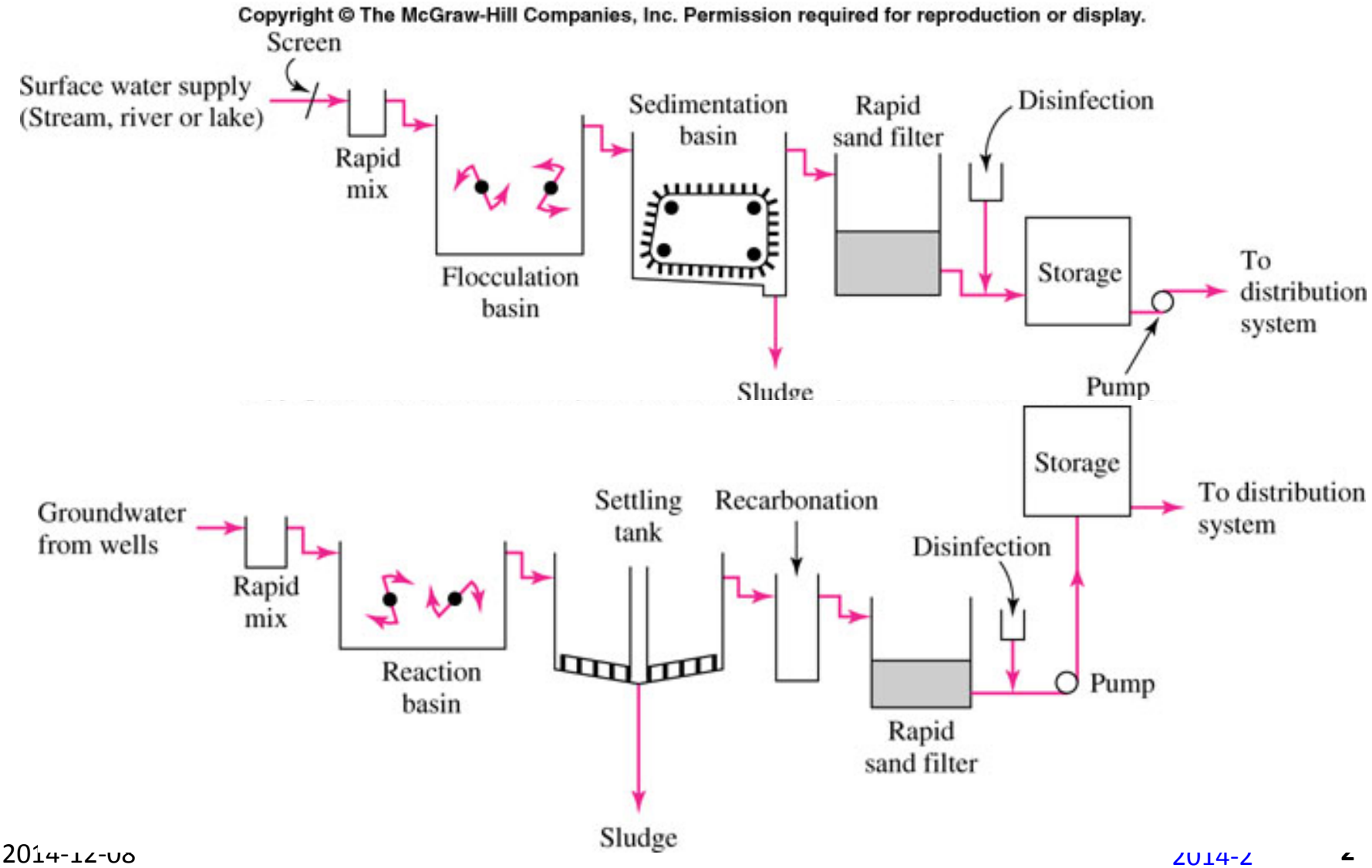
Final review

Water treatment processes



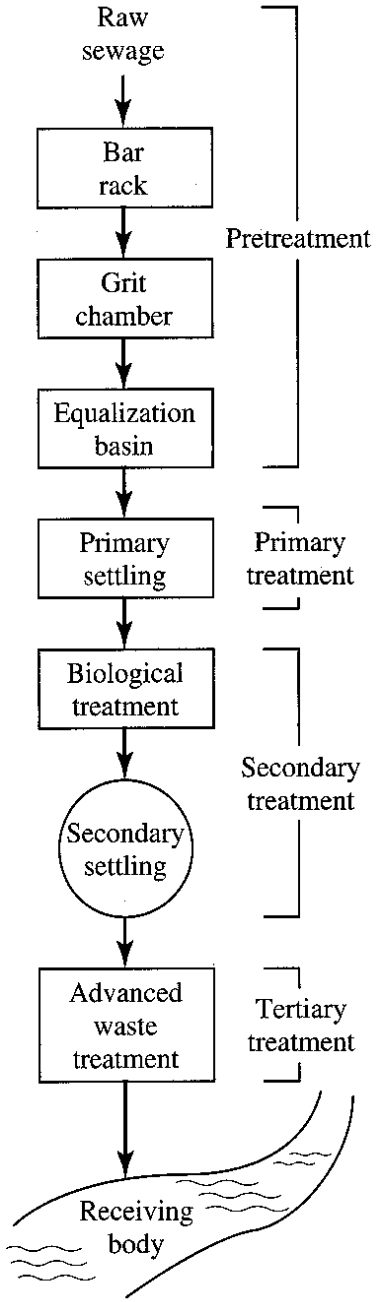
Water treatment - hardness

Q: A water sample having a pH of 7.4 is analyzed to have the following ion concentrations. Determine the alkalinity, total hardness, carbonate hardness, and noncarbonate hardness of the sample in mg/L as $CaCO_3$.

Ion	Concentration (mg/L)	Ion	Concentration (mg/L)
Ca^{2+}	53.2	HCO_3^-	132
Mg^{2+}	13.1	SO_4^{2-}	58.4
Na^+	17.5	Cl^-	21.2
K^+	4.8		
Fe^{3+}	0.32		

Water treatment - disinfection

Q: A chlorine disinfection is applied for a reactor having a dimension of 5 m x 2 m x 25 m (W x H x L) and receiving an influent flow rate of 1000 m^3/hr. The first-order decay coefficient under the current chlorine dose is 0.31 min^{-1}. Assuming that the chlorine concentration is constant in the reactor and the reactor works as an ideal PFR, would it be possible to achieve 2-log removal of pathogens? What if the reactor cannot be assumed as an ideal PFR?



Wastewater treatment processes

- Pretreatment: removal of materials that may damage mechanical devices & flow equalization
- Primary treatment: sedimentation basin, remove SS & particulate BOD by gravity
- Secondary treatment: remove BOD by microorganisms, further SS removal
- Tertiary treatment: polishing of secondary effluent for improved quality

Wastewater treatment - analysis

Q: An aeration tank with a volume of 4000 m^3 is receiving primary effluent at a flow rate of 10000 m^3/d having a BOD_5 of 500 mg/L. Calculate the effluent BOD_5 and the biomass concentration in the tank when there is no sludge recycle. Does the effluent BOD_5 meet the secondary effluent standard of BOD_5 = 30 mg/L? If not, determine the mean cell residence time required to achieve the standard. What is the biomass concentration in the tank according to the calculated mean cell residence time? Use following parameters.

$K_s = 50\ mg/L\ BOD_5$ $\quad$ $Y = 0.5\ mg\ VSS/mgBOD_5$

$k_d = 0.10\ d^{-1}$ $\quad$ $\mu_m = 3\ d^{-1}$

Air pollution

- Micro-, meso-, and macro-scale
- Primary and secondary pollutants
- Air pollutants: CO, NO_x, SO_x, lead, photochemical oxidants, particulates, other hazardous pollutants (hydrocarbons, heavy metals, dioxins, asbestos, …)
- Indoor air pollution, acid rain, ozone depletion, global warming
- Montreal protocol vs. Kyoto protocol

Air pollution control

- Absorption vs. adsorption
- Combustion
- Cyclones
- Filter
- Liquid scrubbing
- Electrostatic precipitation

Solid waste management

- Classification of wastes (Korea)
  - By sources
  - By hazard
- Recycle
- Composting
- Incineration
- Sanitary landfill
  - Landfill operation – area method
  - Leachate and landfill gas control

Hazardous waste management

- US regulation
  - RCRA (Resource Conservation and Recovery Act)
  - CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act)
- Soil & groundwater treatment technologies
  - In situ vs. ex situ
  - Pump-and-treat, soil vapor extraction, air sparging, permeable reactive barrier, soil washing, thermal desorption, in situ bioremediation

Noise pollution

Q: A sound is measured over 1-minute period and the average dB(A) values are taken at 10 sec intervals as shown below. Calculate the L_{eq} value of the sound over the period. Also, calculate the maximum value of N for L_N = 55 dB(A) assuming linear change in dB(A) between the time intervals.

Time intervals	Average dB(A) at time intervals
0-10 sec	50
10-20 sec	55
20-30 sec	60
30-40 sec	55
40-50 sec	50
50-60 sec	50