

Master of Chemical Engineering Examination, 2017
(1st Semester)

Environmental Pollution Control

Time: Three hours

Full marks: 100

Answer any five questions
Assume any missing data

1. (a) What is the purpose of dust collection? Explain with the help of a sketch, the working principal of gravitational settling chambers. (8)
(b) Discuss about the various design criteria of cyclone separator. Write the advantages and disadvantages of cyclone separator. (12)
2. (a) Describe with a sketch the operation of a horizontal rectangular settling tank for treatment of waste water. (5)
(b) Design a primary tank to handle an average rate of flow of 10 MLD. (15)
Assumptions:
 - (i) Designed BOD removal in primary treatment unit = 32%
 - (ii) Surface settling rate = 40,000 l/m²/d
 - (iii) Weir loading = 1,85,000 l/m/day
 - (iv) Slope of hopper = 2 vertical in 1 horizontal
3. (a) Discuss about various construction features of trickling filters. (9)
(b) Write the different operational problems of trickling filters. (6)
(c) Design a low rate on standard filter to treat 6.0 MI/d of sewerage of BOD of 210 mg/l. The final effluent should be 30 mg/l and organic loading rate is 320g/m³/d. Use NRC equation

$$E2 = \frac{100}{1 + 0.44 \sqrt{F_{1BOD} / V_1 R_{f1}}}$$

The terms have their usual meaning.

(5)

4. (a) Describe with a flow diagram the working principal of an activated sludge process. (5)
(b) Discuss about the different aeration facilities of the activated sludge process. (5)

(c) Design a conventional activated sludge plant to treat 28000 kL/d of settled sewage of BOD = 220 mg/l from the following data (10)
Effluent BOD = 15 mg/l

Food to microorganism ratio = 0.22

Mixed liquor suspended solid = 3000 mg/l

Adopt diffuser aeration system, and take VSI = 90

Air required = 100 m³/kg BOD removed

5. (a) Describe with the help of a sketch the working principal of bag filter. (8)

(b) A bag house designed to handle 36000 ft³/min of air containing dust particles. The fan develops a constant pressure of 1.5 inches of water. The bags are shaken in sequence row by row on a 10 min cycle. Filtration occurs at constant pressure so that the air velocity through each bag will decrease during the time between cleanings according to the relation

$$U_s = \frac{12.5}{1+0.3t}$$

Where U_s is in ft³/min of gas per ft² of cloth and t is in min. Each bag is 1 ft in diameter and 20 ft high. The bag house is to be square in cross section with 1 ft, spacing between bags and 1 ft. clearance from the walls. Determine (12)

(i) Number of bags required

(ii) Width of the bag house

(iii) Fan horse power. (Fan efficiency = 55%)

The fan horse power requirement (W) may be determined from the equation

$$W = 0.000157Q_r / h$$

Where Q_r and h is the gas flow rate in ft³/min and head or pressure drop in inches of water respectively.

6. (a) Write the different objectives of screen chambers in case of wastewater treatment (4)

(b) Design a screen chamber from the data given below (16)

Maximum flow = 0.42 m³/s

Average flow = 0.21 m³/s

Minimum flow = 0.084 m³/s

Assumption

- (i) Velocity of flow in the outfall sewer at peak = 0.75 m/s
- (ii) Width of the screen chamber = 1.5 diameter of outfall sewer
- (iii) Minimum area of screen = 200% of the cross sectional area for peak flow of incoming sewer.

7. Write short notes on (any four)

(4x5)

- (a) Sloughing of filters
- (b) Impact separator
- (c) Advantages and disadvantages of oxidation pond
- (d) Biological treatment kinetics
- (e) Growth pattern of microorganism
- (f) Working principal of Grit chamber
- (g) Proportional weir
- (h) Return sludge line system