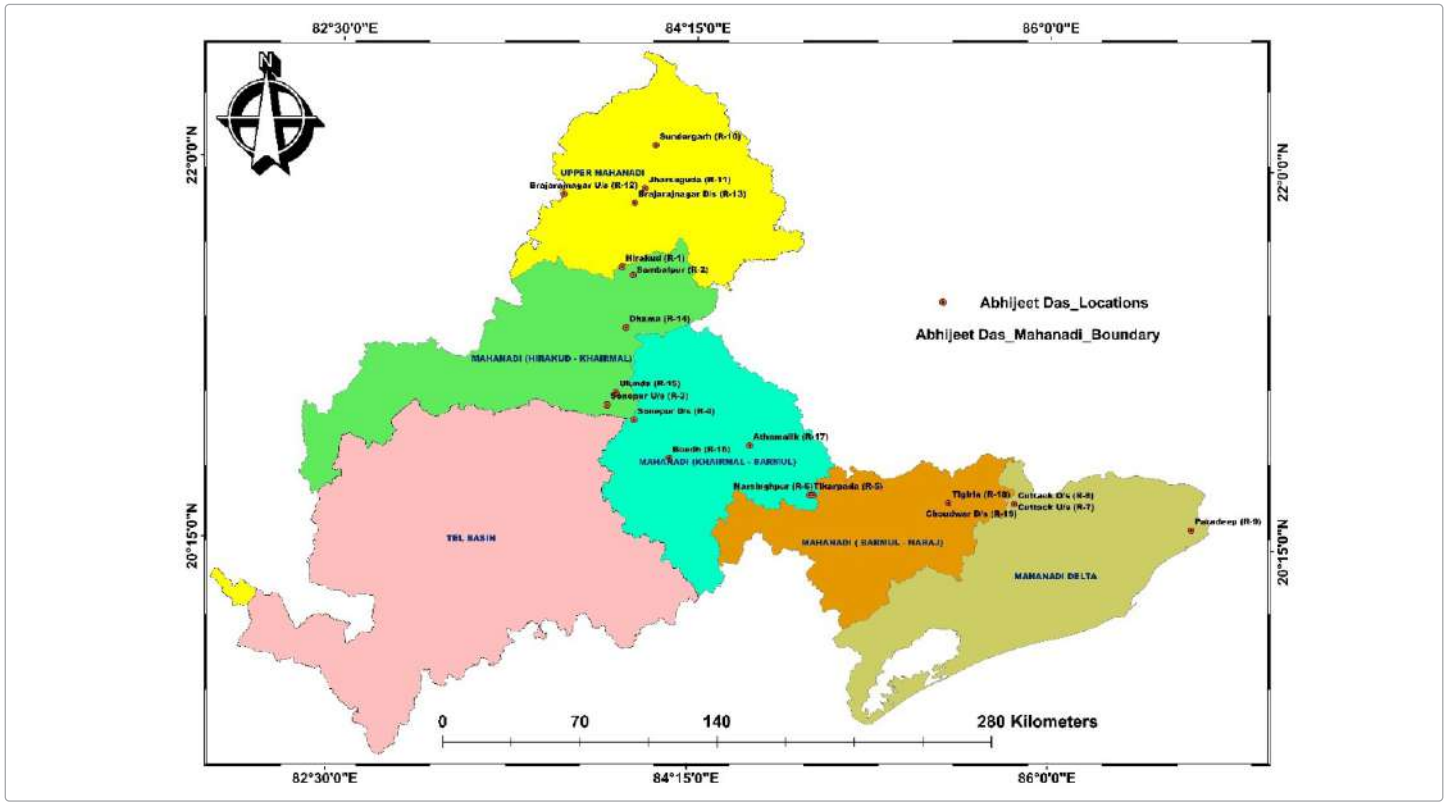

Figure 1. Map indicating the sampling stations located along Mahanadi River

III. Sampling of data

A composite screening method was used to collect samples from 19 sampling stations over the duration of 1 year, or 2021–2022, using clean, labelled testing bottles that were kept in an icebox. After standardization, digital equipment is used to test the pH and dissolved oxygen (DO) in the field. The iodometric method was used to measure BOD, the Coliform test was used to calculate TC, and the Modified Winkler's method was used to estimate DO. The (APHA 2005) and (WHO 2004) regulations for standard analytical methods were applied. Data from laboratory results were uploaded to ArcGIS 10.3 and also recorded in the statistical package Excel 2010. The research area's pH, DO, BOD, and TC parameters were created using the method of ordinary kriging classification of spatial map interpolation (Panneerselvam et al. 2021).

IV. CCME Water Quality Index

The Canadian Water Quality Index (CCME WQI) was first created (CWQI). It consists of three elements and has a lot of evidence (CCME 2001). The parameters for different measures can differ from station to station, and the sampling technique calls for measuring at least four parameters at least four times. The following expression can be used to calculate index values: CCME WQI = 100 - [({F12 + F22 + F32}0.5)/1.732] where scope (F1) = There are numerous elements whose targets are not fulfilled. , F1 = (No of failed variables/ Total number of variables) *100, Frequency (F2) = The frequently with which the expectations are not realized, F2 = (No of failed tests/ Total number of tests) *100, Amplitude (F3) = By how much the objectives are not reached, Excursion i = (Failed test valuei / Objectivej)-1, Normalized sum of Excursions (NSE) = ∑_(i=1)^n 〖excursion i〗 / Number of tests. F3 = (NSE/0.01NSE + 0.01). The index has been normalized using a value of 1.732 from 0 to 100. Be aware that a value of zero (0) denotes extremely low water condition, whereas following values to 100 imply excellent water reliability. Poor (values 0-44), Marginal (values 45-59), Fair (values 60-79), Good (values 80-94), and Excellent (95-100) are the five categories in which the water quality is categorised. To comprehend the surface water quality in the research area, a WQI model was generated with the assist of the CCME WQI taxonomy.

V. Results and discussion

The pH, DO, BOD, and TC concentrations at 19 sampling stations are being used to compute the river's water quality status, that would be used to determine whether the water is safe for drinking. The concentration values are classified in accordance with WHO drinking water criteria. Water's acidity or alkalinity is measured using the pH scale, with a lesser pH value rendering it more caustic and a greater pH offering a poor taste and having negative effects on the human body and eyes (Rao and Rao 2010). At various sampling sites, the pH value has varied from 7.74 to 7.92. According to the current investigation, the water is alkaline at different stations. Moreover, it is clear that the pH value is within the permitted range of 6.5 to 8.5 (WHO 2004). The amount of DO in rivers varies according to their trophic levels, and the most common effect of water pollution is likely the reduction of DO in water (Srivastava et al. 2009). It is a crucial factor to consider when evaluating the water's ability to absorb trash (Rao and Rao 2010). The range of DO is higher than the WHO-recommended 6 mg/l, ranging between 7.26 and 7.83 mg/l. Elevated DO occur everywhere because to the river being pumped with millions of gallons of water, the presence of too many nutrients, and maybe urban waste pollution during the river's voyage (Bawa and Gaikwad 2013). BOD suggests organic waste accumulation (Siraj et al. 2010). The amount of oxygen taken by microorganisms to stabilized organic compounds that is decaying beneath aerobic conditions is called the oxygen requirement (Sawyer and

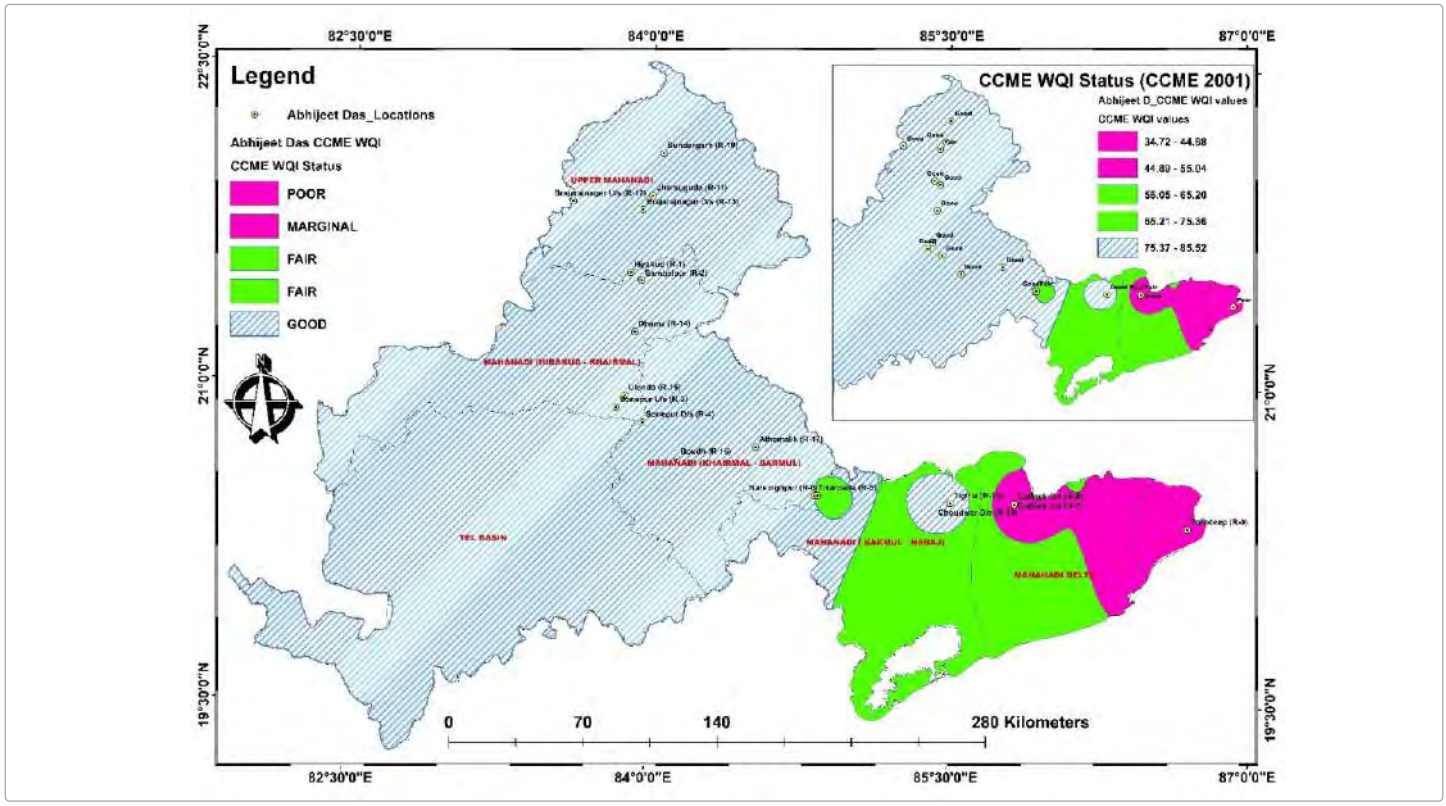

Figure 2. CCME WQI status/rating of various sampling sites of Mahanadi Basin

McCarty 1978). The WHO drinking water standard states that BOD shouldn't be higher than 3 mg/l (De 2003). BOD concentrations varied from 1.05 to 2.04 mg/l. The findings make it clear that BOD concentrations were significantly below the established limit of 3 mg/l. A modern indication of bacterial contamination is TC. The TC count of the samples taken during the study period ranged from 1212.4 to 42529.3. According to recommendations made by (WHO 2004), TC should be less than 1000. According to the findings, every station is beyond the permitted levels. The vast number of sewage discharges including human waste, surface runoff from metropolitan areas, and the percolation process may be responsible for this. This indicates that the water was contaminated and needed to be treated before use. Four key factors, including pH, DO, BOD, and TC, are taken into account for the CCME-WQI evaluation. The suggested categories for the water quality of the monitoring stations are determined based on the CWQI readings (CCME 2001). The computed WQI values for the current investigation (Figure 2) range from 34.71 to 85.52. Every location is in the good category, with the exception of R-13, R-6, and R-19, which are in the fair category and R-8 and R-9, which are in the poor category. The TC criteria that are being downgraded have their roots in the tidal influence. These outcomes are brought on by a highly populated that produces a lot of waste material, residential effluents, encroaching, and sewage systems. Following the ingestion of polluted water, the majority of the major pathogenic diseases, dangers, and dermatological issues are now known (Koli et al. 2018). The results clearly show that the water is in the "Good to Poor" segment. Therefore, more than 50% of the locales fit within the criterion of good. Using the WQI findings of 19 gauging stations, an appropriate diagram is constructed by a geospatial analysis approach for the clear visualization of the zones which are classified under different water parameters. The demographic variables were indicated on the GIS map with multiple colours, and each colouring corresponds to detailed descriptions of freshwater of variable quality.

VI. Conclusion

In this study, the Mahanadi River in Odisha had its water quality assessed. To do so, 19 sampling stations were identified, and 4 parameters were chosen. The river water sample has alkaline qualities, according to the results of the physicochemical study of water samples. The amount of dissolved oxygen in the river has increased as contaminants are introduced at various locations. BOD readings are considerably within the limits even though there have been more contaminants added at these locations. Colony of coliform was found in every sample, indicating a high level of bacterial contamination that caused a significant portion of the population to experience dysentery, diarrhoea, and typhoid. This could be related to filthy habits including open defecation, contaminated water spreading from adjacent areas and runoff through nearby ditches. The CCME WQI values were compared within the categories of Good to Poor. In terms of water performance evaluation, more than 73% of the samples fell into the "good" category, making them appropriate for consumption. The remaining 27% of the specimens required treatment before being used for drinking. According to the research aforesaid, a population growth has led to more human activities along rivers, which lower the quality of drinking environment. Consequently, the recommended actions would contribute to reducing human involvement in and all along the Stream Channel. It is also beneficial to conserve the renewable environment and lessen any adverse potential consequences of such actions.

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WATER: ETERNAL SOURCE OF LIFE

By Tariq Siddiqui, Chief Strategist, TS Advisory Services

Driven by population growth, rapid urbanization and a universal rise in the standard of living, the need for clean water is becoming higher every year. The world is facing enduring water risks with the demand-supply gap increasing at an alarming rate. With a 40% gap between global water supply and demand by 2030 and water demand for manufacturing alone projected to swell by 400% between 2017 and 2050, it is not only the people suffering from scarcity, but the industrial output is being compromised due to lack of clean water.

Sourcing water and managing wastewater is becoming increasingly difficult and expensive and hence is an important aspect for the sustainability of water. Globally there are almost 2.2 billion people suffering from water scarcity and devoid of clean water sources. The Indian scenario is not different, over 600 million people suffering with severe to extreme water scarcity. A large population in several big states in India is finding it difficult to access clean water sources near their premises.

With population and demand growth, the industrial sector in India has become an important stakeholder in water resource management along with agriculture sector and both the sectors needs to be proactive in combating water risks. Increasing industrial production, especially in water-intensive industries like thermal power plants, steel, pharmaceuticals, tanneries, pulp & paper, textiles, fertilizers, beverages, and automobile etc. is putting pressure on the limited freshwater resources in India. This coupled with increased water demand from other sectors like infrastructure development, agriculture, domestic, etc. is leading to conflicts over water availability.

Water sector can learn more from other sectors when it comes to technological intervention and better use of resources with agility in decision making and taking the risk to make bold moves for greater sustainability.

Industries that are heavily dependent on water have to cut down on their production at times due to scarcity mainly during the summer.

Such scenario has become more frequent in the past few years due to increasing water stress. Therefore, it is very critical that industries use water judiciously and reduce their water footprint as much as possible in order to be sustainable in the future.

Most industries in India have wastewater reduction targets with zero liquid discharge (ZLD). Similarly all water utilities in India should have wastewater treatment and reuse targets as the commitment. We are seeing severe impacts of untreated wastewater discharge into water bodies at an unprecedented scale with high level of contamination is all water sources.

Investment Conundrum

The continuous underinvestment in essential water and wastewater infrastructure puts the economic progress of India at risk. Closing the investment gap would make drinking water and wastewater systems more sustainable and will play a significant role in water security and industrial and commercial development leading to better economic return.

India's water infrastructure is aging, with most of the drinking water systems and wastewater treatment plants already surpassed or nearing the end of their respective design lives causing contamination and huge water loss. India's NRW is almost 50% of total supplies, losing almost 3.4 trillion litres of clean water annually to the leaking pipes.

United Nation's World Water Development report has expressed serious concern over

India will need to invest $270bn in water and wastewater infrastructure development in next 15 years.

underfunding of water infrastructure around the world. In India also, the extremely significant water infrastructure has been aging for decades and at most places it has become precarious and unreliable. The underfunding in infrastructure development limits access to clean water leading a large population to face challenges related to poor drinking water quality. According to a report by the Bank of America Merrill Lynch, India will need as much as $270 billion (INR 2.2 trillion) investment in water infrastructure over the next 15 years.

A look at India Investment Grid portal is showing the opportunities available for water infrastructure development under different segments, as following:

Sectors	No. of Projects	Planned Investment
Water Treatment Plants	1547	$112.11 Bn (INR 91,163 Cr)
Irrigation	722	$161.35 Bn (INR 1.31 Lac Cr)
Sewage Collection, Treatment & Disposal	432	$11.04 Bn (INR 8,978 Cr)
Storm Water Drainage System	166	$3.37 Bn (INR 2,740 Cr)

These projects are apart from Jal Jeevan Mission projects for rural and urban India which already have a dedicated budget of $796 billion (INR 6.47 trillion) for the period of 5 years leading upto 2024. The true challenge of water sector in India is not only to increase access to infrastructure but to increase access to reliable, sustainable, and affordable services of drinking water supply and wastewater management.

Water Use Optimization

The ardent need in India is to have effective water use optimization, improving water accounting systems, and identifying water losses and opportunities for water savings that can serve as effective approaches for reducing water consumption. Over 80% of fresh water is being used by agriculture both from surface and groundwater sources need definite target for year-on-year optimization. The industrial sector needs to optimize the consumption with recycling and reusing generated wastewater at least in the most water guzzling sectors. Optimization of water use by industries is important because it can lower water withdrawals from local water sources thus increasing water availability while also lowering effluent discharge and pollution load, reducing energy consumption, increasing productivity and making better commercial returns.

Also, efficient wastewater treatment technologies and recycling and reuse practices can bring down water consumption and wastewater generation. Further, substantial costs which are associated with water and wastewater management like water sourcing, pumping, water treatment, effluent treatment & disposal, etc. can be effectively reduced through better water and wastewater management. Periodic water audits will also help in understanding the requirement of optimization in a better manner.

Pollution Challenges

India is generating approximately 72 billion litres of municipal wastewater and around 14 billion litres of industrial wastewater on daily basis. But the treatment capacity is quite limited as just around 40% of the municipal wastewater and about 60% generated industrial effluents being treated. A huge quantity of both kind of wastewater is not receiving any form of treatment and being disposed into water bodies making them more contaminated and polluted. This trend of releasing used water into fresh water sources has dire consequences on public health as well as economic burden for healthcare. It is estimated that water borne diseases affect almost 40 million people annually while nearly 7 lac premature deaths are attributed to drinking contaminated water.

Remedial Measures

The world is changing with new innovations and the water industry has to pace with this change. There are new roles and expectations from water utilities; they do not only have to provide water supply and wastewater services, but care for the environment and the wellbeing of people they serve, while reducing carbon emissions and ensuring their services are resilient to disruptions. Technological interventions will be key to adapt and grow and embracing new ways of thinking and

The resilience of water and wastewater services primarily relies on planned investment to build and rehabilitate infrastructure across service chain of water supply and wastewater treatment and reuse facility. The world needs a more holistic approach in water sector.

anticipating risks. Unfortunately, binding constraints – short-term planning, safety and quality concerns, budget limitations, higher water loss percentage, and technological gaps pose severe risk impeding progress at the required pace and scale.

Mitigating the risk should be on the agenda of not only the water utilities, but the government should support the efforts with matching grants and required permissions. Some of the measures that could help is listed below:

- Better manage water supply complexities with a unified view of consumer data across the supply and distribution network for production of potable water and collection of used water.
- Address market dynamics and use data to monitor demand and supply capacity in real time. Correct data will help better manage network complexities with a unified view of improved asset utilization.
- Unlock valuable data for better decision-making from strategic planning to daily operations. With information at hand, utilities can ensure uninterrupted water supply while saving time and additional expenses.
- Scale new alternatives of generating water by recycling and reusing municipal and industrial wastewater.
- Building infrastructure for both supply augmentation and distribution network and addressing management of service with the goal of sustainability.
- Adopt, implement and use digital technologies such as advanced analytics and intelligent information system, AI and visualization to improve system reliability.
- Easy access of financing to create infrastructure coupled with overlapping responsibility of policy making, planning, financing, implementation, maintenance and regulation.
- Training of water engineers with the aim of providing a wider understanding of the water challenges, source augmentation, aspects of water audit, wastewater management, recycling and reuse.

Our thinking has evolved over the last few decades around wastewater as a risk to be managed rather than a resource to be captured needs to change for creating 'new water' from the wastewater. Similarly, our thinking around water harvesting and capturing storm water need to evolve into our responsibilities around the water cycle rather than being seen as separate substance.

Currently, the way water is being perceived does not match with the natural water cycle, and we are seeing the limitations of finances, regulatory and governance structures that require serious thinking and planning for the long term sustainability.

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EFFECTS OF LOW TDS (TOTAL DISSOLVED SOLID) WATER IN OUR BODY (TREATED THROUGH REVERSE OSMOSIS /OTHER SYSTEM)

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

Water is an important source of minerals in our body which are essential for proper growth and maintenance of cells/ tissues and other metabolic activities/system because they work as catalyst for different type of metabolic activities. But these minerals should be in balanced condition; neither should be much more nor less in quantity (as per prescribed limits mentioned in various national and international standards, laid down by various national and international organizations like World Health Organization (WHO), Bureau of Indian Standards (BIS) etc.). If, concentration of these mineral (Macro and micro nutrients) deviates from prescribed limits, may pose different type of metabolic aberrations/ diseases in system; either due to deficiency or excess concentration of these minerals. In present scenario, Due to urbanization, industrialization, increasing population, quality and quantity of fresh water (surface and under-ground water) reducing drastically in India and worldwide. For fulfillment of this gap, Proper management of water resources are utmost important. Due to lack of sufficient quantity and good quality of potable (palatable and aesthetically pure) and wholesome drinking water, consumers are using Reverse Osmosis (R.O.) system or other similar technologies for further treatment of surface, ground or treated water (supplied by various municipalities/organizations). Although this technology is boon for treatment of hard water or any other water which is not fit for drinking, cooking, bathing and other purposes as per national and international guidelines, but when using R.O system in piped drinking water (potable and wholesome drinking water) then its mineral contents become very low which is not beneficial for our metabolism. According to the WHO and other organizations, low TDS drinking water is not suitable for long term drinking purpose. Due to lack of sufficient quantity of mineral contents, its taste is also affected. According to Rigveda, good quality of drinking water should have following five properties:

A. Sheetham (cold to touch) B. Sushihi (clean) C. Sivam (should have balanced amount of minerals) D. Istham (transparent) E. Vimalam lahu Shadgunam (its acid base balance should be within normal limits.

Reverse osmosis (R. O) is a membrane based treatment technology, which is used to separate dissolved solutes from water or other solvents through the semi-permeable membrane against the concentration gradient (means move from a higher concentration to a lower concentration). R.O system removes most of the chemical and biological contaminants, but also removes some desired/ important minerals in maximum extent. In this regard, many scientific organizations made studies and accepted that very low TDS (Total Dissolved Solid) water adversely affecting our different type of metabolic activities. As some important minerals occurs only in water, not in other food material which we regularly consuming.

Water is an essential and vital component of life support system. The grounds as well as surface water resources are being utilized for drinking, irrigation, industrial and other purposes. However, due to rapid growth of population, urbanization, industrialization and agriculture activities, water resources are under stress. Deterioration of water quality due to geo-genic and anthropogenic activities are important factor which is encouraging to consumers to use R O system in their households. According to news published in daily News Paper "*Dainik Jagaran*" dated 14-06-2018; 13491 Million Quesec Meter (MCM) ground water available in Delhi, out of this 10,284 MCM (~ 76%) water is not fit for drinking and other purposes due to higher concentration of chemical contaminants. Due to lack of sufficient infrastructure of Rain water Harvesting in Delhi, ground water table decreasing day by day in the rate of 0.5 - 2.0 meter /years; as citizens of Delhi extracting ~392 MCM ground water/year inspite of only recharging 287 MCM/year. It means a huge difference (~105 MCM) observed between rate of extraction and recharging of ground water in Delhi.

Effects of very low TDS/ mineral water in metabolism of human and other animals, using for long time:

1. Leaching out some minerals from body: When very low TDS (Total Dissolved Solids) RO water is consumed, leaches out some minerals from the body (which is already available in body) and excreted during excretion (mainly minerals and vitamins), means less quantity of minerals intakes by water and much quantity of minerals excreted which causes deficiency of different type of minerals in body; resulting, arising different type of chronic and acute metabolic aberrations in consumers.

2. Disturb Homeostasis of body: If TDS of R O water is very low then its pH reduced (less than 7) means water become acidic which change Homeostasis/ Buffering capacity of our body fluids like blood etc., causes many types of acute and chronic disorders. In general, our body maintains pH of different type of body fluids and organs but when using acidic water for long time, pH of different type of body fluids may affected; Due to elimination of some important essential minerals like Sodium, Calcium, Chloride, Potassium ions etc. disturb the osmotic pressure of blood and other body fluids and causes electrolyte imbalance, and body organs/organelles, may not get sufficient quantity of necessary minerals. Due to this deficiency our body face headache, tiredness, weakness, muscular cramps, and impaired heart rate along with a negative impact on hormone secretion, kidney functions, bone mineral density etc.

3. Increased risk for many diseases: Recently, many studies have been made by national and international organizations and observed that low TDS/RO water may increase risk for many chronic and acute diseases. Due to lack of Calcium, Magnesium, Sodium, Potassium Fluoride and other minerals, increased risk of

cardiovascular diseases, motor neural diseases, Pregnancy disorders, goiter, gastric and duodenal ulcers, growth disorders, Chronic gastritis, bone related abnormalities and other immunity related problems. Due to reduction of body immunity, risk of multiple infections (bacterial/viral/ fungal/other microbes.) also increased manifold.

4. If we use very low TDS (Total Dissolved Solids) water for drinking purpose, it absorbs some toxic metals from the containers in which we kept it. When the concentration of minerals become very low in water then it leach out some metals from the pot; as mineral concentration is very high in pot as compared to water. This metal may be harmful for our metabolic system and causes different type of diseases.

5. If we cook food (vegetable, pulses, cereals, meat etc.) in low mineral water, high loss of Calcium, Magnesium, Cobalt, Copper and other minerals (approx. 50-80%) have been observed. But when use proper mineralized water for cooking, loss of these mineral contents is much lower as compared to less mineralized water.

6. When we consume very low TDS water, we feel Poor taste which is not agreeable as per norms. According to my view, TDS between 100-500 mg/L, having good taste of water. In this TDS range pH of water will be also above 7.0, which is good for health, maintain homeostasis of body and minerals contents will be in balanced condition and fit for drinking and other household purpose.

7. When we use Reverse Osmosis system for treatment of water then most of the water drained out as a wastage (apprx. 70-90 %), which increase water scarcity. Although, this water may be reutilized for secondary purposes (except drinking) like washing of utensils, gardening, flushing or other uses (as per suitability/ quality of waste water).

8. Drained water of R. O. system may contaminate surface/ground water due to excess quantity of heavy metals, trace elements or other minerals. This water increase the hardness and salinity of water bodies in which this water is mixing and after percolation this water mixed into our aquifers and its quality may also affected.

9. Drained water of R. O. system, may change soil texture. if use waste water of R.O. for irrigation of crops for long time. .As this water is full of different type of heavy metals, trace elements etc. and may change the pH, mineral contents, microbial diversity etc. of soil which affect the quality and nature of soil and ultimately, the productivity of land may reduce drastically.

10. Maintenance of R.O. system is expensive as compared to other simple filtration system because different type of membranes are being using in R.O system which are costly and required to replace it periodically for getting sufficient amount of desired quality of water. It also increase electricity bill and ultimately increased financial implications. Risk of bacteria/ or other microbial growth in final filtered water increase, if membrane could not cleaned/ replaced timely in R.O. system.

Alternate technologies of RO systems:

1. Boiling of water: This method is using by consumers for last many decades, when R.O and other such type of technologies were not existed. This method is very useful for removal of microbial contaminants like bacteria, viruses, fungi etc. In present prospective this technology is equally important and mineral loss have been not observed after boiling of water.

2. By using different type of disinfectants: This is the important technology for eradication of microbial and other biological contaminants. This is also being in use for last many decades. Some important disinfectants are Chlorine, Chlorine dioxide, Ozone etc. Liquid Chlorine is using in different type of small and large scale water and waste water treatment plants as a disinfectant in large scale.

3. Soil/ metal Pots: Since ancient time, people were using earthen/metal (copper and other alloy) pots for storage of drinking water. Copper pots having microbicidal property and it kills different type of microbes which may available in water. Earthen pots are also good for cooling of drinking water especially in summer season due to availability of small pores which help in evaporation and cooling of water.

4. Ultra violet rays or other simple filters: Ultra-violet rays filters are very useful for filtration of water; as this filter kills different type of microbial contaminant and also remove dust particles if available in water. This technology is boon for the consumers which are getting water, supplied by various municipalities; as different municipalities treating surface or ground water in water treatment plants or other suitable location by using different type of technologies before supplying to consumers. These utility organizations also checking water quality randomly from WT P till consumers houses for ascertaining the quality of supplied water as per norms laid down in IS 10500:2012 or other national and international guidelines.

On the basis of above discussion, we may conclude that primarily, we should discourage use of R.O. system in treated water (As it is treated and tested as per national and international norms before supply to consumers). National Green tribunal (NGT) also suggested to avoid R.O. system in drinking water which is fit for drinking purpose as per BIS-10500-2012. Secondly, BIS (Bureau of Indian standards) and other national and International agencies may set guidelines for treatment of water through RO like other packaged/treated drinking water. Minimum and maximum desired limits should be clearly mentioned in guidelines and must be mandatory to adopt/implement by all the stakeholders like manufacturing companies and consumers also.

ABOUT THE AUTHOR

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

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

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THE FUTURE OF TRENCHLESS TECHNOLOGY FOR PIPE INSPECTIONS I HOW ROBOTICS ARE REMOVING THE NEED FOR CONFINED ENTRY

By Riley Kooh, Content Manager at Pipe Trekker

Content Start

Across any industry, staying on top of asset conditions is vital for safety, efficacy, and budget forecasting. Stormwater systems are no exception. Visual inspections of material storage and outdoor processing areas, as well as discharge areas and their surrounding environments are essential to a well-functioning stormwater system. Over time, asset integrity begins to dwindle, and having consistent condition intel is the only way to minimize risks of contamination, flooding, blockages, and collapsed pipes."

What is Examined in a Stormwater Inspection?

Depending on the size of the site location, stormwater systems can be immense. With the potential to affect millions of citizens or contaminate massive plots of land in the event of a system failure, detailed inspections are vital. When inspecting a stormwater system, there are a variety of potential issues that can be cause for concern.

- Cracks
- Leaks
- Offsets/Disjoints
- Ovality
- Blockages in Pipes/Sediment Build-up
- Foreign Debris
- Corrosion
- Collapses
- Status of previous repairs

Why is a Stormwater Inspection Important?

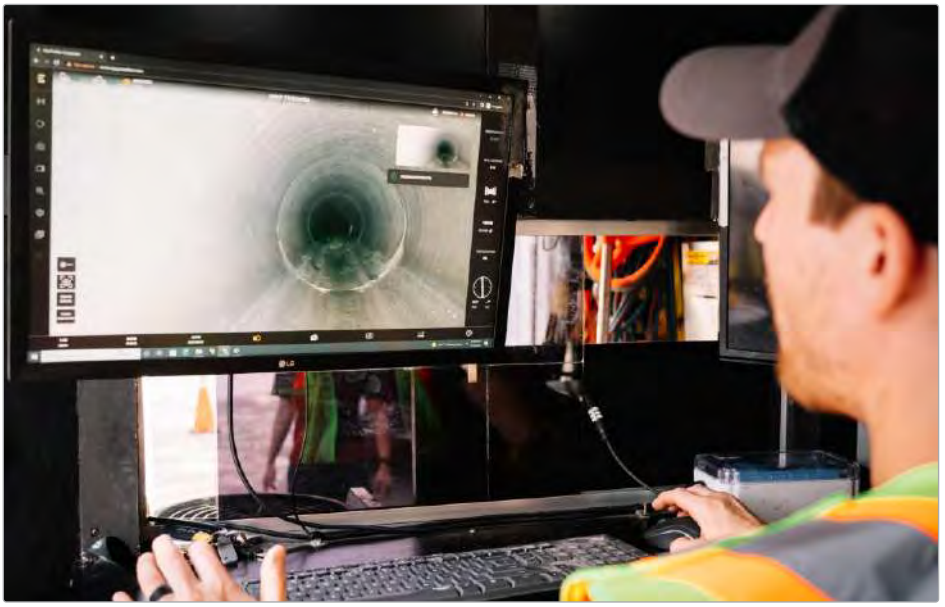
It is crucial to manage stormwater for several key reasons. With the proper tools, inspections are a non-invasive, low-risk preventative measure against issues, from the health of local waters and aquatic life to flood risk mitigation.

Maintain the Hydrologic Cycle

Improperly managed stormwater can reduce moisture replenishment in the soil and minimize groundwater recharge. Soil moisture is essential for vegetation, while loss of groundwater recharge can severely reduce stream baseflow, necessary for aquatic life. By managing stormwater correctly, the hydrologic cycle can be maintained to ensure healthy plant and aquatic life.

Prevent Flooding

Without adequate stormwater maintenance, the risk of flooding, especially in urban areas, is greatly increased. As water cannot be



absorbed into the concrete that covers large swaths of towns and cities, the excess water from rain and thunderstorms must be managed to prevent loss of life and property damage by flooding.

Prevent Stream Erosion

While erosion is a normal part of stream behavior, excess stormwater can greatly increase the amount of erosion as abnormal amounts of water enter streams during storms. This extra water increases both the volume and rate at which water - and the sediment in the water - is delivered to streams. This extra water can increase erosion on stream banks and beds, damaging the natural form of these streams. The degradation of these streams can lead to a massive decline in plant and animal diversity. Proper stormwater management can effectively mitigate these risks.

Forecasting for Maintenance Budget Optimization

While no future outcome is 100% predictable, inspection report data is a beneficial tool for educated predictions of budget allocation. By following a dedicated asset health grading system, facilities should be able to narrow down to the year when maintenance will be required. Having this information on hand lowers the risk for costly surprise repairs or large-scale collapses.

How is a Stormwater Inspection Conducted?

In order to conduct a proper inspection, a full visual inside the length of the pipeline is required. Depending on the pipe dimensions and water levels, this can either be done by manned entry or remotely using ROVs or Pipe Crawlers. Generally, in order for a pipe to be entered safely, the diameter must measure a minimum of 48" (122cm). In modern practice, portable robotic solutions streamline visual inspections for safety, access a wider variety of pipes, and instantaneously run reports.

The Tools Used

Pipe Crawler

Pipe Crawlers are an extremely effective way to inspect dry or partially submerged stormwater pipes. Stormwater pipes are often corrugated steel, HDPE, or concrete. Opting for pneumatic tires, tracks, or rubber wheels are ideal for traction on these materials, being adept at traveling through mud, sand, or for getting over debris.

ROV

For fully submerged large diameter pipes, ROVs are the most effective tool for visual inspections, offering intuitive controls and tilt cameras to make it incredibly easy to get crisp visuals of the entire pipeline. One of the drawbacks of a ROV inspection is that the entire pipe must be filled with water for a full survey.

Floats

For partially submerged, large diameter (900mm/36"+) pipes, floats can be a viable option. Floats can provide multi sensor capability and can travel long distances, but generally need significant flow to operate. For extremely large tunnels that are dry, manned entry is still a reasonable option. However, deploying a crawler is the safest alternative.

Reporting Software

Visual inspections provide integral information to municipalities or organizations about the status of their storm and sewer infrastructure. Using tested and validated reporting programs ensure that teams are provided a convenient import and export using the NASSCO file.

There are several NASSCO certified software options that are used to document PACP inspections. Pipe Trekker offers straightforward WinCan and POSM software compatibility, and integration with GraniteNet, ITPipes,and CTSpec, among others.

How Pipe Trekker can Make a Difference in Storm Water System CCTV Inspection
Implementing a Pipe Trekker crawler or Deep Trekker ROV for stormwater inspections empowers operators to conduct inspections safer and easier than ever before. From 2011 - 2018, 61 fatalities were reported on the job inside a manhole, sewer system, or storm drain. With the use of remote inspection vehicles, operators never have to enter a confined space.

Town of Renfrew - Case Study

The town of Renfrew is a small municipality, with a storm and sanitary system including 89 km (55 miles) of pipe. In 2005, Renfrew hired a CCTV service company to inspect 75% of their system, totaling $400,000 to complete. The town used to call on a contractor 10 - 12 times a year to provide CCTV services.

Mission Objective

Renfrew understood that CCTV camera inspections of storm water pipes ensure the integrity of the system, and minimize risks of contamination, flooding, blockages and collapsed pipes, although the high cost of inspections limited their abilities to do so. Their mission was to reinvent this process in order to minimize these sunk costs for continuous inspections while maintaining employee safety.

Equipment Used

A Pipe Crawler was a perfect solution for Renfrew's high inspection costs. At the time,this system cost USD$13,000 to purchase, and gave their internal staff the ability to effectively inspect pipelines 8 - 36" in diameter.

Internal, on-board batteries mean that no generators or topside power sources are required. Traditionally, CCTV inspection systems require a dedicated truck for all of the components including a tether, winch, and power source. The crawler packs down into two carrying cases and can be set up and deployed in less than a minute.

Results

Nearly immediately upon purchase, everyone on the municipality's team was able to operate the handheld controller, maneuver the CCTV camera and view the live video feed on the unit's super-bright integrated screen. The first day of ownership, Renfrew successfully used the crawler to inspect a 10" storm pipe that would have previously been contracted out. "Another reason we opted to purchase the equipment was to deploy the camera on our schedule rather than waiting on a contractor." - Lane Cleroux, Town of Renfrew

Toronto Water - Case Study

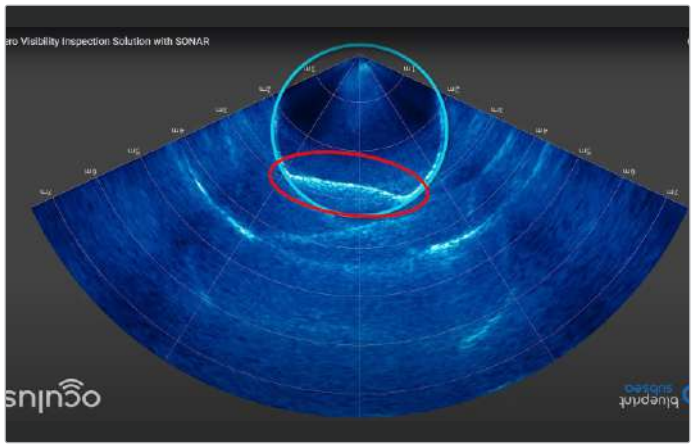
Mission Objective

The goal of this particular mission was to evaluate the condition of a combined sewer and storm water tunnel for Toronto Water. PipeTek needed to provide a report of the tunnel and associated pump and intake structures to determine the best next steps for managing the structure.

Equipment Used

Since this was a 530m long, fully submerged tunnel, the REVOLUTION ROV was chosen for the task. Longer tunnels with sediment in the bottom proved to be more difficult for pipe crawlers, robots that PipeTek had significantly more experience with at the time.

Results



The problem with pipe crawlers is that their wheels or tracks stir the sediment, obstructing the view of the tunnel. They also have a shorter range of view, because their cameras can only raise so far from the bottom of the tunnel. Human entry in this long of a tunnel would be far too dangerous. By utilizing a free swimming ROV with an imaging sonar, PipeTek was able to capture a thorough report of these tunnels and structures.

Overall, this survey was a complete success despite having zero visibility for the camera. Using the imaging sonar combined with the flexibility of the rotating camera head on the REVOLUTION, PipeTek was able to identify several points of interest for Toronto Water to evaluate and plan to reinspect, such as protruding laterals, pits, cracks, and sediment levels. Not only were these points of interest located and photographed, they also were able to measure these with the sonar tools available.

Sustainable Solutions for Effluent Treatments

Whether the concern is to maintain water quality or supply consistent intel on asset conditions, key challenges can be identified easier by robotic CCTV inspections. The integrated sondes of the Pipe Trekker A-Series greatly improve efficiency. Offering a visual inspection alongside location identification, workers can pinpoint exact locations of concern for targeted section maintenance.

ABOUT THE AUTHOR

Riley *has been the Content Manager at Pipe Trekker since late 2020. His experiences in the field working with dedicated customers in sewer, stormwater, general infrastructure, and other industries have shaped his work with various case studies and editorials about the use of robotics for pipe inspections. As a goal to limit the need for dangerous confined entry for workers around the world, Riley's work highlighting the benefits of remote inspections can be seen published in Trenchless Technology Magazine, The Journal of Ocean Technology, International Water Power and Dam Construction Magazine, Subtel Forum, and more.*

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BIOTECHNOLOGY INNOVATION BOOSTS ANAEROBIC DIGESTION

By Dave Shackleton, CEO, SISBIO

The Problem

Anaerobic digestion deals with the majority of organic load in wastewater treatment. This may be through pre-digestion, through digesting sludge that is removed in settlement tanks and clarifiers, or as waste activated sludge from aerobic treatment tanks.
Anaerobic digestion is achieved with enzymes that successively break down long chain biochemical polymers (proteins, lipids, carbohydrates etc) into their sub-components.

The first step in the production line is hydrolysis and this breaks up

- Carbohydrates into sugars
- Proteins into amino acids
- Lipids into fatty acids

(Note that acids are produced, which will lower pH below neutral 7)
In the next step in the process, enzymes drive acidogenesis (the generation of more acids) as the sugars, amino acids and fatty acids are broken down to produce substances such as acetic acid.

The final step is methanogenesis, or methane (biogas) production. The problem is that the microbes responsible for methanogenesis are very sensitive to pH, and require a pH between 6.5 and 8.0 to function.

Acidogenesis can cause pH to drop below 6.5, inhibiting methanogenesis. This means that the process can become self-limiting over time if the pH of the digester remains low. The production line is blocked, and we say that the digester has "gone sour".

This is particularly a problem if the anaerobic digester is intended to produce biogas (methane).

When undigested sludge is discharged into sludge drying beds, there is minimal reduction in the volume of solids, and sludge drying beds become unusable because they are full of undigested sludge. This must be physically removed, and does not provide bioavailable nutrients if it is used as an agricultural fertilizer, resulting in nutrient runoff when it rains which contaminates natural water resources.

The Solution

Each step in the digestion production line is driven by enzymes that are produced by bacteria. When pH rises and the bacteria responsible for producing the enzymes for the next step of the

Undigested sludge in a sludge drying bed

process are inhibited and die off, a back-up is created and the whole of the rest of the production line is affected.

Adding more bacteria or microbes into such an environment is ineffective because they soon succumb to the hostile environment. However, adding the enzymes that the bacteria produce allows the process to be driven forward, and efficient digestion to be restored.

Key Parameters

The key parameters that indicate that the digestion process is inhibited are

- **pH** which should be above 6.5
- **Total Fats, Oil & Grease**
- **Volatile Fatty Acids**
- **Total Alkalinity**
- **Volatile Fatty Acids to Alkalinity ratio** – this should be maintained between 0.5 and 0.15.

Proof of Performance

Two anaerobic digesters had become completely dysfunctional, the digesters themselves had a solid layer of sludge 5 feet thick and sludge management processes were unable to cope with the volume of solids and the costs of trying to do so were unaffordable.

Laboratory analysis of samples taken from the digesters showed how bad the situation was.

	Before	Target
pH	5.96	6.5 – 8.0
Total Fats, Oils & Grease	226 ppm	
Volatile Fatty Acids (VFA)	1 100mg/l	
Total Alkalinity	1 700mg/l	
VFA / Alkalinity Ratio	0.62	0.50 - 0.15

Biotechnology in the form of enzymatic supplementation allows us to tackle the problem at the biochemical level directly. By dosing the enzymes that are in short supply because of the inhibition of the microbes responsible for producing them due to the low pH causing an acidic environment, the enzymes clear the hold-up in the "production line" and restore functionality.

Enzymes were dosed into the digesters, and circulation pumps run for a few hours daily. The improvements achieved within 7 days are shown below.

	Before	Target	After 7 days	% Improvement
pH	5.96	6.5 – 8.0	6.86	
Total Fats, Oils & Grease	226 ppm		9 ppm	96%
Volatile Fatty Acids (VFA)	1 100mg/l		64mg/l	94%
Total Alkalinity	1 700mg/l		1 400mg/l	18%
VFA / Alkalinity Ratio	0.62	0.50 – 0.15	0.05	92%

With full functionality and performance restored to the anaerobic digesters, the amount of residual sludge and solids was reduced by over 80%, making management of this easier and cheaper.

When sludge is fully digested volume reduction of over 80% is achieved in sludge drying beds, and the remaining solids can be swept out with a broom.

Note newly filled sludge drying bed to the right, remaining solids being swept out with a broom to the left

ABOUT THE AUTHOR

Dave Shackleton *is the Co-Founder and CEO of SIS.BIO, a provider of biotechnology solutions to support the renewal of our world's water systems.*

For the last 10 years, Dave has worked with water resource managers and wastewater systems operators across four continents to help restore compromised waterways and wastewater systems. SIS.BIO's multidisciplinary approach prioritize nature and eliminates the need for chemicals. Prior to entering the water sector, Dave played leadership roles in new technology start-ups ranging from the first digital music recording studios to digital satellite TV, cellular telephony, internet service provision, e-commerce, software and IT services, establishing dominant players in their markets.

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

MAINSTREAM NITROGEN REMOVAL IN WASTEWATER BY SIMULTANEOUS NITRIFICATION AND DENITRIFICATION UNDER LOW DISSOLVED OXYGEN CONCENTRATION ENVIRONMENT

By VINCI Construction Grands Projects: M. Olivier GUERANGER, M. Jonathan PRINS, INRAE UR REVERSAAL : M. Jean-Marc PERRET, with the Participation of BDP EnviroTech LLC, USA

Introduction

Aeration represents almost half of the energy consumption of a treatment plant ref 1: a conventional activated sludge system treating nitrogen during the aeration phases has an excess of dissolved oxygen concentration so that oxygen is not the limiting factor in treatment. Typical dissolved oxygen concentration for activated sludge is in the range of 1.0 to 1.5 mg O2 / L. The nitrates are eliminated by the heterotrophic bacteria either during the anaerobic phases (separation in time), or in a second unventilated reactor (separation in space) ref 2.

In order to significantly improve the energy consumption of biological treatment and reduce the footprint of the entire wastewater treatment stations due to increasing landscape restrain, it is advantageous to treat nitrogen by carrying out the nitrification/denitrification simultaneously in the same continuously anaerobic tank ref 3.

An innovative process, invented by BDP EnviroTech, allows a simultaneous nitrification/denitrification (SND), and its purifying performance could meet the requirement of the discharge level, particularly on nitrogen concentration (output <10 mg/L), with high compact footprint (50% less landholding than a traditional process). In addition, energy consumption is a particularly advantage (50% less energy consumption on the aeration station compared to a conventional process) thanks to the extreme low O2 concentration required in the biological reactor.

The company BDP EnviroTech has over sixty plants globally plants of the process in the USA, Europe and Asia

In 2019, VINCI Construction Grands Projects entered into a global technology licensing agreement with BDP EnviroTech LLC.

A study was conducted by Vinci Construction Major Projects and IRSTEA of Lyon, now INRAE, in order to study the function and the

Figure 1: BDP AIO-Loop TM pilot test, installed in the IRSTEA - INRAE experiment hall, Mar 2018

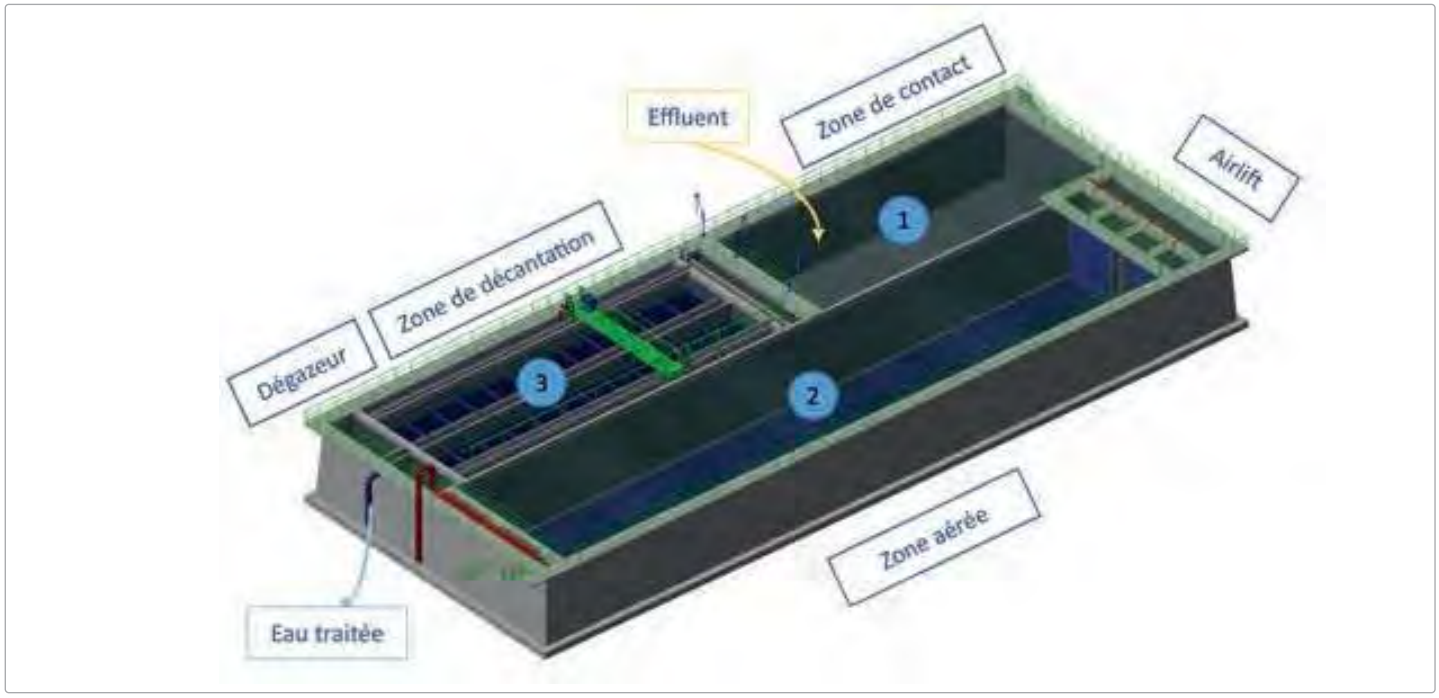


Figure 2: 3D scheme of BDP AIO-Loop process

performance of this process, called AIO-LoopTM ("All-in-One Loop"). A summary of the results of this study is presented below.

1) Material and Methods

1.1) Material

Industrial pilot – BDP AiO-Loop™ process:

Sized at low mass load, the BDP AiO-Loop™ operate with a high biological sludge concentration. A strong internal circulation of sludge of the order of 20 times of the incoming flow is provided by the airlift.

The industrial pilot (effective volume of 48.5m3) is a small-scale reproduction of the process and consists of three sections, numbered in the diagram above:

1) **An anaerobic and mixing basin that the effluent to be treated flows into (Contact Zone)**
   This section allows good homogenization of the effluent to be treated with the biological sludge. The strong internal circulation means that the detention time in this basin is too short for the denitrification reaction to take place.

2) **Aeration Zone**
   Hydraulic circulation is provided by an airlift placed at the front of this zone. The aeration system patented by BDP EnviroTech helps prevent the coalescence of air bubbles. The entire area of this aeration zone is covered by the aeration system at the bottom, allowing a homogeneous distribution of the aeration.

3) **A degasser and a clarification section (Fast Clarification Zone)**
   The water is clarified in the clarification zone by the lamella. The sludge continues to circulate at the bottom of the structure towards the Contact Zone (1), which forms the closing operating loop of the process.

1.2) Methods

1.2.1 Effluent

The pilot test is operated continuously and at a constant rate with raw municipal wastewater after the bar screening process (5cm mesh and 10mm mesh), the characteristics of the influent are as follows:

Analysis parameters	Average concentration (4 months)	Units
TSS	312	mg/L
BOD_5	219	mg/L
COD_{Total}	470	mg/L
$COD_{filtered}$	156	mg/L
N-NH4	42	mg/L
Conductivity	1255	µS/cm
pH	8	[pH]

1.2.2 Sludge Seeding

The sludge in the pilot test is carried out from a nearby wastewater treatment plant with good settling properties (sludge index SVI = 120 mL/g). During the sludge feeding, a high dissolved oxygen concentration (1.5mgO2/L) was maintained in the aeration zone to create a similar dissolved oxygen concentration environment to the sludge in the original environment, in order to minimize the huge change of environment and effluent for biology.

1.2.3 Load Increasing

The development of the biomass after seeding will increase over a period of 1.5 months (increasing from 1.7 g/l to 5 g/l MLSS) while keeping the load constant.

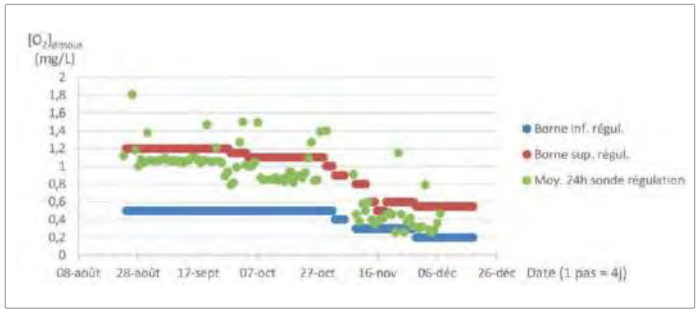


Figure 3: Evolution over time of the average concentration over 24hours of O2, dissolved with the upper and lower thresholds

The seeding of the reactor with the sludge from an existing wastewater treatment plant, allowed us to speed-up the start-up process, although this is not a process prerequisite.The sludge then naturally adapted to the process conditions (low aeration, high circulation).

The initial high oxygen delivery during the seeding phase does not correspond to the normal settings and it has been slowly reduced while controlling the impact on the overall treatment.

Two different sequences can be observed in the monitoring: first sequence (before changing the setpoint), comparing to the conventional activated sludge type aeration (1 <O2 <1.2 mg / L), and second sequence (before changing the setpoint), with a lower dissolved oxygen concentration (0.3 <O2 <0.5 mg / L), corresponding to the instruction.

1.2.4 Operation Parameters

The operation of the pilot plant is based on a 0.1 kg of BOD5 / kg MLVSS mass load during the entire monitoring. With a temperature between 17 and 24 °C, the sludge concentration in the reactor could reach 5g TSS/L, maintaining the sludge circulation under 20 times of the feed rate ref 4.

2) Result

2.1) Characteristics of biological sludge

During the monitoring of the pilot plant, the changes of MLVSS rate and the sludge index were observed, which indicate that biomass adapts the low dissolved oxygen

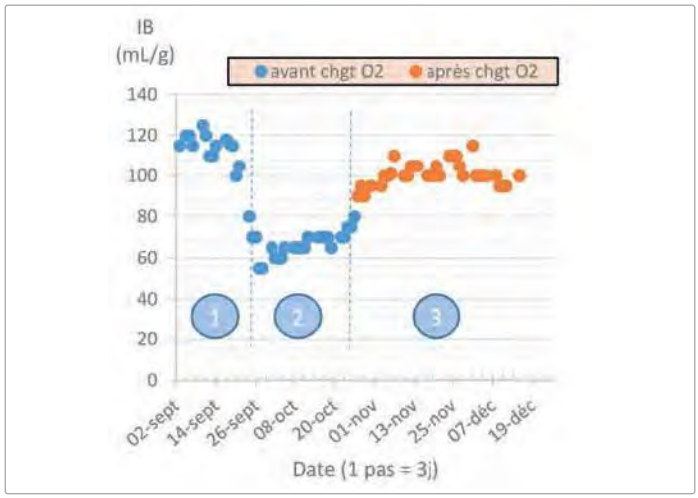


Figure 4: Evolution of the sludge index over time

Figure 5: Evolution of the MLVSS rate over time

concentration and high internal hydraulic circulation environmental. These changes

in the sludge coincide with the change in the dissolved oxygen setpoint, as shown in Figure 4 and 5.

The parameters evolution over can be distinguished according to several phases:

1) **September:** Adaptation phase of the feeding sludge to the new process.

2) **October:** Formation of successive "plateau", which correspond to a stabilized condition, with a strong sludge adaptation of hydraulic circulation and dissolved oxygen concentration of around 0.9 mg/L.

3) **November - December:** Transit to a new plateau, with the change of the oxygen setpoint applied at the end of October, reaching a stabilized condition with low concentration of dissolved oxygen which is capable of carrying out simultaneous

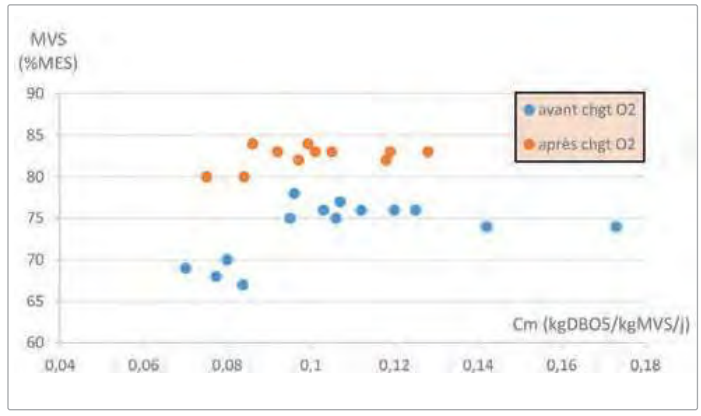


Figure 6: MLVSS rate as a function of the applied mass load

nitrification/denitrification.

Before reaching this final stabilized state (phases 1 and 2), the nitrate releases amount was substantial, which between 25 and 30 mg N-NO3-/L, indicating the sludge denitrifying ability with the high oxygen concentration setpoint.

The level of MLVSS measured (84%) is higher than the normal recorded value

Date	TSS	T	DO regulation concentration	DO probe 1	DO probe 2	[N-NH4] analysis	[N-NH4] probe	[N-NO3] analysis	[N-NO3] probe
	g/L	°C	mgO2/L	mgO2/L	mgO2/L	mg/L	mg/L	mg/L	mg/L
Nov.15	5.04	19.6	0.35	0.38	0.27	5.0	1.2	1.7	1.3
Nov. 20	6.02	16.5	0.48	-	0.41	1.7	0.3	1.6	0.4
Nov. 27	4.49	15.4	0.42	0.39	0.39	<0.5	0.2	5.0	6.2
Nov. 29	5.03	16.8	0.32	0.32	0.30	1.9	1.0	0.9	1.6
Dec. 04	5.45	16.9	0.26	0.48	0.27	1.2	1.9	1.6	0.3
Dec. 07	4.98	17.2	0.34	0.45	-	6.2	0.5	1.6	2.7

The values presented are averages over 24 hours, except the suspended solids of the basin
Table 1: best performances examples of the nitrogen concentration at the effluent and aeration balance

(normally around 75%) with prolonged aeration of activated sludge.

Figure 6 represents the rate of MLVSS measured as a function of the mass load applied to the pilot.

We observe that the different levels of MLSS measured (before and after changing the ventilation) are not a function of the mass load in the range. Therefore, they correspond well to a modification of the sludge due to the different operation conditions of the process.

2.2) Treatment of Nitrogen

Experimentally, good simultaneous nitrification/denitrification performance was achieved for a dissolved oxygen concentration measured in the aerators, which between 0.3 and 0.4 mg O2/L. (Figure 7).

The optimum value for dissolved oxygen in the aeration tank is 0.36 mgO2/L. When the dissolved oxygen concentration greater than this value, nitrate release will increase linearly, while the dissolved oxygen concentration lower than this value, the ammonium release will increase exponentially.

Therefore, under the optimum value of the dissolved oxygen, the release amount of N-NH4+ and N-NO3- are 2.5mg / L N-NH4+ and 2.5mg / L N- NO3- respectively.

During the experimental, the effluent concentration reaches the lower value after stabilization.

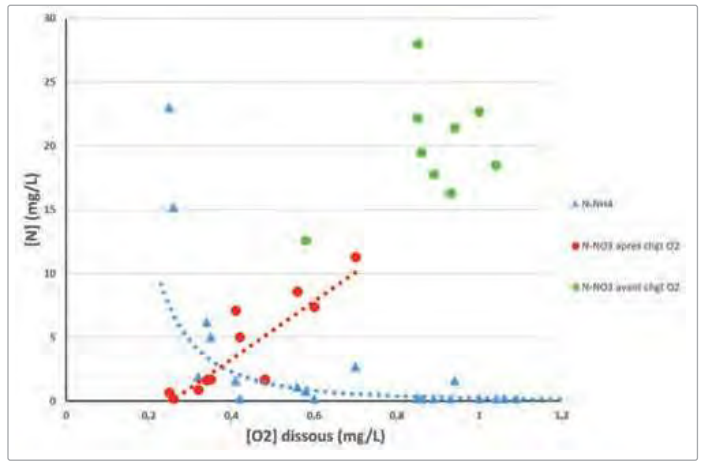
These results indicate the possibility of obtaining the excellent nitrogen removal performance with low dissolved oxygen concentration and continuous in the aeration tank.

2.3) Release and elimination yield

During the monitoring, the concentrations of the release and the elimination yields

	COD	$COD_{filtered}$	BOD_5	TSS	N-NH4	$N-NH_3$	TNK	$P-PO_4$
mg/L	90-95	20-25	10	41	1-3	2-5	2-6	4-4.5
%	86	87	97	79	95	-	95	16

are as follows:
There's a non-optimized carbon treatment, which is because the sludge losses due to the insufficient sizing of the pilot plant in the clarification zone (insufficient STP). Simultaneous nitrification/denitrification carried out with continuous aeration at a low concentration of dissolved oxygen and conventional assimilation of phosphorus.



The values presented are averages over 24 hours Figure 7: Concentration of N-NH4 and N-NO3 at discharge, depending on the dissolved oxygen in the aeration basin.

Therefore, the results measured on the pilot plant met the discharge compliance according to the law in nitrogen-sensitive areas for wastewater treatment plants less than 100,000 PE.

3) Conclusion

The BDP AIO-loop™ process opens up prospects for wastewater treatment systems with less energy consumption and more compact footprint. In fact, in the case of simultaneous nitrification/denitrification and under low dissolved oxygen concentration environment, all the biomass is active. The characteristics of biomass is that the floc consist of a sufficiently ventilated external layer, responsible for nitrification, and a core responsible for the denitrification.

The sludge in the process has a notable specific characteristic: a high concentration of biological sludge (5 g TSS/L obtained during this experiment) and a high level of MLSS. Through simultaneous nitrification/denitrification biological treatment, the structure is much compact, and the footprint is smaller. The internal circulation loop includes a lamellar clarification zone which also contributes to the compaction of the treatment. There is no sludge recirculation or thickening of the clarification part. This last feature allows energy savings in comparison to a conventional installation as there is no need of pumping devices for re-circulation of the sludge. In addition, the sludge index obtained during monitoring is low (SIV= 100 mL/g), which shows the good ability of the sludge settling.

The environmental conditions of the process as well as the characteristics of the

sludge allow simultaneous nitrification/denitrification, without recourse to bio-media or syncopation aeration, unlike already existing simultaneous nitrification /denitrification processes. Given the absence of sowing prerequisites, such as using media or culturing the particular biological beforehand, the start-up of this process could be done without constraint. The BDP AIO-Loop™ process, compact and innovatively designed for the treatment of municipal water, paves the way for less energy-consuming sectors, taking a new step towards the wastewater treatment plants in the future.

4) Thanks

This study was carried out jointly over a period of 10 months by:

- Vinci Construction Grands Projects - Hydraulic International, which designs and builds water treatment stations and purification stations, as well as other hydraulic structures, in France and internationally.
- IRSTEA, a public research institute which merged on January 1, 2020 with INRA to form INRAE (National Research Institute for Agriculture, Food and Environment).

We would particularly like to thank BDP EnviroTech, inventors of the process, special thanks to Eric Li, Gilles Kauer, and Yang Shoubin of BDP for complete technology package with the commercial treatment pilot unit and technical assistance during the study.

5) Reference

Ref. 1: Consommations énergétiques des stations d'épuration françaises : État des lieux et recommandations, Irstea, janvier 2018

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M. Jonathan PRINS, Process & Design Engineer

INRAE UR REVERSAAL : M. Jean-Marc PERRET, Head of La Feyssine Research Hall

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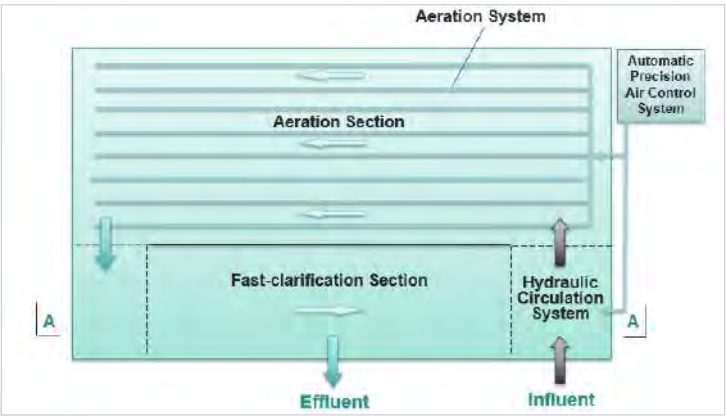

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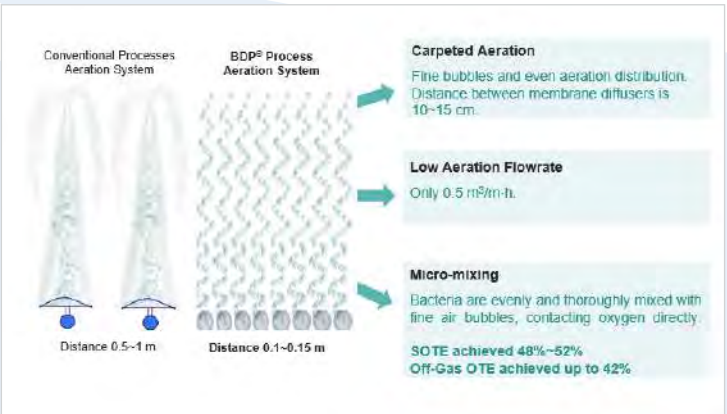

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2. ***USA - BDP "aeration technology is highly efficient"***
3. ***China - BDP "highest nitrogen removal wastewater treatment".***

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ENERGY FROM THE OCEAN – BLUE ENERGY

Pieter Hack – Chairman & CEO and Geeta Singh, Director, REDstack Energy India Private Limited,

Pieter Hack – Chairman and CEO of REDstack B.V. (the Netherlands) has now established REDstack Energy India Private Limited, to be able to continue working on 100% renewable and fully sustainable energy, produced by mixing the two water sources, ocean water with river water, called "Blue Energy". REDstack uses the Reverse ElectroDialysis ("RED") technique for generating electricity from fresh-saltwater differences. In Reverse ElectroDialysis (RED), two types of ion-selective membranes allow respectively positive and negative sodium and chloride ions to pass through, creating a small potential. By placing several membranes in series, a voltage difference is created, which is converted into electricity.

Reverse electrodialysis is the reversed operating mode of the process used to desalinate salt water using ion-selective membranes (electrodialysis or ED).

Oceans are a source of abundant renewable energy potential, capable of driving a "blue economy" based on sustainable use of ocean resources. Energy harnessed from the oceans, through offshore renewables, can contribute to the decarbonisation of the power sector and to other end-use applications that are relevant for a blue economy. Nascent ocean energy technologies – including wave, tidal, ocean thermal energy conversion and Salinity Gradient Energy – can make use of this enormous potential in line with overall sustainable energy and economic development.

REDstack is looking to address one such issue of being able to use water resources to generate full continuous energy (365 x 24 x 7) power. The REDstack technology derives energy from the difference in salinity of two water bodies (also known as Salinity Gradient Power/ Osmotic Energy/ Blue Energy), which can be extracted by placing ion-selective membranes between a fresh and a salt water stream.

Through generation of Blue Energy, REDstack is trying to provide an alternative Energy Transition opportunity to the World. Electricity generation accounts for about 26% of total greenhouse gas emissions making it an important target for emissions control in the war against climate change. For a sustainable energy transition for sustainable electricity generation and supply in line with commitments of the Paris Agreement aimed at reducing greenhouse gas emissions and limiting the rise in global average temperature to 1.5°C above the pre-industrial level, the sustainable transition strategies typically consist of three major technological changes namely, energy savings on the demand side, generation efficiency at production level and fossil fuel substitution by various renewable energy sources and low carbon nuclear.

India has stated and ambitious target of 450 GW of Renewable Energy capacity addition by 2030. In order to achieve this plan target, India needs to work on four fronts:

Grid Stability: coupling large scale renewable energy projects with battery storage systems, in order to have a stable grid, as the load of conventional power from fossil fuels is reduced.

Limited availability of Lithium Ion: We are well aware that the availability of Lithium Iron for creating batteries is limited/ scarce and can jeopardize the future of round the clock renewable energy. Blue Energy offers a solution to harvest osmotic energy, without having to use any raw material, which is not available in abundance.

Large transmission network: since renewable is a distributed form of energy, the government needs to build in large transmission network, to be able to offtake the power generated.

Variable renewable energy sources: though solar, wind, biomass and wind energy have immense potential; however, it is not sufficient to meet the energy transition needs. Therefore, there arises a need to work on innovative form of renewable energy, such as Osmotic energy, Tidal energy, etc.

REDstack B.V. has set up world's first kW scale Blue Energy pilot project (containing full scale process design which can be implemented for 100 MW Blue Energy project), in Breezanddijk on the Afsluitdijk in 2014 and officially put into use by King Willem-

Mr. Rik Siebers, REDstack's Managing Director, received the National Icon award from the Dutch Minister of Economic Affairs, on behalf of the Dutch government in 2016

Alexander. Initial years of these projects went into addressing hick-ups such as clogging and fouling. The company was able to overcome all such obstacles and the project has now been running successfully for over 2.5 years, generating 1 kW sustainable and renewable electricity.

RED (Reverse Electro Dialysis) is a form of sustainable energy extraction. The 'fuel' consists of fresh and salt water. Rivers flow into the sea and there the fresh water mixes with the salt water. These are the most obvious suitable locations for the application of RED. Some of the river water is led in parallel with seawater through a membrane stack in an enclosure called the RED-stack. This is where the company REDstack got its name from. Salt and fresh water are contacted in a controlled manner in the stack and electrical energy is gained through this process. The resulting brackish water is returned to the sea and the electrical energy is delivered to the grid and distributed from there.

The driving force is derived from nature. Nature wants to level out differences. REDstack uses the difference in salt concentration as the driving force for ion transport through the membranes. By alternately stacking two types of ion-selective membranes, the positive and negative ions from the salt water are forced to flow into opposite directions, creating a voltage difference. This voltage difference is converted to electric current at the electrodes.

The method for extracting this energy - and this is the method developed by REDstack, is to use membranes that allow only the charged salt particles (ions) to pass through. Salt ions, (Cl- and Na+), are very small, so that - given the right composition of the membrane - a fast, efficient and safe (no damage to the membrane) process can take place. This is the principle method that was described by R.E. Pattle in 1954, in its essence. First it was a theory, then proven in the lab at WETSUS water research Centre in the Netherlands. This is also the technique used by REDstack - now at the Afsluitdijk development site and soon in its commercial operating phase.

REDstack is currently actively working to seriously scale up its system on the Afsluitdijk in the Netherlands, in order to build confidence and take the final step towards large-scale installations with end users in a commercial pathway.

The process design and calculations suggest 75% energy efficiency/ CUF* of the project, meaning about 25% of the energy generated is consumed within the power plant, for running the whole process (aux consumption). So, for example, if we are to set a 100 MW power plant, the project shall have 75% CUF (or 100 MW generating 75 MW Power at full continuous operation) is the net output.

The world-wide potential is 1 TW (8600 TWh per year), comparable to 12% of the world energy demand.

(*Please note: This calculation is also based on the assumption that sea water and

river water is at the same level. If there is any change in the level of sea water/ river water, these calculations may change, resulting in slightly lower efficiency, however the Blue Energy plant is then acting as a power generating pumping station)

The potential in India is significant, as 26 rivers are flowing into the warm and saline sea. REDstack and Blue Energy are ready to make a great contribution to the Energy Transition by using Energy from the Ocean.

ABOUT THE AUTHORS

Pieter Hack *is an entrepreneur in sustainable technologies. Skilled in Sustainable Development, Water Treatment, Environmental Impact Assessment, Environmental Awareness, and Manufacturing. Strong professional with an MSc focused in environmental technology from Wageningen University. His entire career focuses on scaling up and implementing environmental and energy technology. A driven SME entrepreneur with worldwide experiences.*
Pieter has completed his engineering in Environmental technology/ Water treatment from Agricultural University of Applied Sciences Wageningen (now: WUR) the Netherlands, and MBA from INSEAD, France.

He worked with Paques BV in Balk, the Netherlands for about 14 years, where he worked as Director Paques Solid Waste Systems BV; developing solid waste digestion system into pilot plant scale.

In 1997, he acquired MAGNETO, which was a special anodes BV (Schiedam NL). He grew the business of this company from Euro 4 mn to Euro 11 mn in revenue. He further then expanded the technology scope by undertaking national and international projects and involving business partners and clients. Later, he went on to become founder of MAGNETO in Suzhou, China. The company successfully ran its operations in China and grew to about Euro 15 mn in revenue. In 2016, he sold MAGNETO to EVOQUA water technologies LLC (USA).

He is currently the founder of REDstack B.V. (Blue Energy) in Sneek, the Netherlands and is CEO and MD in PureWaterGroup in Sprundel, the Netherlands.
He was also Board Member and Chairman of the Dutch Association of Environmental Technology Companies (VLM).

Ms. Geeta Singh *is Director, REDstack Energy India Private Limited. She is Impact Investment professional with about 14 years of experience in Equity Raise, Bond Placement, Structured Finance, Mergers and Acquisition and Project Finance, IPOs, etc. Has worked on transactions of over $8bn and successfully closed transactions of over $1bn, in the clean energy financing space.*

Founder of Dazbog Power Private Limited – a company focused in the clean energy financing, helping the MSME companies raise capital in the form of equity, bond placement, mergers & acquisitions, project finance, working capital finance, etc.

Ms. Geeta has been advising several renewable energy companies and multi-lateral institutions in the clean energy financing sector. She has helped several MSME renewable energy developers, manufacturers raise critical funds in the form of equity, structured finance, project finance, working capital finance and mergers and acquisitions.

She has completed her MBA Wx in Applied Finance from Narsee Monjii Institute of Management Studies, Mumbai, India. In her career span of 14 years, she has worked on various new and innovative clean energy financing in the clean energy sector, focusing on developing the framework for financing new technologies such as EVs, Hybrid Renewable Energy Projects, Round the Clock Renewable Energy Projects, Storage Renewable Energy Projects and Green Hydrogen.

She has been instrumental in setting up REDstack Energy India Private Limited, and has joined Pieter Hack as Co- Director and Lead REDstack Energy India Pvt Ltd.

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CASE STUDY

DELIVERING WATER TECHNOLOGY AS A SERVICE

By Mr. Simone Callioni, Global Lead- Project Development, Aquatech International LLC, USA

With rising environmental and discharge regulations, coupled with the lack of technology and treatment expertise available to treat challenging and complex wastewater, many industries are forced to spend millions of dollars each year to have their liquid waste hauled away and treated or disposed of offsite.

With the evolution of innovative business models and water management approaches, these challenges can be overcome and addressed quickly by turning to experts, like Aquatech, which provide outsourced solutions ranging from water purchase agreements to the leasing and rental of mobile or decentralized treatment plants and a range of aftermarket services aimed at helping reduce risk and cost of operations.

This case study will detail how an international chemical manufacturer leverages Aquatech's MoVap™ mobile evaporation technology to reduce discharge costs and carbon footprint while maintaining business continuity and compliance.

Challenge

An international chemical manufacturer experienced several challenges with wastewater management after bringing a new product online. The new product caused more challenging wastewater, damaging the system, leading to high internal charges for treatment and additional fees associated with hauling the wastewater offsite.
This required transporting over 2,200 trucks per year of liquid waste to a third-party treatment provider to avoid local discharge exceedances, compromised product quality, and higher operating costs. The manufacturer sought an alternative treatment solution to reduce its discharge costs and environmental impact resulting from the CO_2 emissions from the hauling trucks.

Solution

While investigating a long-term solution to the problem, the manufacturer turned to Aquatech for help. Aquatech explored biological and thermal treatment, conducting initial sampling in conjunction with a pilot study to develop the optimal solution for this site's unique high-strength wastewater. Conventional biological wastewater treatment was ruled out because of the wastewater's complexity and the cost and footprint needed to accommodate this type of system.

To the chemical manufacturer's delight, with Aquatech's vast experience in evaporation through its ICD Process Technologies division, they were able to offer a novel thermal solution. Aquatech was not only able to offer an optimal solution utilizing its Horizontal Spray Film™ but also an immediate solution through the rental of its MoVap mobile evaporator.

Aquatech's MoVap™ mobile evaporator was selected for its compatibility with challenging applications such as produced water or other industrial waste with high total dissolved solids. The MoVap mobile evaporator concentrates wastewater by 10x, or 90% recovery rate, enabling wastewater to be hauled off at a much lower volume. In addition to the mobile rental solution, Aquatech also supplied the manufacturer with a skilled operator who helped run the day-to-day operation of the wastewater plant.

Customer Benefits

The implementation and managed operation of the mobile evaporation solution allowed Aquatech to take on the challenge for the customer without investing millions in capital expenditure, enabling them to focus on their core business operations. In addition

International chemical manufacturer reduces carbon footprint and saves USD 4MM in discharge costs annual with outsourced mobile wastewater solution

At a glance

Challenge

A chemical manufacturer experienced several challenges with wastewater management after bringing a new product online, leading to high internal charges for treatment and additional fees associated with hauling the wastewater offsite.

Solution

Aquatech was not only able to offer an optimal solution utilizing its Horizontal Spray Film™ but also an immediate solution through the rental of its MoVap mobile evaporator.

Customer Benefits

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to continuously delivering value for the customer, the chemical manufacturer also:

Value delivered to the customer:

Reduced discharge costs by $4 million annually by reducing hauling costs

Reduce carbon intensity score (CI Score) by reducing the carbon emitted from hauling trucks

Reduced safety risk associated with the the number of trucks and external personnel onsite

Improved community impact by reducing the traffic from hauling trucks

Thanks to Aquatech, the customer implemented a simple yet robust, treatment solution, giving them the peace of mind needed.

ABOUT THE AUTHOR

Mr. Simone Callioni *is the Global Lead- Project Development, Aquatech International LLC,USA*

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

WATER PROJECTS WORLDWIDE INDUSTRY FOCUS: FATS, OILS, & GREASE TREATMENT

By Angela G Walker, Wastewater Pretreatment Compliance Coordinator, Brunswick-Glynn JWSC

Angela G Walker with her clients, Smisson-Mathis Energies, and Governor Brian Kemp of the State of Georgia, USA.

Fats, Oils, and Grease are the biggest nuisance to wastewater treatment facilities. The treatments in the past have been mostly ineffective and have been the cause of sanitary sewer overflows, equipment failures, along with additional costs for disposal of biosolids from the wastewater treatment facility. Newer treatment methods utilized prior to entry into the wastewater collection system are offering better removal of the fats, oil, and grease. These newer methods of disposal are also offering a by-product for use in biodiesel and fertilizers.

The original methods of disposal of grease trap waste, were to utilize an in-ground gravity flow concrete grease interceptor, that only removed part of the fats, oils, and grease (FOG). The other method of FOG disposal was for it to end up directly in the wastewater collection system and eventually the wastewater treatment facility. Both methods, offer less than adequate treatment of the FOG and create problems for kitchen staff at food service establishments from backups, collection system operators who repair sewer lines from overflows, and wastewater operators at the wastewater treatment plants due to clogged pumps, foaming and dewatering issues.

The amount of FOG that escapes grease traps, either from improper sizing or inadequate cleaning practices, is one of the major causes of sanitary sewer issues facing most municipalities. Sanitary sewer overflows caused by grease build-up are costly in terms of manpower, asset usage and possible fines from higher government entities. The FOG also creates problems in the biosolids removed from the wastewater facilities because the FOG entraps water, which increases the weight of the solids and increases disposal costs for the biosolids.

Many industrial food service manufacturing facilities utilize units, known as diffused air floatation (DAF) systems, to remove the FOG and other solids from the food production prior to the wastewater stream flowing to the sanitary sewer. This FOG and solids have in the past also been either land applied or sent to landfills for ultimate disposal or burned in anaerobic digesters to provide some power to the wastewater facility.

The only original method that offered any revenue from the FOG was the recovered biogas in the anaerobic digesters. This process is still in use in many larger municipal wastewater facilities to offset power costs. Now, along with the biogas production, commercial haulers and disposal units are recovering much of the brown grease from the FOG waste to sale for either biodiesel or fertilizer additives.

There are several methods of recovering the brown grease from the grease trap waste and most disposal units are now utilizing one method or another to separate out the brown grease. One of the first steps in the brown grease recovery, is removing the food solids and other inert materials from the waste stream. This can be completed by either time and manual devices to remove the grease, such as skimmers in DAF units, or by newer equipment sold by some manufacturers that can separate the waste stream into three separate products: water, solids, and grease.

The second step for these disposal units is to further process the brown grease to remove as much water as possible. This is either completed by centrifuge or one of the tricanter units marketed across the world. The water produced is usually sent to a municipal wastewater plant or land-applied for disposal. The solids produced by the separation methods are hauled away to a landfill for disposal. The wastewater and solids removed by the processes are both disposed of at a cost to the disposal unit. Most disposal units charge the commercial haulers for accepting the grease trap waste to offset the cost of disposal of the unwanted products produced by the separation of the brown grease.

Once the brown grease is harvested, the product can then be sold to a biodiesel refiner or sold to be added to fertilizer to increase the effectiveness of the products being created. Both uses make this previously unwanted, throwaway product desirable as a commodity. Brown grease can now be found on the stock market and has become a profitable business. The new uses for this originally throw away product, now keeps it out of landfills and land application sites, which helps preserve the space that it has been taking up in the environment.

Brown grease is used in biodiesel production by being broken down into by-products, by a process called transesterification, which separates out glycerin and leaves behind biodiesel. The catalyst that makes this process work is a chemical reaction from an additive, typically methanol. The process of separation of the brown grease has been simplified for this article, but it is quite interesting to watch and fascinating to see the final products made from the process. Many companies across the world are now utilizing this method to capture the biodiesel for use in either equipment or to be mixed with diesel to make the diesel more affordable.

When brown grease is used as an additive for fertilizer, it is mixed with other products, such as dirt, pine straw and mulch. The brown grease is used due to the fats having the ability to be used as energy in the fertilizer to make it more effective for the vegetation. Having brown grease as an additive allows the disposal units to dispose of the brown grease without as much processing, as when selling for biodiesel because the water and solids will not be as detrimental to the final process of creating the biodiesel.

These uses for FOG are helping to create less problems for municipal sanitary sewers and helping bring down the cost of disposing of this once throwaway byproduct of food production. From homes, to

restaurants, to hospitals and care facilities, to large food manufacturers, the costs associated with disposing of FOG will eventually become more affordable as more companies recognize the need for alternative fuels and begin utilizing this throwaway, forgotten product. This new interest in FOG will also make disposal locations more accessible, as well as more desirable, as the world recognizes the need to save the environment for future generations. At the end of the article, there will be a list of resources for further exploration.

- The Key To Better FOG Control At Wastewater Treatment Plants (in-pipe.com)
- Home of the Muffin Monster | JWC Environmental
- Anaerobic Digestion & Biogas Processes | JWC Environmental
- Environmental Impact | Smisson-Mathis Energy Solutions
- How Grease Trap Contents Are Reused and Resold (safewayusedoil.com)

Note - The Author is thankful to Mr. Franklin Mathis, who fueled her desire to find uses for FOG.

ABOUT THE AUTHOR

Angela G Walker *is the Owner/Consultant and currently working as the wastewater pretreatment compliance coordinator for the Brunswick-Glynn JWSC. She started her career in wastewater in 1987.*

I started in wastewater in 1987 as an 18-year-old high school graduate. She has worked in the wastewater field for 25 years. She had held this position since September 2014. In her current position she monitors industrial discharge and enforce the FOG program. She is also the the owner and consultant for Angela G Walker LLC.

She holds a State of Georgia Class 1 Wastewater Operator License & a State of South Carolina Class A Physical/Chemical Wastewater License. She also has a bachelor's degree in Psychology and a Juris master's in International Law.

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FERTILIZER & CHEMICAL INDUSTRIES VS CONTIGUOUS HUMAN SETTLEMENTS MUTUAL DISREGARD CAN BECOME MUTUAL REGARD

By A. Jawahar Thomas, Dr S Saktheeswaran

Abstract

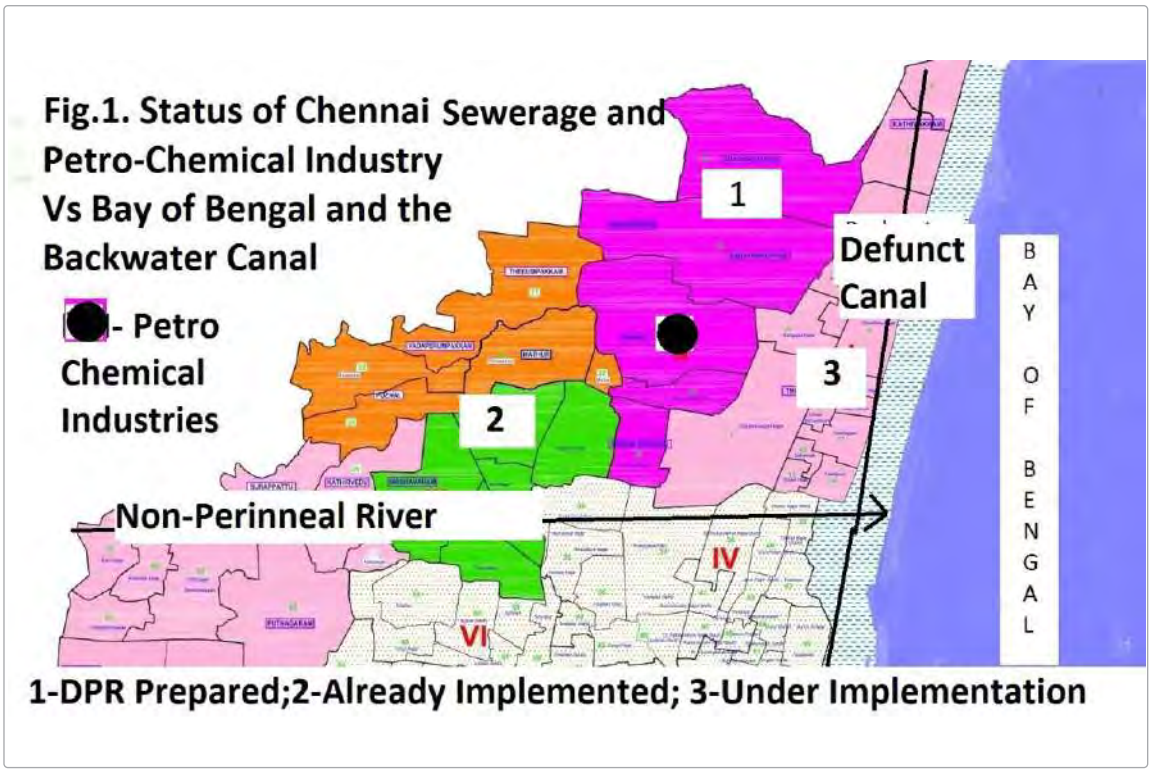
In general, the above industries and the petroleum refineries fall under the category of Petro-Chemical Industries and exist in an uneasy mutual disregard with the contiguous human habitations. This disregard is mainly in the stakes on bulk fresh water needs for public water supply Vs the cooling with the once through being a gurgler compared to the recirculation cooling. It all started with the Bethlehem Steel Mills in Maryland USA in 1950's to demonstrate the mutual regard by recourse to the treated sewage instead of fresh water. The practice has since come a long way but the moot lurking issue is the volumes in once through and hence, the recirculation cooling with limited water needs only for makeup has come to stay. However, the thermodynamics mandates limiting the dissolved solids (TDS) content as disproportionately influencing the heat liberation during circulation. To this extent, sewage with its typical content of 1500 to 2000 mg/l being put through reverse osmosis to recover a water of only about 500 mg/l is the order of the day. However, the "million Dollars question" is what is happening to the reject stream with nearly 5000 to 6000 mg/l of salt lurking around in the soil and aquatic environment. This article brings to light a case in point as a replicable proposition elsewhere.

The Chennai Petro-Chemical Complex Water & Wastewater Status

The physical setting is shown in Fig.1. It may be seen that the location is landlocked and not coastal as generally perceived. The refineries and fertilizers were grounded in mid 1960's and the cooling water makeup of 30 million liters daily (MLD) was from distant inland freshwater aquifer. The "blow down" of the cooling water with all its chemicals and solids had to go into the backwater canal. As of now, in 2023, cooling water is from nearby city sewage reuse plant but R O Rejects flow into the above canal.

The Stipulation in the GOI Manual on Sewerage

The issue of industry and its cooling water needs from sewage reuse is in the news again and again without taking cognizance of the stipulation by the GOI Manual on Sewerage and Sewage Treatment systems, 2013, Part-C, chapter-2, para 2.16 which mentions," A major reservation by industries is on the disposal of final R O rejects.



Normally, its TDS will be much higher than that of the raw sewage. Industries do not want to inherit thermal evaporators for this. Instead it needs to be absorbed by the ULB in the sewer system at a designated point. After all the volumes of reuse by industries will be much lesser than the overall volume of sewage and hence, such disposal may be possible as reportedly happening even in the early sewage reuse plant in the 1970's by the Air India building at Mumbai".

The chance to conserve the Backwater Canal Ecosystem at Chennai

An argument that has been consistently advocated all through is that the TDS in the R O Rejects will be only about 5000 to 6000 mg/l as compared to that in the backwaters which is de facto seawater with its TDS at about 7 to 8 times higher and as such, the R O Rejects is a diluent. The reality is the cooling water blow down also has to get blended at some point with the R O rejects and this bleed has all sorts of chemicals sustained in the cooling circulating water to carry out among other requisites, the corrosion control and scaling of the tower media. It is these which understandably is not covered by the discharge standards and are steadily seeping into the soil environment all along the said canal. This region was not habited in the early times of 1960's but now it is not so and populated. The boon is the sewerage scheme will soon come into use as in Fig.1 and as in the GOI-Manual, it is high time to officially take note of this at this stage itself (if not already done) to receive the said R O Rejects and cooling tower blow down as an insignificant volume in the mass of sewage from this zone and thereby conserve the soil and aquatic ecosystem along this canal and the industry can also officially qualify comprehensively for the ISO and LEEDS certifications.

A similar approach has to be officialized for other similar petro chemical complexes in the country also and thus put an end to this "neither here and nor there" situation. Extending the argument, it may well result in industrialization of peri-urban locations where the new industry can come forward to own up the cost of the prospective contiguous sewer system whereby the local authority can supply the public water supply to the habitation and the industry can own up the sewerage part and thus, the environment can become unified and also the hitherto "mutual disregard" between the industry and contiguous population can transform to one of "mutual regard" The only question now is to become realistic to the needs.

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DREADED PSEUDOMONAS – THE OZONE SOLUTION

Pseudomonas is a gram Negative strain, dreaded by both Pharmaceutical companies as well as Hospitals. Gram-negative bacillus of late presents a major clinical significance; Many instances of infections with these organisms have been noted regularly now . Infections include bacteraemia/septicaemia caused by contaminated solutions .Environmental studies have revealed that the organism can survive in chlorine-treated municipal water supplies, often colonizing sink basins and taps, intubation tubes, humidifiers, incubators for new-borns, ice chests and syringes, contaminated medical devices such as blood gas analysers, nebuliser equipment and has become a potential reservoir for infections in the hospital environment

Role of Bio films

The sources of water in most Pharmaceutical Industry /hospitals are from sources outside and unknown to them. Water supplies are under contract to these water suppliers. This water is treated and used for all purposes including advanced treatment process for pharmaceutical compounding, Water for Injections in Pharmaceutical companies and for all purposes in Hospitals. Pseudomonas can pass through even advanced treatment process and emerge in the final product water. As these ordinary treatment processes continue, there is a formation of bio film in all the water pipes. Conventional Bio films removal process such as CIP with Hydrogen peroxide, per-acetic acid or even steam have not found to be too effective against Bio film removal .These biofilms provide safe haven to most of these opportunistic bacteria and they proliferate when opportunity arises. The locations that have been identified are areas especially where there are increased storage facilities, and in areas where chlorine residuals are removed with SMBS .

Inferences that can be drawn are:

1. All of them are Gram Negative
2. All of them find their way into water through soil contamination/sewage contamination
3. Most of them hide behind bio fouling material to escape disinfectant action
4 All pseudomonas and many of the other species are chlorine resistant

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 (pseudomonas) are more susceptible to ozone

Gram negative bacteria are more susceptible to ozone than gram positive organism's .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.

Ozone solutions to Obtain pathogen free water

1 Ozone is very effective against gram negative bacteria because of its mode of action
2 Ozone is very effective against pseudomonas strain unlike chlorine
3 Ozone destroys bio-fouling material on the inner surfaces of the pipes and tanks , hence prevents subsequent proliferation of these bacteria and exposes them to ozone action

Ozone on Bio films:

Biofilms can be classified as
1. Primary films
2. Secondary films

Primary films are the biofilms that have been formed and exists in layers on the surfaces of the tanks and pipes. Secondary films are Bio films that are relatively new and appear in clusters on the surfaces or in the pipes. Ozone can remove exo-polysaccharides in the biofilm matrices and is very effective against biofilms against secondary bio films and can remove them totally with small amounts of residual ozone and lower contact time. Residual ozone of below 0.3 ppm ozone has found to be effective. Regular use of ozonated water will prevent formation of such Bio films

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WATER ALSO REPRODUCES

By Dr. Jeoraj Jain, Ex – Tata Motors

1. Introduction:

1.1. After doing literature survey, a project was undertaken in 2003 to investigate, whether water exists as a Living Being (LB). As per current simple and basic scientific definition, a Living Being (LB) is an entity, which has active DNA/ RNA. As such, it is considered to be grossly unscientific, even to think of water to be a LB, because it does not contain these chemicals.

Still, in view of its importance and myriad behavior, I ventured to undertake this impossible looking project to investigate scientifically its various aspects to assess, whether water could be a sort of a living-being.

Here, we are not talking about water assisted or water supported living-beings. We are talking about water-bodied living-beings, whose bodies are made of water itself. Since the hypothesis that water is living-being [1] has now been questioned by a scientist, the whole hypothesis has to be critically re-examined and researched.

1.2. The earlier comprehensive study of Water encompassed the following 5 related fields [1]:

i) Structure of water-cells and its interaction with Air,
ii) Life-Science: Establishing new set of Basic Criteria of a LB and proving its applicability to Water,
iii) Non-living water and its Shelf-Life,
iv) A handy tool to Identify and Differentiate living from non-living water,
v) Science of Potable water and Mass health.

The objective of present paper is to discuss and critically re-examine the research work done in the first two fields, which culminated in formulation of the hypothesis that water is a Living-Being [1]. Now it is to be further investigated, whether water can reproduce?

The research and development work done in the above last three areas, pertains to Improvement of quality of drinking water. A paper, "Bhasmi-Jal, an indigenous health Drink" was published in this esteemed magazine [2] in January, 2022. If required, it would be re-examined in the subsequent issues of this magazine.

2. Origin and Criteria of a Living-Being

2.1. Science has systematically explained the sequence of events, which took place after the Big-bang, creating different types of energies and then matters. The matter developed further in different types of Organic and Inorganic structures, like RNA/DNA – to cell wall and nucleus. Subsequently, life matures under different environmental conditions to the present human beings. At all stages from the beginning, it was in waveform. Considering this water (possibly air) and later vanaspati (Plant life) is the initial stage of development. They all follow the law of waves.

2.2. In the sequence of developments, science does define the formation of different types of Organic and Inorganic structures, like RNA/DNA. However, these structures are no more than the so called, "Yoni structures", where life originates. Modern Science declares that life matures here (in aboriginal structures) under different environmental conditions. However, by just declaring that "Life Matures", without understanding its mechanism, looks to be an ignorant ad-hoc statement by science.

2.3. To my mind science has still to understand Life or "Soul" and its characteristics. How does the life mature here to make the Yoni-structures? The mechanism of making non-living to living object has to be investigated and explained logically and scientifically.

2.4. What traits, an object or a structure should exhibit, to be called a Living-being? The hypothesis of reversible and irreversible reaction conditions, as put forth by scientists to explain livingness, could not sustain for long.

2.5. Schrödinger [3] defined life in " What is Life" in 1944 as "Order from disorder". Life feeds on negative Entropy. Higher entropy means higher disorders. That means increase in orderliness would signify it to be LB.

However, living systems, under certain circumstances, do not follow this principle. [4]. It shows limitations for the Life in Womb or for the formation of Crystals during the metallurgical cooling processes. Moreover, it is difficult to make an accurate entropy balance of an organism with its environment.

i) Water cell has lower entropy. But as soon as a radicle interacts with this cell [4], entropy increases due to movement of radicle (Metabolism), when it is getting digested (metabolic processes). That means the entropy of living-system will increase from its previous level of non-living water cell.

ii) However, the radicle may also sit in the quantum vacancy of the cell, in which case its entropy may decrease. But it may be or may not be a living system.

2.6. After the discovery of the Silicon based Inorganic form of Life in deep Oceans, it became imperative to modify the most prevalent theory in the science arena that a LB should have active DNA / RNA, at least for Organic form of Life .

2.7. While working on this problem, we had tried to understand and analyse the role of DNA /RNA. This time I raised a pertinent question before the science community about the basic and minimum functions, DNA /RNA chemicals must perform to bring that entity into the category of Living-Beings (LB). After a number of Brain-Storming sessions with 4 experts in special areas of Biology, i) HOD, Bio-Sciences of Co-Operative College, Jamshedpur ii) HOD, Biology Dept, Workers College, Jamshedpur iii) Head, Environmental Sciences, Tata Steel and a Medical Doctor from Jaipur, on the question as to what could be the basic functions of DNA/RNA, they must perform to bring the entity in the realm of LB. The criteria evolved from the responses received from expert Biologists of India, was the same that DNA/RNA must perform among others, the following 3 fundamental functions in any LB [1].

2.8. It postulates that DNA/RNA give the entity capability to

I) Exchange energy i.e., to fix energy and transfer it in a directed way, (In other words, it should be able to select and consume its food and convert it into another form of energy.),
ii) Remember and pass-on information, (In other words, it should be able to exhibit memory power, i.e., one should be able to train it, and in turn it should also be able to train others)
iii) Have sensitivity to external stimulation. (It should react differently, when abused or praised.)

It was agreed upon by them that DNA / RNA do carry out the above noted minimum 3 functions in Living-Beings.

iv) A hypothesis was developed that the water structures formed naturally are living-beings. It was published in the "International Journal of Engineering Science Invention [1]. However, an important comment on the livingness [1], received from a Bio-scientist of CSIR unit at Delhi, said that these 3 traits are OK, but still he would not accept water as a LB. His objection was that water does not reproduce and hence it cannot sustain its specie. Hence, technically the hypothesis that water is a LB, would be valid only, if water exhibits the 4th criteria of reproduction also?

3. An Opportunity to Enrich the Hypothesis:

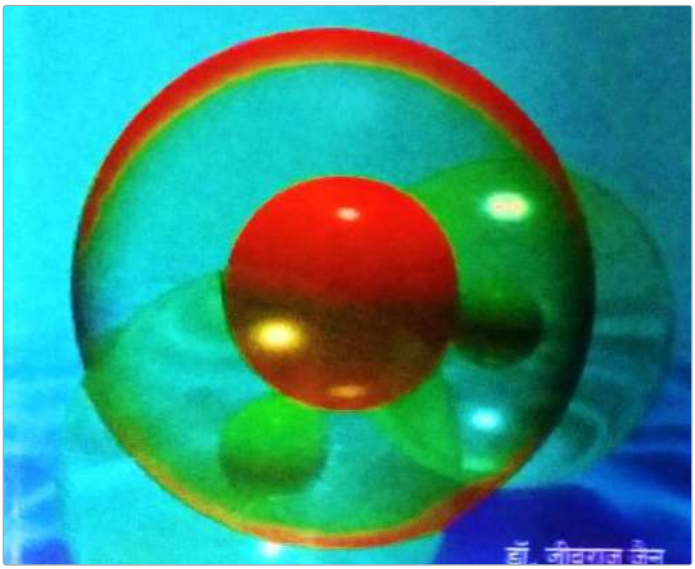

Fig.1a: An artist's view of A Water Molecule H2O

i) Although this looked to be a very difficult criteria to find, nonetheless it was considered to be the most basic property of a LB. It needed in-depth restudy of the mechanism of Yoni formation.

ii) To find the reproduction phenomenon, occurring in water, a deeper study of the mechanism of Yoni formation and cell structure was thought to be essential. To start with, the special structure and properties of water molecules were thoroughly re-studied from different chemical and physical viewpoints (fig. 1a, 1b, 2a, 2b). As is seen here, the structure stood slightly modified or rather improved to provide flattened openings for the net-like Yoni structure. Its findings and explanation is given in Annex -1. It is to be kept in mind that this structure exhibits, even with its modified form, at least the above noted 3 criteria of LB.

iii) The knowledge of the fact that the net-like Yoni structure has flattened openings, may be helpful in examining and checking, whether it possesses the 4th criteria of reproduction also?

iv) A search of the oriental scriptures was also restarted along with our regular interactions with some learned scholars of ancient sciences. As a result, we could discover in Bhagvati Sutra [5], a trait called "Pauttha padihar" found in plants. After understanding it properly from different angles, we tried to apply it to water-bodied LB. Ultimately it could theoretically be explained and experimentally demonstrated that a similar type of phenomenon exists in water. Instead of reproduction, water

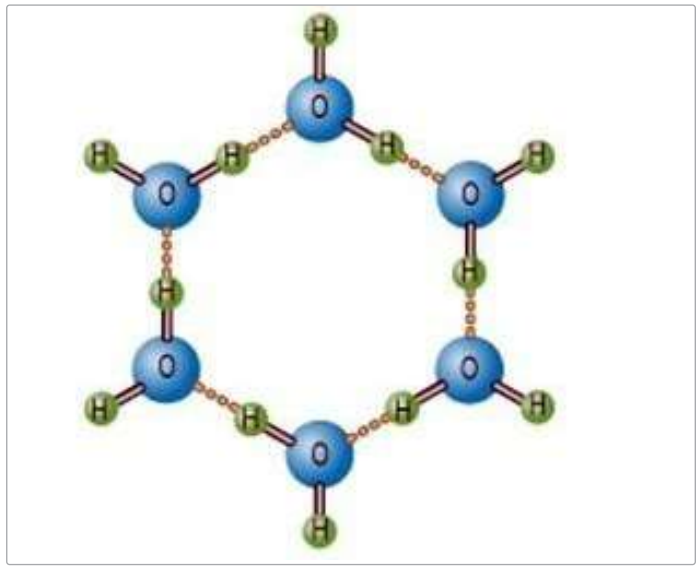

Fig.1b: A Liquid Crystalline Water structure

Red = Oxygen Molecule, Green = Hydrogen Molecules

resorts to Revival for the survival of its specie. It took about 6 months to find and establish that water has a mechanism in place to continue to survive. (Annex- 2).

Fig.3: JJ Venn Diagram of Water-Being

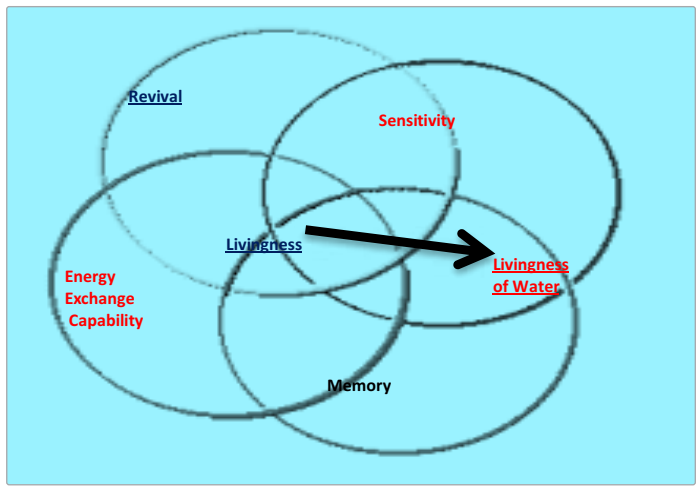

Fig.3: JJ Venn Diagram of Water-Being

v) Consequently our earlier hypothesis of livingness was modified to include the survival trait i.e., to Reproduce, rather to Revive to sustain its specie. Thus Livingness, in general, proves to be a subset of 4 Traits in Venn diagram. (fig. 3).

4. Reproduction/ Revival capability in Water (Paautha Padihar)

Since we have never seen any dead or living water, it is difficult to grasp the trait of reproduction by water. However, survival trait of specie is considered to be the most important Criteria of a living-being in order to maintain continuity of that specie. Let us now investigate this most important trait. It is also called reproduction.

4.1. After exploring various options, feasibility of following options of specie - sustenance were considered worth investigation. Specie - sustenance can be

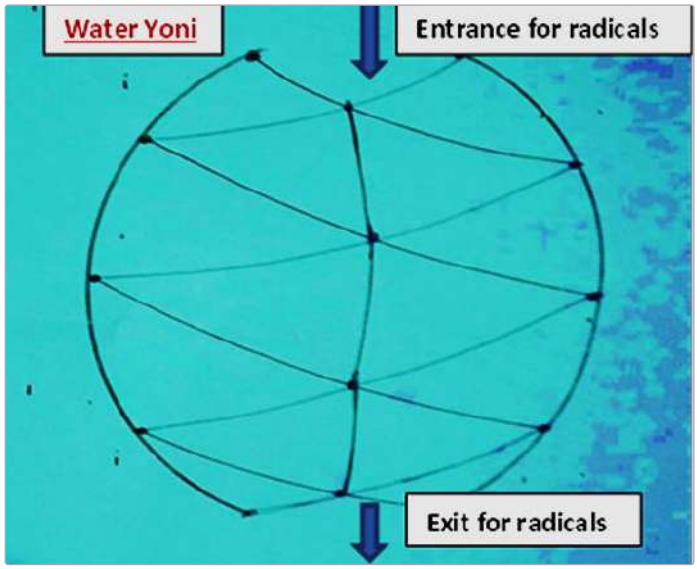

Fig. 2a:'Yoni': Bee-hive Configuration of Flattened Bubble of Water-Molecules $6H_2O$

achieved either by reproduction (sexual or asexual) or through revival process. In Scriptures [5], a process, called "पउट्ट-परिहारं परिहरंति is mentioned for survival of specie of plant Living -Beings. In simple words, it means, re-adoption of the dead body of a fellow-being attached to the Main body of the Plant by a Soul, which is leaving the body of a fellow-being.

Investigations proved that Water achieves this criterion by a similar method (पाउट्ठ पड़िहार) of revival of dead bodies to livingness. When living water dies and becomes non-living, any one or all of the following 3 changes take place:

I) its body structure is broken and its molecules are scattered randomly,
ii) the content of its dissolved oxygen falls below a certain critical level,
iii) the pores of its body structure are blocked by microscopic particles of a foreign material, so that it cannot breathe.

As per scriptures these conditions can be achieved by Boiling or by dissolving some foreign materials or by mixing waters from different sources.

Water has the unique capability to bounce back to life, after it is killed. Whenever suitable conditions of temperature and air absorption are provided to dead water, its self-induced capability to re-assemble and re-absorb air, restores its livingness. Some types of solutes in dirty dead water are segregated and removed from its pores by its self-cleansing property. This also helps it in reviving its livingness (Criterion 4).

4.2. Revival is a Natural Process in Water

I) The body structure of water has, by nature, capability to re-assemble and bounce back to life again and again infinite times, as against the solitary nature of life of other species.

The bodies of mobile living-beings are killed forever, once they become dead. The revival technique (Pautta-parihaaram- pariharanti, i.e. pravritta-parihaar ka parihaa, -Bhag. Sutra [5]) of water is essential for survival or continuity of the specie. This trait is normally found in plants or immobile type of living-beings. After the death, the soul can take rebirth in the same dead body or in its dead parts, fed and supported by its main body Soul to make it sentient.

ii) Scientifically expressed, reproduction in living-being starts taking place by conversion of organic food into organic tissues. Here tissue growth in 3-D is a natural phenomenon. Whereas the Revival process does not take any organic food, so logically cannot have any physical dimensional growth.

As seen earlier, water absorbs air containing oxygen from the surroundings. The oxygen is converted into radicles and singlet oxygen (1O2). The energy field of Radicles reacts with the field of the spherical water cells. We have seen above, as to how they generate bio-field and influence the shape of the living cell of water. When water is boiled, the solubility of air becomes zero. All the air is driven out. The Hydrogen bond of water molecules breaks down. The water becomes dead with randomly scattered molecules.

At lower temperatures during cooling, the electro-static forces start dominating the thermal forces to form again spheres by water molecules by hydrogen bonding. Water starts absorbing air from its surroundings. The rate of absorption is influenced, as is known, by the ambient temperature, humidity, wind speeds and exposed surface area. Generally, near its saturation point of air, all the events of yoni formation and birth of Living-Being (LB) are completed, making the water a living entity. This is, clearly a Revival process to keep the specie survived. The events make this process completely different from the reproduction process.

iii) The dissolved air in cooling water releases molecules as well as singlet oxygen (1O2) and the whole process of revival to livingness would be repeated. Thus in the dead water-body, either a new or the soul of that dead body of water-being is re-born due to the effect of environmental conditions. The scattered water molecules of the dead body start re-assembling to become potential Yonies i.e., they become worthy of revival to life. [5].

Water does not reproduce its species in the traditional sense of the word. However, we have seen that water, when made dead, can after some time, revive back to livingness. This method of survival of species is termed as Revival to livingness. It is obviously different from the Reproduction mechanism.

4.3. We know that higher category of developed living-beings, like humans, does not have this type of capability to Revive. The quality of their dead body is irreversible. Hence they are burnt or buried after death.

Thus Water satisfies the trait of Revival for maintaining the continuity of its specie. Thus water is proved to satisfy all the 4 trait of Living-beings. This finding is labeled as a "Revolutionary Discovery" by Gerald Pollack [7].

5. Two important facts worth noting regarding livingness

Even when a seed does not reproduce, it is called a living-being, only because it has potential capability for maintaining continuity of specie. Corona virus was termed as non-living in the beginning, but lately, it has been termed as Living, because of its potential to reproduce. However, an unfertilized egg is called a living-being, even when it neither reproduces nor does it have capability to reproduce. It remains like a eunuch, whose capability to reproduce for continuity has been deficient by birth.

Water has aerobic breathing, as against the anaerobic respiration by plant seeds. Even when a seed does not reproduce, it is called a living-being, only because it has capability for maintaining continuity.

6. Here comes the Discipline of "HYDRO-LIFE"

6.1. Need for further Research and Developments

After proving Water to be a Living-Being, having all the 4 essential criteria, a vast field has now opened up for research to find answers to the following initial queries: How does water become lifeless? What is the shelf- life of non-livingness of water?

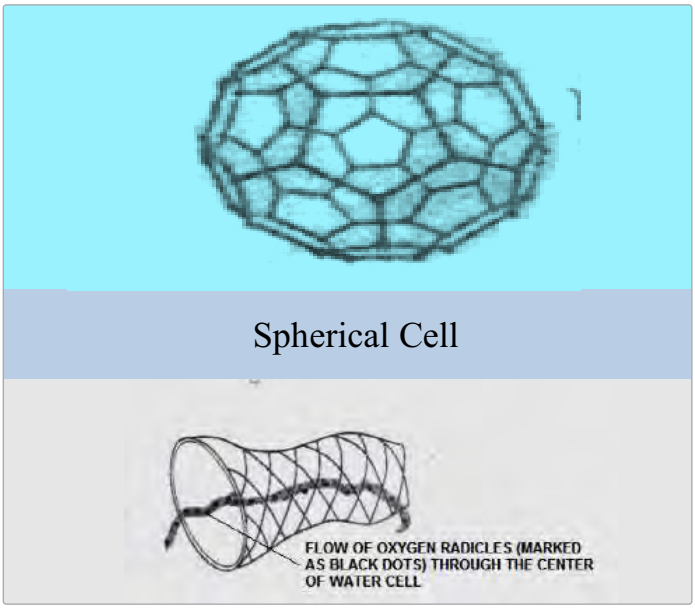

Fig.2b:Tubular-Net with moving Radical (A Living-Cell)

What action triggers the non-living water to become Living water? Is there any visual method to differentiate between living and non-living water etc.

6.2. This basic and novel research presents a great scientific theory of Hydro-Life. Further research has a great potential to expand and develop its horizon to enrich our knowledge in the important fields of evolution, biology and medicine. It may develop into an exclusive field of science stream, like the Botany for the benefits of mankind and preservation of eco-system.

Annex. 1: Re-Study of Micro Structure of water-cells and its interaction with Air

1. To investigate whether water has the trait of reproduction, we have to re-study its molecular structure. The bi-polar molecules of pure water have very special properties. They form self-assembled 2-dimensional nano-structure in hexa-. or pentagonal shape (fig 1a, 1b). These "unit" structures further form net-like stable 3-D hollow sphere, like a football, by joining with neighboring identical units to achieve minimum surface energy (fig.2b, top). Furthermore, water has another important quality. It starts absorbing air from the atmosphere, till it reaches its saturation point.

The dissolved air releases molecules as well as singlet oxygen (1O2). Some molecules (about 15 %) get converted into oxygen radicals (anions). Their electro-magnetic field interacts with the field of the spherical cages or Bucky balls of water (fig.2b, top). It is assumed that some of these radicles are pushed into it. This flattens the spherical surface at entrance and exit, transforming it into a constricted open ended distorted sphere(fig.2a). Some are digested in its quantum vacancy and some would travel through it (fig.2b, lower).

That means these loose bubble shaped nano-tubes are flattened or elongated (fig. 2a), to allow oxygen radicals (ions), move effortlessly through it. Their movement generates energy-field, which keeps the movement of oxygen radicals in dynamic balance (fig. 2b, bottom). Thus it acts as a transducer.

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Dr. Jeoraj Jain, *born in 1938 is a Gold Medalist of Rajasthan University. He obtained the degree 'Doctor of Engineering' (Dr.-Ing.) from Germany in '68. He worked with Tata Motors for 21 years. He is a recipient of National Award in Fabrication Technology.*

He has advanced a hypothesis of Life form of Water without DNA and RNA. He discovered that the contents of Jain Loka are described by Statistical Method in ancient Literature. It resolves the contradictions with modern Cosmology. He received the "Vigyan Ratan Award" from Gyan Sagar Science Foundation, 2017. He has authored 3 books on Water and Lokakash.

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TENDERS

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Competition: Domestic Competitive Bidding
FTID : 230118229130
Operation And Maintenance Of Sewerage Scheme Joginder Nagar Town Sh Operation And Maintenance Of 1.735 Mld Sewage Treatment Plant Of Joginder Nagar Town And Sewer Network Of 43.89 Km Along With 1620 Nos. Main Hole Chamber For A Period Of One Year.

OWNERSHIP:
Authority : Directorate Of Forests
Name : The Divisional Forest Officer, 24-Pgs (S) Division
Address : Office Of The Divisional Forest Officer 24 - Parganas (South) Division, 4th Floor, New Administrative Building 12, Biplabi Kanailal Bhattacherjee Sarani Alipore, Kolkata - 700 027.
Location : Kolkata | West Bengal | India
Bid Open Date : 24 Jan 2023
Tender Value : ₹ 1.94 Lac
Doc Collection Date : 24 Jan 2023
Competition: Domestic Competitive Bidding
FTID : 230118241340
Repairing Of Water Treatment Plant At Chulkati Under Ramganga Range Under 24-Parganas (South) Division.

OWNERSHIP:
Authority : Directorate Of Forests
Name : The Divisional Forest Officer, 24-Pgs (S) Division
Address : Office Of The Divisional Forest Officer 24 - Parganas (South) Division, 4th Floor, New Administrative Building 12, Biplabi Kanailal Bhattacherjee Sarani Alipore, Kolkata - 700 027.
Location : Kolkata | West Bengal | India
Bid Open Date : 24 Jan 2023
Tender Value : ₹ 3.21 Lac
Doc Collection Date : 24 Jan 2023
Competition: Domestic Competitive Bidding
FTID : 230118241350
Repairing Of Water Treatment Plant At Bhubaneswari Under Raidighi Range Under 24-Parganas (South) Division.

OWNERSHIP:
Authority : Directorate Of Forests
Name: The Divisional Forest Officer, 24-Pgs (S) Division
Address : Office Of The Divisional Forest Officer 24 - Parganas (South) Division, 4th Floor, New Administrative Building 12, Biplabi Kanailal Bhattacherjee Sarani Alipore, Kolkata - 700 027.
Location : Kolkata | West Bengal | India
Bid Open Date : 24 Jan 2023
Tender Value : ₹ 2.53 Lac
Doc Collection Date : 24 Jan 2023
Competition: Domestic Competitive Bidding
FTID : 230118241360
Repairing Of Water Treatment Plant At Binodpur Under Raidighi Range Under 24-Parganas (South) Division.

OWNERSHIP:
Authority : Public Health Engineering
Name: Executive Engineer, Bmd, Phe, Dte
Address : Office Of The Executive Engineer.Bankura Mechanical Division. P.H.E. Dte.Ailakundi, Po Kenduadihi, Bankura 722102.
Location : Bankura | West Bengal | India
Bid Open Date : 03 Feb 2023
Doc Collection Date : 03 Feb 2023
Competition: Domestic Competitive Bidding
FTID : 230118242190
Operation, And Guarding Of Pumping Station And Sub-Station Equipments Of Water Treatment Plant , Intake (Raw Water) Pumping Station, Sub-Station And Gaseous Chlorination Plant Of Khatra, Hirbandh, Ranibandh Surface Water Based Piped W/S Scheme

OWNERSHIP:
Authority : West Bengal State Electricity Distribution Co. Ltd
Name: Project Manager, Rhp, St-Ii
Address : Administrative Building, Dovan, Lodhoma, Darjeeling, 734201
Location : Darjeeling | West Bengal | India
Bid Open Date : 08 Feb 2023
Tender Value : ₹ 48.86 Lac
Doc Collection Date : 08 Feb 2023
Competition: Domestic Competitive Bidding
FTID : 23011826790
Renovation Of Bituminous Road From Lodhoma Police Station To Jagatae Khola Along With Protection Wall And Drain Below Water Treatment Plant (Ib Complex) Under Rhp, St-Ii

EVENT CALENDAR

JANUARY 2023

Water Expo & Forum
Mon, 16 - Wed, 18 Jan 2023
Abu Dhabi, UAE
https://www.worldfutureenergysummit.com/en-gb/water.html

NEWEA Annual Technical Exhibition & Conference
Mon, 23 - Wed, 25 Jan 2023
Boston, USA
https://annualconference.newea.org/

13th IWA International Conference on Water Reclamation and Reuse
15 January, 2023 to 19 January, 2023
Chennai, India

13th IWA International Conference on Water Reclamation and Reuse
15 January, 2023 to 19 January, 2023
Chennai, India
https://iwareuse2023.com/

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

Michigan Onsite Wastewater Conference
Tue, 10 - Wed, 11 Jan 2023
Lansing, USA
https://www.canr.msu.edu/events/michigan-onsite-wastewater-conference

WWT Wastewater Conference and Exhibition
Wed, 25 - Thu, 26 Jan 2023
Solihull, UK
https://ukwir.org/wwt-wastewater-conference-exhibition-2022-25012022-birmingham

NDRWSA Water Systems EXPO
Tue, 31 Jan - Thu, 02 Feb 2023
Bismarck, USA
https://www.ndrw.org/water-expo

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 Expo
Thu, 09 - Sat, 11 Feb 2023
Kochi, India
https://www.waterindia.net/

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

India Smart Utility Week (ISUW) 2023
Wed, 01 - Sat, 04 Mar 2023
Lalit Hotel, New Delhi
http://www.isuw.in/

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

New England Water Well Expo
Fri, 10 - Sat, 11 Mar 2023
Marlborough, USA
https://www.newwassociation.org/

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/

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

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

Water Philippines Expo & Conference
Wed, 22 - Fri, 24 Mar 2023
Pasay, Philippines
https://www.waterphilippinesexpo.com/

Waptema Water Expo
March 3 - 5, 2023
Netaji Subhash Place, Pitampura, New Delhi
https://waptema.in/

APRIL 2023

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
https://www.txwater.org/

MAY 2023

AZ Water Conference & Exhibition
Tue, 09 - Thu, 11 May 2023
Phoenix, USA
https://www.azwater.org/

Ozwater 2022
10 May, 2023 to 12 May, 2023
Brisbane Convention & Exhibition Centre
Australia
https://www.ozwater.org/

Watrex Expo
Mon, 15 - Wed, 17 May 2023
Cairo, Egypt
https://waterxexpo.com/

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

Water and Plumb Skills Expo
18 May 2023 – 19 May 2023
Pragati Maidan, New Delhi, Delhi

JUNE 2023

Power & Water Nigeria Exhibition & Conference (PnW Exhibition)
Tue, 20 - Thu, 22 Jun 2023
Lagos, Nigeria
https://pnwnigeria.com/

JULY 2023

West Africa Water Expo (WAWE)
Tue, 11 - Thu, 13 Jul 2023
Lagos, Nigeria
https://elanexpo.net/waweexpo/

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
www.eawaterexpo.com

SEPTEMBER 2023

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

EVENT CALENDAR

THAI WATER
Wed, 30 Aug - Fri, 01 Sep 2023
Bangkok, Thailand
https://www.thai-water.com/

SR Onshore Wind Conference
Wed, 06 Sep 2023
Glasgow, UK
https://www.scottishrenewables.com/

Gat Wat
Wed, 06 - Thu, 07 Sep 2023
Cologne, Germany
https://www.gat-wat.de/

WasteEcoExpo
Tue, 12 Sep 2023
Krasnogorsk, Russia
https://en.waste-tech.ru/

Taiwan International Water Week
Wed, 20 - Fri, 22 Sep 2023
Taipei, Taiwan
https://www.taiwanintlwaterweek.com/

WCW Conference & Exhibition
Mon, 25 - Thu, 28 Sep 2023
Saskatoon, Canada
https://www.wcwwa.ca/page/AnnualConf

OCTOBER 2023

Wetex
Mon, 02 - Wed, 04 Oct 2023
Dubai, UAE
https://www.wetex.ae/

IFAT India
Wed, 18 - Fri, 20 Oct 2023
Mumbai, India
https://www.ifat-india.com/

Pak Water & Energy Expo
Wed, 25 - Fri, 27 Oct 2023
Lahore, Pakistan
https://pakwaterexpo.com/

AWT Convention and Exposition
Wed, 04 - Sat, 07 Oct 2023
Grand Rapids, USA
https://www.awt.org/events/annual-convention/

Envitech
Tue, 10 - Fri, 13 Oct 2023
Brno, Czech Republic
http://envitech.co.in/

VietWater
Wed, 11 - Fri, 13 Oct 2023
Ho Chi Minh, Vietnam
https://www.vietwater.com/en/

Water In Industry
Tue, 31 Oct 2023
Moscow, Russia
https://www.aquatechtrade.com/news/industrial-water/

NOVEMBER 2023

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

The Water Expo & Forum

ISGF has been organising its flagship annual event, India Smart Utility Week (ISUW) since 2015 and it is considered as one of the top five international events on Smart Grids and Smart Cities. ISUW 2023 will bring together India's leading Electricity, Gas and Water Utilities, Policy Makers, Regulators, Investors and world's top-notch Smart Energy Experts and Researchers to discuss trends, share best practices and showcase next generation technologies and products in smart energy and smart cities domains. ISUW 2023 will include plenaries, interactive workshops, keynotes, technical sessions, technical paper presentations and master classes from tutors from the USA and Canada. Bi-lateral Smart Grid workshops with EU, USA, Sweden, Germany, France are also expected to be a part of the upcoming edition. 7th edition of ISGF Innovation Awards 2023 will be organised as part of ISUW 2023 on 03 March 2023.

Date: 01-04 March 2023
Venue: Lalit Hotel, New Delhi
Website: : http://www.isuw.in/

Water & Waste Expo 2023

Confederation of Indian Industry (CII) is pleased to announce its second edition of Water & Solid Waste Expo 2023 schedule from 16 to 18 February 2023 at Pragati Maidan, New Delhi. This would be a co-located event alongside CII's 25th edition of its flagship event, International Engineering and Technology Fair (IETF 2023).

Water & Solid Waste Expo 2023 is a biannual event and aims at providing an excellent international platform, to showcase the full range of environmental technologies including water, sewage, refuse, recycling, and energy conservation management in India, focusing on basic to highly sophisticated machinery and environmental solutions from domestic and international exhibitors.

Date: 16-18 February 2023
Venue: Pragati Maidan, New Delhi
Website: https://watersolidwaste.com/

InterAqua 2023

The 14th International Water Solution Exhibition, is a unique exhibition for water industry which will showcase a material, component, and apparatus which are indispensable in the process of water reuse, industrial cleaning, drainage, and recycle use for water and its energy saving and cost reduction.

Against the backdrop of the ever-growing global need for quantitative and qualitative solutions in the water industry, various key players from Japan and overseas will gather to open up a path to the next generation in water-related business.

The three-day exhibition will offer an opportunity for participants to sow seeds of innovation, seek out technological cooperation and engage in business alliances through consultations and networking.

Date: 01-03 February 2023
Venue: Tokyo Big Sight, Japan
Website: https://www.interaqua.jp/

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: 03-05 August 2023
Venue: Pragati Maidan,
New Delhi, India
Website: www.eawaterexpo.com

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118	Toshniwal	Double Page	+91 98291 12345	crm@toshcon.com	www.toshniwal.net
119	Water & Solid Waste Expo 2023	05	+91 98183 91920	info@watersolidwaste.com	www.watersolidwaste.com
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25. Chemical Feed
26. Chemical Water Treatment
27. Chillers
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40. Cooling Towers
41. Cooling Water – Chemical/ Treatment
42. Corrosion Control
43. Couplings
44. DAF Systems
45. Data – Acquisition / Transmission / Equipment
46. Dealkalizers
47. Dechlorinators
48. Degasifiers
49. Deionizers
50. Demineralisation Plants
51. Demineralized Water Systems
52. Desalination – Equipment / Systems / Plants
53. Detectors / Monitors / Recorders
54. Dewatering – Equipment / Services / Supplies
55. Diffusers
56. Disinfection – Equipment / Systems
57. Distillation Units
58. Drainage
59. Dredging – Equipment / Services / Systems
60. Drilling / Boring – Equipment / Supplies
61. Drinking Water Systems
62. Drives
63. Education / Training
64. Effluent Treatment – Chemicals
65. Effluent Treatment – Equipment / Plants
66. Ejectors
67. Electrical Accessories / Equipment
68. Electro Magnetic Treatment
69. Electrocoagulation
70. Electrodeionization
71. Electrodes
72. Electrodialysis
73. Energy Management Systems
74. Engineering Services
75. Erosion Control Products
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90. Fittings & Connectors
91. Flocculants
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104. High Purity Water Systems
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112. Industrial Wastewater Treatment
113. Industrial Water Treatment
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117. Instrumentation – Flow
118. Instrumentation – Lab Use
119. Instrumentation – Recording
120. Instrumentation – Water & Wastewater
121. Iodinated Resin
122. Ion Exchange – Equipment / Media / Supplies / Systems
123. Irrigation – Equipment / Systems
124. Joints / Jointing Materials
125. Lamps, Sterilizing
126. Leak Detection – Equipment / Systems
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128. Locators
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130. Membrane – Bioreactors (MBR)
131. Membrane – Cleaning
132. Membrane – Degasifiers
133. Membrane – Diffusers
134. Membrane – Filtration
135. Membrane – Housings / Systems
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140. Membrane – Treatment Systems
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143. Meters – Flow
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149. Neutralizers
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151. Odour Control Systems
152. Oil & Water Separators / Skimmers
153. On Site Wastewater Systems
154. Ozone Generators / Ozonators
155. Ozone Systems
156. Packaged Treatment Plants – Water / Wastewater
157. pH – Adjustment / Analyzers
158. Pipes / Pipe Fittings
159. Plumbing – Accessories / Fixtures / Tools
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165. Pressure Vessels
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168. Public Water Services Management
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199. Reverse Osmosis (RO) – Components / Equipment / Housings / Systems
200. RO Cabinets
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203. RO Plants – Industrial
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205. Sanitizers
206. SCADA
207. Screens / Screening Systems
208. Scrubbers
209. Sedimentation
210. Sensing Equipment / Sensors
211. Separators
212. Sequencing Batch Reactors
213. Sewage – Ejection Systems
214. Sewage Treatment – Equipments / Plants
215. Sewer – Rehabilitation
216. Sewer – Vacuum / Flushing
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219. Softeners – Components / Accessories / Systems
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242. Wastewater – Collection Treatment
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244. Wastewater – Treatment Components / Plants / Systems
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247. Water – Conditioners
248. Water – Conservation
249. Water – Coolers
250. Water – Dispensers
251. Water – Distribution
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