

RI
INDIAN INSTITUTE OF TECHNOLOGY Kharagpur

Section 2

Date: FN/AN TIME: 3Hrs. Full Marks: 50 Deptt. Civil Engineering
Sub. No. EV20001 End Autumn Semester Examination 2012-13
II, and III Yr B.Tech. (H), Sub. Name Environmental Science

Part 1

1. An urban region can be thought of as composed of a multitude of point sources that fit into a box. The base of the box is the rectangular boundary of the city and its height is the mixing height above the city. Assume that the sources are uniformly distributed throughout the urban area and the box is a well-mixed vessel. Also assume that wind blows fresh air into one side of the box causing polluted air to be blown out of the opposite side.

Develop an expression for concentration of a pollutant within the city as a function of time. What is the steady state pollution concentration predicted by the model? If the width of the box is 30 km and its height is 250 m, what will be the steady state CO concentration when emission rate is 15000 tons/day and the average wind speed is 3.5 m/s.

[6]

2. (a) What is EIA? What are the steps involved in conducting a systematic EIA study for a developmental project? [4]

- (b) Distinguish between
(i) Single-stage and two-stage precipitators.
Dry and wet precipitators. [2]

- (c) What are the objectives of using control equipment? [2]

3. Consider an area-source box model for air pollution above a peninsula of land. The length of the box is 15 km, its width of 80 km, and a radiation inversion restricts mixing to 25 m. Wind is blowing clean air into the long dimension of the box at 0.5 m/s. Between 4 and 6 P.M. there are 250000 vehicles on the road, each being driven 40 km and each emitting 4 g/km of CO.

- (a) Find the average rate of CO emissions during this two-hour period (g CO/s per m² of land).
(b) Estimate the concentration of CO at 6 P.M. if there was no CO in the air at 4 P.M. Assume that CO is conservative and that there is instantaneous and complete mixing in the box.
(c) If the wind speed is zero, derive a relationship between CO and time and use it to find the CO over the peninsula at 6 PM.

[7]

P.T.O.

4. A plate-type electrostatic precipitator for use in a cement plant for removing dust particles consists of 10 equal channels. The spacing between the plates is 0.15 m, and the plates are 2 m high and 2 m long. The unit handles 10 000 m³/hr of gas. What is the efficiency of collection? What should be the length of the plates for achieving 99% collection efficiency if other condition are the same.

[5]

5. Before the installation of an ESP, the stack gas of a power plant contained 6.0 g particulates per m³ of gas. The gas flow rate is 350 m³/min and the new precipitator can remove 2400 kg particulates per day.

- (i) What is the emission rate of particulates before and after pollution control in kg/day.
- (ii) What is the efficiency of electrostatic precipitator?
- (iii) Will the new system meet an emission standard of 0.7 g/m³.

[5]

6. The maximum CO concentrations normally measured in downtown Salt Lake City (early 1990s) are about 31000 µg/m³. These values occur during strong inversions, for which we may estimate the values of u and H as 0.5 m/s and 100 m, respectively. The background concentration for this situation is estimated to be 1000 µg/m³. The downtown area of Salt lake City may be approximated as a 4-km by 4-km square. Estimate the emission density (g /s. m²) for CO for downtown Salt Lake City.

[4]

Part 2

7. Provide the primary techniques of waste minimization. Illustrate your answer by a diagram or flow chart. Briefly discuss one of the techniques for handling solid waste

[7.5]

8. Discuss the food web as expected in a tropical rain forest setting. Explain your answer further in perspective of food chain and energy pyramid

[7.5]