## **Explanation of Example Problem**

A 100 m<sup>3</sup> tanker containing a 100 mg/m<sup>3</sup> solution of 2,4-dinitotoluene wrecks and empties its entire contents above an aquifer. The cross-sectional area of the spill is 50 m<sup>2</sup>. The aquifer has a porosity of 30 percent, a bulk density of 1.6 g/cm<sup>3</sup>, a velocity of 10 m/yr, and a dispersion coefficient of 10 m<sup>2</sup>/yr. The distribution coefficient of 2,4-dinitotoluene for this aquifer material has been measured to be 2.5 mL/g. 2,4-dinitotoluene biodegrades through a first order reaction at a rate of 0.693 yr<sup>-1</sup>. How far and how fast will 2,4-dinitotoluene migrate through the aquifer?

## Solution:

1. Calculate the retardation factor from the distribution coefficient.

$$R = 1 + \frac{\int_{b} K_{d}}{n},$$

$$= 1 + \frac{1.6 \frac{g}{cm^{3}}}{0.3} = 14.33.$$

2. Correct the cross-sectional area of the spill site to the void volume rather than the total volume.

Cross-sectional area \* porosity =  $50\text{m}^2 \times 0.3 = 15 \text{ m}^2$ .

3. Calculate the total mass of chlordane spilled.

Volume spilled \* concentration of solution = 
$$(100 \, \text{m}^3) = 1000 \, \frac{\text{mg}}{\text{m}^3} = 100,000 \, \text{mg or } 100 \, \text{g}.$$

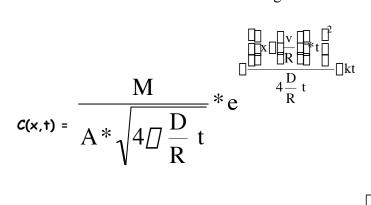
4. If necessary, calculate the first order degradation rate from the half-life.

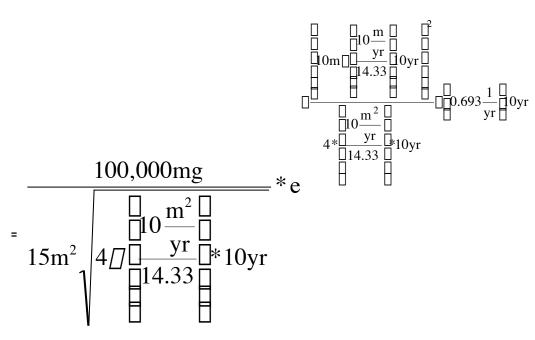
5. Arrange data into proper units

groundwater velocity, 
$$v = 10 \text{ m/yr}$$
, the retardation factor,  $R = 14.33$ ,

the mass of contaminant, M = 100,000 mg the dispersion coefficient,  $D = 10 \text{ m}^2/\text{yr}$ , the reaction rate constant,  $k = 0.693 \text{ yr}^{-1}$ , and the cross-sectional area,  $A = 15 \text{ m}^2$ .

- 6. Input data into program and obtain graph.
- 7. Calculate the concentration 10 meters down gradient from the lagoon ten years after the input.





=  $1,971 \text{ mg/m}^3 \text{ or } 1.971 \text{ mg/L } 2,4\text{-dinitotoluene.}$