UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

November 2008

**EAP 582/4 – Wastewater Engineering**

Duration: 3 hours

Please check that this examination paper consists of **FIVE (5)** pages of printed material before you begin the examination.

**Instructions**: Answer **FIVE (5)** questions. All questions carry the same marks.

You may answer the question either in Bahasa Malaysia or English.

All questions **MUST BE** answered on a new sheet.

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

1. (a) To aid sedimentation in the primary settling tank, 25mg/l of Ferrous sulphate ($FeSO_4 4H_2O$ ) is added to waste water. Determine the minimum alkalinity to react initially with ferrous sulphate. How many gram of lime should be added as CaO to react with $Fe(HCO_3)_2$ and the dissolved oxygen in the wastewater to form insoluble $Fe(OH)_3$ ?

[8 marks]

(b) The chlorine residual measured when various dosages of Chlorine were added to a wastewater are given below. Determine (a) the breakpoint dosage and (b) the design dosage to obtain of 0.75mg/L free available chlorine.

| Dosage, mg/L | 0.1 | 0.5 | 1.0 | 1.5 | 2.5 | 3.0 |
|---|---|---|---|---|---|---|
| Residual, mg/L | 0.0 | 0.4 | 0.8 | 0.4 | 0.9 | 1.4 |

[6 marks]

(c) A waste water treatment plant discharges to a small stream. The characteristics of effluent from wastewater and the characteristics of stream are given below.

| Stream | Effluent |
|---|---|
| Flow = 0.4m³/s<br>BOD = 2.0mg/L<br>Nitrate = 2mg/L<br>Ammonia = 0mg/L | Flow = 10,000m³/d<br>BOD = 25mg/L<br>Nitrate = 10mg/L<br>Ammonia = 7mg/L |

Determine the stream characteristics after mixing with the waste has occurred.

[6 marks]

2. (a) List **TWO (2)** main units under each of the following and discuss the functions of each:

(i)    Secondary treatment

(ii)    Advanced treatment

[5 marks]

(b) In advanced treatment nitrogen changes in a biological treatment process what we call as nitrification and denitrification process, explain including the reaction occurred.

[5 marks]

(c) A 3.79 x $10^3$ m$^3$/d wastewater treatment plant is to achieve nitrification at 25°C. The BOD is 850 mg/L and the NH$^3$-N is 150mg/L. The alkalinity is 380mg/L. Design the facility for the following conditions:

Effluent BOD       = 30mg/L
MLVSS           = 3500mg/L
(a= 0.55, b= 0.1 day$^{-1}$, $X_d$= 0.60, $a_N$ =0.15, $\theta$ = 1.05)

[10 marks]

3. (a) With a neat diagram, explain the various phases of microbial life cycle

[10 marks]

(b) (i)      How will you define BOD and COD.
    (ii)      What is their significance in wastewater treatment?
    (iii)      Which of the two will be higher in a wastewater sample and why? Explain.

[6 marks]

(c) Estimate the total quantity of a sewage of a town (whose design population is 50,000). The water supply is 150L/capita/day (average) and the estimated infiltration of ground water is 8000L/km line per day. The proposed sewerage system will have 65km of sewer line; out of which, nearly 50 percent will be below ground water table. Assume that 80 percent water supply comes back as sewage.

[4 marks]

4. (a) Write a notes on sludge volume index (SVI) and explain its significance in the design of wastewater treatment

[5 marks]

(b) Design a suitable rectangular sedimentation tank (provided with mechanical cleaning equipment) for treating the sewage from a city, provided with an assured public water supply system, with a maximum daily demand of 12 million litres per day. Assume a suitable value of detention period, about 80 percent of water supplied to the city becomes sewage and velocity of flow in the tank to be maintained as 0.3m per minute. Other assumptions such as effective depth of tank as 3m and a free-board of 0.5m.

[10 marks]

(c) (i) What are grits and how are they removed from wastewater through the rectangular grit chamber?

(ii) What is the advantage of using an aerated grit chamber for wastewater treatment?

[5 marks]

5. (a) An average operating data for conventional activated sludge treatment is as follows;

| | | |
|---|---|---|
| Wastewater flow | = | $35000m^3/d$ |
| Volume of aeration tank | = | $10900m^3$ |
| Influent BOD | = | 250mg/L |
| Effluent BOD | = | 20mg/L |
| MLSS | = | 2500mg/L |
| Effluent suspended solids | = | 30mg/L |
| Waste sludge suspended solids | = | 9700mg/L |
| Quantity of waste sludge | = | $220m^3/d$ |

Based on the information above, determine:

(i) Aeration period (hours)

(ii) Food to microorganisms ratio (F/M) (kg BOD per day/kg MLSS)

(iii) Percentage efficiency of BOD removal

(iv) Sludge age (days)

[10 marks]

(b) Explain the breakdown of organics by:

    (i)      Aerobic bacteria

    (ii)     Anaerobic bacteria

Illustrate your answer by means of simplified equations.

[10 marks]

6. (a) In Regulation 8 which is Parameter limits of effluent to be discharged into inland waters in Environment Quality (Sewage and Industrial Effluent) Regulation, 1979 already listed several item that needs to be follow about discharging effluent in Third Schedule, Fourth Schedule and Fifth Schedule.

    (i)     Describe briefly any two of three mention schedule content.

[4 marks]

    (ii)     Discuss briefly two impacts to the environment if the law has been broken related to the **THREE (3)** mention schedule.

[4 marks]

(b) What would be the significant if one sewerage treatment plant in urban area has a certified MS ISO 14000 in Environmental Management System.

[4 marks]

(c) As a environmental officer, you have been receive a report that a livestock compound operating in one area made an extension to its compound with out any approval from local authority. It's been suspected that this compound also make an improper effluent discharge from its compound to the river through land area near it. Describe briefly 4 sampling consideration that needs to be taken in ground investigation in identifying potential and degree of contaminant in effected land area.

[8 marks]

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