NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF CIVIL AND WATER ENGINEERING
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONOURS) DEGREE
PART V FIRST SEMESTER EXAM.- APRIL 2009
WATER QUALITY MANAGEMENT: TCW 5201

INSTRUCTIONS

Answer any four questions.

Time: 3 hours
Total Marks: 100

QUESTION 1

(a) Define the following terms of disease transmission related to water and give at least two examples of diseases that fall under each category: (i) water borne, (ii) water washed, (iii) water based and (iv) water related insect vector. (13 marks)

(b) A discrete spherical particle has a diameter of 0,15mm and a relative density of 1. 2. Calculate the settling velocity in water at 20^0C. (Kinetic viscosity of water at 20^0C is 1.01 x $10^{-6}m^2$ /s). (12 marks)

QUESTION 2

(a) Describe any five factors that influence the bactericidal efficiency of chlorine in water. (11marks).

(b) A Stream with a flow of 0.75 m^3 /sec and BOD 3.3 mg / L is saturated with DO (9.17 mg/L at 20^0). It receives an effluent discharge of $0.25m^3$/sec, BOD 20mg/L and DO 5.0 mg/L. Determine the DO deficit at a point 35 km down stream if the average velocity of flow is 0, 2 m/sec. Assume temperature is 20^0C throughout, K_1 for effluent / water mixture is 0.10/ day, K_2 for stream is 0.40/day. (14 marks)

QUESTION 3

(a) Compare slow sand filters with rapid sand filters. (12marks)

(b) A filter bed is made of 0.45 mm size angular sand (θ = 0. 73) and has an overall depth of 800mm and a porosity of 40 percent. Use Corman-Kozeny formular to estimate the head loss of the clean bed at a filtration rate of $120m^3$ / m^2 day. Kinetic viscosity of water = 1.01x 10^{-6} m^2 / s. (13marks)

QUESTION 4

(a) Describe the purpose of carrying out a jar Test in water treatment and explain the procedures involved in doing it. (10 marks)

(b) A filter sand bed of depth 0.8m and porosity 0.44 is backwashed at 1.5 x 10^3 m^2/m^2 (kinematic viscosity of water = 1.2 x10^{-6} m^2/s). If the sand grains are of 0.8mm diameter and density of 2650kg/m^3, calculate the height of the expanded bed, and its porosity after it is fluidifed . (15 marks)

QUESTION 5

(a) Describe the compounds that are formed when chlorine is added to:
(i) Water free from organic matter and ammonia. (5marks)
(ii) Water in which ammonia is present. (5marks)
(iii) Which of the compounds formed in the chemical reactions above are most effective or powerful bactericides. (5 marks)

(b) Calculate the contact time (in minutes) required to reduce the number of E-coli bacteria by 99.4% from a wastewater in which residual chlorides level is 2mg/l. (10marks)

USEFUL FORMULAE

$$Vs = g \frac{(\rho_p - \rho\omega}{18\mu} d^2 p$$

$$Vs = \sqrt{\frac{4gd\,(\rho_p - \rho w)}{3C_d}}$$

$$C_d = \frac{18.5}{Re^{0.6}}$$

$$C = \frac{24}{Re} + \frac{3}{\sqrt{Re}} + 0.34$$

$$RE = \frac{\phi V s \rho d_2}{\mu}$$

$$V_s = \sqrt{\frac{4gd}{3C_d}(\rho_p - \rho_w)}$$

$$t_c = \frac{1}{K_2 - K_1} \log \frac{K_2}{K_1} \left[1 - \frac{D_o (k_2 - k_1)}{L_o K_1} \right]$$

$$D_c = \frac{K_1}{K_2} L_{10} - K_1 - K_1 t_c$$

$$D_t = \frac{K_1}{K_2 - K_1} L_o (10^{-K1t} - 10^{-K2t}) + D_{o10}{}^{-k}{}_{2t}$$

$$\text{Log } 10 \frac{(N_t)}{N_o} = Kt^2$$

$$h = 1.07 \frac{\frac{l_{cd} V^2}{4}}{\phi g d f}$$

Particles shape factor, ϕ for spherical sand = n1.0, worn sand = and angular sand = 0.73

$$\frac{h}{l} = \frac{(1 - f)}{f^3} \frac{V_s^2}{gd\phi}$$

$$E = 150$$