MAXIMIZING WATER REUSE:

ADVANCED RO MEMBRANES IN FOOD & BEVERAGE

ZwitterCo

OVERVIEW

In the food and beverage industry, water is essential not only as a vital ingredient, but also for cleaning and cooling processes. However, this high water usage results in large volumes of wastewater that must be treated efficiently, especially as freshwater resources become more scarce.

This eBook explores the critical role of reverse osmosis (RO) membranes in wastewater treatment for the food and beverage industries. It highlights the limitations of conventional RO membranes, especially when dealing with high organic effluent, and introduces ZwitterCo's advanced membrane technology as a game-changing innovation.

ZwitterCo is not reinventing the wheel – just making it *better*.

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> Water is not just a nice-to-have sustainability goal – ***it's a license to operate.***

CHAPTER 1

Wastewater Treatment in Food & Beverage

Water is integral to every aspect of food and beverage production, from cleaning machinery to being a key ingredient in final products. Given the significant water consumption in this industry, the volume of wastewater produced is also substantial. With the world's dwindling freshwater supply, many food and beverage companies are implementing water reuse systems to support corporate sustainability agendas by increasing water efficiency and reducing freshwater withdrawal.

Food and beverage wastewater often contains high amounts of organics (BOD/COD), nutrients, and suspended solids, all by-products of the production processes. Treating this wastewater often requires complex systems to purify it to the point where it can be reused in utilities like boilers, condensers, cooling towers, or even reintroduced into the influent water system.

In addition to conventional treatment methods, RO membranes play a critical role in helping food and beverage companies meet stringent discharge limits for wastewater. RO technology is capable of removing dissolved salts, organics, and other contaminants, allowing wastewater to be treated to a high level of purity. This not only supports regulatory compliance by reducing pollutants like total dissolved solids (TDS), but also opens up more opportunities for water reuse within the facility.

TYPICAL WASTEWATER TREATMENT SYSTEMS

Most food and beverage wastewater treatment systems involve two main treatment processes: primary and secondary treatment, with additional preliminary steps. For wastewater intended for reuse, a third step – tertiary treatment – is applied to achieve higher purity levels.

01. PRIMARY TREATMENT

Primary treatment typically removes around 50-70% of suspended solids through physical methods such as filtration and settling. It helps eliminate grit, debris, oil, grease, and lighter solids.

This stage plays a critical role in reducing the load on downstream processes and ensuring that larger pollutants are filtered out early in the treatment cycle.

02. SECONDARY TREATMENT

Secondary treatment focuses on further reducing organic matter using biological processes such as aeration and activated sludge treatment.

This step is essential for breaking down dissolved biosolids and further polishing the wastewater before it undergoes more advanced treatment, like reverse osmosis (RO) in the tertiary stage

03. TERTIARY TREATMENT

Tertiary treatment, also known as “effluent polishing” often utilizes RO membranes to reduce total dissolved solids (TDS). While primary and secondary treatment prepare wastewater for safe discharge into the environment, tertiary treatment with RO membranes **elevates water quality for reuse in water-intensive processes,** and in some cases, even as potable water.

CHAPTER 2

Challenges with RO Membranes in the Food & Beverage Industry

FREQUENT MEMBRANE FOULING

RO in tertiary wastewater processes has become a go-to solution to augment water supplies to combat water scarcity around the world and has proven to provide a cost-efficient way to reuse water. However, while the secondary step in wastewater treatment processes is used to remove the bulk of the suspended solids and organic material found in the wastewater, its effluent *still* contains dissolved organic materials.

In many systems, effluent is sent through a RO process for final polishing. However, high levels of organics can lead to fouling—organic material builds up on the RO membrane, hindering its performance. The first sign of fouling is often a noticeable drop in flow, which forces operators to increase pressure just to keep the system running. Eventually, chemical cleaning becomes necessary to restore performance.

FREQUENT CHEMICAL CLEANING

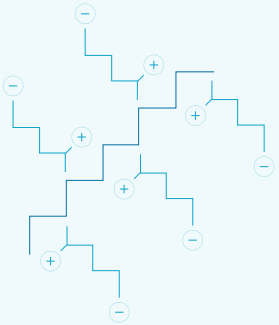
Unfortunately, the high organic load in these systems means chemical cleanings are needed frequently—often every one to four weeks. This not only **drives up operating costs** but also gradually casues the **membrane to deteriorate.**

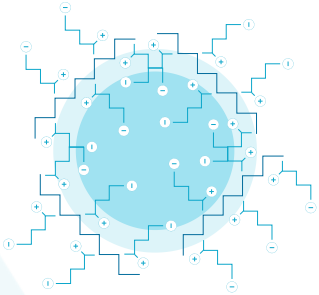
Cleaning agents, especially high-pH or alkaline chemicals used to remove organic build-up, are particularly tough on the membrane, leading to accelerated deterioration. Over time, this deterioration shows up as an increase in salt passage, meaning the membrane is no longer able to meet the required permeate quality.

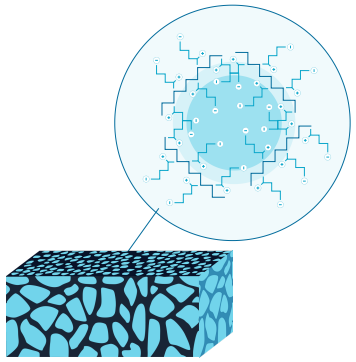
Frequent fouling and chemical cleaning leads to **reduced membrane lifespan, compromised performance,** and **higher replacement costs.**

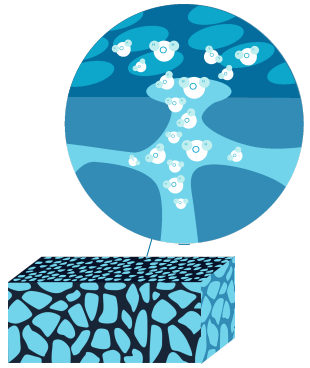
CHAPTER 3

Why ZwitterCo Membranes Are Different









POSITIVE & NEGATIVE CHARGES

First, zwitterions attract water molecules, displacing or repelling organic compounds.

PROPRIETARY CO-POLYMERS

Co-polymers bind zwitterions with hydrophobic molecules for stability, preventing wearing away over time.

FOULING IMMUNITY

Zwitterions create water-loving channels, ensuring immunity to fouling internally and externally.

CLEAN PERMEATE

Zwitterionic channels retain contaminants and produce clean water and can operate for years at full capacity.

THE SCIENCE

ZwitterCo has set new standards in the membrane industry with its innovative zwitterionic technology. By integrating the technology with **proven commercial brackish water membranes,** ZwitterCo RO addresses the critical and persistent issue of irreversible organic fouling - making it a thing of the past.

A zwitterion is simply a small organic molecule that carries both positive and negative charges, which balance each other out, resulting in a molecule that is net neutral. In 2013, researchers at Tufts University made a breakthrough, discovering that specialized copolymers combining hydrophilic zwitterionic monomers with hydrophobic monomers could yield stable materials with the astonishing ability to form self-assembled pore structures.

Being extremely hydrophilic, the zwitterions are central to ZwitterCo's membrane technology, as they create water-loving channels that prevent organic compounds from adhering to the membrane surface, significantly enhancing fouling resistance.

SUSTAINABILITY BENEFITS

Designed to offer stable performance even in high-fouling streams, ZwitterCo membranes can be fully restored with less freqent cleaning. This results in at least twice the membrane life, which keeps OPEX costs low, minimizes waste, and reduces chemical usage.

By efficiently treating and reusing wastewater, while reducing chemical and element waste, ZwitterCo RO membranes help food and beverage companies **reach their sustainability goals more easily.**

ECONOMIC BENEFITS

The economic advantages of ZwitterCo RO membranes are substantial long-term. By reducing cleaning frequency by up to 90%, ZwitterCo RO elements may also last at least twice as long as conventional RO elements, reducing element replacements and lowering overall operating costs.

Not only can ZwitterCo RO membranes reduce your overall operating expenses (OPEX) significantly, but they are also designed to be drop-in replacements, offering a no-risk opportunity for users to upgrade their system and lower costs without additional capital expenditure (CAPEX).

OPERATIONAL BENEFITS

ZwitterCo membranes offer unparalleled organic fouling resistance, reducing the frequency of high pH chemical cleaning by up to 90%. This means longer operational periods without the need for shutdowns and maintenance, enhancing overall system efficiency.

2x

ZwitterCo membranes last at least twice as long as conventional membranes.

CHAPTER 4

ZwitterCo RO in Food & Beverage Wastewater Treatment

LESS CLEANING NEEDED

If we consider a food and beverage processor using traditional RO systems, the high organic content in wastewater might require frequent chemical cleanings, as often as every few weeks. This leads to costly downtime, increased maintenance, and a reduction in membrane lifespan.

By switching to ZwitterCo RO membranes, plants could reduce cleaning frequency by **up to 90%,** which is a significant improvement in both operational efficiency and uptime.

Reduced membrane cleanings would result in fewer production interruptions, extended operation times between cleanings, and a dramatic reduction in chemical usage. In a large-scale facility, even **reducing downtime by 10% could lead to significant gains in output and revenue.**

LESS FREQUENT REPLACEMENTS

From an economic perspective, ZwitterCo RO membranes could substantially lower the OPEX for food and beverage processors. With a **reduction in cleaning frequency** and **at least double the membrane life**, processors may save on operating *and* maintenance costs.

Moreover, with traditional membranes often needing replacement every 1-2 years, ZwitterCo RO membranes, which last at least twice as long due to their enhanced durability, could also reduce the CAPEX associated with membrane replacements.

Food & Beverage ZwitterCo RO Example Installs

- Distillery WW – ***KY, USA***
- Dairy Water Polisher – ***MN, USA***
- Distillery WW – ***UK***
- Food Processing WW – ***UK***
- Beverage Production WW – ***South Africa***
- Dairy Water Polisher – ***WI, USA***

Food and beverage processors can significantly reduce operating costs by switching to ZwitterCo RO membranes, which **reduce cleaning frequency, extend membrane life, and boost efficiency.**

CHAPTER 5

Pricing and Availability

Both ZwitterCo RO High Rejection and Low Energy elements are generally available from stock or with very competitive lead times to meet customer requirements.

While the value delivered from lower cleaning costs, more uptime, and longer membrane life justifies a price 2-3 times that of a conventional RO membrane, ZwitterCo offers special pricing and terms for new users. Our goal is to make it easy for users to **see the performance benefits for themselves.** We not only help new adopters benefit from special pricing, but also offer tier 1 technical/ operational support and direct access to our product team.

To learn more about getting started, click here.

Learn More

CONCLUSION

The introduction and adoption of new membrane chemistry is critical to make real change in the water industry, and as we often say – *every industry is a water industry*. This new era of membrane technology will enhance efficiency, sustainability, and cost-effectiveness, setting a new standard for water treatment and reuse.

ZwitterCo's innovative membranes are at the forefront of this change, offering solutions that are not only more effective but also more resilient. If you are interested in discovering how much your operation could save by switching to ZwitterCo membranes, we invite you to use our savings calculator or contact us directly for more information.

ⓘ ADDITIONAL RESOURCES

ABOUT ZWITTERCO

ZwitterCo has developed a breakthrough in materials science, a new class of zwitterionic membranes that are immune to irreversible organic fouling, making it practical and affordable to treat challenging water and wastewater. Our mission is to provide industries with the tools to create clean water from every source, whether it involves accessing novel sources of water, shoring up distressed assets, or enabling onsite wastewater reuse. The company has been recognized as Breakthrough Technology Company of the Year at the Global Water Summit and by the Department of Energy and the National Science Foundation as a leader in clean water technologies.

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