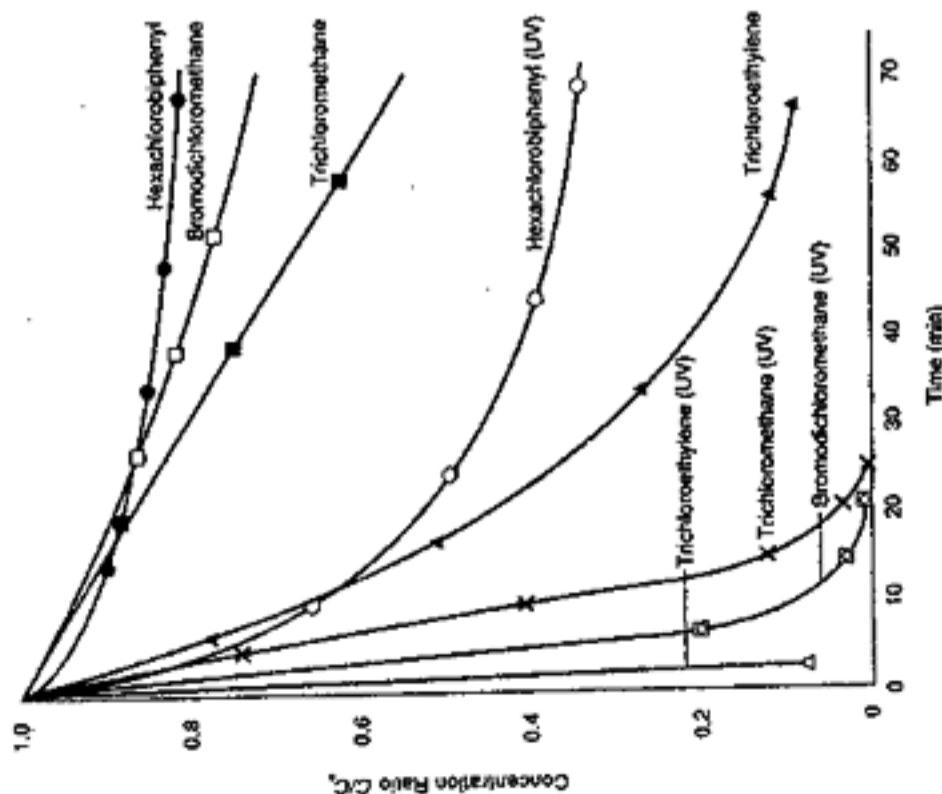


1. Briefly describe the sources of volatile emissions from a landfill. (25%)

2. A chemical plant generates a process wastewater stream which has averaged 500 gal/min and 5,000 mg/L of COD over the past three years. The regulatory agency has stated that the organic chemical constituents must be reduced to 100 mg/L measured as COD. The stormwater runoff from the site also contains the organic chemicals of concern, and all runoff from an annual average rainfall of 60 inches must also be treated. Rainfall/runoff measurements over three months reported a total of 12 inches of rainfall over the period, which yielded 3,300,000 gallons of runoff containing 300 mg/L of COD. Treatability tests of the process wastewater reported the data: BOD/COD = 1/2; Biomass production rate = 0.7 mg/mg BOD removed; and Endogenous decay rate = 0.05 day⁻¹.
The plant is evaluating the feasibility of treating the wastewater and runoff in a full-scale completely mixed, suspended growth system with solids recycled. Based on the above information, could a sufficient biomass concentration be maintained to prevent settling problems? (25%)

3. A liquid injection incinerator has a stack gas that contains 7% oxygen by volume on a wet basis at standard conditions. The incinerator is burning benzene at a rate of 234 lb/hr with air. (25%)
 - a.) What percent excess air is required?
 - b.) If the stack gas had been on a dry basis, what would the excess air be?
 - c.) What is the combustion efficiency of the system if the CO content of the flue gas is 600 ppmv?

4. Determine the amount of ozone required to treat 760 L/min of ground water contaminated with trichloroethylene at 151 µg/L. Assume 90% removal is required, and the data of Figure A apply. (25%)



* At pH 6-7, ozone dose rate = 1.0-1.4 mg/L min. UV frequency is 254 nm from a low pressure mercury lamp, with a flux of 0.42 W/L.

Figure A
Destruction of chlorinated organics by ozone with and without UV radiation. #7