

***Hollow Fiber  
Cleaning and  
Storage  
Procedure***



# HF Element Cleaning & Storage Procedure

## 1. Pre-CIP Procedure

### Pre-Flush Element with Buffer and Water

#### 1.1. Establish and set process conditions

##### 1.1.1. Add buffer to feed vessel

##### Recommended Feed Volume:

10 – 20 liters per m<sup>2</sup> (1 – 2 liters per ft<sup>2</sup>)

##### 1.1.2. Open feed, retentate and permeate valves completely.

##### 1.1.3. Direct retentate and permeate streams to waste.

#### 1.2. Flush feed - retentate process stream with buffer ([recommended option](#)).

##### 1.2.1. Turn pump on and increase pump speed to a feed flow rate ( $Q_F$ ) that will generate a shear rate on the membrane between 8,000 – 12,000 sec<sup>-1</sup>.

##### 1.2.2. Flush feed – retentate and permeate stream to waste with total buffer volume.

#### 1.3. Flush feed - retentate process stream with water.

##### 1.3.1. Add water to feed vessel

##### Recommended Feed Volume:

10 – 20 liters per m<sup>2</sup> (1 – 2 liters per ft<sup>2</sup>)

##### Recommended Feed Temperature:

25°C (minimum) – 45°C (preferred)

##### 1.3.2. Turn pump on and increase pump speed to a feed flow rate ( $Q_F$ ) that will generate a shear rate on the membrane between 8,000 – 12,000 sec<sup>-1</sup>.

##### 1.3.3. Flush feed – retentate and permeate stream to waste with total water volume.

##### 1.3.4. Drain water from system

## 2. CIP Procedure

### Clean Membrane Element with Caustic / Oxidant Solution

#### 2.1. Establish and set process conditions

2.1.1. Add cleaning solution to feed vessel.

##### Recommended CIP Volume:

10 – 20 liters per m<sup>2</sup> (1 – 2 liters per ft<sup>2</sup>)

##### Recommended Cleaning Solution & Conditions:

0.5N NaOH at 35-45°C (for moderate foulants)

or

0.5N NaOH + 400ppm NaOCl at 35-45°C (for difficult foulants)

2.1.2. Open feed, retentate and permeate valves completely.

2.1.3. Direct retentate and permeate back to feed vessel.

#### 2.2. Clean-In-Place (CIP)

2.2.1. Turn pump on and increase pump speed to a feed flow rate ( $Q_F$ ) that will generate a shear rate on the membrane between 8,000 – 12,000 sec<sup>-1</sup>.

2.2.2. After 5 – 10 minutes, close permeate valve.

2.2.3. Continue to recirculate feed – retentate stream back to feed vessel.

##### Recommended CIP Time:

45 – 60 minutes

2.2.4. Drain cleaning agent from feed vessel and flush vessel to hold clean water.

## 3. Post-CIP Procedure

### Flush & Remove Cleaning Agents from Membrane Element

#### 3.1. Establish and set process conditions

##### 3.1.1. Add water to feed vessel

Required Volume to Flush Feed-Retentate:

10 – 20 liters per m<sup>2</sup> (1 – 2 liters per ft<sup>2</sup>)

Recommend Volume to Flush Permeate:

10 – 20 liters per m<sup>2</sup> (1 – 2 liters per ft<sup>2</sup>)

Recommended Flush Temperature:

25°C (minimum)

45°C (preferred)

##### 3.1.2. Open feed, retentate and permeate valves completely.

##### 3.1.3. Direct retentate and permeate streams to waste.

#### 3.2. Flush feed – retentate stream

##### 3.2.1. Turn pump on and increase pump speed to a feed flow rate ( $Q_F$ ) that will generate a shear rate on the membrane between 8,000 – 12,000 sec<sup>-1</sup>.

##### 3.2.2. Flush feed – retentate stream with total feed volume to drain.

#### 3.3. Flush permeate stream

##### 3.3.1. Open permeate valve completely and directed to waste.

##### 3.3.2. Lower feed flow rate ( $Q_F$ ) and adjust retentate pressure to deliver a TMP of 3 - 15psig.

##### 3.3.3. Flush permeate stream with total feed volume to drain

## 4. Membrane Recovery

### Determine Cleaning Effectiveness

#### 4.1. Water Flux Rate

- 4.1.1. During flushing of permeate stream (step 3.3.3.), measure the permeate water flux rate.
- 4.1.2. Set TMP between 8 – 15 psig (with permeate completely open) and measure the permeate water flow rate.

#### 4.2. Normalized Water Permeability (NWP)

- 4.2.1. Calculate the normalized water permeability (NWP) after cleaning by using the following equation:

Normalized Water Permeability:

$$[\text{Filtrate Flux Rate} / \text{TMP}] \times \text{Temperature Correction Factor}$$

#### 4.3. Membrane Recovery

- 4.3.1. Compare the calculated NWP after cleaning to the “pre-use clean NWP”
- 4.3.2. Calculate % membrane recovery using the following equation:

% Membrane Recovery:

$$[\text{NWP}_{\text{after CIP}} / \text{NWP}_{\text{pre-use}}] \times 100\%$$

- 4.3.3. If membrane recovery is below desired target, repeat cleaning. Extend CIP time if necessary.

Recommended Membrane Recovery:

80% - 90% (minimum)

90% - 100% (preferred)

## **5. Storage Procedure**

### **Flush & Retain Membrane Element with Caustic**

#### **5.1. Establish and set process conditions**

5.1.1. Add 0.1N NaOH to feed vessel

**Required Volume:**

10 – 20 liters per m<sup>2</sup> (1 – 2 liters per ft<sup>2</sup>)

5.1.2. Open feed, retentate and permeate valves completely.

5.1.3. Direct retentate to feed vessel

5.1.4. Direct permeate to waste

#### **5.2. Flush system**

5.2.1. Turn pump on and increase pump speed to a feed flow rate ( $Q_F$ ) that will generate a shear rate between 4000 – 5000 sec<sup>-1</sup>.

5.2.2. Adjust retentate valve to generate a TMP of 3 - 15 psig.

5.2.3. Flush system for approximately 5 – 10 minutes

5.2.4. Stop pump

#### **5.3. Shut down system**

5.3.1. Close feed, retentate and permeate valves.

5.3.2. Remove and discard caustic storage solution