Handling, Storage, and Preservation Guide for Industrial Aquaporin Inside® RO Membrane Elements

Aquaporin RO Membrane Elements should be handled in such a way that biological growth and change in membrane performance during storage, shipping or system shutdowns are prevented. The elements should preferably be stored and shipped outside the pressure vessels and loaded into the pressure vessels just prior to start-up. Element preservation is needed for long-term storage of new and used elements, and system shutdown of > 48 hours.

Handling and Storage of New Membrane Elements

New membrane elements are shipped either in dry condition or as wet and preserved membrane elements. Wet membrane elements are preserved in a standard storage solution containing a buffered 1 wt% food-grade sodium metabisulfite (SMBS). The storage solution prevents biological growth during storage and shipping of membrane elements. It is advised to flush membrane elements prior to use to eliminate residual preservative in the product stream. To maintain good membrane element performance, store and handle the membrane elements with the following guidelines:

1. Store the membrane elements in a cool, dry place within a temperature range of 5 °C to 35 °C (41 °F to 95 °F). Avoid storage in direct sunlight.
2. During transportation, the membrane elements should not be exposed to temperatures below freezing (0 °C or 32 °F), or above 40 °C (104 °F). If the duration of transport is longer than 2 months, the temperature should not exceed 35 °C (95 °F).
3. If the ambient temperature in the membrane element storage area is expected to drop below freezing point (0 °C or 32 °F), measures should be taken to keep the membrane elements at a temperature above freezing. Do not allow membrane elements to freeze.
4. Do not stack more than 5 layers of carton boxes when re-stacking from originally delivered packing (export packing).
5. Always keep the original membrane element packaging dry to preserve their structural integrity.
6. To avoid damage, handle each membrane element with care. Avoid dropping the membrane element. To minimize the potential for contamination, handle the membrane elements with clean hands or gloves. Take precautions to keep the exterior of membrane element clean.
7. Wet membrane elements are shipped in sealed oxygen impermeable plastic bags and sturdy carton boxes. Only open the membrane element boxes directly prior to membrane element installation.
8. Store and ship membrane elements as packaged by Aquaporin and only load membrane elements into pressure vessels directly before start-up.

Caution: Avoid direct skin and eye contact with the storage solution and fiberglass wrapping of the membrane elements. Use safety rubber gloves and safety glasses during handling.

Storage of Used Membrane Elements

Any membrane element that has been used and removed from the pressure vessel for storage or shipping must be preserved in a preservation solution as follows:

1. Using softened, good-quality water (preferably RO permeate), prepare the preservation solution of 1 wt% food-grade SMBS.
2. Soak the membrane elements for about 1 hour in the storage solution, keeping them standing in a vertical position so that the entrapped air can escape. Allow excess preservative to drip out, and then seal the membrane element into an oxygen barrier plastic bag. Seal and label the bag(s), indicating packaging date & details of the storage solution. We recommend reusing the original bag or original spare bags available from us. Do not fill the plastic bag with the preservation solution – the moisture in the element is sufficient, and leaking bags might create a problem during transport.
3. Storage conditions for used and repackaged membrane elements are the same as for new membrane elements explained earlier in the "Handling and Storage of New Membrane Elements" section.
4. Preserved membrane elements should be visually inspected for biological growth every three months. When the preservation solution appears to be not clear, or after six months, the membrane element should be removed from the bag, soaked in a fresh preservation solution, and repacked.
5. The pH of the preservation solution must never drop below pH 3. A pH decrease can occur when bisulfite is oxidized to sulfuric acid. Therefore, the pH of the bisulfite preservation solution should be spot checked at least every 3 months. Re-preservation is mandatory when the pH is 3 or lower.
6. Wear protective gloves and sleeves to avoid prolonged contact with skin and sleeves when working with preservative solution.

Short-term RO System Shutdowns

Short-term shutdown refers to the period when an RO plant remains out of operation for less than 48 hours with membrane elements in place. Procedure for the storage of membrane elements during short term shutdown is as follows:

1. Flush the membrane elements with pre-treated RO feed water at low pressure (0.1 - 0.2 MPa) for 10 - 20 min. The vent valve should be kept open to ensure the venting of any gases which may be present in the system.
2. After flushing, the pressure tube is filled with pre-treated RO feed water.
3. Close the vent valve.

Long-term RO System Shutdowns

Long-term shutdown refers to the period when an RO plant remains out of operation for more than 48 hours with membrane elements in place. Depending on the previous operational history of the plant, it will be necessary in almost all cases to clean the membrane elements in place (CIP) prior to shut down and preservation. This applies to cases when the membrane elements are known or assumed to be fouled. Prepare each RO train as follows:

1. Clean the membrane elements in place (CIP). Please refer to the *"Membrane Clean-in-Place (CIP) Guide for Industrial Aquaporin Inside®* RO Membrane Elements".
2. Completely immerse the membrane elements in the pressure vessels in a solution of 1.0 - 1.5% food-grade SMBS, venting the air outside of the pressure vessels. Use the overflow technique: circulate the SMBS solution in such a way that the remaining air in the system is minimized after the recirculation is completed. After the pressure vessel is filled, the SMBS solution should be allowed to overflow through an opening located higher than the upper end of the highest-pressure vessel being filled.
3. When the RO section is filled with SMBS solution, close the valves to retain the SMBS solution in the RO section. Any contact with oxygen will oxidize the SMBS and void the preservative properties.
4. Repeat steps 2 and 3 with fresh preservation solution every 30 days if the temperature is below 27 °C (80 °F). If the temperature is above 27 °C (80 °F), check the pH once a week. When the pH

value drops to 3 or lower, change the preservation solution.

5. During the shutdown period, the plant must be kept frost-free, and the temperature must not exceed 45 °C (113 °F).
6. When the RO system is ready to be returned to service, flush the system for approximately one hour using low-pressure feed water with the permeate dump valve open to drain; then flush it at high pressure for 5 to 10 minutes with the permeate dump valve open to drain. Before returning the RO system to service, check for any residual SMBS in the permeate, e.g. by electrical conductivity or TDS measurement. Electrical conductivity or TDS should be at normal levels.

Disposal of Used Membrane Elements

Used membrane elements can be disposed of as municipal waste, provided that:

1. No preservation solution or other hazardous liquid is contained in the membrane element, and
2. No hazardous substances, such as heavy metals, organic pollutants, radioactive material, etc., have been deposited on the membrane surface and inside the membrane elements during operation. Be aware when membrane elements have been used for wastewater treatment or contaminant removal.

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