Prof Veeresh S. Gali

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT
END-SEMESTER EXAMINATION (MAY- 2015)
M. Tech. (II- SEM.)

COURSE CODE: 14M31CE212 MAX. MARKS: 45
COURSE NAME: Contaminant Transport
COURSE CREDIT: 3 MAX. TIME: 3 HRS

Note: Attempt all Questions. Assume suitable data if required.

Section A – (10 x 1.5 = 15 Marks)

1. Answer the following

a) Mention different chromatography techniques used in the analysis of water and gas samples and their applications in environmental engineering

b) Define "Piston Velocity"

c) How do you estimate gas exchange coefficient in surface water bodies from measurable hydraulic attributes

d) How ionic chemical species undergo sorption onto metal hydroxides through surface complexation

e) Write a note on "Ion Exchangers"

f) Differentiate between "Bioconcentration" and "Bioaccumulation"

g) Define "Bioconcentration Factor"

h) What site specific data are required for cleanup of contaminated sites

i) What do you mean by "Retardation Factor"

j) In a laboratory study, a certain fish species was observed to metabolize and/or excrete 2,4', 5-trichlorinated biphenyl with a first order rate constant of 0.021/day. Estimate how long it will take for a contaminated fish, on being placed in clean water, to undergo depuration (cleansing of pollutants) if the initial biphenyl concentration in the fish exceeds regulatory standards by a factor of three.

Section B – (3 x 5 = 15 Marks)

2. a) What type of chemicals undergo photodegradation and how? **[02 Marks]**

b) What is the light intensity at 1-m depth in a lake, given an intensity of 3000μE/(m^2.sec) just beneath the lake's surface and an extinction coefficient (base e) of 0.6/m? If an aquatic plant has a light compensation point (the light intensity at which respiration rate equals photosynthetic rate) of 150μE/(m^2.sec), what is the maximum depth at which the plant may be expected to grow? **[03 Marks]**

3. a) Define "Hydrolysis". What type of chemicals undergoes hydrolysis? Discuss with reactions **[03 marks]**

b) An ester compound is spilled at an industrial site and runs into a pond where it accumulates to a concentration of approximately 20ppb. Assuming the water pH is 6 and hydrolysis is the only degradation process, estimate the half-life of the compound. Hydrolysis rate constant are given as under:

$k_a = 1.4x10^{-4} /(M.sec); k_n = 1.1x10^{-7} / sec; k_b = 1.0x10^{1} /(M.sec)$ **[02 Marks]**

4. a) How does the physical conceptualization of air-water gas exchange of "Thin Film Model" differ from that of "Surface Renewal Model". On what assumptions are these models based. **[02 Marks]**

b) Spilled benzene dissolves into a river flowing at an average velocity of 0.3m/sec. Will biodegradation significantly decrease the concentration of benzene in the river over a 20-mi reach? **[03 Marks]**

Section C – (2 x 7.5 = 15 Marks)

5. a) Derive an expression which relates retardation factor to bulk density and porosity **[03 Marks]**

b) What are the reasons for nonideality in retardation **[1.5 Marks]**

c) The porous material of an aquifer has a bulk density of 2 g/cm^3 and contains 0.5% organic carbon. Estimate the retardation factor for the most commonly used pesticide, Atrazine. If the porosity of the aquifer is 0.24, the hydraulic conductivity is 10^{-3}cm/sec, and the hydraulic gradient is 0.001, how fast will a plume of naphthalene advance in the aquifer? **[03 Marks]**

Log K_{oc} = 0.544 log K_{ow} + 1.377; log Kow = 2.68

6. a) Differentiate between the kinetics of bacterial growth in surface and subsurface environment. **[2.5 Marks]**

b) What are the various approaches used for remediation of subsurface environment **[2.5 Marks]**

c) How do you enhance the rate of biodegradation in subsurface environment? Discuss the techniques used **[2.5 Marks]**