Lafayette College

Department of Civil and Environmental Engineering

CE 321: Environmental Engineering and Science Fall 2019

Homework #8

### Due: Monday, 11/04/19

1. Describe the difference between a food web and an ecological pyramid?
2. Describe how the growth in a mixed culture differs from that in a pure culture?
3. An often-used chemical representation of algae is C106H263O110N16P.
   1. Determine the mass (mg) of each element in 1 g of algae.
   2. Suppose there are 0.10 mg of N and 0.04 mg of P available for algal production per liter of water. Assuming adequate amounts of the other nutrients, which is the limiting nutrient?
   3. What mass of algae could be produced (milligrams algae per liter of water)?
   4. If the nitrogen source could be cut by 50 percent, how much algae (mg/L) could be produced?
   5. If the phosphorous source could be cut by 50 percent, how much algae (mg/L) could be produced?
4. Suppose the N and P content of some algae is as shown in the following table. The third column shows milligram of nutrient available per liter of water.

|  |  |  |
| --- | --- | --- |
| Nutrient | mg/(g of algae) | Milligrams available per Liter |
| Nitrogen | 60 | 0.12 |
| Phosphorous | 10 | 0.03 |

a. What percent reduction in nitrogen is needed to control algal production to 1.0 mg/L?  
b. What percent reduction in phosphorus is needed to control algal production to 1.0 mg/L?

1. You have been conducting a water quality study of Lake Arjun, which has a surface area of 8.9 x 105 m2. The average depth of the lake is 9 m. The lake is fed by a stream having a flow rate of 1.02 m3/s and a phosphorous concentration of 0.023 mg/L. Runoff from homes along the lake is contaminated with phosphorous and enters the lake at an average annual rate of 1.25 g/s. The river flow from the lake at a flow rate of 1.02 m3/s. The average phosphorus concentration in the lake is 13.2 ug/L. Assume evaporation and precipitation negate each other. What is the calculated average settling rate of phosphorus? (hint – SS- Nonconservative Mass Balance Problem where k is the settling rate of P)
2. Describe how human activities are altering each of the nutrient cycles we spoke about in class. (carbon, nitrogen, phosphorous).
3. Total Theoretical Oxygen Demand – This is a practical stoichiometry problem.
   1. Determine the theoretical oxygen demand (as mg/L) required to oxidize the following organic compound glutamic acid (C5H9O4N). Also report the resulting concentration (mg/L) of ammonia (NH3) produced. Assume the initial concentration of glutamic acid to be 150 mg/L  
      
   2. Based on the concentration of ammonia produced in part a, what will be the additional theoretical oxygen demand (mg/L) required to convert all of the ammonia to nitrate (NO3)?  
      
   3. Based on the initial 150 mg/L of glutamic acid what is the total theoretical oxygen demand (mg/L) (i.e., a + b)?
4. The concentration of pentachlorophenol has been measured to be 42.8 ug/L in Adonis Pond. A study of the Matsu fish revealed an average lipid concentration of the chemical to be 30,600 ug/kg. What is the bioconcentration factor for this fish?
5. The bioconcentration factor for bis(2-ethylhexyl) phthate, a commonly used plasticer, in the organism *Daphnia* is 5200 L/kg. If the concentration of bis(2-ethylhexyl) phthate in a lake is 3.6 ug/L, estimate the concentration of bis(2-ethylhexyl) phthate in *Daphnia* in units of ug/kg.
6. One of the congeners (a related chemical) of toxaphene, a persistent pesticide that was used on cotton, is 1,2,3,4,7,7-heptachloro-2-norbornene. The bioconcentration factor for this chemical in fish was determined to be 11,200 L/kg. If the concentration is of 1,2,3,4,7,7-heptachloro-2-norbornene is 1.1 ng/L in Lake Greenway, determine the estimated concentration in fish.