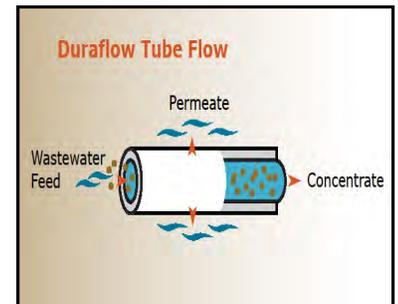


### Membrane Cleaning

#### Challenges

Membrane cleaning is a routine part of the system operation. In the filtration process, chemically pre-treated wastewater is re-circulated from the concentration tank through one or multiple trains of membrane modules. The interior surface of the membrane tubes will gradually be coated with inorganic and organic particles in the wastewater. As a consequence, the effective filtration area will be reduced and the filtrate flow or flux will decrease. Although effective chemical pretreatment can extend the time between cleanings, all systems will require cleaning eventually.



#### Duraflow Solution

When the filtrate flow drops to below the design level, the fouled train will be shut down and isolated for clean-in-place (CIP) with chemicals to restore the design filtration capacity. Depending on the type of fouling material, various cleaning chemicals can be used, which include mineral acids (sulfuric acid, hydrochloric acid, etc.) and oxidizing chemicals (bleach, peroxide, etc.). Most of the time, a single cleaning cycle with one chemical is sufficient. However, for some operations, a back-to-back cleaning with 2 different chemicals is required to restore the design flow. To thoroughly remove organic foulants from the membrane, the modules are often filled with a chemical and soaked for an extended period of time. Figure 1 illustrates a Duraflow system with membrane cleaning equipment. As a standard design, membrane cleaning is manually operated and controlled by an operator. As an option, membrane cleaning can be performed automatically by a programmable logic controller (PLC)/human machine interface (HMI) system.

**Single Cycle Pump-Through Cleaning** – Cleaning solution is continuously re-circulated through the train with the following steps.

- Flush sludge from modules with clean water
- Re-circulate cleaning solution through the modules for a pre-determined amount of time, with back pressure applied to maximize the cleaning effect.
- Drain cleaning solution back to cleaning tank
- Rinse modules with clean water

**Back-to-Back Cleaning** - Repeat the above steps using a second cleaning solution as needed.

**Soak Cleaning** – Instead of re-circulating through the modules, cleaning solution is transferred and contained in the modules to provide extended contact with the membrane surface in a static condition.

# Membrane Cleaning

**Membrane Cleaning Automation** - For automated cleaning, the system is equipped with control valves fitted with pneumatic or electric actuators, re-circulation pump for each cleaning chemical, instruments for cleaning solution pH and filtrate flow measurement, and a PLC/HMI system which is typically used for treatment process control as well.

The cleaning cycle through sequential operation of valves and pumps is controlled by a PLC which receives input from a HMI having a display of variables and command entry. There are several parameters of operation that are monitored by the PLC, including filtrate flow and rinse pH. These parameters are monitored for completeness of the cleaning operation. The HMI lists types of cleaning that can be selected by the operator – Single Cycle, Back-to-Back, Acid Soak, Oxidant Soak, etc. The initiation of the cleaning can be determined by the operator or filtrate service flow rate. When a cleaning cycle is completed, the operator can put the cleaned train back to normal service mode. With the PLC system, the cleaning operation does not require a dedicated operator.

**Figure 1 – Duraflow System Showing Tanks and Piping for Membrane Cleaning**

