ROWAN UNIVERSITY
CHEMICAL ENGINEERING 0906-314

SPRING
RO-3

GIVEN: $C_f = 15000$ mg/L NaCl

$J_w = 15$ gal/day ft^2

$\Delta P = 600$ psi, $T = 25$ C

% Rejection $= 95.0$

a)

$$J_w = A_w(\Delta P - \Delta\pi)$$

$$A_w = \frac{J_w}{(\Delta P - \Delta\pi)}$$

$$\pi = \psi C_f \qquad \psi = 0.0114 \text{ psi/mg/L}$$

$$\Delta\pi = \pi_f - \pi_p = \psi(C_f - C_p)$$

$$\%R = \left(1 - \frac{C_p}{C_f}\right)100 \quad , (1-R)C_f = C_p$$

$$(1-0.95)(15000 \text{ mg/L}) = C_p$$

$$C_p = 750 \text{ mg/L}$$

$$\Delta\pi = 0.0114 \frac{\text{psi}}{\text{mg/L}}(15000 - 750 \text{ mg/L})$$

$$\Delta\pi = 162.45 \text{ psi}$$

conversion of flux

$$A_w = \frac{\left[\left(\frac{15\ gal}{day\ ft^2}\right)\left(\frac{3.785\ L}{gal}\right)\left(\frac{ft}{30.48\ cm}\right)^2\left(\frac{day}{24\ hr}\right)\left(\frac{hr}{3600\ sec}\right)\left(\frac{1000\ g}{L}\right)\left(\frac{mole}{18.0\ g}\right)\right]}{\left[(600\ psi)\left(\frac{atm}{14.7\ psi}\right) - \left(\frac{atm}{14.7\ psi}\right)(162.45\ psi)\right]}$$

$$A_w = \frac{3.930 \times 10^{-5}\ gmole/cm^2\ sec}{(40.82\ atm - 11.05\ atm)}$$

$$\boxed{A_w = 1.320 \times 10^{-6}\ \frac{gmole}{cm^2\ sec\ atm}}$$

b)

$$J_s = \frac{J_w C_p}{C_{wp}}$$

$J_w = 7.074 \times 10^{-4} \frac{g}{cm^2 sec}$ from part 'a'

$$J_s = \frac{\left(7.074 \times 10^{-4} \frac{g}{cm^2 sec}\right)\left(750 \frac{mg}{L}\right)}{\left(10^6 \frac{mg}{L}\right)} = 5.306 \times 10^{-7} \frac{g}{cm^2 sec}$$

$$B_s = \left(\frac{J_s}{C_f - C_p}\right) = \frac{\left(5.306 \times 10^{-7} \frac{g}{cm^2 sec}\right)}{\left(5000 - 750 \frac{mg}{L}\right)\left(\frac{g}{1000 mg}\right)\left(\frac{L}{1000 cm^3}\right)}$$

$$\boxed{B_s = 3.72 \times 10^{-5} \frac{cm}{sec}}$$