Aquatic Environmental Science
#06: Dissolution and Kinetics

Exercise
(Model answer)

Q1. Answer the following questions regarding physicochemical reaction.

(1) Disintegration of cesium137 to barium137 follows first-order reaction with rate constant of 0.023 $year^{-1}$. Please estimate a half-life of cesium137. Note that *ln* 2 =0.693. 2pt

Time-dependent change of cesium137 can be described as follows:

$ln[Cs137]_t = -k*t + ln[Cs137]_0$

A half-life time ($t_{1/2}$) is the time when the concentration becomes half of initial concentration, then:

$ln[Cs137]_0 *1/2 = -k*t_{1/2} + ln[Cs137]_0$

Rearranging gives:

$ln1/2 = -k*t_{1/2}$

$t_{1/2}$=(ln2)/k=0.639/0.023=30.1 (year)

(3) Assume first-order reaction (A→B). If you got the time-course date for concentration of molecule A (say every seconds from time zero to 1 hr), how do you determine the rate constant of this reaction? Please describe a brief methodology. Do you need any statistical approaches to this end? 3pt

After plotting ln $[A]/[A_0]$ as a function of time (t), the rate constant (k) can be calculated by use of linear regression analysis (as a slope of line). Thus, statistical approach will be used.

Q2. Solve the differential equation for concentration (C) in a plug-flow system, assuming a first-order decay rate . 3pt

$C = C_0 \exp(-kx/u)$

Q3. Write one question related to today's lecture. 2pt

Any question is acceptable as long as it's related to the content of the class.