

1. The regulatory agency has stated that the organic chemical constituents are hazardous and must be reduced to 100 mg/L measured as COD. An industrial plant generates a wastewater stream which has averaged 440 gal/min and 4,800 mg/L of COD over the past five years. 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. The industrial plant conducted some studies and found the following:

- (1) 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.
- (2) Treatability tests of the process wastewater reported the following data:  
BOD:COD = 1:2; Biomass production rate = 0.7 mg/mg BOD removed;  
Endogenous decay rate = 0.05 day<sup>-1</sup>

Currently, the plant is evaluating the feasibility of treating the wastewater and runoff in a full-scale completely mixed, suspended growth system with solids recycle. Based on the above information, could a sufficient biomass concentration be maintained to prevent settling problems? (20%)

2. The total mass of contaminants leached in a column leaching test from the unstabilized and pozzolanic reagent stabilized Imhoff sludge is as follows:

Parameter	Untreated sludge	Treated sludge
Arsenic	0.725	0.048
Cadmium	3.3	0.125
Chromium	0.566	1.16
Copper	3.86	3.2
Iron	48.4	1.57
Lead	0.238	0.019
Manganese	11.5	1.48
Zinc	120	3.02

Calculate the percent reduction in the mass of the leached constituents. What do

(背面仍有題目,請繼續作答)

you consider the average reduction in leached constituent concentrations?  
Which chemical parameter requires further consideration in evaluating the effectiveness of stabilization and why? (20%)

3. Identify the sources of volatile emissions from a landfill. (10%)
4. Illustrate the fate of metals in waste incineration systems. (10%)
5. A liquid injection incinerator has a stack gas which contains 7% oxygen by volume on a wet basis at standard conditions. The incinerator is burning toluene at a rate of 184 lb/hr with air. What percent excess air is required? If the stack gas had been on a dry basis, what would the excess air be? What is the combustion efficiency of the system if the CO content of the flue gas is 500 ppmv? (20%)
6. A waste water stream of 20,000 L/day contains 200 mg/L of NaCN. Determine the theoretical (stoichiometric) amount of chlorine required daily to destroy this waste. (10%)
7. A waste gas with a composition of 4.5% CO<sub>2</sub>, 26.0% CO, 13.0% H<sub>2</sub>, 0.5% CH<sub>4</sub>, and 56.0% N<sub>2</sub> is burned with 10% excess air. The barometer reads 750 mmHg. Calculate the dewpoint of the stack gas. (10%)

$$(\ln P_{\text{water}}^* (\text{mmHg}) = 18 - (3816 / (-46 + T(\text{K})))$$