

1. Problem 28.1-1

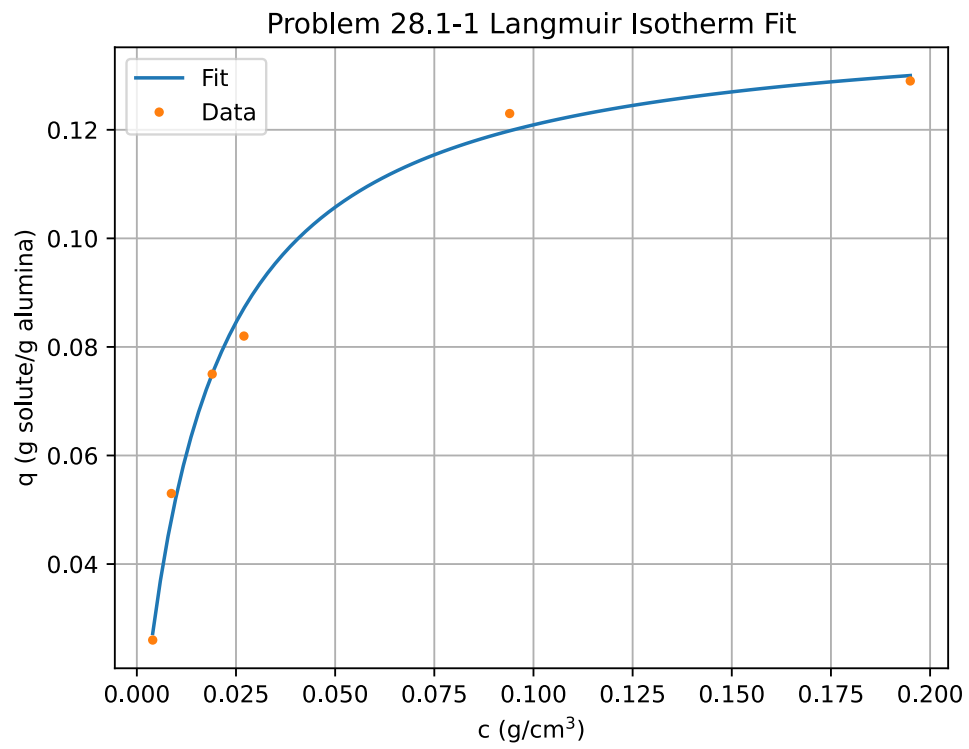
Fit the data in Problem 28.1-1 to the Langmuir isotherm

$$q = \frac{q_0 c}{K + c}$$

$$q_0 = 0.1412$$

$$K = 0.01675$$

Compare fit parameters to data.



2. Problem 28.3-1

(a)

Parameters for original column from Example 28.3-1

$$t_b = 3.65$$

$$H_B = 9.9$$

$$H_{\text{UNB}} = 4.1$$

Find new  $H_{\text{UNB}}$

$$t_b = 8.5$$

$$H_{\text{UNB}} = \frac{8.5}{3.65} \cdot 9.9$$

$$H_{\text{UNB}} = 23.1$$

$$H_T = H_{\text{UNB}} + H_B$$

$$H_T = 23.1 + 4.2$$

$$\boxed{H_T = 27.2 \text{ cm}}$$

$$\text{fraction} = \frac{23.1}{27.3}$$

$$\boxed{\text{fraction} = 0.849}$$

Flow and velocity are the same, and so the diameter is the same.

$$\boxed{D = 4 \text{ cm}}$$

(b)

Find new diameter to keep velocity the same

$$u = \frac{Qt}{A}$$

$$\frac{Q_1 t_1}{A_1} = \frac{Q_2 t_2}{A_2}$$

$$t_1 = t_2$$

$$\frac{Q_1}{\pi/4D_1^2} = \frac{Q_2}{\pi/4D_2^2}$$

$$D_2^2 = \frac{Q_2}{Q_1} D_1^2$$

$$D_2 = \sqrt{\frac{Q_2}{Q_1} D_1^2}$$

$$D_1 = 4$$

$$Q_1 = 754$$

$$Q_2 = 2000$$

$$D_2 = \sqrt{\frac{2000}{754} \cdot 4^2}$$

$$\boxed{D_2 = 6.52 \text{ cm}}$$

### 3. Problem 28.3-2

(a)

Using the data in Problem 28.3-2, compute  $1 - c/c_0$

$$c_0 = 926 \cdot 10^{-6}$$

Interpolate time for  $c/c_0 = 0.02$

$$t_b = 9.546 \text{ hr}$$

Calculate the following integrals numerically from the data

$$A_1 = \int_0^{t_b} \left(1 - \frac{c}{c_0}\right) dt$$

$$A_2 = \int_{t_b}^{t_d} \left(1 - \frac{c}{c_0}\right) dt$$

$$A_1 = 9.54$$

$$A_2 = 1.38$$

$$t_I = A_1 + A_2$$

$$t_I = 9.54 + 1.38$$

$$t_I = 10.9$$

$$\text{fraction} = \frac{A_1}{t_I}$$

$$\text{fraction} = \frac{9.54}{10.9}$$

$$\text{fraction} = 0.873$$

$$H_T = 0.268 \text{ m}$$

$$H_{\text{UNB}} = 0.268 \cdot (1 - 0.873)$$

$$H_{\text{UNB}} = 0.03396 \text{ m}$$

$$\text{Saturation capacity} = \dot{m} c_0 t_I$$

$$\dot{m} = 4052$$

$$\text{Saturation capacity} = 4052 \cdot 926 \cdot 10^{-6} \cdot 10.9$$

$$\text{Saturation capacity} = 40.98 \text{ kg water}/\text{m}^2$$

(b)

$H_{\text{UNB}}$  is the same

$$H_T = 0.4$$

$$H_B = 0.4 - 0.03398$$

$$H_B = 0.366$$

$$\text{fraction} = \frac{0.366}{0.4}$$

$$\boxed{\text{fraction} = 0.9151}$$

Old  $H_B$

$$H_B = 0.268 - 0.03398 = 0.234$$

$$t_b = \frac{0.366}{0.234} \cdot 9.54$$

$$\boxed{t_b = 14.93 \text{ hr}}$$