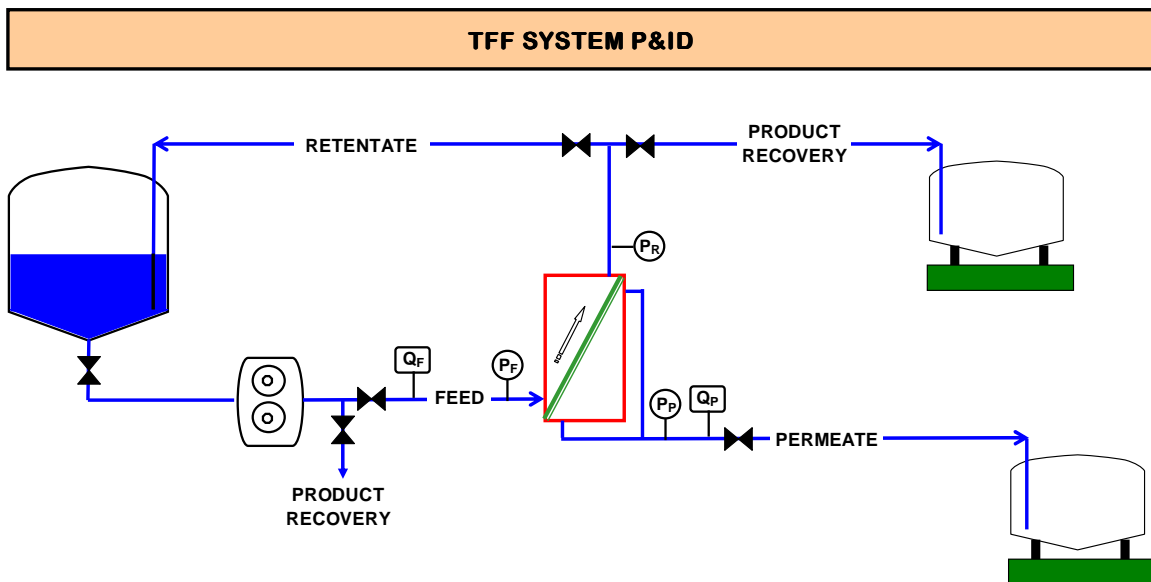
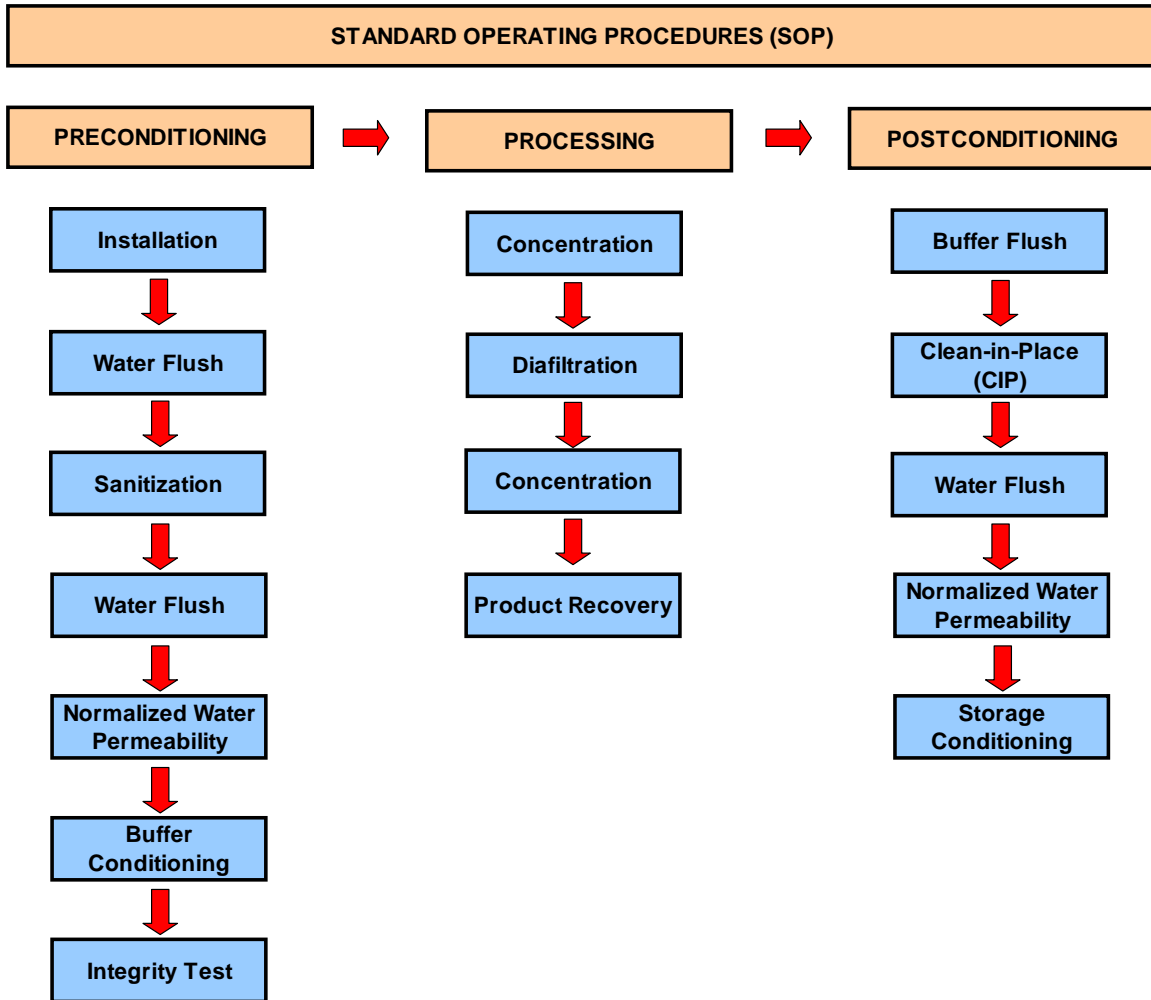


**WaterSep PES Hollow Fiber
Standard Operating Procedure - SOP
Preconditioning for Use Procedure**

**Prepared by: John Rozembersky
Revision: January 2009**

Tangential Flow Filtration (TFF)

Process Flowsheet for UF / DF



PRECONDITIONING

Installation

Hollow Fiber System

Attached the process stream lines to the feed, retentate and filtrate connections of the hollow fiber element.

Water Flush

1. Flush storage agents from membrane element.

1.1. Establish and set process conditions

1.1.1. Add water to feed vessel

Recommended Feed Volume:
50 – 80 liters per m² (5 – 8 liters per ft²)

1.1.2. Open permeate and retentate valves completely.

1.1.3. Direct retentate and permeate streams to waste.

1.2. Flush feed - retentate process stream

1.2.1. Turn pump on and increase feed flow rate speed until a feed-to-retentate pressure differential of 2 - 6 psig is reached (fiber length – FL dependent).
[10" FL \cong 2 psig, 20" FL \cong 3 psig, and 40" FL \cong 6 psig]

1.2.2. Continue to flush feed to retentate stream to waste for 1 - 3 minutes.

1.3. Flush permeate stream process stream

1.3.1. Decrease pump speed and retentate flow rate to ~5 - 10 %.

- 1.3.2. Close retentate valve completely. Then re-open valve to allow a minor flow rate in the retentate stream to prevent a dead-leg situation.
- 1.3.3. Increase pump speed and feed flow rate until a feed pressure of 10 – 15 psig reached for UF membranes (10kD – 500kD) or 3 – 5 psig for MF membranes (750kD – 0.45um).
- 1.3.4. Flush a minimum permeate volumetric throughput of ≥ 40 L/sqm (4 / sqft).
- 1.3.5. Turn off pump.
- 1.3.6. Remove water in feed vessel to bottom port. Keep lines flooded to prevent pump cavitation.

Sanitization

2. Sanitization of TFF System

2.1. Establish and set process conditions

- 2.1.1. Add 0.3 – 0.5N NaOH to feed vessel at 30 – 40°C.

Recommended Fee Volume:

8 – 12 liters per m² (0.8 – 1.2 liters per ft²)

- 2.1.2. Open permeate and retentate valves completely.
- 2.1.3. Direct permeate to waste.
- 2.1.4. Direct retentate back to feed vessel.

2.2. Stabilized Feed-Retentate loop with NaOH

- 2.2.1. Turn pump on and increase pump speed until feed-to-retentate pressure differential of 2 - 4 psig is reached.
- 2.2.2. Allow ~ 2 - 3 minutes for retentate recirculation to stabilize.

2.3. Flood permeate with NaOH (Static sanitization of permeate)

- 2.3.1. Decrease pump speed to ~ 5- 10% of retentate flow rate
- 2.3.2. Close retentate valve completely. Then re-open valve 5 - 10%

- 2.3.3. Increase pump speed up until feed pressure is 10 – 15 psig
- 2.3.4. Continue to flush membrane and flood permeate with NaOH until permeate stream condition reaches equilibrium to feed concentration.
- 2.3.5. Proceed to next step with pump running.

2.4. Sanitization of Feed – Retentate Stream

- 2.4.1. Open retentate valve completely.
- 2.4.2. Close permeate valve completely
- 2.4.3. Increase pump speed until feed-to-retentate pressure differential of 3-5 psig is reached
- 2.4.4. Continue to recirculate

Recommended Sanitization Time : 30 – 45 min

- 2.4.5. Drain NaOH from feed tank and feed/retentate stream
- 2.4.6. Turn off pump

Water Flush

3. Flush sanitization agent from TFF System

3.1. Establish and set process conditions

- 3.1.1. Add water at ~ 25°C – 40°C to feed vessel

Recommended Volume:

50 – 80 liters per m² (5 – 8 liters per ft²)

- 3.1.2. Open permeate and retentate valves completely.
- 3.1.3. Direct retentate and permeate streams to waste.

3.2. Flush feed - retentate process stream

- 3.2.1. Turn pump on and increase feed flow rate speed until a feed-to-retentate pressure differential of 5-10 psig is reached.

3.2.2. Continue to flush feed to retentate stream to waste for 1 - 3 minutes.

3.3. Flush permeate stream process stream

3.3.1. Decrease pump speed and retentate flow rate to ~5 - 10 %.

3.3.2. Close retentate valve completely first and then re-open ~10%.

Note: feed pressure should not exceed 30 psig as retentate valve is closed.
Decrease pump flow rate more should pressure rise beyond this point.

3.3.3. Increase pump speed and feed flow rate until a feed pressure of 10 – 20 psig reached.

3.3.4. Flush a minimum permeate volumetric throughput of 40 L/sqm (4 / sqft).

3.3.5. Continue to next step

Normalized Water Permeability

4. Normalized Water Permeability

4.1. Measure water flux rates

4.1.1. Reduce pump speed to feed pressure = 10 – 15 psig

4.1.2. Measure and Record

- Permeate Flow Rate (Q_P) = _____ Lpm
- Feed Pressure (P_f) = _____ psig
- Retentate Pressure (P_r) = _____ psig
- Permeate Pressure (P_p) = _____ psig
- Filtrate Temperature = _____ °C

4.1.3. Calculate

- Calculate TMP = $[(P_f + P_r)/2] - P_p$ = _____ psig
- Calculate filtrate flux rate (J) = Q_P / Area = liters/m²/hr (LMH)
 J = _____ LMH
- Determine temperature correction factor ($TCF_{20^\circ C}$) = _____

$$TCF = 0.0005T^2 - 0.0449T + 1.7021$$

- Calculate filtrate flux rate at 20°C $(J)_{20^{\circ}\text{C}} = J \times \text{TCF}_{20^{\circ}\text{C}}$
 $J_{20^{\circ}} = \underline{\hspace{2cm}} \text{LMH}$

- Calculate Normalized Water Flux Rate (NWP) = $J_{20^{\circ}} / \text{TMP}$
 $\text{NWP}_{20^{\circ}\text{C}} = \underline{\hspace{2cm}} \text{LMH/psig}$

4.2. Determine Percent Membrane Recovery (%MR)

- 4.2.1. Initial $\text{NWP}_{20^{\circ}\text{C}}$ constant (clean) = $\underline{\hspace{2cm}} \text{LMH/psig}$

If this is first time use for this membrane lot, the value calculated in 4.1.3. is the initial $\text{NWP}_{20^{\circ}\text{C}}$ constant (clean)

- 4.2.2. If element is in re-use mode, calculate %MR at this point.

$$\% \text{MR} = \text{NWP (step 4.1.3)} / \text{Initial NWP}$$

$$\% \text{MR} = \underline{\hspace{2cm}} \%$$

**Buffer
Conditioning**

5. Buffer Condition TFF System

5.1. Establish and set process conditions

- 5.1.1. Add Buffer solution to feed vessel with same temperature as feed solution.

Volume required:
 10 – 20 liters per m² (1 – 2 liters per ft²)

- 5.1.2. Open permeate and retentate valves completely
 5.1.3. Direct permeate to waste
 5.1.4. Direct retentate back to feed vessel

5.2. Stabilized Feed-Retentate loop with buffer

- 5.2.1. Turn pump on and increase pump speed until feed-to-retentate pressure differential of 3-5 psig is reached.
 5.2.2. Allow ~ 2 - 3 minutes for retentate recirculation to stabilize..

5.3. Flood permeate with buffer

- 5.3.1. Decrease pump speed to 5- 10% of retentate flow rate
- 5.3.2. Close retentate valve completely first and then re-open ~10%.
- 5.3.3. Increase pump speed and feed flow rate until a feed pressure of 10 – 20 psig reached.
- 5.3.4. Flush permeate stream to waste with 10–20 liters per m² (1 – 2 liters per ft²)

5.4. Reduce the buffer in the feed vessel.

- 5.4.1. Drain buffer down to the bottom of the feed vessel near the exist port.
Feed – retentate lines should remain flooded with buffer. Do not permit air to be drawn in the feed – retentate. Lines should remain flooded and air free.
- 5.4.2. Turn off pump

Integrity Test

6. Integrity Testing of Membrane Element (optional)

Pressure hold test at 10 psig = HOLD for ~1-2 minutes
Air Diffusion at 10 psig < 10 cc/min