Explanation of Example Problem

A waste lagoon containing 100 mg/L benzene is contaminating the underlying aquifer. The aquifer has a porosity of 30 percent, a bulk density of 1.6 g/cm^3, a velocity of 10 m/yr, and a dispersivity of 10 m. The distribution coefficient of benzene for this aquifer material has been measured to be 5 mL/g. Benzene biodegrades through a first order reaction at a rate of 0.025 yr^{-1}. How far and how fast will benzene migrate through the aquifer?

Solution:

1. Calculate the retardation factor from the distribution coefficient.

$$R = 1 + \frac{\rho_b K_d}{n},$$

$$= 1 + \frac{\left(1.6\ \frac{g}{cm^3}\right)\left(5\ \frac{mL}{g}\right)}{0.3} = 27.67.$$

2. If necessary, calculate the dispersivity from the dispersion coefficient and the velocity.

$$D = \alpha_x v, \text{ so } \alpha_x = D/v = \frac{100\ \left(\frac{m^2}{yr}\right)}{10\ \left(\frac{m}{yr}\right)} = 10\ m$$

3. If necessary, calculate the first order degradation rate from the half-life.

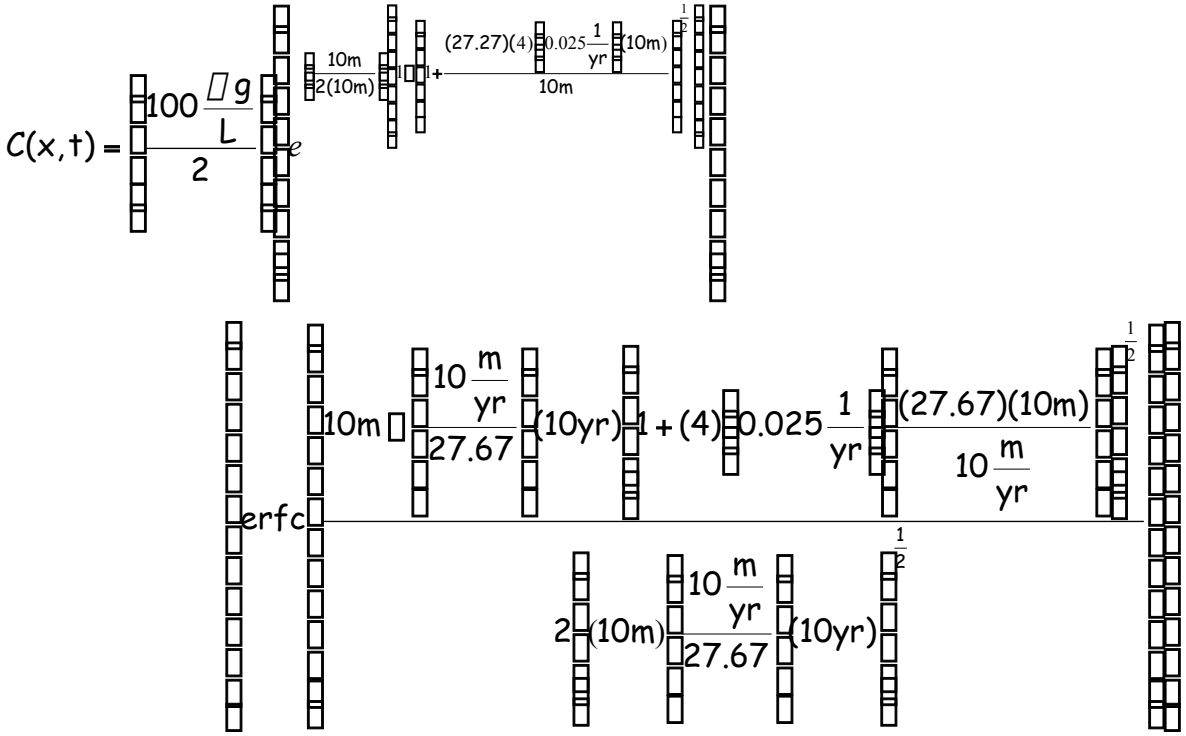
$$-\frac{\ln 0.5}{t_{1/2}} = k = = -\frac{-0.693}{27.72(yr)} = 0.025\ yr^{-1}.$$

4. Convert data into proper units

Co = 100 **m**g/L,
v = 10 m/yr,
$\mathbf{a}_x$ = 10 m,
R = 27.67, and
k = 0.025 yr^{-1}.

5. Input data into program and obtain graph.

6. Calculate the concentration 10 meters downgradient from the lagoon ten years after the input.



= 0.78 μg/L benzene.