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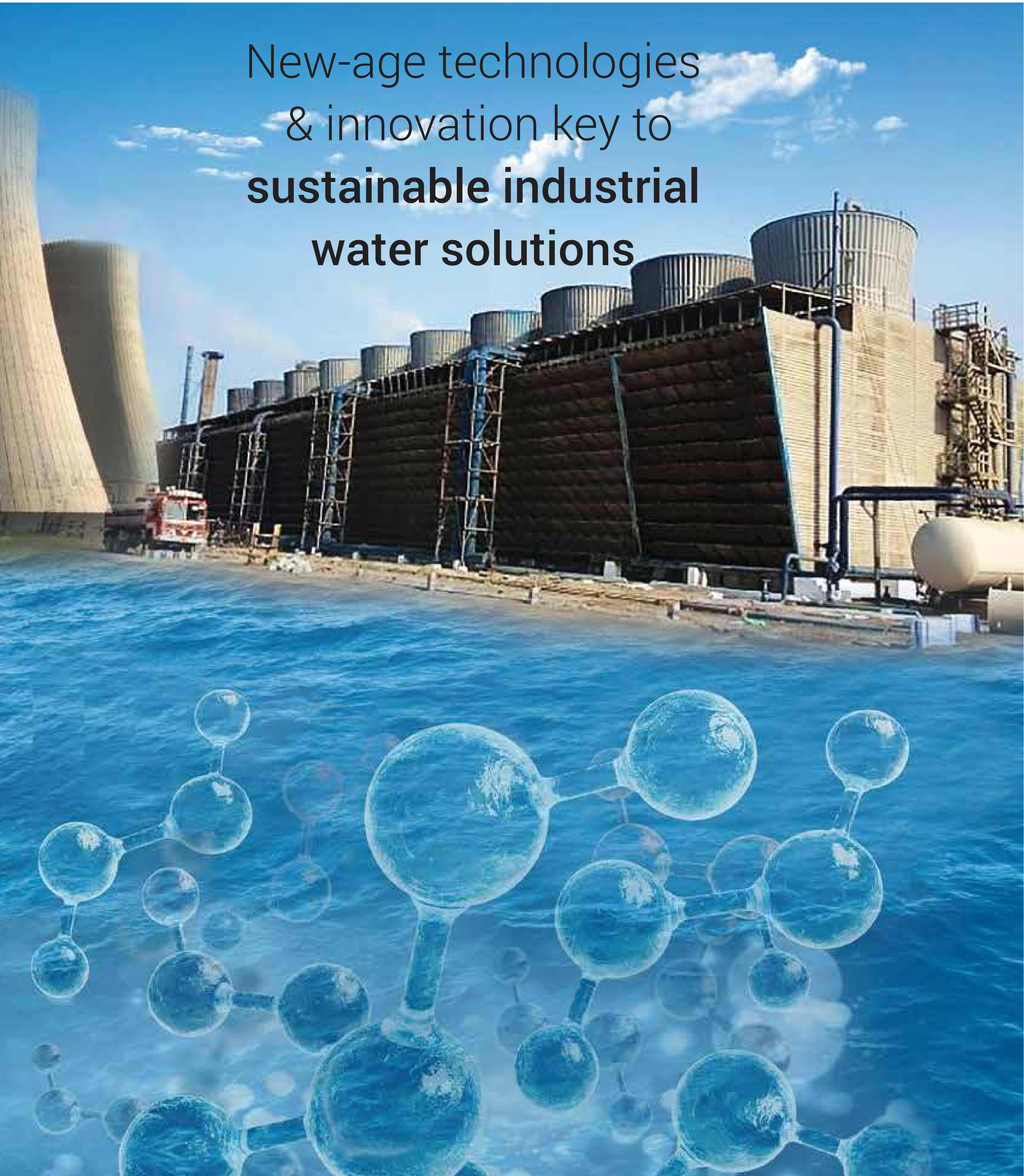
New-age technologies & innovation key to **sustainable industrial water solutions**



New-age technologies & innovation key to sustainable industrial water solutions

> "In a world where demands for fresh water are ever growing and limited water resources are increasingly stressed by over-abstraction, pollution and climate change, neglecting the opportunities arising from improved wastewater management is nothing less than unthinkable."
>
> 2017 World Water Development Report.

The United Nations estimates that as much as 80 percent of wastewater worldwide is released into the environment without treatment. According to the Centre for Science and Environment, each litre of wastewater discharged further pollutes 5-8 litres of water. By this measure, the share of industrial water use stands at somewhere between 35-50 percent of the total water usage and not 7-8 percent that is considered as industrial water use .

With water scarcity rising to alarming levels, industrial wastewater collection, treatment and reuse is increasing in importance. Further, besides water itself, industrial wastewater contains a number of useful materials such as nutrients, minerals and organic materials, which can be used for other productive purposes. As such, wastewater can play a pivotal role in the circular economy through sustainable management. Consequently, new wastewater technologies, especially in industrial and manufacturing are focused beyond merely removing impurities from wastewater flows and reusing reclaimed water. They emphasise on recovering useful by-products from the treated water.

The scope of such technologies in the industrial sector is much higher owing to the globally accelerating pace of urbanization and industrialization. According to the Food and Agriculture Organization, industrial water is the fastest growing sector in the global water market. Consequently, businesses and policymakers alike are looking for industrial wastewater management solutions that are process efficient and cost effective. Without doubt there is immense potential for industrial water treatment technologies which are estimated to be worth USD 11 billion by 2020 .

According to the Food and Agriculture Organization, industrial water is the fastest growing sector in the global water market.

The significance of water stewardship for industry

Water is vital for industries *(refer figure I: The Value of Water in Industriess)*[3]. Disruption in water supply can lead to a lot of tangible and intangible business consequences for manufacturers.

Figure I: The Value of Water in Industries

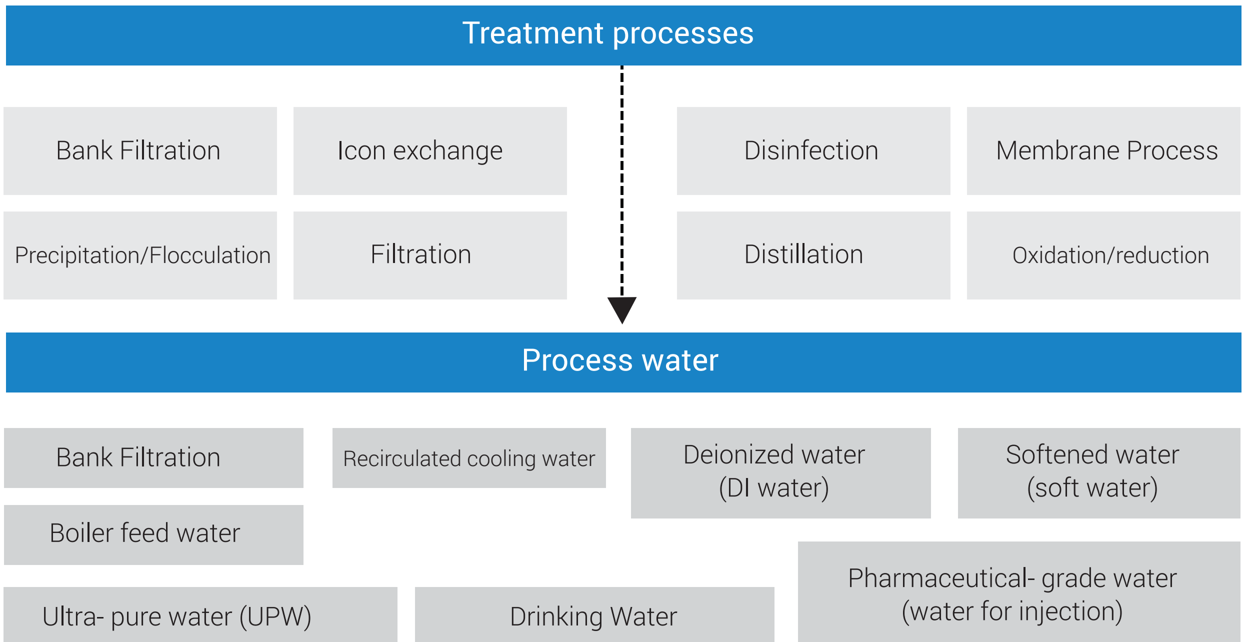
	Value	Risk
Tangible Value	Business continuity	Scarcity of water supplies can disrupt normal operations & lead to a loss that can be quantified in economic terms
Intangible Value	Social licence to operate	A business risk that many mining, oil & gas, food & beverages companies know too well. Social licence to operate is no longer a simple permit, but a complex & potentially volatile relationship with the many local stakeholders that share the water basin. Withdrawal of the licence to operate means that the company needs to stop operation at that location
	Reputation & brand value	Reputation & brand form part of a company's assets. Inability to operate sustainably may cause reputational risks & can damage the brand value.

Toxicity, mobility and loading of industrial pollutants have a more significant impact on water resources, human health and the environment than actual volumes of water. Mishandling the resource has extraordinary implications for all stakeholders. Consequently, industries across the world are ensuring that they demonstrate exemplary stewardship in protection of fresh water, treatment of wastewater and long-term availability of clean water. Essentially, regulatory compliance of water management products, processes and solutions that helps in running businesses through cost savings and optimal usage will win market leadership going forward.

Given the widespread consequences, technological advances in industrial wastewater management are critical for preserving the ecosystem as well as saving the precious natural resource. In addition, advanced process steering systems provide real-time information – which can result in process efficiency and reliability. For industries, this input reduces non-compliance risks as well as costs.

Trends in industrial wastewater management

Figure II: Industrial Water - Treatment & Processes



Water needs differ across industries and locations. Even the wastewater generated from different industries contains vastly varied elements. *(refer Figure II: Industrial Water - Treatment and Processes)*[4] . Hence, standardized solutions for wastewater treatment are rendered infeasible. Mixed effluents require complex treatments and face stringent regulations. Industrial water treatment providers need to provide tailor made solutions for each type of wastewater. The process also needs to meet various performance and reliability criteria while ensuring compliance with regulatory discharge and safety requirements. Economic constraints also form a consideration.

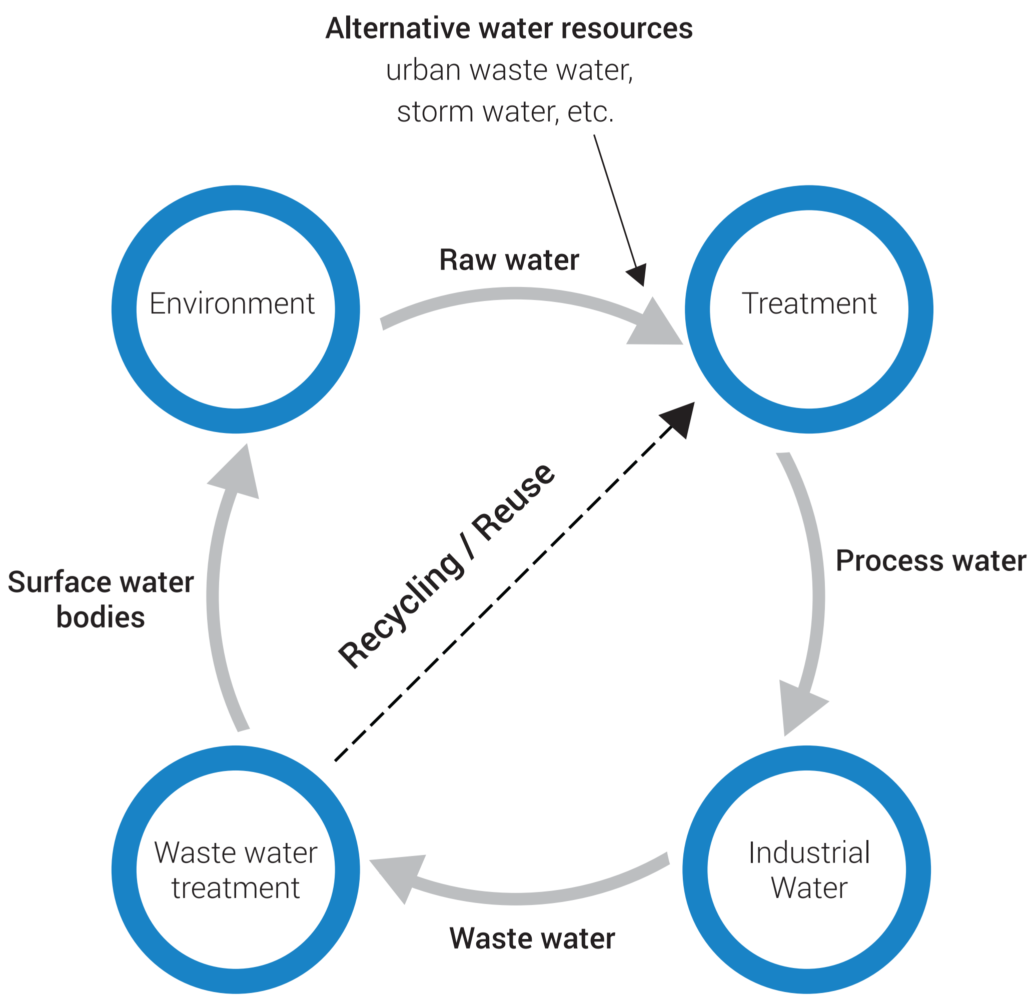
Globally, countries with inadequate water supply are world leaders in industrial water treatment. For instance, Israel reuses 70 percent of industrial discharge water. In Western Australia, where the main industry in water-intensive mining, the government is committed to achieving 30 percent water recycling in key cities by 2030 and 60 percent by 2060. In California, the government has begun investments to reuse water bringing it up to drinkable quality.

However, the latest technologies are expensive. Industries, especially the small and medium ones find it more economical to pay fines than to invest in capital intensive processes that meet strict regulations. However, the amount of untreated effluence discharged into the environment, especially in developing covuntries, is colossal. Keeping in mind the consequences, it is better to design process systems that are a mix of traditional and modern technologies, while requiring minimal investments from industries. This can render the water quality required for its next role.

Industrial wastewater treatment A shift in approach

The last few years have witnessed a paradigm shift in the approach towards industrial wastewater management. Global organizations have changed their methodology from 'treat to discharge' to 'recycle, reuse and zero liquid discharge'. In line with changing industry landscape, new-age industrial wastewater treatment technologies are aimed at returning superior quality of water back to the ecosystem with greater reliability *(refer figure III: Industrial Water Cycle)*[6].

Figure III: Industrial Water Cycle



In addition, they are working to optimize their process efficiencies from both the economic and technical perspective. Recent developments in wastewater management aim to curb the rising demand for fresh water and thus decrease the process costs of water itself. The water heat generated from industrial water utilization contains valuable energy which can be redirected into the process itself. The implementation of such process modules contributes substantially to cost reduction.

The above trend signifies that traditional technologies which aimed at merely cleaning industrial water before dispensing it back into the environment have evolved. Today, they are more focused on creating value from the same wastewater. One example could be that of oil removal technologies shifting from floatation technologies to ceramic membranes. While the former clarifies wastewater (or other water) by the removal of suspended matter such as oil or solids, the latter focuses on increasing efficiencies by improving the quantity of organics removed. It further aims to reduce the waste footprint by creating energy out of the sludge generated.

From traditional to modern: The need to bridge the gap

For optimal water utilization, process waste water recycling must be combined with water treatment. These different needs can be addressed by a permutation and combination of traditional processes and modern technology. For instance, modern wastewater treatment technologies aim at substituting traditional end-of-pipe solutions with an increasingly decentralized approach. To elaborate, traditional technologies aim at treating wastewater filled with effluents discharged at the end of an industrial process. Modern technologies, however, work to intervene mid-process and treat selected wastewater streams in an economic and effective manner. Moreover, as a part of their zero-discharge objective, these technologies reduce the overall effluent emission and reuse the wastewater generated.

This holistic approach to wastewater treatment is a step further from the traditional strategy of simply treating industrial water and making it fit for environmental discharge. To ensure the wide adoption of such strategies for optimized resource solutions, industrial wastewater treatment should harness new technologies on the basis of existing technologies used in factories. This will lead to reduced investments for manufacturers and result in long-term cost and resource savings.

Experts in developed countries argue that it is very difficult to upgrade existing infrastructure for wastewater processing and often, the results are not very efficient. However, manufacturers in developing economies have very limited budgets for investments in such strategies. To ensure that the water is not left untreated before being discharged back into the ecosystem, infrastructure upgradation is an imperative.

To elaborate, traditional technologies aim at treating wastewater filled with effluents discharged at the end of an industrial process.

Evolving solutions to model the way forward

One example of effective technology use is that of advancements in membrane technologies. While there was always a vast array of membrane technologies available, its application was majorly in large-scale applications. However, recent improvements have made the technology last longer and enabled the membranes to resist degradation during cleaning. This allows more water to flow through the membranes while decreasing the time spent on maintenance – thus, increasing the efficiency of the technology.

Such improvements make the membrane useful for sectors where its use was challenging in the past; for instance, in the textile industry. Further, these advances also make the technology economically accessible for small and medium scale industries. Consequently, many companies in the oil and gas, mining and consumer businesses, which use large quantities of fresh and saline water in most stages of their project lifecycle, have dramatically reduced their raw water intake .

Another example of improvement and augmentation in industry wastewater treatment is that of floatation and thermal technologies. Historically, these have been considered too expensive and energy inefficient to be used on a large-scale. Also, the chemicals used in these solutions are prohibitively expensive. However, recent research focuses on improving the efficiency of these technologies and reducing the amount of chemicals used in the process.

Efforts are being made to improve technologies not just to reuse wastewater but also to treat unusable water to address the growing scarcity of the resource. For instance, efforts are dedicated towards making the infamously energy-intensive seawater desalination technology cheaper and more efficient. Conclusively, water treatment and reuse technologies are getting increasingly sophisticated and, in the process, cheaper, more operative and competent. Technological innovation in the segment is also throwing up new opportunities in the use and treatment of wastewater by-products such as sludge.

Conclusion

The pressures of climate change, urbanization and industrialization are increasing in developing nations as they push for progress. Their need for wastewater reuse and recycling is also rapidly. However, they may not always have the budgets to invest in new-age wastewater technology infrastructure. These economies therefore need technologies that are developed on the basis of tweaking and modernising their existing infrastructure.

Recent technological advancements in wastewater reuse have made the process cost-effective and improved the purification quality to derive further value from wastewater. Their output and efficiency are reflected in the rapidly improving water reuse capabilities of advanced economies. However, much remains to be achieved in making these advancements more accessible to developing nations.

For the sake of the betterment of our ecosystem, the path forward should be a mix of traditional and modern technologies. One without the other is unusable and hence a futile effort.

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Sicagen

Corporate Office:

Spic House, 4th Floor, 88 Mount Road, Guindy, Chennai - 600032 India.

For more information contact or Fax:

+91 44 30070300 | +91 44 30070399