Homework #4

Released: 11/10/2014 (Mon) - Due: 11/19/2014 (Wed), in class

The homework will NOT be graded, but we will check for MISSING ANSWERS and CHEATING. Note that a cheated homework will get 80% of the lowest score in the class. You can give the answers **either** in English **or** Korean.

1. [Water treatment] Look up the drinking water quality standard[1] for your own country. Summarize the standards for following disinfection byproducts: trihalomethanes (THMs), haloacetic acids (HAAs), and bromate (BrO_3^-).

   [1]한글명: 먹는물의 수질기준

2. [Water treatment] A groundwater sample with pH=7.2 is analyzed to have the following ion concentrations. Determine the total and carbonate hardness (in mg/L as $CaCO_3$).

Ion	Concentration (mg/L)	Ion	Concentration (mg/L)
F^-	1.1	HCO_3^-	318.0
Cl^-	4.0	SO_4^{2-}	52.0
NO_3^-	0.0	Fe^{2+}	0.5
Na^+	14.0	Mn^{2+}	0.07
K^+	1.6	Zn^{2+}	0.27
Ca^{2+}	96.8	Ba^{2+}	0.2
Mg^{2+}	30.4		

3. [Water treatment] Explain why the dual media filter using anthracite coal and sand is used to improve the performance of the drinking water filtration system.

4. [Wastewater treatment] Draw a diagram of the general municipal wastewater treatment system. Briefly (not more than a sentence for each) explain the function of each step.

5. [Wastewater treatment] A 1000 m^3-sized activated sludge aeration tank is going to receive primary treatment effluent having a soluble BOD_5 of 150 mg/L at a flow rate of 8000 m^3/d. Using these data, you are trying to adjust the return sludge flow rate (Q_r) and sludge wasting flow rate (Q_w) to achieve the target effluent soluble BOD_5 of 10 mg/L. From experiment, it was observed that an MLSS concentration 10000 mg/L can be obtained at the bottom of the secondary settling basin (this equals to the return sludge MLSS concentration). Eighty percent of the MLSS was MLVSS. For the microorganism in the activated sludge process, following parameters were obtained:

   yield coefficient = 0.50 maximum specific growth rate = 2.5 day^{-1}

   decay rate = 0.05 day^{-1} half saturation constant = 100 mg/L

   Assuming that the MLSS and MLVSS in the primary treatment effluent and the secondary settling basin effluent are negligible, determine the following:

   i) The mean cell residence time to achieve the target effluent soluble BOD_5 concentration

   ii) The MLVSS concentration in the aeration tank when the target effluent soluble BOD_5 concentration is achieved

   iii) The sludge wasting flow rate (Q_w) and the return sludge flow rate (Q_r)