
UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2009/2010

November 2009

EAP 313/2 – Wastewater Engineering
[Kejuruteraan Air Sisa]

Duration : 2 hours
[Masa : 2 jam]

Please check that this examination paper consists of **FIFTEEN (15)** printed pages including appendices before you begin the examination.

*[Sila pastikan kertas peperiksaan ini mengandungi **LIMA BELAS (15)** muka surat bercetak termasuk lampiran sebelum anda mula menjawab.]*

Instructions: This paper contains **FOUR(4)** questions. Answer **QUESTION 1** and **ANY OTHER 2 QUESTION**

*[Arahan: Kertas ini mengandungi **EMPAT(4)** soalan. Jawab **SOALAN 1** dan **MANA-MANA 2 SOALAN LAIN**]*

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

[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

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

*[Semua soalan **MESTILAH** dijawab menggunakan muka surat baru.]*

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

[Tuliskan nombor soalan yang dijawab di luar kulit buku jawapan anda.]

ANSWER QUESTION 1 AND ANY OTHER 2 QUESTION.

1. (a) Name **FOUR (4)** physical and chemical characteristics of wastewater. Briefly explain **ONE (1)** example each.

(8 marks)

- (b) Calculate the value of suspended solid (SS) in mg/L from a small locality with population of 1000 people and a flow rate of 225 m³/day. Assume the SS load as 68 gm/capita day.

(8 marks)

- (c) Determine the size of suitable sewer to carry wastewater from a town with following designed data :-

$$Q_{\text{peak}} = 36,288 \text{ m}^3/\text{day}$$

$$\text{Slope} = 0.1\%$$

$$\text{Manning coefficient} = 0.013$$

Design at 70% full

(12 marks)

- (d) A radial flow primary sedimentation tank has the following data, which is designed at

Q_{peak} .

$$\text{PE} = 1000 \text{ people}$$

$$\text{Radius} = 10 \text{ m}$$

$$\text{Depth} = 4 \text{ m}$$

Determine the retention time and the Surface Loading Rate for the sedimentation tank.

(12 marks)

2. (a) Sketch a flow diagram of pre-treatment stage in a conventional wastewater treatment plant.

(5 marks)

(b) A screen is designed in a small wastewater treatment plant based on the following data :

- Spacing of bar = 10 mm
- Spacing between blades = 25 mm
- Approaching velocity of wastewater = 60 m/minute
- Depth of wastewater = 70 cm
- Density of screen = 800 kg/m³

i) Determine the width of a suitable screen chamber.

(6 marks)

ii) Calculate the total weight of screening materials in 5 day.

(6 marks)

(c) A wastewater treatment plant discharge 20m³/s of final effluent to a stream with BOD₅ of 4 mg/L. If the effluent contains BOD₅ = 200 mg/L and Q = 1000 m³/day, calculate the BOD₅ concentrations downstream the effluent discharge point.

(7 marks)

(d) Determine suitable width of a pump sump designed based on the following data :

- Q_p = 2500 m³/day
- Retention time at Q_p = 30 minutes
- Depth of sump = 5 m
- Length to width ratio = 3:1

(6 marks)

3. (a) i) Using a sketch diagram, draw different classes of settling in a sedimentation basin and indicate the concentration of particle in your diagram.

(4 marks)

ii) For the Question 3(a)(i), name the location for each type of settling.

(4 marks)

(b) Determine the volume and retention time of the secondary sedimentation tank based on the following parameters with Q_p of $7500 \text{ m}^3/\text{d}$, $\text{MLSS} = 3500 \text{ mg/L}$ and Solids Loading Rate = $100 \text{ kg/m}^2 \cdot \text{day}$.

(11 marks)

(c) A wastewater treatment plant has the following information :

$$Q_p \text{ at 4 DWF} = 10000 \text{ m}^3/\text{day}$$

$$\text{MLVSS} = 2625 \text{ mg/L, representing 75\% of MLSS}$$

$$F : M = 0.3 \text{ kg BOD}_5/\text{kg MLSS} \cdot \text{day}$$

Calculate the volume and retention time of this aeration tank

(11 marks)

4. (a) Given **TWO (2)** wastewater, Sample A is from a textile factory where the BOD_5^{20} is 250 mg/L and Sample B is from a paper mill factory with BOD_5^{30} is 250 mg/L . The BOD rate constant at 20°C for Sample A is 0.15 day^{-1} and for Sample B is 0.12 day^{-1} .

i) Determine the rate of decomposition in percent for Sample A and Sample B based on the ultimate BOD values respectively.

(5 marks)

ii) Between Samples A and B, determine the highest oxidizing process and give **TWO (2)** reasons to support your answer base on enzyme reaction aspect.

(5 marks)

(b) i) Name **TWO (2)** sources of sludge in a wastewater treatment plant.

(2 marks)

ii) Describe why sludge is needed to be treated before being disposed from treatment plant.

(4 marks)

iii) Describe how the chemical or organic content in sludge can benefit the agriculture sector if sludge is used as a fertiliser replacement.

(4 marks)

(c) Calculate the retention time of a facultative pond using the following information :

PE = 2000 people

BOD₅ (influent) = 250 mg/L

BOD₅ (effluent) = 20 mg/L

Depth = 2 m

Temperature = 30°C

(10 marks)

JAWAB SOALAN 1 DAN MANA-MANA 2 SOALAN LAIN

1. (a) Namakan masing-masing **EMPAT (4)** ciri fizikal dan ciri kimia air sisa. Secara ringkas, terangkan satu contoh setiap satu.

(8 markah)

(b) Kirakan nilai pepejal terampai (SS) dalam mg/L dari suatu kawasan kecil dengan penduduk 1000 orang dan kadalir 225 m³/hari. Anggap beban SS sebagai 68 gram/kapita. hari.

(8 markah)

(c) Tentukan saiz pembedung yang sesuai untuk mengalirkan air sisa dari suatu bandar dengan data reka bentuk yang berikut :

$$Q_{\text{puncak}} = 36,288 \text{ m}^3/\text{hari}$$

$$\text{Cerun} = 0.1\%$$

$$\text{Pemalar Manning} = 0.013$$

Reka bentuk pada 70% penuh

(12 markah)

(d) Suatu tangkai enap primer aliran jejari mempunyai data berikut, yang direka bentuk pada Q_p .

$$PE = 1000 \text{ orang}$$

$$\text{Jejari} = 10 \text{ m}$$

$$\text{Kedalaman} = 4 \text{ m}$$

Tentukan masa tahanan dan Kadar Beban Permukaan tangki ini.

(12 markah)

2. (a) Lakarkan rajah kadalir peringkat pra-olahan di sebuah loji olahan air sisa konvensional.

(5 markah)

(b) *Penyaring perlu di reka bentuk di sebuah loji olahan air sisa kecil berdasarkan data berikut :*

<i>Lebar bilah</i>	=	<i>10 mm</i>
<i>Bukaan di antara bilah</i>	=	<i>25 mm</i>
<i>Halaju tuju air sisa</i>	=	<i>60 m/minit</i>
<i>Kedalaman air sisa</i>	=	<i>70 cm</i>
<i>Ketumpatan bahan saring</i>	=	<i>800 kg/m³</i>

i) Tentukan lebar kebuk penyaring yang sesuai

(6 markah)

ii) Kirakan jumlah berat bahan saring dalam 5 hari

(6 markah)

(c) *Suatu loji olahan air sisa melepaskan effluen akhir sebanyak 20m³/s ke suatu alur air dengan nilai BOD₅ 4 mg/L. Jika effluen ini mengandungi BOD₅ = 200 mg/L dan Q = 1000 m³/day, kirakan kepekatan BOD₅ di hilir titik pelepasan effluen ini.*

(7 markah)

(d) *Tentukan lebar kebuk pam yang sesuai, direka bentuk menggunakan data berikut :*

<i>Q_p</i>	=	<i>2500 m³/hari</i>
<i>Masa tahanan pada Q_p</i>	=	<i>30 minit</i>
<i>Kedalaman kebuk</i>	=	<i>5 m</i>
<i>Nisbah panjang ke lebar</i>	=	<i>3:1</i>

(6 markah)

3. (a)i) *Dengan bantuan lakaran, lukiskan jenis-jenis enapan yang biasa berlaku di loji olahan air sisa. Tunjukkan kepekatan zarah pada lakaran anda.*

(4 markah)

ii) Berikan lokasi biasa berlakunya enapan yang anda namakan dalam (i)

(4 markah)

(b) Tentukan isipadu dan masa tahanan suatu tangki enap sekunder dengan $Q_p = 7500 \text{ m}^3/\text{hari}$, $MLSS = 3500 \text{ mg/L}$ dan Kadar Beban Pepejal = $100 \text{ kg/m}^2 \cdot \text{hari}$.

(11 markah)

(c) Suatu loji olahan air sisa mempunyai data reka bentuk seperti berikut:

$$Q_p \text{ pada 4 KCK} = 10000 \text{ m}^3/\text{hari}$$

$$MLVSS = 2625 \text{ mg/L, mewakili 75\% MLSS}$$

$$F : M = 0.3 \text{ kg BOD}_5/\text{kg MLSS hari}$$

Kirakan isipadu dan masa tahanan tangki pengudaraan ini.

(11 markah)

4. (a) Diberi **DUA (2)** sampel air kumbahan, Sampel A daripada kilang kain dengan BOD_5^{20} adalah 250 mg/L dan Sampel B daripada kilang membuat kertas dengan BOD_5^{30} adalah 250 mg/L . Pekali kadar BOD pada suhu 20°C adalah 0.15 hari^{-1} bagi Sampel A dan 0.12 hari^{-1} bagi Sampel B.

i) Tentukan peratusan pengoksidaan bagi Sampel A dan Sampel B berpandukan BOD muktamad masing-masing.

(5 markah)

ii) Di antara Sampel A dan B, tentukan sampel yang mempunyai proses pengoksidaan yang tertinggi dan berikan **DUA (2)** sebab bagi penyokong jawapan anda berdasarkan aspek tindakbalas enzim.

(5 markah)

(b) i) Namakan **DUA (2)** sumber enapcemer yang terdapat di loji olahan air sisa.

(2 markah)

ii) Terangkan mengapa enapcemer perlu olah sebelum dibuang daripada loji olahan.

(4 markah)

iii) Terangkan bagaimana kandungan kimia atau organik di dalam enapcemer boleh memberi faedah kepada pertanian sekiranya enapcemer digunakan sebagai pengganti baja.

(4 markah)

c) Kirakan masa tahanan suatu kolam fakultatif menggunakan data berikut :

PE = 2000 orang

BOD₅ (influen) = 250 mg/L

BOD₅ (effluent) = 20 mg/L

Kedalaman = 2 m

Suhu = 30°C

(10 markah)

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