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Reduce, Reuse, Reduce Again: How Industrial Water Reuse Creates Operational Security

Water has historically been treated as a low-priority utility cost for industrial facilities. In many cases, that assumption is starting to create unintended constraints on operations and long-term financial planning.

Reliable access to water and tightening regulatory requirements have pushed this resource from an occasional consideration to a persistent limiting factor for manufacturers of all sizes. Now, as water-related challenges rise, facilities are taking on new practices to get the most out of every drop. Implementing water reuse shifts the resource from an operational constraint to a controllable input, removing the uncertainty and variable conditions that can inhibit production volume and eat into a plant's bottom line.

When to Consider Reuse

Water reuse projects are rarely implemented in isolation. Typically, systems are designed years in advance, taking into account the specifics of a site, required treatment levels, existing equipment, and the long-term goals of the facility. However, unexpected infrastructure or

compliance concerns can trigger these conversations sooner, leading to short-term changes to the ways a facility sources, treats, and discharges its water. In either case, the facilities who are able to anticipate and react to these inflection points tend to have more flexibility in leveraging the economic and operational benefits of these projects as opposed to viewing it as just a cost.

In many cases, facilities don't explore water reuse unless something starts to break, tighten, or limit growth. It may be worth evaluating if any of the following are already happening or are expected soon:

- Expansion plans, new lines, or added shifts could push beyond permitted water withdrawals or discharge limits
- Wastewater surcharges are increasing, or pretreatment requirements are becoming more stringent due to aging municipal systems
- Upcoming permit renewals or modifications are introducing added scrutiny or uncertainty
- System reliability issues or capacity constraints are beginning to disrupt operations
- Internal water, ESG, or resiliency goals require measurable reductions that current infrastructure may not support

Not every facility facing these conditions will need reuse, but these are often the points where it starts to become part of the conversation.

Implementing Water Reuse

Effective reuse systems tend to align with existing infrastructure, but more importantly, they're designed around the specific needs of the facility. Initial planning typically considers big-picture factors like end application for the water and reliability, as well as more site-specific characteristics, such as variable influent quality, redundancies, failsafes, and bypasses. In addition, they plan for the long-term, both in their economics and the viability of their equipment, especially for any future upgrades. This ensures that miscalculations early in the design process do not snowball into costly mistakes down the line.

Facilities with complicated treatment trains, including tertiary treatment and polishing, may find that implementing high-quality potable reuse is a relatively low technical lift. This opens the door to a number of applications, including returning it to use in production, the first step towards a ZLD (Zero Liquid Discharge) or closed-loop system. However, if their main purpose for the water is for spot cleaning, they likely do not need as much reuse, nor do they need to attain potable quality. As such, their system would likely utilize water diverted from the system

before the advanced processes to avoid needless treatment. In comparison, a facility that does minimal treatment to reach industrial effluent quality may never be able to attain potable reuse quality within their current context without a complete system overhaul. What they can attain are significant boosts to their water productivity and cost basis by simply utilizing their effluent a second time within their production process. In addition, surcharges for BOD, COD, TDS, etc., can be mitigated by driving more efficient effluent usage practices, even in the most basic applications.

Aging industrial wastewater systems make ideal opportunities for new water reuse projects.

Designing Reuse Systems

When planning a new water reuse system, the aforementioned considerations can help significantly reduce costs and internal friction when implementing reuse while ensuring effectiveness and longevity. Additionally, many of these overlap with the planning and design that go into traditional water treatment infrastructure. With this in mind, it is essential to consider reuse early in any planning around wastewater systems. By accounting for the lifecycle of the equipment, variable production data, permitting requirements, future expansion, and operator capacity, a facility gains a holistic viewpoint that ensures the system will fit their exact needs.

While intended water quality and technical implementation are important considerations, so is the level of reuse needed. Some facilities, such as those in pharmaceuticals and chip manufacturing, strive for ZLD to ensure the highest possible quality of water is attained

without constant, expensive treatment on influent. For those looking to attain similar goals without the technical requirements associated with ZLD, closed loop systems provide similar levels of water productivity by reusing all of their water while allowing for some predictable loss and waste discharge. However, both of these require significant up-front costs and design efforts. More commonly, facilities are turning to partial or purpose-specific reuse, in which their effluent is treated up to the required level for their most water-intensive practices, such as clean-in-place, boiler feed, or in cooling towers.

Economics of Reuse: A Strategy for Resilience

Many facilities we speak to shy away from the growth opportunities created by reuse due to the significant up-front capital required for its implementation. In addition to the costs of equipment and system design, facilities must also consider other factors, such as construction, updated operator training, and any necessary pauses in production. In doing so, they can more effectively weigh the long-term value of risk reduction and operational stability offered by a well-planned system.

Not only does reuse reduce overall water consumption, it is an essential tool for managing operational costs and surcharges. In addition, water reuse also offers significant protection against the ever-shifting hydrological conditions across the US. By building a reliable and secure water reuse system, facilities can protect themselves from droughts, allocation cuts, and moratoriums in water-strained regions. Such practices insulate operations from municipal or local infrastructure failures, supporting long-term reliability in production.

Given this contrast, industrial facilities must find a way to balance their economic planning for these projects to ensure an accurate perspective on the cost of risk reduction vs. business-as-usual. By taking a holistic perspective on water and wastewater as an operational expense, businesses can gain a more accurate viewpoint on the potential savings from implementing advanced wastewater treatment and reuse. Furthermore, there are more options than ever for them to overcome up-front equipment and implementation costs through water-as-a-service and partnership models.

Water Reuse Challenges and Misconceptions

Often, we hear from industrial clients that advanced wastewater treatment and water reuse will not work for their specific context. Historically, businesses have avoided the negative perception of re-using water for production processes. However, given the growing discussions around water scarcity and the challenges around water-intensive manufacturing

processes, facilities are realizing that the benefits heavily outweigh the challenges of incorporating water reuse into their existing systems.

Some of the other misconceptions we hear are:

“We would need potable-quality water for reuse to be worth it.”

That can make sense, depending on how the water is being used. In many cases, industrial facilities do not need potable-quality water to achieve meaningful reuse benefits. The value of reuse depends on matching treated water quality to the intended application. Many common industrial uses, such as cooling towers, boiler makeup, washdown, CIP pre-rinse, irrigation, or utility water, can be reliably supplied with non-potable reuse water that meets fit-for-purpose standards.

“This would be too complex for our team to operate.”

It might be, especially if it adds another layer on top of what’s already in place.

That said, many modern systems are designed to integrate seamlessly into existing operations. A combination of modular treatment technologies, automation, and remote monitoring helps to replace or simplify legacy treatment processes and reduce the need for specialized on-site expertise. In addition, some systems can even offset their own costs by recovering energy or reducing chemical and hauling expenses.

“Reuse only makes sense in extreme drought”

That’s often how it’s viewed. In some cases, though, the bigger issue isn’t supply, it’s capacity. Water reuse has shifted from a necessity for businesses in water-strained regions to a widespread capacity and risk-management strategy. As municipalities continue to tighten limits on water usage and wastewater discharges, particularly for industrial users, these constraints can cap production growth even when market demand is strong. By implementing water reuse, facilities can distinguish their production capacity from freshwater availability, enabling the flexibility to expand output, add shifts, or bring new lines online without exceeding permitted water or discharge limits.

"Our permits don't include reuse"

Permits can definitely be one of the more limiting factors, depending on the region and

timing. In some cases, though, it becomes less about whether reuse is allowed today and more about how early it's introduced into the permitting process. Permitting, historically a pain for industrial facilities, now poses opportunity for those operating in water-conscious regions of the US. In places such as the arid West and parts of the Southeast, regulators and water quality boards are increasingly supportive of reuse projects that reduce strain on local supplies and infrastructure. While permitting does require careful planning, clear treatment objectives, and robust hazard assessments, agencies are supportive of well-designed reuse projects.

"Reuse costs are too much to implement"

When you think about upfront costs, do you feel they give the full picture of what a long-term water reuse project could mean for your operations? Upfront costs are an important consideration, but they do not reflect the full economic picture of a long-term water reuse project. When compared to the potential costs of halting production, unanticipated system failures, rising surcharges, volatile utility pricing, or compliance risks, water reuse often proves to be a stable investment that can significantly reduce operational costs over the lifetime of the system.

Utilizing Partnerships for Reuse Implementation

Construction and equipment not only pose the largest capital requirements and operational challenges for reuse projects, they often create the greatest friction during implementation. Designing systems that combine aging equipment with new technology, then getting them online without pauses to production, all under the umbrella of strict effluent requirements, can pose an insurmountable challenge for smaller operational teams. That's why more organizations are turning to third party partnerships to leverage the long-term benefits without worrying about how to secure the necessary capital to get started.

Cambrian's innovative partnership model helps facilities across manufacturing industries attain crucial funding, bringing more and more of these projects to life to build operational resilience and cut water costs across the board. Our robust treatment and reuse systems make recycling water the cost-effective choice for manufacturing facilities of all sizes.

If you're curious whether water reuse could help reduce risk or stabilize costs, and how it might fit within your current operations, Cambrian can explore options with you without any upfront investment or obligation. That said, we know this approach isn't the right fit for every facility, which is why the first step is simply evaluating whether it makes sense for your specific situation.

Let’s Talk

Whether you're exploring a new operational model or looking to upgrade without the capital, Cambrian is ready to partner for long-term success.

Your next liquid asset is already on site. Let’s put it to work.

Schedule a conversation with Cambrian:
www.cambrianinnovation.com/contact