12-4

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

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

$$r = \frac{C_{in} - C_{out}}{C_{in}} \times 100\,\% = 99.98\,\%$$

$$logR = log(\frac{C_{in}}{C_{out}}) = 3.70$$

12-6

Flow rate $Q = 4.47\ ml/min$

Temperature $T = 289K$

Pressure $P = 0.67bar$

$$J(289K) = \frac{Q}{a} = \frac{4.47\frac{ml}{min}}{23.3cm^2} = 0.19\frac{ml}{cm^2 \cdot min} = 114\frac{L}{m_2 \cdot h}$$

$$J(293K) = J(289K) \times 1.03^{T_s - T_m} = 115.1\frac{L}{m_2 \cdot h}$$

$$J_{sp} = \frac{J(293K)}{\triangle P} = 231.5\frac{L}{m_2 \cdot h \cdot bar}$$

$$k_m = \frac{\triangle P}{\mu J} = \frac{0.67 \times 10^5\ kg/s^2 \cdot m \times 3600s/h \times 1000L/m^3}{0.001\ kg/m \cdot s \times 114\ L/m^2 \cdot h} = 2.70 \times 10^{12}\ m^{-1}$$

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

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

$P = 0.85\ bar$

$$J(283K) = J(280K) \times 1.03^{T_s - T_m} = 82.0\frac{L}{m_2{\cdot}h}$$

$$J_{sp} = \frac{J(283K)}{\triangle P} = 96.4\frac{L}{m_2{\cdot}h{\cdot}bar}$$

12-9

According to the μ with the different temperature

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

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

Day 1

$$J_{sp} = \frac{J(294K)}{\triangle P} = 116.1\frac{L}{m_2{\cdot}h{\cdot}bar}$$

Day 2

$$J_{sp} = \frac{J(278K)}{\triangle P} = 70.0\frac{L}{m_2{\cdot}h{\cdot}bar}$$

Calculate the percent loss of performance due to fouling

$$\frac{J_{sp}(day1) - J_{sp}(day2)}{J_{sp}(day1)} \times 100\,\% = \frac{(116.1 - 70)\frac{L}{m_2{\cdot}h{\cdot}bar}}{116.1\frac{L}{m_2{\cdot}h{\cdot}bar}} \times 100\,\% = 39.7\,\%$$

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

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

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

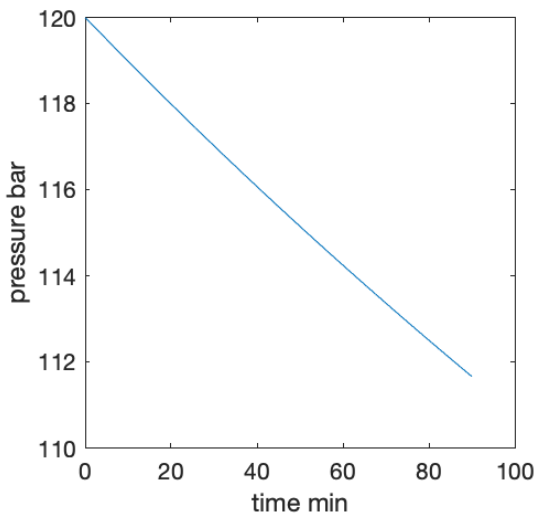
Where $K_K = 5$ $\rho = 1050\ kg/m^3$

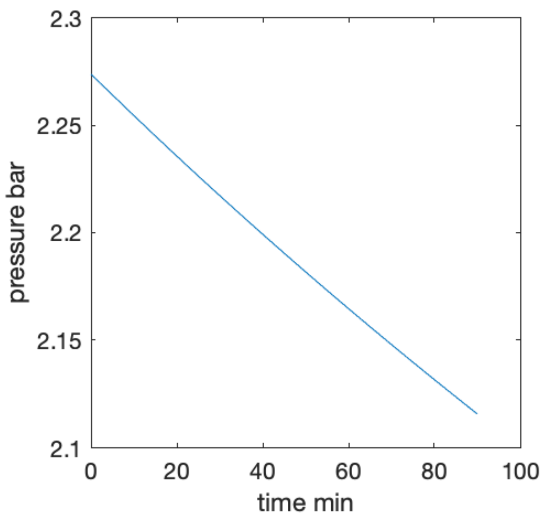
$\epsilon = 0.38$ $K_m = 2.7 \times 10^{12}\ m^{-1}$

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

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

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





12-15

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

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

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

According to the equation 12-26

$$t_{bw} = 2\ min \times \frac{1440min\ .d}{22min} = 130.9\ min$$

$$t_{cip} = \frac{4h \times 60min/h}{30d} = 8\ min$$

$$\eta = \frac{1440 - t_b - t_{dit} - t_c}{1440} = 0.90$$

(2) recovery r

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

$$V_f = Jat_f = \frac{80L/m^2 \cdot h \times 45m^2 \times 20min}{60min/h} = 1200L$$

$$r = \frac{Q_p}{Q_f} = \frac{V_f - V_b}{V_f} = 0.80$$

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

$$Q_f = \frac{Q_c}{r} = 95000\ m^3/d \qquad a = \frac{Q_f}{J\eta} = 1319.4m^2$$

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

$$N_{mod} = \frac{a}{A} = 29.4 < 30 \qquad N_{mod/rack} = \frac{Nmod}{N_{max}} = 0.37$$