UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2004/2005 Academic Session

October 2004

EAP 585/4 – Solid and Hazardous Waste Management

Duration : 3 hours

Instructions to candidates:

1. Ensure that this paper contains **THREE (3)** printed pages before you start your examination.

2. This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions only. Marks will be given to the **FIRST FIVE (5)** questions put in order on the answer script and **NOT** the **BEST FIVE (5).**

3. All questions carry equal marks.

4. All questions **MUST BE** answered in English.

5. Each question **MUST BE** answered on a new sheet.

6. Write the answered question numbers on the cover sheet of the answer script.

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1. (a) Describe the listing approach for the classification of hazardous wastes.

(10 marks)

(b) Explain waste stabilization by chemical fixation.

(10 marks)

2. (a) Describe any **TWO (2)** of the following characteristics of hazardous wastes:
   (i) Flammability
   (ii) Toxicity
   (iii) Reactivity
   (iv) Corrosiveness

(10 marks)

(b) Discuss the use of personal protective equipment (PPE) at hazardous waste sites.

(10 marks)

3. (a) What is incineration? Discuss the advantages and disadvantages of a rotary kiln incinerator.

(10 marks)

(b) Describe the operation and working of a fluidized-bed incinerator.

(10 marks)

4. (a) Once equipment and labour requirements have been determined, collection route must be laid out. List any **FIVE (5)** rules to determine the collection route of waste truck.

(5 marks)

(b) Estimate the generation rate of waste from a residential area if the following data were given:

No of trucks to collect domestic waste	= 20/ week
Capacity of the truck	= $12m^3$
Truck compaction factor	= 1.5
No of open-top trucks to collect yard waste	= 10/week
Factor of truck usage	= 0.85
Density of domestic solid waste	= 180 kg/m^3
Density of yard waste	= $120kg/m^3$
Total no of houses	= 2,000
Average no. of household	= 4 people

(5 marks)

(c) Write short notes on any **TWO (2)** of the following:
   i) Physical properties of waste
   ii) Leachate treatment
   iii) Siting of landfill

(10 marks)

5. (a) Develop a process flow diagram to process mixed recyclable composed of tin and ferrous cans.

(5 marks)

(b) Using the process flow diagram developed in question 5(a), prepare a layout of the materials recovery facility.

(5 marks)

(c) Solid waste from a new apartment block is to be collected in large containers. Determine the number of trips per day, based on 8 hour workday.

Assume the following data holds:

Time from garage to first container	= 15 min
Time from last container to garage	= 25 min
Haul distance to landfill	= 30 km
Average speed of truck	= 80km/h
Time required to pick up loaded container	= 21 min/trip
Time required to unload container	= 3min/trip
Time driving between container locations	= 6 min
Off - route factor	= 0.15

(5 marks)

(d) Discuss the environmental monitoring systems used during closure and postclosure of landfill.

(5 marks)

6. (a) Calculate the volume of methane and carbon dioxide gases from organic waste with the following characteristics:

Component	Dry weight (kg)	kg			
		C	H	N	O
Food wastes	25.0	12.3	0.35	0.07	2.5
Paper	10.0	25.0	5.0	0.10	29.0
Cardboard	5.0	4.5	6.0	0.02	4.5
Yard wastes	7.5	2.5	4.5	0.15	7.5

Given : Density of methane, $CH_4 = 0.11\ kg/m^3$, $CO_2 = 1.98\ kg/m^3$
Relative atomic mass: C=12 , H =1, O=16, N=14

(8 marks)

(b) By using suitable diagram(s), discuss the variation in the generation of landfill gases according to the different phases.

(6 marks)

(c) Discuss the passive and active control of landfill gases.

(6 marks)

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