**If we only consider advection and**
**start with a "point" of material with $C_o$=1000mg/l**

A point has no volume so can it have a concentration? So why do we say a "point"?

**K = 0.1 cm/sec**
**dh = 10 cm**
**dl = 100 cm**
**$\phi$ = 0.2**
**How long will it take for the material to move 50cm?**
**What will the concentration be at that location at that time?**

in the down gradient direction

$$\bar{v} = \frac{Kdh}{\phi dl} = \frac{0.1\frac{cm}{sec}}{0.2}\frac{10\,cm}{100\,cm} = 0.05\frac{cm}{sec}$$

$$d = \bar{v}t$$

$$t = \frac{d}{\bar{v}} = \frac{50\,cm}{0.05\frac{cm}{sec}} = 1000\ sec = 0.28\,hr$$

$$C = C_o = 1000\frac{mg}{l}$$

**Suppose that source enters the up gradient end of a column**
**At a continuous concentration of $C_o$=1000mg/l**
**K = 0.1 cm/sec**
**dh = 10 cm**
**dl = 100 cm**
**$\phi$ = 0.2**
**Dispersivity $\alpha_x$ = 5 cm**
**What will the concentration be at 50 cm after 1000sec?**

average linear velocity

$$\bar{v} = \frac{Kdh}{\phi dl} = \frac{0.1\frac{cm}{\sec}}{0.2}\frac{10cm}{100cm} = 0.05\frac{cm}{\sec}$$

distance traveled in 1000sec?

$$d = \bar{v}t = 0.05\frac{cm}{\sec}1000\sec = 50cm$$

By inspection we know that the concentration should be 0.5*$C_o$=500mg/l
But let's carry out the calculation

**ALERT! ALERT! CORRECTION IN SUBSEQUENT LECTURE**

**Experiment with the spreadsheet**

**http://inside.mines.edu/~epoeter/_GW/22ContamTrans/C1d.xls**

**Note the values of C using only the first term and then both terms at times and locations where your intutition allows you to know the concentration.**

**When is use of the second term important? When does excel cause it to be in error?**

**Try x = 50, 49, 51, 0, 100 then 10, 30, 200**

**Consider other times**

**TRY 10000sec x = 500, 490, 510, 0, 1000**

**then x = 100, 200, 300, 400, 450, compare 450 to 550 ?symmetrical?**

**Where and when can you know the correct C?**

**The second term is important for calculating C @ early times near the source.**

$$\bar{v} = 0.05\frac{cm}{\sec} \qquad x = 0.05\frac{cm}{\sec}1000\sec = 50cm \quad so \quad X = Y = Z = 0 \text{ and we want } C_{\max}$$

$$D_x = \bar{v}\alpha_x + D^* = 0.05\frac{cm}{\sec}5cm + 1x10^{-10}\frac{m^2}{\sec}\frac{10000cm^2}{1m^2} = 0.25\frac{cm^2}{\sec}$$

$$D_y = \bar{v}\alpha_x\frac{1}{5} + D^* = 0.05\frac{cm}{\sec}5cm\frac{1}{5} + 1x10^{-10}\frac{m^2}{\sec}\frac{10000cm^2}{1m^2} = 0.05\frac{cm^2}{\sec}$$

$$D_z = \bar{v}\alpha_x\frac{1}{10} + D^* = 0.05\frac{cm}{\sec}5cm\frac{1}{10} + 1x10^{-10}\frac{m^2}{\sec}\frac{10000cm^2}{1m^2} = 0.025\frac{cm^2}{\sec}$$

$$C = \frac{M}{8(\pi t)^{\frac{3}{2}}\sqrt{D_x D_y D_z}}$$

$$C = \frac{1000mg}{8(\pi 1000\sec)^{\frac{3}{2}}\sqrt{0.25\frac{cm^2}{\sec}0.05\frac{cm^2}{\sec}0.025\frac{cm^2}{\sec}}}$$

$$C = 0.0402\frac{mg}{cm^3}\frac{1000cm^3}{l} = 40.2\frac{mg}{l} \sim 40\frac{mg}{l}$$