12-4

Influent concentration $C_{in} = 6.85 \times 10^5 / mL$

Effluent concentration $C_{out} = 136\ / mL$

$$r = \frac{C_{in} - C_{out}}{C_{in}} \times 100\,\% =$$

$$logR = log(\frac{C_{in}}{C_{out}}) =$$

12-6

Flow rate $Q = 4.47\ ml/min$

Temperature $T = 289K$

Pressure $P = 0.67bar$

$$J(279K) = \frac{Q}{a} = \frac{4.47\frac{ml}{min}}{23.3cm^2} = 0.19\frac{ml}{cm^2 \cdot min} = 114\frac{L}{m_2 \cdot h}$$

$$J(283K) = J(279K) \times 1.03^{T_s - T_m} =$$

$$J_{sp} = \frac{J(283K)}{\triangle P} =$$

$$k_m = \frac{\triangle P}{\mu J} = \frac{0.67 \times 10^5\ kg/s^2 \cdot m \times 3600s/h \times 1000L/m^3}{0.001\ kg/m \cdot s \times 114\ L/m^2 \cdot h} = m^{-1}$$

As we can seen, the resistance coefficiency depends on the changes of temperature and pressure. The liner relationship between flux and pressure in Equation 12-6 suggests that the flux can be maximized by operating at the highest possible transmembrane pressure.

12-8

$J(280K) = 75\ L/m^2 \cdot h$

$P = 0.85\ bar$

$$J(283K) = J(280K) \times 1.03^{T_s - T_m} =$$

$$J_{sp} = \frac{J(283K)}{\triangle P} =$$

12-9

According to the μ with the different temperature

When T = 294K $\mu(294K) = 0.9975 \times 10^{-3} kg/m \cdot s$

When T = 278K $\mu(277K) = 1.5673 \times 10^{-3} kg/m \cdot s$

Day 1

$$J_{sp} = \frac{J(294K)}{\triangle P} =$$

Day 2

$$J_{sp} = \frac{J(278K)}{\triangle P} =$$

Calculate the percent loss of performance due to fouling

$$\frac{J_{sp}(day1) - J_{sp}(day2)}{J_{sp}(day1)} \times 100\,\% =$$

Loss of flux due to fouling

12-11

membrane resistance coefficient of 2.7 × 10^{12} m^{-1}

According to the equation 12-12, 12-13 and 12-14

$$\alpha_c = \frac{aK_c}{CV} = \frac{36K_K(1-\epsilon)}{\epsilon^3 \rho d_p^2} = 1.29 \times 10^5\ kg/m$$

$$J_t = \frac{J_0}{1 + \frac{2\alpha_c C J_0 t}{K_m}}$$

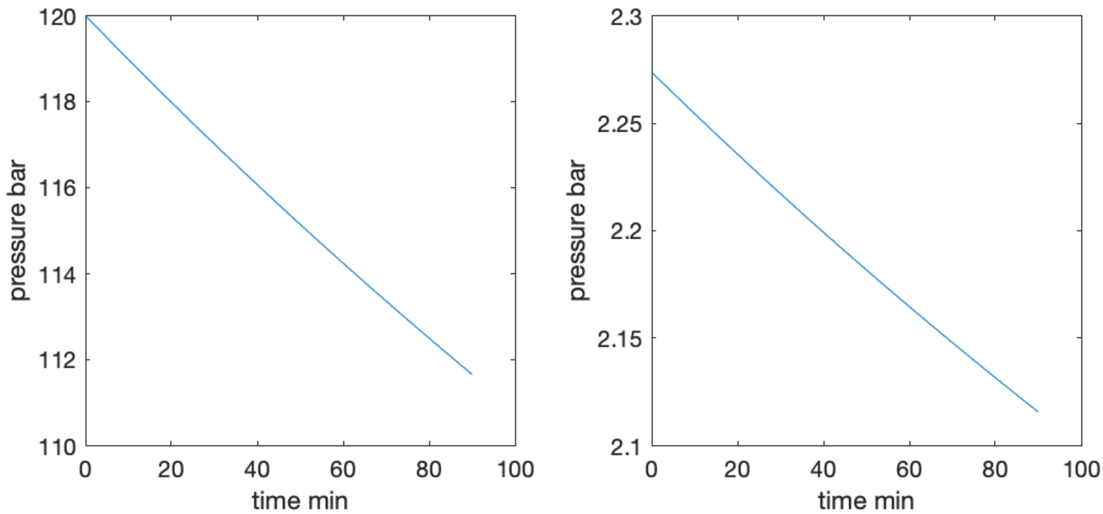
Where $K_K = 5$ $\rho = 1050\ kg/m^3$

$\epsilon = 0.38$ $K_m = 2.7 \times 10^{12}\ m^{-1}$

$C = 150\ mg/L$ $a = 2.82 \times 10^{-3}\ m^2$

$J_0 = 120 L/m^2 \cdot h$

$$\triangle P = J_t \mu (K_m + K_c)$$



12-15

$Q_c = 76000\ m^3/d$ $\qquad$ $J = 80\ L/m^2{\cdot}h$

$A = 45\ m^2$ $\qquad$ $V_b = 240L$

$N_{max} = 80$ $\qquad$ $t_{dit} = 10\ min/d$

According to the equation 12-26

$$t_{bw} = 2\ min \times \frac{1440min\,.\,d}{22min} =$$

$$t_{cip} = \frac{4h \times 60min/h}{30d} =$$

$$\eta = \frac{1440 - t_b - t_{dit} - t_c}{1440}$$

(2) recovery r

$$t_f = 22min - 2min = 20min$$

$$V_f = Jat_f = \frac{80L/m^2{\cdot}h \times 45m^2 \times 20min}{60min/h} =$$

$$r = \frac{Q_p}{Q_f} = \frac{V_f - V_b}{V_f} =$$

(3) feed flow rate. (4) total membrane area required

$$Q_f = \frac{Q_m}{r} = \qquad a = \frac{Q_f}{J\eta} =$$

(5) number of skid (6) number of modules per skid

$$N_{mod} = \frac{a}{A} = \qquad N_{mod/rack} = \frac{Nmod}{N_{max}} =$$