Print version

CEE 577: Surface Water Quality Modeling

Lecture #29

Toxics: Lake Models, Sorption

QUAL2E: tutorial

(Chapra, L40 & L41)

Steady State Solution

- Water column

$$c_1 = \frac{Qc_{in}}{Q + k_1 V_1 + v_v A f_{d1} + (1 - F_r')(v_s f_{p1} + v_d f_{d1})A}$$

- Mixed Sediments

$$c_2 = \frac{v_s f_{p1} + v_d f_{d1}}{k_2 H_2 + v_r + v_b + v_d f_{d2}} c_1$$

Sediment Feedback & k

- **The ratio of sediment feedback to total sediment purging**

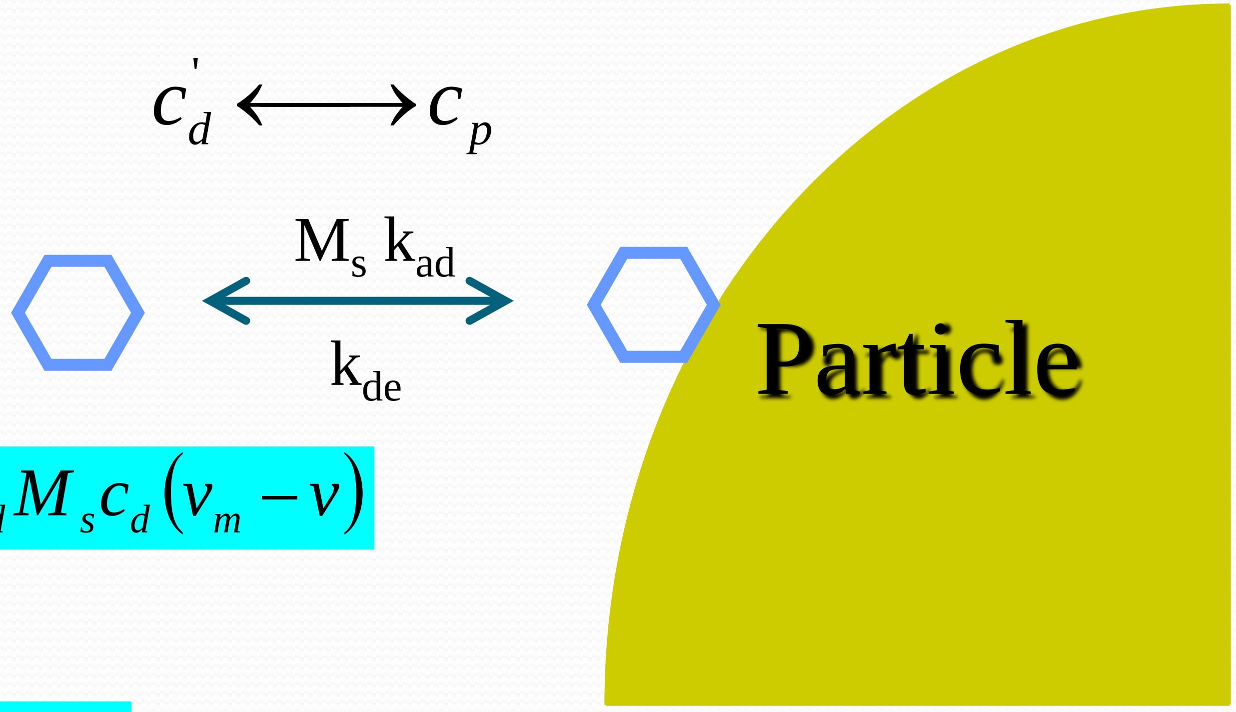
$$F_r' = \frac{v_r + v_d f_{d2}}{v_r + v_b + v_d f_{d2} + k_2 H_2}$$

- The first-order constants k1 and k2 incorporate various decay processes
  - Biodegradation
  - Hydrolysis
  - photolysis

Sorption

- Langmuir Isotherm

$$c_d' \longleftrightarrow c_p$$



$$R_{ad} = k_{ad} M_s c_d \left(v_m - v\right)$$

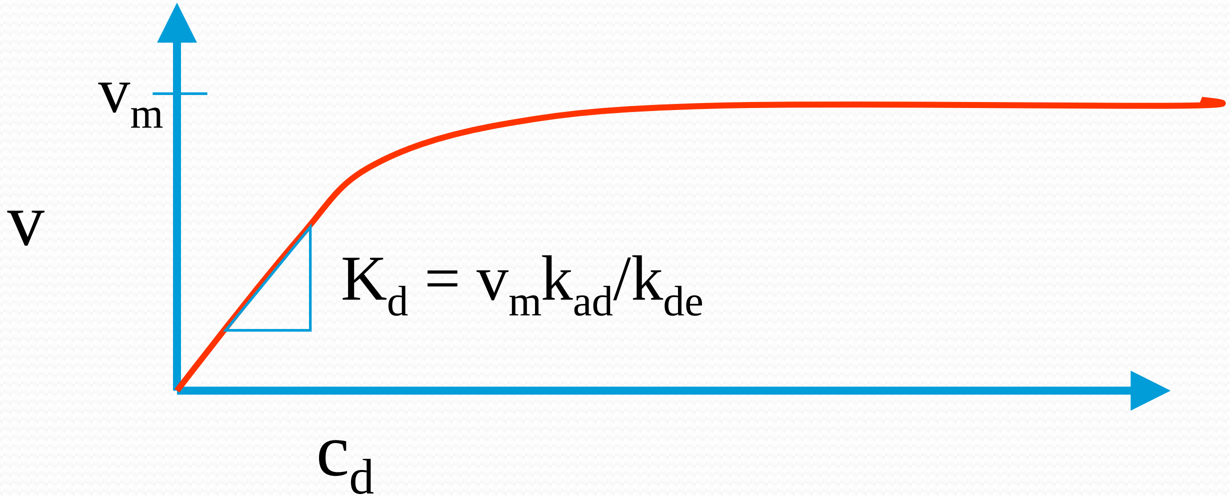
$$R_{de} = k_{de} M_s v$$

Langmuir Isotherm

- At equilibrium, $R_{ad}=R_{de}$

$$v = \frac{v_m c_d}{\left(k_{de}/k_{ad} \right) + c_d}$$

- Which gives the Langmuir Isotherm



Linear Partitioning

$$\nu = K_d C_d$$

- When appropriate
  - Predicted at low C_d's with Langmuir isotherm
  - Expected for all C_d 's when solute is thought undergo ideal "dissolution" in organic layers
- Significance
  - particulate phase concentration is obtained from dissolved by

$$C_p = m\nu = mK_d C_d$$

Development of fractions

- Recapitulating and combining, we get:

$$c_p = mv = mK_d c_d$$

$$c = c_d + c_p = c_d + mK_d c_d$$

- and the fractions can be expressed as:

$$f_d \equiv \frac{c_d}{c} = \frac{c_d}{c_d + mK_d c_d} = \frac{1}{1 + K_d m}$$

$$f_p \equiv \frac{c_p}{c} = \frac{mK_d c_d}{c_d + mK_d c_d} = \frac{K_d m}{1 + K_d m}$$

- To next lecture