Handout for Chapter 5 Water pollution—Part I Surface water

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1. Properties of Water
   - Density→Stratification Effect (分層化作用)
   - Melting and Boiling points
   - Specific Heat
   - Greenhouse effect. Water vapor is the most important greenhouse gas in our atmosphere.

   NOTE: Greenhouse effect vs Global warming

2. The Hydrologic cycle (水文循環)

   Evaporation, Evapotranspiration ( ), runoff

3. Water pollutants
   - Pathogens ( )
   - Oxygen-demanding Wastes

     DO

     COD

     BOD
   - Nutrients ( )

     (Cultural) Eutrophication

     Limiting nutrients: Freshwater _____; seawater _____

   - Salts

     TDS

     Freshwater_____; Saline water_____; seawater_____

     Drinking water (USA) _____

   - Thermal pollution

     Two key factors: Metabolic rates; DO amount

   - Heavy metals(_____)

     Most metals are toxic. Totally **nondegradable**. Nutrients/poison.

     Inhalation, Ingestion. Example: lead in gasoline →aerosols

     Kidneys → the most important organ for the elimination of metals (Cd, Pb, Hg)

   - Pesticides: Insecticides, Herbicides

     Organochlorines: DDT/DDE→ bioresistance, bioaccumulation/biomagnification, food chain, ecosystem

Organophosphates:

Carbamates → carbamic acid, H_2NCOOH

Herbicides ( ): 2,4-D, 2,4,5-T (banned) because_____

- Volatile organic compounds (VOCs)

4. BOD (biochemical oxygen demand)

   Definition:

   Aerobic/anaerobic

   BOD_5 Carbonaceous oxygen demand (CBOD)

   $$BOD_5 = \frac{DO_i - DO_f}{P}$$ (unseeded)

   $$BOD_5 = \frac{(DO_i - DO_f) - (B_i - B_f)(1-P)}{P}$$ (seeded)

   Modeling BOD:_____order reaction

   $$BOD_t = L_o(1-10^{-kt})$$

   $$k_T = k_{20}\theta^{(T-20)}$$ θ=_____

5. Nitrification and NBOD (Nitrogenous oxygen demand)

   Definition: (eqs. 5.16, 5.17)

   Figure 5.12 (p195); Figure 5.13

   mgO_2/mgN_2

6. COD, ThOD
7. The oxygen Sag Curve(_____)

   Oxygen input: Reaeration

   $$Rate = k_r D$$

   D ( )= _____

   $$k_r = \frac{3.9u^{0.5}}{H^{1.5}}$$

   Oxygen decay: Deoxygenation

   $$Rate = k_d L_0 e^{-k_d t}$$

Rate of increase of the deficit:

$$\frac{dD}{dt} = k_d L_o e^{-k_d t} - k_r D$$

$DO=DO_s$-[ ] (Streeter-Phelps oxygen sag equation)

Critical time: