DOW™ Membranes
DOW Food Processing and Sanitary Element Cleaning Guide

The following are general recommendations for cleaning DOW™ full-fit and sanitary design spiral elements used in food, dairy, and other consumables process streams. More detailed procedures for cleaning a membrane system are typically included in the operating manual provided by the system supplier or from a contracted cleaning chemical supplier. The recommendations included in this guide are not intended for use for cleaning membranes which may be used in water purification. Do not use this cleaning guide for water purification membranes.

Introduction

The surface of a membrane is subject to fouling by foreign materials which may be present in the feed stream such as hydrates of metal oxides, calcium precipitates, organics and biological matter. The term “fouling” includes the build-up of any type of material on the membrane surface, including mineral scaling.
Membrane surface fouling manifests itself in a performance decline; lower permeate flow rate and/or higher solute passage. Increased pressure drop between the feed and concentrate may be a side effect of fouling.
Cleaning can be accomplished very effectively because of the combination of pH stability and temperature resistance of DOW membranes.
It is assumed for food and dairy streams that cleaning may be required daily for DOW membranes.

Safety Precautions

1. When using any chemicals indicated in subsequent sections, follow accepted safety practices. Always wear eye protection as a minimum. In the case of handling corrosive chemicals (e.g., sulfuric acid), wear full face cover and protective clothing. Consult the chemical manufacturer for detailed information about safety, handling and disposal.
2. When preparing cleaning solutions, ensure that all chemicals are dissolved and well mixed before circulating the solutions to the elements.
3. High-quality water must be used for flushing, cleaning and disinfecting DOW membranes. This water must be chlorine-free for reverse osmosis (RO) and nanofiltration (NF) systems. See Water Quality section in this Product Information bulletin for specific requirements.
4. Cleaning chemicals will be present on both the permeate and retentate sides of the membrane immediately after cleaning. Care should be taken to properly flush residuals from the system prior to operation with the feed stream.
5. During recirculation of cleaning, disinfecting and flushing solutions, the temperature and pH must not exceed the guidelines for the specific membrane type. See additional guidelines in this Product Information bulletin.
Cleaning Method

The cleaning method described below is known as cleaning in place (CIP). This means the cleaning is performed in very much the same way as ordinary production; however, it is done with proper adjustment of the operating parameters, temperature and pressure. The cleaning procedure is more effective when performed at an elevated temperature. Typically cleaning is conducted between 45-50°C and chemical disinfection is at or below 25°C. Dosing of the cleaning chemicals and operation of the cleaning procedure can be performed manually or automatically, depending on the specific design requirements.

In general, the cleaning regimen will include the following steps. Note that between each step in the cleaning procedure, the system must be flushed with high-quality water.

- Purge feed stream from the system
- Flush with water
- Clean in one or more steps, according to the selected procedure
- Flush with water
- Disinfection when required
- Flush with water after disinfection

Please refer to Table 1 for cleaning guidelines for DOW FILMTEC™ RO and NF elements.

Table 1.

<table>
<thead>
<tr>
<th>Cleaning, maximum 2 hours/day*:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
<td>1 - 5 bar (15 - 75 psi)</td>
</tr>
<tr>
<td>NaOH %, typical</td>
<td>0.05 - 0.1%</td>
</tr>
<tr>
<td>Na-EDTA %, typical</td>
<td>0.2 - 0.3%</td>
</tr>
<tr>
<td>Strong acid (e.g., H₃PO₄, or HCl) %, typical**</td>
<td>0.1 - 0.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disinfection, short-term, when required:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
</tr>
<tr>
<td>Maximum temperature</td>
</tr>
<tr>
<td>Free chlorine</td>
</tr>
<tr>
<td>Hydrogen peroxide/peroxyacetic acid blends @ 25°C</td>
</tr>
</tbody>
</table>

Note: Please check with chemical supplier for concentrations of formulated cleaning agents.

* Each cleaning step is approximately 30-45 min @ 45-50°C
** Straight nitric acid is not recommended with NF membranes.

Limits for pH Range and Temperature during Cleaning

<table>
<thead>
<tr>
<th>Element type</th>
<th>Max Temp 50°C (122°F) pH range</th>
<th>45°C (113°F) pH range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max Temp</td>
<td>Max Temp</td>
</tr>
<tr>
<td>RO</td>
<td>1.8-11</td>
<td>1.8-11.2</td>
</tr>
<tr>
<td>NF</td>
<td>1.8-11</td>
<td>1.8-11.2</td>
</tr>
</tbody>
</table>

Typical cleaning step of 30 -45min
Buffering, rapid response sensors and other measures may be needed to properly manage pH at min and max limits
11.5 pH at 45°C may be used for heavily fouled membranes, but is not recommended for daily use
Water Quality

Water is the most important cleaning agent and the one used in the largest quantities. Consequently, the quality of the water used for CIP is of the utmost importance in order to avoid unwanted deposits on the membranes originating from the water.

RO quality water is recommended for flushing, cleaning and disinfecting of DOW™ FILMTEC™ membranes, but prefiltered water may be used. Especially important in the CIP water is the content of sparingly soluble components such as iron, manganese and silicates. It is also important that CIP water meets a good bacteriological standard.

To ensure that water quality meets the recommendations in Table 2, CIP water quality should be monitored regularly and a complete water analysis should be made every three to six months.

### Table 2. CIP water recommendations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron content (Fe)</td>
<td>&lt; 0.05 ppm</td>
</tr>
<tr>
<td>Manganese content (Mn)</td>
<td>&lt; 0.02 ppm</td>
</tr>
<tr>
<td>Aluminum content (Al)</td>
<td>&lt; 0.05 ppm</td>
</tr>
<tr>
<td>Silicate content (SiO₂)</td>
<td>&lt; 5 ppm</td>
</tr>
<tr>
<td>Hardness†</td>
<td>&lt; 85 ppm as CaCO₃</td>
</tr>
<tr>
<td>Chlorine</td>
<td>0 ppm</td>
</tr>
<tr>
<td>Particle size</td>
<td>&lt; 10 microns</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt; 0.5 NTU</td>
</tr>
<tr>
<td>Silt density</td>
<td>&lt; 1 SDI</td>
</tr>
<tr>
<td>Total plate count</td>
<td>&lt; 1,000 per ml</td>
</tr>
<tr>
<td>Coli form bacteria</td>
<td>&lt; 1 per 100 ml</td>
</tr>
</tbody>
</table>

† Though soft water is recommended, in some areas cleaning chemicals are specially formulated for hard CIP water. Please check with your chemical supplier if using hard water for cleaning.

Multi-Step Cleaning

Most applications require several independent cleaning steps – for example, an alkali cleaning containing detergents succeeded by an acid cleaning (or vice versa). In such cases it is recommended NOT to mix chemicals from one step with residual chemicals in the system from the preceding step. Each cleaning step has to be followed by water flushing to remove impurities and used chemicals before new chemicals are put into the system.

Checking Cleaning Effectiveness

One common means of checking the effectiveness of the cleaning procedure is to measure the water permeate flow after cleaning. The water flux results may be an indication of whether surface foulants have been adequately removed or if an additional cleaning step should be considered.

When the cleaning procedure has been completed and before operation with product is resumed, the water permeate flow should be measured at standard operating parameters. The temperature of the water and feed pressure should be noted. By tracking and generating a history of the water permeate flux, a system operator may be alerted to a cleaning or operating upset.

Disinfection

Where high-grade bacteriological conditions are required (as in many food and dairy plants), cleaning is followed by disinfection. Frequency of disinfection will be based on plant need, feed quality and membrane type. When performing a chemical disinfection, the procedure is similar to the cleaning procedure (i.e., dosing and circulation of the solution followed by water flush). It is important that chemical disinfection using peroxide be done only at or below 25°C and in acidic conditions. Also, care should be taken to have removed the presence of iron from the membrane surface and/or disinfection water prior to disinfecting with chemical disinfectants.
### Cleaning Precautions

Field experience has demonstrated that certain chemicals and cleaning conditions may have an adverse effect on membrane performance. We recommend caution with the following:

- Frequent disinfection with an oxidizing solution (such as a hydrogen peroxide blend) more than 1-2 times per week may cause premature membrane oxidation.
- Straight nitric acid solutions may have an oxidizing effect on polypiperazine membranes (such as NF). Phosphoric acid – nitric acid blends are recommended over straight nitric acid. Hydrochloric acid is the preferred acid for membrane cleaning.
- Aggressive alkaline cleanings at high temperature and pH may cause membrane degradation and lead to premature failure. We recommend cleaning within the conditions specified in this bulletin.

Enzymatic cleaning may be used as a step in a cleaning regime (typical pH 9-10). Please check for compatibility with DOW™ products prior to use.

Please consult with your membrane or chemical supplier for specific recommendations.

### Preservative & Storage

If the system, after cleaning, will remain shut down for more than 24 hours, the membranes should be stored in a preservative solution. This is also true if membrane elements are removed from the system for storage or shipment.

When storing elements, a 1.0 weight percent sodium metabisulfite (food grade) solution is adequate for the inhibition of biological growth. Ensure that the system is air tight and that all piping is closed so the system remains full.

The system should be checked on a regular basis to ensure that the system is full of the storage solution and samples taken and analyzed for bisulfite concentration. If the solution becomes discolored or if the bisulfite concentration drops, the storage solution should be replaced.

Before operating the system after storage, the storage solution should be flushed from the membranes, and a full cleaning cycle should be run. Many operators also sanitize prior to operation.

While this solution is known to not adversely affect the performance of DOW™ membranes, other storage solutions may also be used. Please consult your chemical supplier for recommendations.

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**DOW™ Membranes**

For more information about DOW membranes, call the Dow Water & Process Solutions business:

- North America: 1-800-447-4369
- Latin America: (+55) 11-5188-9222
- Europe: (+32) 3-450-2240
- Pacific: +60 3 7958 3392

[www.dowwaterandprocess.com](http://www.dowwaterandprocess.com)

Notice: The use of this product in and of itself does not necessarily guarantee the removal of cysts and pathogens from water. Effective cyst and pathogen reduction is dependent on the complete system design and on the operation and maintenance of the system.

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Form no. 609-03012
**FILMTEC™ Membranes**  
FILMTEC Reverse Osmosis and Nanofiltration Element Three-Year Prorated Limited Warranty

FilmTec Corporation ("hereinafter FilmTec") provides a limited warranty on the materials, workmanship, and performance of its spiral-wound reverse osmosis and nanofiltration elements, when installed and operated in accordance with FilmTec's recommended design and operating specifications, according to the following provisions:

**Materials and Workmanship Limited Warranty**

FilmTec warrants that its new reverse osmosis and nanofiltration elements are free from defects in materials and workmanship. FilmTec's obligation under this limited warranty covers a period not to exceed 12 months from date of receipt by Buyer, provided that such elements are operated and maintained in accordance with FilmTec's published specifications and good engineering practices. FilmTec's obligation under this limited warranty is limited to the repair or, at FilmTec's discretion, replacement of any element which, when examined by FilmTec, appears to be defective under this provision of the limited warranty.

**Prorated Performance Limited Warranty**

FilmTec warrants the performance of its elements for three years from whichever of the following events occurs first:

**ELEMENT SHIPPED WET**
- First use in system;
- Three (3) months following date of shipment from Minneapolis to a location in the United States, Puerto Rico, Canada, and Mexico; or
- Six (6) months following date of shipment to any other destination.

**ELEMENTS SHIPPED DRY**
- First use in system;
- Twelve (12) months following date of shipment.

**Initial Performance**

FilmTec warrants that the elements herein offered have the initial minimum permeate flow and initial minimum salt rejection as specified in the Technical Bulletin(s). These parameters are established under standard test conditions specified by FilmTec.

Should any element(s) not meet performance specifications, and Buyer notifies FilmTec of such deficiency, FilmTec will, upon confirmation of faulty performance, repair or issue credit for the defective element(s). Shipping costs, in such case, will be paid by FilmTec.

**Performance During Three-Year Limited Warranty Period**

During the first three years of operation of the element(s), FilmTec warrants that minimum permeate flow, when operated under standard conditions published by FilmTec, shall be at least 70 percent of the specified initial average flow. FilmTec further warrants that maximum salt passage, when an element is operated under standard test conditions published by FilmTec and pressure required to give the initial rated flow, will not exceed 1.35x the specified maximum value. FilmTec will, on confirmation of loss of performance during the warranty period, credit 1/36 of the original purchase price of the element for each unused month of the warranty period toward the purchase of a replacement element at the current prevailing price.

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1 Elements used in food, dairy, and sulfate removal are not covered by this warranty.
2 Nanofiltration elements shall be tested on magnesium sulfate when determining salt passage.
Conditions of Prorated Performance Limited Warranty

The performance limited warranty described in the previous section, Performance During Three-Year Limited Warranty Period, shall be null and void if any of the following conditions are not met:

a. The design parameters (array, recovery, etc.) plus instrumentation and other components of the system in which the element(s) are employed shall be consistent with sound engineering practice. FilmTec reserves the right to review system design.

b. Feedwater temperature shall be less than 113°F (45°C).

c. Feedwater SDI (15 min., 30 psi) shall be less than 5.0.

d. Feedwater shall contain no ozone, permanganate, or other strong oxidizing agents.

e. The element(s) shall not be exposed to pressure greater than 1200 psi for seawater elements, 600 psi for brackish water, tap water, and nanofiltration elements, unless otherwise stated in the product specification.

f. Backpressure (where permeate static pressure exceeds reject static pressure) shall not exceed 5 psi at any time.

g. The element(s) shall be operationally protected against hydraulic transients (water hammer).

h. The element(s) shall be maintained in a clean condition, unfouled by particulate matter or precipitates or biological growth; if scaling or fouling should occur, or normalized element flow decline 10 percent, cleaning procedures must be employed in accordance with the procedures as published in the literature pieces entitled “Cleaning Procedures for FILMTEC™ FT30 Elements” (Form No. 609-23010), and “Cleaning and Disinfection Procedures for FILMTEC NF200 and NF270 Elements” (Form No. 609-00388).

i. During continuous operation the pH shall be no less than 2.0 nor greater than 11.0 for reverse osmosis elements and no less than 3.0 nor greater than 10.0 for nanofiltration elements.

j. There shall be no membrane fouling by colloidal or precipitated solids.

k. Adequate provisions against microbiological contamination shall be incorporated into the system design, as well as into all operating and maintenance procedures.

l. The reverse osmosis or NF90 element(s) shall not be exposed during cleaning, or in shutdown periods, to a pH less than 1 nor greater than 13. All other nanofiltration element(s) shall not be exposed during cleaning, or in shutdown periods, to a pH less than 1 nor greater than 12.

m. Neither nonionic nor cationic surfactants should be used for membrane cleaning or come in contact with FILMTEC elements. The buyer is fully responsible for the effects of non-compatible chemicals on FILMTEC elements; their use will void the warranty.

n. Buyer is responsible for providing the user with adequate system operating and maintenance manuals, operator and supervisor training; ensuring user’s ability to perform cleaning and other performance restoration and diagnostic procedures.

o. Buyer shall ensure that frequent, adequate system and subsystem normalized performance data are routinely recorded in a systematic format and reviewed. Such information to be available to FilmTec on a reasonable basis in the event a claim is made against FilmTec pursuant to this performance warranty.

p. Element(s) must be stored in accordance with FilmTec’s published guidelines as published in the literature piece “Handling, Preservation, and Storage” (Form No. 609-02103).

q. Customer must keep Element(s) moist at all times after initial wetting.

r. Permeate and concentrate obtained from first hour of operation should be discharged.
**Repair or Replacement**

Buyer’s sole remedy for any breach of warranty is limited to and shall be fully discharged by FilmTec repairing any defective element or, at FilmTec's discretion, replacing same at the then selling price f.o.b. FilmTec's plant. FilmTec reserves the right to test the alleged defective elements and the reverse osmosis systems on user's or Buyer’s premises or to request Buyer to perform such inspections or tests and forward the results thereof to FilmTec. If the element failure is determined to be from cause other than breach of warranty as set forth above, Buyer shall pay to FilmTec a fee of $1000 per day, plus direct travel expenses incurred by FilmTec's employees, in connection with any inspection and testing of such elements and system on Buyer’s premises. Elements shipped to FilmTec for warranty examination must be shipped freight prepaid. Elements examined as part of a warranty claim which are found to be performing as warranted will be returned to the Buyer freight collect.

**Reminders**

1. Elements must be in use for at least 6 hours before formaldehyde is used as a biocide. If the elements are exposed to formaldehyde before this period, a severe loss in flux may result.
2. Before returning any element(s) to FilmTec for warranty examination, see the Element Return Procedures technical bulletin.

**Warranty Notice**

Failure or refusal to fully disclose to FilmTec the use and operating parameters of FILMTEC™ membrane elements shall render all warranties other than that covering materials and workmanship null and void.

LIABILITY FOR CONSEQUENTIAL, INCIDENTAL, SPECIAL, EXEMPLARY, AND PUNITIVE DAMAGES ARE EXCLUDED.