Hints for Problem 15.26

Some of the parameters required to solve 15.26 (S&H) need to be found in the literature (e.g. Perry's). We have provided those below to save time:

1. The concentration of water in air at 80°F, 1 atm and 80% relative humidity (from psychrometric chart)

   $$= \frac{0.0177 \ \text{lb}\, H_2O}{\text{lb dry air}}$$

2. The diffusivity of water vapor in air at 1 atm, 80°F

   $$D_i = 0.26 \times 10^{-4} \frac{m^2}{s}$$

3. The viscosity of air at 80 °F

   $$\mu = 1.75 \times 10^{-5} \frac{kg}{m\,s}$$

Additional advice:

- *Pay attention to units throughout the problem.*
- You can use the ideal gas law to calculate the density (in lb/ft^3) of the gas entering the bed, which is a mixture of water vapor and air.
- Assume that the cross-sectional area of the bed is 1 ft^2.
- Use the equation $\rho_p = \frac{\rho_b}{1 - \epsilon_b}$ to calculate ρ_p, the particle density, (lb gel/ ft^3 particles) from the density of the silica given in the problem statement $\rho_b = 39 \frac{lb}{ft^3}$ and the void fraction $\epsilon_b = 0.47$.
- The units of the equilibrium constant, K, should be in $\frac{\text{lb}\, H_2O / ft^3 \text{ gel}}{\text{lb}\, H_2O / ft^3 \text{ gas}}$ to use Equation 15-106 (S&H).
- If using Excel to solve the Klinkenberg equation, use erf carefully and remember that erf (-z) = - erf (z).