UNIVERSITI SAINS MALAYSIA

First Semester Examination
2007/2008 Academic Session

October / November 2007

EAP 582/4 - Wastewater Engineering

Duration: 3 hours

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

Instructions: Answer **FIVE (5)** questions only. 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) Define Cleaner Production (CP). By giving an appropriate example, describe how 'input substitution' can be applied for waste minimization.

(8 marks)

(b) Calculate the Population Equivalent (PE) of a poultry industry which produces flowrate of 1000 m^3/day and BOD_5 of 2,500 mg/L. Take per capita BOD_5 per day as 55 gram.

(6 marks)

(c) A housing scheme has the BOD loading of 5.625 kg/day. Design the rectangular septic tank if BOD_5=250 mg/L. Assume the ratio of length to width as 3:1, and the tank's depth is 1.5 m. Take retention time as one day.

(6 marks)

2. (a) Sketch the typical flow diagram of slaughterhouse wastewater treatment.

(6 marks)

(b) The BOD_5 value of a given domestic wastewater is 350 mg/L which contributed by a population of 20,000 people. Water consumption rate is 225 liter/capita.day. Propose the suitable surface area of tank for the following treatment plants:

i) An anaerobic pond with an Aerial Organic Loading 650 kg BOD_5/ha.day.

(4 marks)

ii) A facultative pond with an Aerial Organic Loading 0.060 kg BOD/m^2.day.

(4 marks)

iii) A trickling filter with 3 m depth and having the Volumetric Organic Loading of 0.75 kg BOD_5/m^3.day. Assume 55% of volume is void.

(6 marks)

3. (a) Explain briefly one of the sludge thickening techniques.

(5 marks)

(b) Calculate the amount of sludge produced in m^3/day from the following data:

Population Equivalent 20,000 person
Suspended Solids 600 mg/L
SS removal at primary sedimentation tank 60%
SS removal at secondary sedimentation tank 40%
Specific Gravity of sludge 1.06
Water consumption rate is 225 Liter/capita.day

(5 marks)

3. (c) A raw processing food wastewater is flowing into a treatment plant with BOD_5 value of 300 mg/L.
   i) Calculate the maximum concentration of BOD_5 allowed in the treated wastewater discharge if the required treatment efficiency is 90%.
   ii) If the flow rate is 4 m^3/d, calculate the kilogram of BOD_5 discharged per day.

(5 marks)

(d) An activated sludge tank is 30 m long, 15 m wide and has a side water depth (SWD) of 5 m. The wastewater flow is 2 ML/d and the BOD_5 is 300 mg/L. The MLSS concentration is 1500 mg/L. Compute the F/M ratio for the system. Assume 35% of the raw BOD_5 is removed in the primary clarifier.

(5 marks)

4. (a) List **TWO (2)** main units under each of the following and discuss the functions of each:
   (i) Preliminary treatment
   (ii) Tertiary treatment

(6 marks)

(b) A grit chamber has a wastewater depth of 0.9 m. Calculate the time required by a 0.2 mm sand particle to settle at the bottom of the grit chamber. Also compute the length of the grit chamber if the flow through velocity is 0.3 m/s. Assume that the 0.2 mm sand particle settles at a rate of 2.3 cm/s.

(4 marks)

(c) A trickling filter has a diameter of 20 m and a liquid depth of 2.5 m. Calculate the organic loading rate for an influent of 10.00 MLD having a 220 mg/L BOD_5

(4 marks)

(d) It is proposed to treat a wastewater flow of 500 m^3/d having 150 mg/L soluble BOD by an extended aeration system. Assuming the following design criteria, determine the reactor volume:

Design criteria:

Biomass concentration in aeration tank	=	4000 mg/L
True yield coefficient	=	0.4
Endogenous decay coefficient	=	0.03 d^{-1}
Specific substrate utilization constant	=	0.1 L/mg-d

Given:

$$K_d = KSY_t$$

$$\frac{VXK_d}{(S_o - S)} = Y_t Q$$

$$VX = Q_o S_o$$

(6 marks)

...4/-

5. (a) An Indah Water Konsortium (IWK) sewage treatment plant is having a raw sewage with BOD_5 of 220 mg/L. This raw sewage is applied to a conventional sewage treatment plant based on activated sludge process. If the primary treatment units remove 25% of the BOD, determine the MLVSS to be maintained in the reactor to control the F/M ratio of 0.6, assuming a wastewater flow rate of 0.5 MLD.

(5 marks)

(b) The BOD_5 of a wastewater sample measured at 20°C is 250 mg/L and the reaction constant K' (to base e) is 0.35 d^{-1}, compute the ultimate and the 3-day BOD.

(4 marks)

(c) Differentiate between the attached growth and suspended growth systems of biological treatment of wastewater and gives **TWO (2)** examples of each systems.

(6 marks)

(d) A circular sedimentation tank is to operated at maximum detention time of 3 h and a maximum overflow rate of 20 $m^3/m^2.d$. Determine the required diameter of the tank if the average flow rate through the tank is 6 ML/d.

(5 marks)

6. (a) A conventional aeration tank is to treat a flow of 80,000 L/day of primary effluent with a BOD_5 of 125 mg/L. The MLSS concentration is to be maintained at 1800 mg/L, and a food-to-microorganism ratio of 0.4 is specified.
   i) Compute the required volume of the aeration tank
   ii) If the side water depth (SWD) is to be 5 m and the tank's length is to be three times its width, calculate the length of this tank.

(5 marks)

(b) A wastewater flow of 15,000 m^3/day is received at Taman Bukit Minyak sewage treatment plant. The population served is 40,000 plus a few industries. If the BOD_5 of the wastewater is 500 mg/L estimate the BOD (in kg/day) due to;

(i) domestic sewage
(ii) industries

Assume BOD_5 rate as 54g/capita/day.

(5 marks)

(c) i) List **THREE** components required for microorganism growth.
ii) List **THREE** factors that influence the enzymatic reaction.

(6 marks)