Major Examination, 28 November, 2006
Department of Civil Engineering, I I T, Delhi

CEL 795 M. Tech. (Env. Engg.)

Time: 120 Minutes **Max. marks: 100**

1. Caleulate the ehlorine dose equivalent to 0.8 mg/L of Cl_2 at a pH of 7.00 if HOCl is 80 times as effeetive as OCl^- for disinfection and the pH of the water is 6.00. Perform the same calculation if HOCl is 200 times as effective as OCl^-. Use a temperature of 25°C. $Ka = 4.0 \times 10^{-4}$. [20]

2. Would the recycle of the effluent improve the efficiency of a continuous flow fixed bed carbon adsorption unit? Why or Why not?

[10]

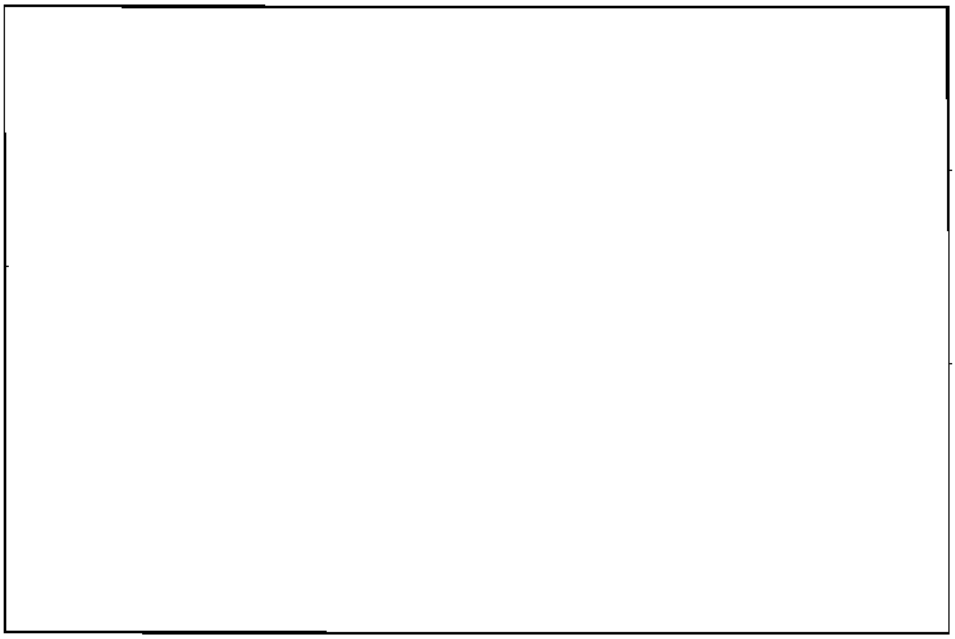
3. A painter is cleaning her paintbrush with solvent. The mass of the brush fibers is 250 g and the fibers have 50 g of paint on them. The brush will be immersed in solvent and agitated until equilibrium eonditions are established. A Freundlich isotherm applies with K = 0.90 and n=3.14 for q in mg/g and C in mg/L.

a) Find the mass of the paint remaining on the brush if it is immersed in a solvent volume of 1.0 L.

b) Find the total volume of solvent required to achieve the same degree of eleansing as in (a) if two equal volumes of solvent will be used in succession. The brush is immersed in the first volume and agitated until equilibrium is established, removed and the exercise is repeated with the second volume. Assume that the solvent remaining in the brush after it is removed from the first bateh is insignificant. [20]

4. A rapid sand filter has a bed depth of 0.7m. It is composed of sand grains that have a speeific gravity of 2.65 and a shape factor of 0.82. The porosity of the bed is 0.45 throughout. The sieve analysis of the sand is shown below.

Sieve No.	Mass retained %	Average particle size, mm
14-20	0.87	1.0
20-28	8.63	0.71
28-32	21.30	0.54
32-35	28.1	0.46
35-42	23.64	0.38
42-48	7.09	0.32
48-60	3.19	0.27
60-65	2.16	0.23
65-100	1.02	0.18



MBR Layout

S.No.	Inlet Chamber for Screen	1.2 X 1.2 X 0.4D + 0.3 FB
1	Fine Screen Chamber	2.0 X 1.2 X 0.3 D+0.3 FB
2	MBR Bioreactor	8.0 X 15.0 X 4.5 D + 0.5 FB
3	MBR Cassette Holding Tank	6.0 X 2.0
4	MBR Permeate Holding Tank	4.0 X 1.5 X 4.0 D + 0.3FB
5	Control Room	3.0 X 3.5
6	Blower Room	5.0 X 3.0

Determine the head loss through the bed if the flow rate is 5.0 m/h and the water temperature is 25°C. [20]

5. What is the minimum up flow velocity required to wash out sand particles with a nominal diameter of 4.4×10^{-2} em or smaller at a temperature of 20 °C.

[10]

6. In order to operate a filtration unit at a higher rate of filtration, it is required to utilize the whole filter depth. Full filter depth could be utilized if the filter media with bigger diameter is used in top filter layers and fine sand is used in the bottom layers, since such an arrangement would allow the penetration of suspended and colloidal impurities deep in the filter bed.

However, if such an arrangement is made, after the first filter back wash the coarse (bigger) particles may rapidly settle at bottom, while finer may slowly settle at top. Suggest an scheme which may overcome such a problem.

[10]

7. What do you understand by the Water Quality Index? Discuss its application at the national level to manage river pollution. [10]

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