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UNIVERSITI SAINS MALAYSIA

1<sup>st</sup>. Semester Examination  
2004/2005 Academic Session

October 2004

**EAP 585/4 – Solid and Hazardous Waste Management**

Duration : 3 hours

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**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.

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 <sup>3</sup>      |
| 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 <sup>3</sup> |
| Density of yard waste                       | = 120kg/m <sup>3</sup>  |
| 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<sub>4</sub> = 0.11 kg/m<sup>3</sup>, CO<sub>2</sub> = 1.98 kg/m<sup>3</sup>  
 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)