CE 5364 Groundwater Transport Phenomena
Exercise Set 2

Exercises

1. (Problem 6-1, pg. 567) Chloride (Cl^-) is injected as a continuous source into a 1-D column 50 centimeters long at a seepage velocity of 10^{-3} $\frac{cm}{s}$. The effluent concentration measured at $t = 1800$ s from the start of the injection is 0.3 of the initial concentration, and at $t = 2700$ s the effluent concentration is measured to be 0.4 of the initial concentration.

   Determine:

   (a) Sketch the system.

   (b) The longitudinal dispersivity.

   (c) The dispersion coefficient.

   (d) The volumetric flow rate through the column.

2. (Problem 6-2, pg. 567)

   Chloride (Cl^-) is injected as a continuous source into a 1-D column. The system has Darcy velocity of 5.18×10^{-3} $\frac{in}{day}$, a porosity of $n = 0.30$, and longitudinal dispersivity of $5m$.

   Determine:

   2. The ratio $\frac{C}{C_0}$ at a location 0.3 meters from the injection location after 5 days of injection. 3. The ratio $\frac{C}{C_0}$ at a location 0.3 meters from the injection location after 5 days of injection, if the dispersivity is 4 times larger ($20m$). 4. Comment on the difference in results.

   Determine:

   (a) Sketch the system.

   (b) The ratio $\frac{C}{C_0}$ at a location 0.3 meters from the injection location after 5 days of injection.

   (c) The ratio $\frac{C}{C_0}$ at a location 0.3 meters from the injection location after 5 days of injection, if the dispersivity is 4 times larger ($20m$).

   (d) Comment on the difference in results.

3. (Problem 6-3, pg. 587)

   The estimated mass from an instantaneous release of benzene is $107 \frac{kg}{m^2}$ of a 1-D aquifer system. The aquifer has a seepage velocity of $0.03 \frac{in}{day}$ and a longitudinal **dispersion coefficient** of $9 \times 10^{-4} \frac{m^2}{day}$

   Determine:

   (a) Sketch the system.

   (b) Plot a concentration profile at $t = 1$ year for $x = 0$ to $x = 50$ inches, in 1-inch increments.

   (c) Plot a concentration history at $x = v \times (1 \text{ year})$ (this value stays constant) for $t = 0$ to $t = 2$ years in $\frac{1}{12}$-year increments.

   (d) The maximum concentration at $t = 1$ year and its location.