# Enabling High-Strength Dairy Wastewater Reuse

High-strength dairy wastewater can be very hard to treat - especially using spiral-wound membranes - due to its high organic content, suspended soils, fouling potential, and variability.

The fat and suspended solids can clog treatment systems and make it difficult to remove organic matter. Common dairy treatment options include dissolved air flotation (DAF), activated sludge treatment, anaerobic and aerobic digestion, and hauling to offsite treatment.

## Water Reuse Made Possible

ZwitterCo provides a unique technology for removing FOG (fats, oils, and grease), protein and other solids from high-strength dairy wastewater. ZwitterCo's spiral membranes have an unprecedented ability to capture and remove FOG and proteins without irreversible organic fouling, eliminating the need for biological or chemical-based processes to achieve wastewater objectives.

Water efficiency and conservation is essential as water scarcity intensifies globally. Reusing water can help companies achieve their sustainability goals without sacrificing their bottom line. There are cost savings to be realized through reduction of freshwater and wastewater costs, elimination of municipal surcharges, high system uptime, and cost-effective cleaning.

## Benefits of ZwitterCo Superfiltration

### Reduce Costly Wastewater Hauling

Integrating superfiltration and reverse osmosis can reduce hauling volumes by 50% or more

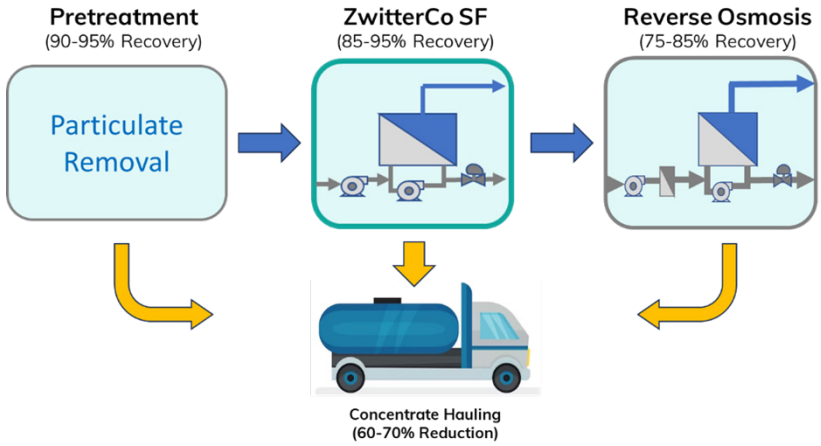
### Avoid Surcharges

ZwitterCo membranes can meet discharge limits based on suspended solids or FOG limits

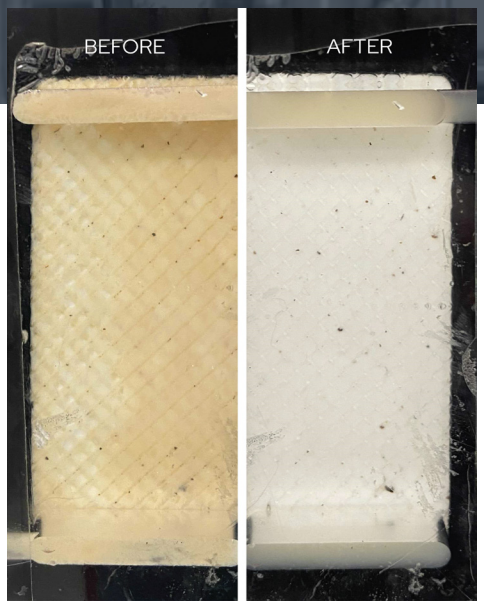
### Maximize Sustainability

Generate reuse-quality water & reduce freshwater consumption

# Where Does ZwitterCo Fit the Process?




*Figigure 1: Solution design basis showing 60-70% reduction in hauling costs.*




## Seeing It in Action

A multi-stage ZwitterCo superfiltration system paired with a reverse osmosis system is commercially installed at a dairy processing facility. The system generates clean water for discharge while also saving the facility ~60-70% in overall hauling costs and emissions by concentrating the plant wastewater.

- Figure 2 shows the difference between a dairy wastewater feed, concentrate, SF permeate and RO permeate.
- The system featuring ZwitterCo's superfiltration membrane was installed with a 25-micron pretreatment screen, superfiltration, and reverse osmosis.
- The solution led to ~20% in annual savings.

*Figure 2: (left to right)* Raw WW batch 1, raw WW batch 2, ZwitterCo SF Concentrate, ZwitterCo SF Permeate, RO Permeate.

# Achieve Steady Permeance Recovery

Zwitterionic membranes are changing the treatment landscape. They can handle up to 5% FOG, are highly chlorine and pH tolerant, achieve extreme permeate recoveries (>90%) in high-strength organic wastewater, and can be cleaned with ambient water flushes and mild chemical maintenance washes. Specifically, we find great use cases around reducing wastewater hauling costs and valorizing high protein and FOG concentrate streams.

- After more than 6 months of operation it was found that the SF system maintained a steady permeate recovery of **80-90%** (5-10X concentration factor).
- Figure 3 shows 18 days of operation at consistent performance
- This consistency allows facilities to **accurately predict wastewater hauling schedules** while also **drastically reducing the volume of hauling**

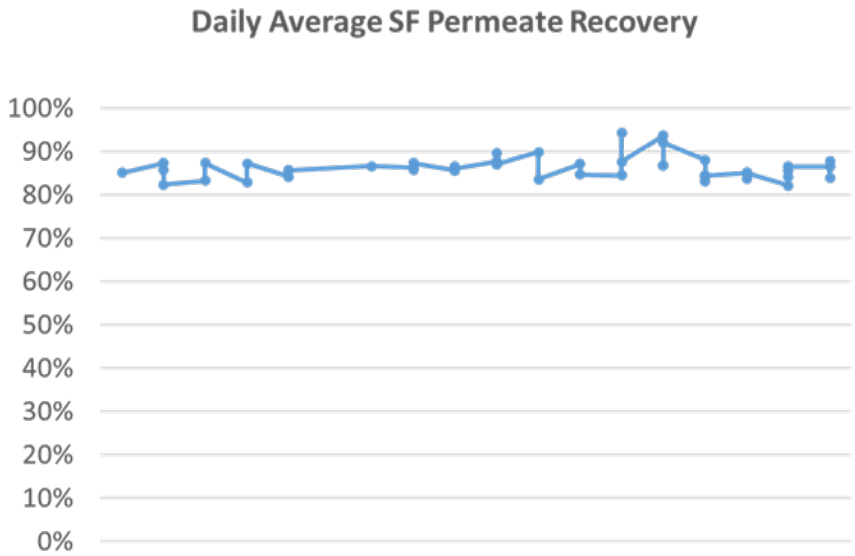


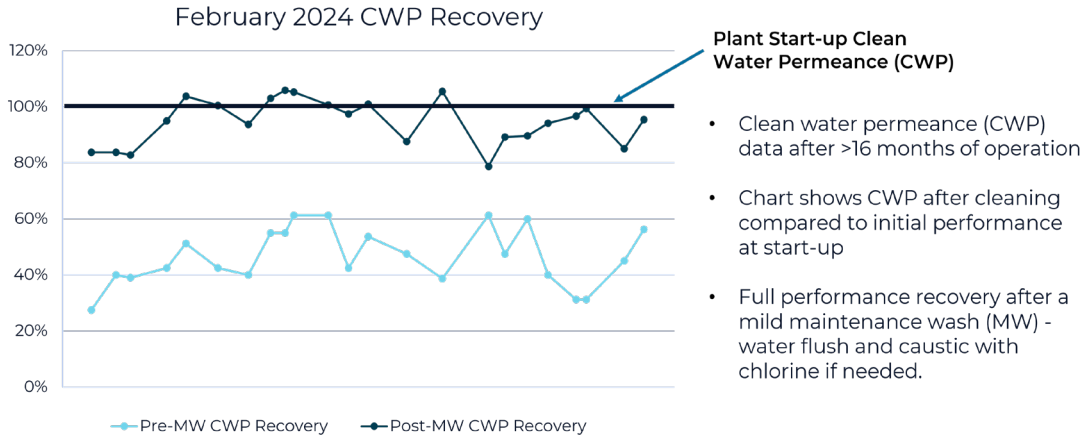

*Figure 3:* Permeate recovery after >6 months of commercial operation

The SF system is designed as a continuous feed and bleed process where the system will run for ~22 hours per day and then will undergo a short water flush (and caustic/chlorine cycle if needed) to recover membrane performance.

# Immune to Irreversible Organic Fouling

The SF membranes are **immune to irreversible organic fouling,** especially in high FOG and protein-rich streams.

Figure 4 below shows clean water permeance before and after a clean, where the membranes consistently recover to the original "start-up" clean water permeance after more than seven months of operation.




- Clean water permeance (CWP) data after >16 months of operation
- Chart shows CWP after cleaning compared to initial performance at start-up
- Full performance recovery after a mild maintenance wash (MW) - water flush and caustic with chlorine if needed.

*Figure 4:* Clean water permeance (CWP) recovery after > 16 months of commercial operation

Competitor membranes require a daily multi-step 4-hour CIP cycle, which is usually still not sufficient to overcome irreversible fouling. The ZwitterCo SF membranes require a short 1-2 hour maintenance wash at ambient temperature, which improves system uptime, lowers chemical contact time and consumption, and likely extends membrane lifetime.

## See the Difference

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