Technical Service Bulletin

September 2018 TSB125.03

Reverse Direction Cleaning of RO Membrane Elements

This bulletin provides general information about how to clean RO membrane elements in a reverse direction (from the reject side of pressure vessels to the feed side).

Background

CIP (Clean-in-Place) systems have historically been designed to clean the RO systems in a manner that allows the cleaning solution to enter the feed end of the pressure vessels and flow through the RO elements until exiting the pressure vessels at the reject end. This flow pattern is the same way that the RO system operates under normal conditions. Cleaning in this manner is usually effective and very common. But there are certain cases where it has been found to be beneficial to be able to reverse the cleaning flow direction. In cases of heavy biological, colloidal, or particulate fouling, the foulant can be very heavily concentrated at the feed end of the lead (or front) element. Trying to break up and then push this foulant through all of the other RO elements in the pressure vessel can be very difficult. But in many of these cases, by reversing the direction of the cleaning solution it becomes much easier to remove these foulants (see diagrams on page 3). There are certain precautions that must be taken when doing reverse cleanings though. These precautions will be addressed in this bulletin.

Removal of Tail-end Scaling

Cleaning in the normal (forward) direction is always recommended if scaling is present. Scaling occurs when sparingly soluble salts precipitate and fall out of solution at the tail end of RO systems. These salts must be removed before doing any reverse direction cleaning. The crystals that form during scaling can have very sharp edges that can damage the membrane surface, and reverse direction cleaning can potentially cause greater damage than normal cleaning if these crystals are not removed first.

Limitation of Cleaning Flow Rates

When cleaning in the normal direction, the tail end RO elements are supported by a thrust ring which helps prevent the elements from telescoping. But when cleaning in a reverse direction the lead membrane will not be supported by a thrust ring to prevent telescoping. For this reason, we recommend limiting the reverse cleaning flow rates

during cleaning, at least initially until the dP is reduced. Normal cleaning flow rates for standard 8-inch diameter elements are 36 – 48 gallons per minute (136 – 182 liters per minute). We recommend limiting the reverse cleaning flow rates to 2/3 of our normal cleaning flow rates. This corresponds to 24 – 32 gallons per minute (91 – 121 liters per minute). In cases of high fouling and very high dP's (where dP's have more than doubled), we recommend reducing the flow rates further to 1/3 of our normal cleaning flow rates (12 – 16 gallons per minute or 45 – 61 liters per minute) in order to reduce the chance of telescoping the elements. For 8-inch LD elements which have a thicker feed spacer than standard elements, the cleaning flow rates are higher, as listed in the table below. It is always recommended to start cleaning with low flow and increase it slowly in steps according to actual dP values. The flow rates can then be slowly raised as the foulant is removed and dP reduced, with the reverse CIP being done at normal (forward) cleaning flow rates as the final step.

Normal (Forward) Cleaning and Flushing Flow Rates per RO Pressure Tube
(Pressures are not to exceed 60 psi (4 bar) at inlet to tubes.)

Element Diameter	GPM	LPM
8-inches – Non LD Elements	36 to 48	136 to 182
8-inches – LD Elements	40 to 53	151 to 201

Reverse Cleaning and Flushing Flow Rates per RO Pressure Tube
(Pressures are not to exceed 60 psi (4 bar) at inlet to tubes.)

Element Diameter	GPM	LPM
8-inches – Non LD Elements	24 to 32	91 to 121
8-inches – LD Elements	27 to 36	101 to 135

Heavily Fouled Reverse Cleaning and Flushing Flow Rates per RO Pressure Tube
(Pressures are not to exceed 60 psi (4 bar) at inlet to tubes.)

Element Diameter	GPM	LPM
8-inches – Non LD Elements	12 to 16	45 to 61
8-inches – LD Elements	13 to 18	50 to 67

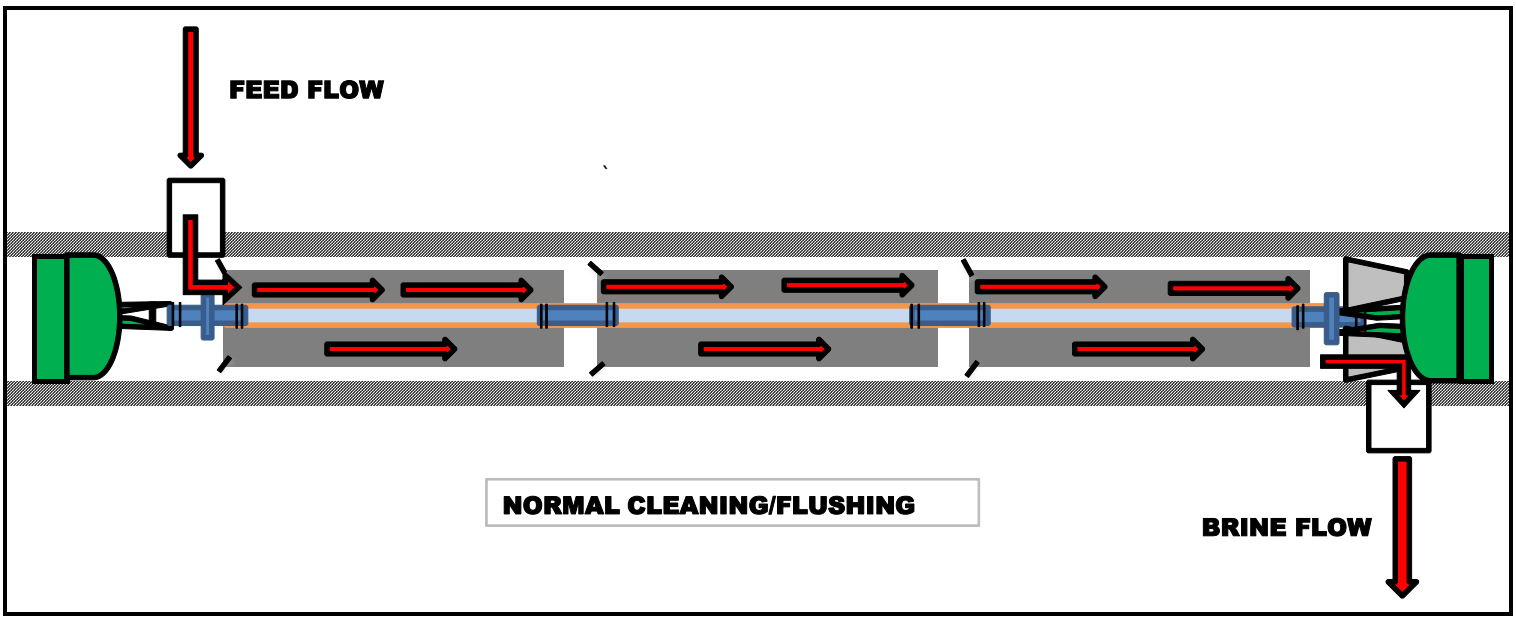
NOTE: NEVER CLEAN THE RO ELEMENTS FROM THE PERMEATE SIDE. THIS CAN LEAD TO PERMEATE BACKPRESSURE OF THE ELEMENTS WHICH WILL IRREVERSIBLY DAMAGE THE ELEMENTS.

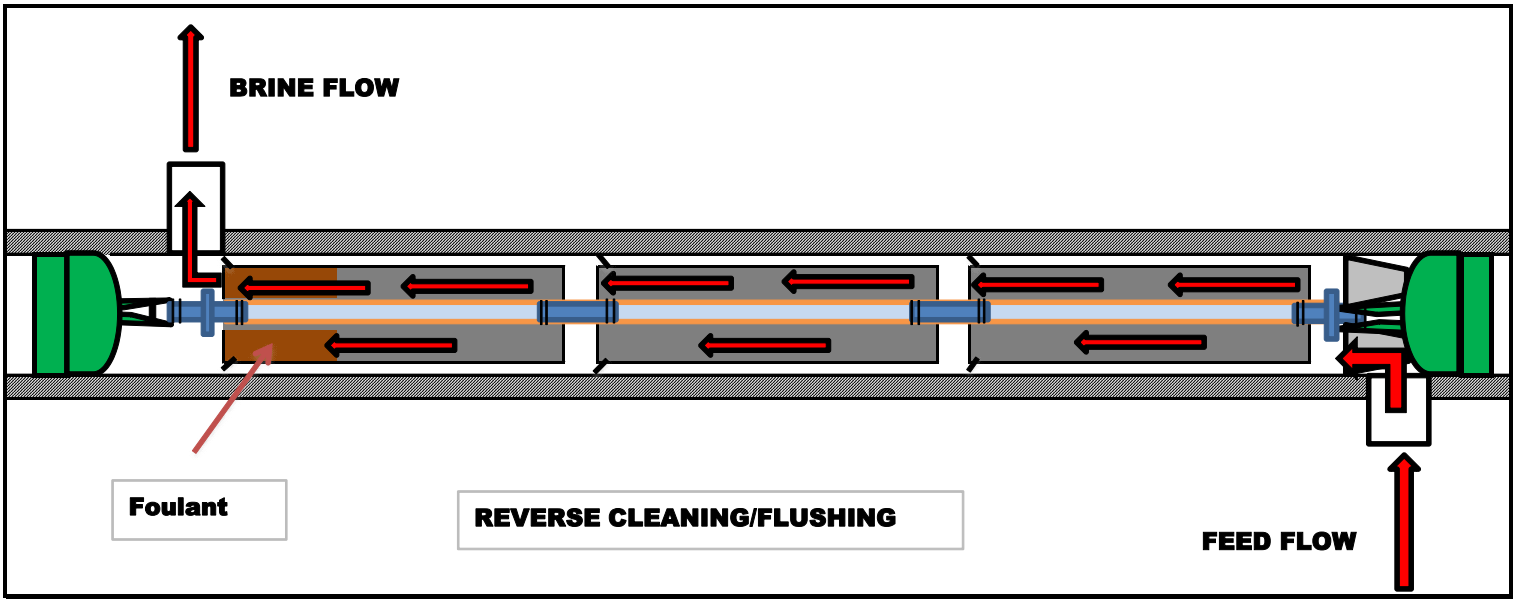
Not all RO systems can be modified easily to allow for reverse flow cleanings. The best option is to design the RO system to be able to clean from either direction when the

system is being built. It is important to note that cleaning in ***BOTH*** directions is required, so do not design a system that can clean only in reverse direction.

A second option is to design the system to be able to permeate flush in a reverse direction (from brine to feed). While not as effective as reverse cleaning, it will still help to remove front end fouling from the RO system. A third option is to remove the heavily fouled lead element, remove the brine seal, turn the element around, and place the brine seal on the other (formerly brine) end. This element can then be loaded into a tail position (at the very back of the RO system). The heavy fouling can then be more easily removed with a normal conservative forward cleaning, and in many cases normal operation in this mode will help remove the foulant.

The cleaning solutions, the pH, and the temperature limits for reverse cleanings are the same as for normal cleanings (please see TSB107 – Foulants and Cleaning Procedures).





Hydranautics Corporate office
401 Jones Road, Oceanside, CA 92058, USA Toll Free: +1-800-CPA-PURE Tel: +1-760-901-2500 Fax: +1-760-901-2578
Web: www.membranes.com Email: hy-info@nitto.com