Mass Balance–CMFR with Reactive Pollutant
CENG 340–Introduction to Environmental Engineering
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In Class: September 25, 2013

A tanker truck overturns on the highway and leaks 4545 kg of wastewater from a yoghurt production facility into a small lake. The wastewater is immediately and uniformly distributed throughout the lake. The lake has a volume of V = 10,000 m^3. A stream flows into and out of the lake at a flowrate of Q = 1000 $\frac{m^3}{day}$. Assume that bacteria present in the lake can degrade dairy waste with a first order rate coefficient of 0.005 day^{-1}. What is the concentration of the dairy waste in the lake as a function of time? Calculate how long it will take for the concentration of dairy waste in the lake to equal 5 percent of the initial concentration.

Step 1:

Draw a mass balance diagram, and label your diagram with given information and unknowns.

Step 2:

Write a general mass balance equation:

Step 3:

Determine whether the system is at steady state or not.

Step 4:

Determine whether reactions occur or if conservative.

Step 5:

Rewrite the mass balance equation based on your answers in Step 3 and Step 4, and solve for C = f(t):