
UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2005/2006 Academic Session

November 2005

EAP 585/4 – Solid And Hazardous Waste Management

Duration: 3 hours

Instructions to Candidates:

1. Ensure that this paper contains **FOUR (4)** 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. Each question carry equal marks.
4. All questions **CAN BE** answered in English or Bahasa Malaysia or combination of both languages.
5. Each question **MUST BE** answered on a new sheet.
6. Write the answered question numbers on the cover sheet of the answer script.

1. (a) Estimate the density and energy content of the organic waste components with the following composition:

Component	% by weight	Typical Moisture content, %	Typical Density, Kg/m ³	Typical Energy Content, KJ/Kg
Plastic	10	2	65	32,600
Paper	15	6	85	16,750
Yard wastes	20	50	105	6,500
Food wastes	35	70	290	4650
Tin	15	3	90	700
Glass	5	2	195	150

Assume the weight of waste sample is 250 kg.

The ash content is 5%.

(10 marks)

- (b) Describe any **TWO (2)** of the following:
- (i) Aerobic composting of wastes
 - (ii) Biological treatment of leachate
 - (iii) Transfer station

(10 marks)

2. (a) Waste generated from a residential area with 1000 houses in Taman Sri Putra need to be collected and disposed off at a landfill. A waste truck was used to collect the waste generated. Determine the appropriate truck capacity for the following condition. Assume the following data are applicable:

Average number of residents per service	4
Solid waste generated	1.5 kg/capita.day
Density of solid wastes (in containers)	190 kg/m ³
Containers size	4m ³
Containers per service	2
Collection frequency	Twice per week
Collection vehicle compaction ratio	2.5
Round trip haul distance	35 km
Length of workday	8 h
Trips per day	2
Travelling to first container location from garage	20 min
Travelling to last container location to garage	25 min
Off –route factor	0.15
Haul time constants , a	0.016 h/trip
Haul time constants , b	0.018 h /trip
At site time per trip	0.1 h/trip

(10 marks)

2. (b) Briefly discussed the Laws and Regulations in Malaysia concerning
- (i) Solid Waste Management
 - (ii) Hazardous Solid Waste Management
- (10 marks)
3. (a) With the help of a diagram, discuss the **FIVE (5)** elements of a landfill closure plan.
- (7 marks)
- (b) You are required to prepare a working paper on the design of a new sanitary landfill for Kedah. The following information are given:
- The amount of solid waste collected per collection service = 5 ton/ day
 - The no. of collection service per year = 2,600
 - The density of waste compacted at the landfill = 500kg/m^3
- (i) Calculate the land area required to ensure that the active life of the landfill is sufficient for 20 years. The average depth of the compacted waste is 5m.
- (ii) Estimate the volume of daily soil cover required if the thickness of the soil cover suggested is 15 cm. The width of the cell proposed is 5.0m and the height of the cell is 500 cm
- (6 marks)
- (c) By using suitable diagrams, discuss the formation of gases and its control in a landfill.
- (7 marks)
4. (a) Define Hazardous Waste.
- (2 marks)
- (b) What approaches are used for classification of hazardous waste? What are the advantages and disadvantages of the approaches?
- (6 marks)
- (c) Which approach is used for classification of hazardous waste in Malaysia? Give examples of six groups of hazardous waste in Malaysia.
- (4 marks)
- (d) List the four indicative criteria for characterisation of hazardous waste.
- (4 marks)
- (e) Define any two of the following terms: Bioaccumulation, Phytotoxicity, Genetic Changes, LD_{50} , and LC_{50} .
- (4 marks)

5. (a) Distinguish between incineration and pyrolysis in hazardous waste treatment in terms of combustion, products and possible source of air pollution. (3 marks)
- (b) Explain the working principle of a rotary kiln incinerator. (5 marks)
- (c) Explain the working principle of a plasma arc pyrolysis system. (5 marks)
- (d) Under what circumstances chemical fixation is used for treatment-disposal of hazardous waste? How chemical fixation is achieved? What are the fixation techniques? (7 marks)
6. (a) What specific considerations are important in evaluating the suitability of a site for a hazardous waste management facility? (4 marks)
- (b) Why landfills are integral part of a hazardous waste management system? (2 marks)
- (c) Why leachate collection and treatment are important in a hazardous waste landfill? (2 marks)
- (d) Sketch the liner and leachate collection system for a hazardous waste landfill. (4 marks)
- (e) Why tracking of the waste is required in a hazardous waste land disposal facility? (2 marks)
- (f) A shipment of petroleum sludge, generated by a process that employs sulphuric acid to refine crude oils, arrives at a landfill for disposal. The operator decides that it would be useful to dispose of the sludge in the area (cells) containing sludge from an old storage lagoon from an electroplating wastewater treatment plant. What do you think? Give reasons why the petroleum sludge should or should not be disposed of in the cells. (3 marks)
- (g) What special care should be taken or monitoring should be done for a closed hazardous waste landfill? (3 marks)