

Technical Service Bulletin

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Procedure for Cleaning HYDRAcap Module(s)

This Technical Service Bulletin provides information for cleaning HYDRAcap® module(s).

Background

Chemical cleanings for HYDRAcap® modules are required when the temperature corrected specific flux (TCSF) has reached 7 gfd/psi (172 lmh/bar) or when the transmembrane pressure of the HYDRAcap® has reached 20 psi (1.4 bar). Chemical cleanings are beneficial for removing inorganic, organic and biological material from the membrane. The following procedure illustrates typical cleaning solution preparation as well as cleaning procedure. The information presented in this technical bulletin is to be considered a guideline for cleaning all HYDRAcap® products. Variations in chemicals, flow rates and contact time may prove more effective than those described below. Verification of cleaning efficacy should be performed after every cleaning by comparing the start-up TCSF with the post cleaning TCSF. (For more on TCSF, please see TSB139.)

NOTE: Users of Hydranautics membrane products must ensure that all chemicals used in conjunction with our products are both safe and effective and do not have an adverse effect on membrane performance. The use of any chemical that impairs membrane performance or that is ineffective is the responsibility of the owner/operator and/or chemical supplier and that Hydranautics has no responsibility or liability in such event. Additionally, oxidants should not be used in cleaning solutions that contain significant amounts of iron, manganese or other transition metals.

NOTE: A bag filter or other type of filter should be incorporated into the discharge line of the cleaning loop to minimize solids entering the module(s). Examples of cleaning skids may be found in the “HYDRAcap® Technical Manual” or contact Hydranautics Application Technology Department.

Cleaning Solutions

Cleaning solutions are either high pH with an oxidant, or low pH solutions. Generic chemicals such as sodium hydroxide, sodium hypochlorite, sodium bisulfite, citric acid, hydrochloric acid (muriatic acid) and sulfuric acid are typically as effective and less expensive than proprietary cleaning chemicals. Chemical quantities required for the solutions will not be provided since concentrations will vary relative to make-up water

quality. Removal of precipitated transition metals may be enhanced by the use of chelating agents (i.e., citric acid, EDTA, DTPA, etc.), or reducing agents (i.e., sodium bisulfite, sodium hydrosulfite, etc.). Add 22 pounds (10 kg) of chelating agent per 264 gallons (1 m³) of solution.

| Solution Description | pH | Hypochlorite | Temperature | Flow Rate |
|----------------------|-------------|--------------|-------------|----------------|
| High pH Solution | 12.0 – 13.0 | ~50 ppm | 32 – 40°C | ≥15 gpm/module |
| Low pH Solution | 2.0 - 2.5 | N/A | 32 – 40°C | ≥15 gpm/module |

Oxidant Limits

Polyethersulfone membranes can be exposed to feed water containing oxidants which are chlorine, chlorine dioxide, chloramine, and hydrogen peroxide. The limits are shown in the table below. The HYDRAcap membrane shall be free of deposited transition metals and dosing of coagulants containing transition metals shall not exceed five (5) ppm if oxidants are to be introduced into the module because it is known that transition metals act as a catalyst to accelerate the effect of the oxidant.

| Oxidant | Maximum Instantaneous Concentration | Maximum Continuous Dosing |
|--|-------------------------------------|---------------------------|
| Chlorine (Cl ₂) | 100 ppm | 2 ppm |
| Chlorine Dioxide (ClO ₂) | 100 ppm | 2 ppm |
| Chloramine (NH ₃ Cl ₂) | 300 ppm | 15 ppm |
| Hydrogen Peroxide (H ₂ O ₂) | 500 ppm | 5 ppm |

Preparing Cleaning Solution

1. Ensure proper safety precautions have been met (i.e., goggles, gloves etc.).
2. Ensure adequate ventilation.
3. Fill cleaning tank with UF filtrate, RO permeate or municipal water.

NOTE: When using UF filtrate or municipal water, care should be taken not to exceed the solubility of sparingly soluble salts (i.e., calcium carbonate) upon addition of the cleaning chemicals.

4. Introduce chemicals into the water filled cleaning tank.



CAUTION: Never introduce water into chemicals as extreme heating may occur.

5. Mix solution with a static mixer or via a special recirculation loop after the cleaning pump discharge. Some cleaning skids may not contain a “mixing loop” and the other techniques must be used.
6. After mixing ensure that the pH is still in the target range.

Recirculation

The first cleaning solution to be recirculated should be the high pH and oxidant solution. Once completed, the low pH solution should be recirculated. If the permeability has not been restored to its' original start-up value, then repeat recirculation of the high pH and oxidant solution.

The recommended cleaning flow rate for all HYDRAcap® modules is at least **15 gpm per module**. Higher cross flow rates will increase the cleaning efficiency.

NOTE: Pressure drop (feed pressure minus concentrate pressure) across the fiber cannot exceed 4 psi (0.28 bar).

1. Cleanings should be performed after a backwash to ensure that the membrane surface and the fibers' lumen are as clear as possible. This will also flush out particulate material that is contained in the feedwater and entrapped in the HYDRABLOC™.
2. Ensure that the HYDRABLOC™ to be cleaned is offline and isolated from the rest of the system.
3. If cleaning is a manual procedure ensure that the cleaning loop connections have been made (i.e., cleaning solution in, cleaning solution out and filtrate out) and that the valve positions are set properly.
4. Initial cleaning should entail cleaning only the lumen of the fiber for at least 45 minutes at the proper pH and temperature. This can be accomplished by closing the filtrate valve on the cleaning skid or on the HYDRABLOC™ itself. The filtrate pressure should be less than 10 psi during cleaning.
5. Begin recirculation, at 15 gpm (minimum) per module, through the lumen by starting the cleaning pump.
6. Begin heating the cleaning solution to 32-40°C.



CAUTION: Never exceed 40C or module damage may occur.

7. Continuously monitor the pH and temperature of the cleaning solution to verify that they are still in the desired range. Long recirculation periods of the cleaning solution may slowly heat the cleaning solution.
8. After the 45 minutes has expired, slowly open the filtrate valve and allow a portion (approx. a third) of the cleaning solution to flow through the membrane and into the filtrate cleaning return line. The total cleaning flow rate should not be below 15 gpm per module.
9. Recirculate the solution for 45 minutes.
10. Neutralization of the cleaning solution(s) is often required. If the cleaning skid is supplied with two cleaning tanks, then the high pH and low pH solutions may be

neutralized by mixing them together. Otherwise, chemical addition or dilution with water will be required to neutralize the solution(s).

NOTE: Do not neutralize cleaning solution through the module(s) as excessive heat and membrane damage may occur.

Rinsing

Rinsing is performed by flushing water through the module(s). This is often accomplished by backwashing. The duration of each backwash step may be altered to ensure complete rinsing of the cleaning chemicals or multiple backwashes may be required for the same effect. Some sites may require neutralization of the backwash effluent prior to discharging it to drain. Discharging the backwash effluent into the cleaning tank and then neutralizing may be used as an option. It may be more effective to solely utilize backwashing with UF filtrate to rinse the modules of the cleaning solution.

NOTE: After cleaning, an integrity test should be performed to verify membrane “barrier” (see TSB133 for Integrity testing procedure).

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