KOCH MEMBRANE SYSTEMS

APPLICATION BULLETIN
Improving Membrane Cleaning

BUSINESS UNIT: Food and Life Sciences

Specially formulated to clean all membrane types—microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO)—KOCHKLEEN® chemicals enhance the performance of your system and prolong the life of your membranes.

KMS Engineering Services Group is available to provide the most effective cleaning program or pre-treatment procedure for your system.

Application of a Cleaning Regime to Crossflow Membrane Systems

Overview

Crossflow membrane systems are widely used in the production of milk and whey products. Food processing regulations require that membrane systems in food plants are cleaned frequently, typically once a day.

An effective cleaning and disinfection regime must accommodate a variety of factors to maximize membrane life while minimizing expense and time. Different membranes require different cleaning routines; the membrane material, configuration (tubular, hollow fiber, or spiral wound), and pore size (microfiltration, nanofiltration, or reverse osmosis) all need to be considered.

The most important issue in membrane cleaning is an adequate crossflow velocity—one that sweeps clean the membrane surface and provides adequate flow conditions to the membrane feed and permeate sides, plus associated piping. It must scour the membrane surface, yet minimize the incremental damage to the membrane due to the aggressive nature of the cleaning compounds.

The Challenge

To establish effective and efficient standard cleaning regimes tailored for specific membrane types.

The Solution

The proper selection of chemicals and the order of cleaning steps are key to efficient membrane cleaning.

Acid solutions are used to remove milk-based calcium fouling and water-related hardness issues.

The alkaline cycle is the most complex of the cleaning steps. The solution must be properly buffered to maintain the correct pH, because the concentration of caustic changes due to its reaction with foulants. Straight caustic is seldom recommended for membrane cleaning.

A combination of nonionic and anionic surfactants will usually provide the best results. The addition of water-conditioning agents and a buffer to the surfactant cocktail completes the recipe for an effective additive.

Adding enzymes (primarily proteases) provides enhanced cleaning results in many applications, particularly those using RO and NF membranes, because chlorine cannot be used on these membranes. Since enzymes are expensive, these cycles are often used only once or twice per week.

The final step in the daily CIP procedure is sanitization. Using chlorine in this step provides a significant cleaning benefit. For membrane polymers that do not tolerate chlorine cleaning cycles, a peracetic acid solution can be substituted.

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Chemicals Used in Basic Cleaning Cycle Steps	
Chemical	**Purpose**
Acid blend @ pH 1.2, 120°F	Removal of soluble mineral salts (optional for low pH applications)
Formulated caustic, surfactants @ pH 10.5, 120°F	Removal of proteins, lipids (may be repeated 2nd time)
Enzyme, caustic @ pH 9, 120°F	Breakdown of proteinaceous material and polymeric foulants
Chlorine, caustic @ pH 10.5, 120°F Alternative – peracetic acid	Sanitization, organic reduction
Preservative @ pH 3.5, ambient	Stabilization, bactericidal prevention (e.g., citric acid)

Tips for Successful Membrane Cleaning

- Preconditioning—Remove any preservatives (typically glycerin) that are shipped with new membranes because they could react with the feed stream and cause irreversible fouling. Circulate a 1 percent solution of a surface active agent, for example, KOCHKLEEN® KLD-III, for 30 minutes at 50°C followed by a standard CIP cycle.
- Temperature Transitions—Membranes are made of polymeric materials and subject to thermal stress. Minimize temperature differences between cleaning and rinse steps by keeping the rinse steps within 20°F of the CIP solution temperature.
- Chemical Addition Sequences—Add chemicals after the system is recirculating to prevent local, high concentrations of chemicals. For the sanitization step, add the caustic and adjust the pH to 10.5, then follow with the sodium hypochlorite. For steps involving surfactants, add any caustic used first and surfactant only after air has been completely purged from the system to prevent excessive foaming.
- Residual Chlorine—Extend or repeat the final rinse to completely remove all trace amounts of chlorine left after the final rinse, because chlorine is particularly destructive to the clean membrane. KOCHKLEEN 150 (formulation based on sodium bisulfite chemistry) can also be added to react with any remaining active chlorine ions.
- Spiral Element Installation—Make sure the spiral element fits properly. A loose element will bypass a large percentage of feed flow, resulting in premature fouling. It will also be subject to low crossflow velocities during cleaning, leading to poor cleaning results.
- System Operating Parameters—Optimizing the operating procedures eliminates rapid fouling that leads to shorter run duration and higher baseline pressure.

Key Cleaning and Disinfection Regime Parameters	
Mechanical Design	**Chemical Usage**
Proper velocity Once-through flushing Chemical addition equipment	Proper selection Control dosage and pH Water conditioning
Temperature	**Time**
50-55°C for UF/MF 45-50°C for RO/NF Enzymes at 35-40°C	20-30 minutes recirculation (limit membrane exposure) 2-4 hour soak for enzyme step if necessary

Typical Operating and Cleaning Flows of UF and MF Membranes by Membrane Configuration			
	Tubular	**Hollow fiber**	**Spiral wound**
Operating			
Pressure	20-80 psi	20-30 psi	30-120 psi
Flow velocity	8-10 fps	3-8 fps	6-10 fps
Cleaning			
Pressure	20-50 psi	15-25 psi	20-60 psi
Flow velocity	7-8 fps	6-8 fps	7-8 fps

This document is for informational purposes only. It is not a guarantee of results to be achieved. Before application of this general information to your specific circumstances, KMS recommends that you consult with a qualified membrane technologist to discuss your particular situation.

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