

National Exams May 2018

04-Env-B5, Industrial & Hazardous Waste Management

3 hours duration

NOTES:

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.
2. This is an OPEN BOOK EXAM.
Any non-communicating calculator is permitted.
3. Marks are indicated beside each question for a total of 100 marks .
4. Clarity and organization of the answer are important.

Q.1. (4 points)

What are the regulations in Ontario that govern the disposal and transportation of hazardous wastes? Show if these are federal or prevention regulations.

Q.2. (4 points)

What are the four characteristics that make a waste hazardous?

Q.3 (4 points)

Show if the following wastes are considered hazardous waste:

- a. A liquid containing less than 14 % alcohol by volume and has a flash point of 65 °C
- b. Liquid lime-based floor cleaner with a pH of 10.9

Q.4. (4 points)

List at least four processes that could be considered for removing volatile organics from soils.

Q.5. (4 points)

Why are chemoheterotrophic bacteria the most important class of microorganisms involved in bioremediation?

Q.6. (5 points)

Explain the difference between soil vapor extraction (SVE) and bioventing.

Q.7. (5 points)

Explain the importance of the vegetative support layer in a landfill cover system.

Q.8. (5 points)

Name at least five tests used to evaluate HW stabilization and solidification.

Q.9. (10 point)

The mixture in the table below is being incinerated at 2200°F. The stack flow rate = 37500 dscfm (dry standard cubic feet per min). If the required DRE of pollutants is 99.99 % and the allowable particulate level is 0.08 grains/dscf (7000 grains = 1 lb), determine if these emissions meet the standards. The incinerator emissions are corrected to 7.0 % oxygen in the flue gas.

compound	Inlet(lb/hr)	Outlet(lb/hr)
Benzene	1025	0.087
Tetrachlorophenol	760	0.056
Toluene	756	0.024
Particulates		20.3

Q.10. (15 points)

The two waste streams in the table below are mixed together.

Waste	% by weight	Density (kg/m ³)	MC %	Arsenic (mg/kg-wet)
A	75	300	20	110
B	25	210	40	55

Calculate:

- The density of the mixed waste in kg/m³
- The arsenic concentration in the dry mixture
- Determine if the mixture is “a leachate toxic waste” based on dry weight? (TCLP limit for arsenic is 2.5 mg/L)?

Q. 11. (10 points)

A 200 m³ recycled bioreactor receives an industrial wastewater at a rate of 400 m³/d. The settled biomass of concentration 15 g/L is wasted at a rate of 300 kg/d (the rate of biomass wastage). Ignore the biomass in the supernatant, calculate the hydraulic detention time and the sludge retention time?

Q.12. (20 points)

Stripping tower is to be designed to strip out chloroform in water at a concentration of 150 µg/L. The desired effluent concentration is 10 µg/L. If the water flows at a rate 100 m³/hr, air flow rate is 3000 m³/hr, $H_D = 2.558 \times 10^{-5}$ atm.L/mg, and $K_{ia} = 30 \text{ h}^{-1}$, calculate the height of the tower (T = 20 C).

Q.13. (5)

An incinerator which normally burns waste with a heating value of 700 - 1,000 Btu/lb and is designed to handle 2×10^7 Btu/hr must burn a rubber waste with a heating value of 12,000 Btu/lb. Estimate the maximum size of a waste batch for this system to perform effectively. Assume the residence time in the incinerator is 6 min.

Q.14. (5)

Given the following octanol water partition coefficients, K_{ow} , indicate for which compounds vacuum extraction is a candidate process for removing the compound from the vadose zone of contaminated soil.

Compound	Log K_{ow}
Polychlorinated biphenyl congeners	6.01
Vinyl chloride	1.38
Ethyl benzene	3.15
Phenol	1.46
2-Butanone (methyl ethyl ketone)	0.26