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B. Tech
PECH 7404

Eighth Semester Examination – 2008

CHEMICAL PLANT WASTE MANAGEMENT

Full Marks – 70

Time : 3 Hours

Answer any **five** questions.

The figures in the right-hand margin indicate marks.



1. An organic waste having a soluble BOD_5 of 250 mg/L is to be treated with a complete-mix activated-sludge process. The effluent BOD_5 is to be equal to or less than 20 mg/L. Determine overall plant efficiency, reactor volume, bio-

mass production rate and hydraulic retention time for the reactor assuming that the temperature is 20 °C, the flow rate is 5.0 Mgal/d, and that the following conditions are applicable. 14

- (a) Influent volatile suspended solid to reactor are negligible.
- (b) Return sludge concentration = 10,000 mg/L of suspended solids = 8,000 mg/L volatile suspended solids.
- (c) Mixed-liquor volatile suspended solids (MLVSS) = 3,500 mg/L = 0.8 × total MLSS.
- (d) Mean cell-residence time $\theta_c = 10$ days.
- (e) Hydraulic regime of reactor = complete mix.

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(f) Kinetic coefficients, $Y = \frac{0.66 \text{ lb cells}}{\text{lb BOD}_5 \text{ utilized}}$,

$$k_d = 0.06 \text{ d}^{-1}.$$

(g) It is estimated that the effluent will contain about 20 mg/L of biological solids, of which 80 percent is volatile and 65 percent is biodegradable. Assume that the biodegradable biological solids can be converted from ultimate BOD demand to a BOD_5 demand using the factor 0.68 [e.g., BOD K value = 0.1 d^{-1} (base 10)].

(h) Waste contains adequate nitrogen, phosphorus, and other trace nutrients for biological growth.

2. (a) With a neat sketch explain the principle, construction, and working of a cyclone

separator. Also, give the proportions of the various parts with respect to cyclone diameter. 7

(b) A conventional cyclone with diameter 1.0 m handles $3.0 \text{ m}^3/\text{s}$ of standard air carrying particles with a density of 2000 kg/m^3 . For $Ne = 6$, determine the cut particle size. 7

Data given :

Entrance width of the cyclone = 0.25 m

Entrance height of the cyclone = 0.5 m.

3. Which do you think is a greater danger to man : pesticides used by farmers and householders, or toxic substances discharged into the air and water by industrial plants ? Explain in detail with proper justification. 14

4. Determine the in-line storage volume required to equalize the flow rate for the given data of a typical flow rate pattern. 14

Time period	Average flow rate During time period (ft ³ /s)
M-1	9.7
1-2	7.8
2-3	5.8
3-4	4.6
4-5	3.7
5-6	3.5
6-7	4.2
7-8	7.2
8-9	12.5
9-10	14.5
10-11	15.0
11-N	15.2
N-1	15.0
1-2	14.3
2-3	13.6
3-4	12.4
4-5	11.5
5-6	11.5
6-7	11.6
7-8	12.9
8-9	14.1
9-10	14.1
10-11	13.4
11-M	12.2

5. (a) Distinguish between : 6

(i) Single-stage and two-stage precipitators

(ii) Pipe-type and plate-type precipitators

(iii) Dry and wet precipitators.

- (b) With reference to electrostatic precipitators, explain the following : 4

(i) Particle resistivity

(ii) Particle re-entrainment.

- (c) Write a note on design parameters for ESP. 4

6. List in a tabular form the advantages and disadvantages of the following methods of solid waste disposal: incineration, sanitary landfill, composting and pyrolysis. 14

7. Write notes on any *two* :

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(a) Bag filters

(b) Aerobic digestion

(c) Spray pond.
