UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2008/2009

NAMA MATA PELAJARAN : REKABENTUK KEJURUTERAAN AIR SISA

KOD MATA PELAJARAN : BFA 4043/ BKA 4333

KURSUS : 4 BFF/ 4 BKA

TARIKH PEPERIKSAAN : APRIL 2009

MASA : 3 JAM

ARAHAN : JAWAB **SEMUA** SOALAN DIBAHAGIAN A DAN **TIGA (3)** SOALAN DIBAHAGIAN B

KERTAS SOALAN INI MENGANDUNGI LIMA (5) MUKA SURAT BERCETAK

BAHAGIAN A

S1   (a)   Lakarkan rajah carta alir yang menunjukkan sebuah loji enapcemar teraktif untuk merawat air sisa. Namakan setiap komponen penting loji tersebut.

(10 markah)

(b)   Air kumbahan mentah yang tidak dimendap dirawat di sebuah loji enapcemar teraktif untuk sebuah komuniti 500 orang penduduk. Tentukan isipadu (m^3) tangki pengudaraan dan keperluan oksigen (juta liter/hari) berasaskan maklumat berikut:

     (i)   Tempoh rekabentuk = 20 tahun
     (ii)   Kadar pertumbuhan penduduk = 4.0% setahun
     (iii) BOD_5 terlarut per kapita = 55 gm per hari
     (iv)   Kadar alir kumbahan per kapita = 225 liter per hari
     (v)   Koefisien kinetik biologikal: $Y = 0.6$; $k_d = 0.05$ per hari
     (vi) $MLVSS = [\theta_c \, Y \, (S_o - S_e)]/[\theta \, (1 + k_d \, \theta_c)]$
     (vii)   MLVSS rekabentuk = 2500 mg/L
     (viii) $\theta_c = 10$ hari
     (ix)   Kualiti efluen, $S_e = 10$mg/L
     (x)   Gunakan dua (2) tangki pengudaraan (berbentuk bulat) dengan kedalaman 3 m bagi setiap tangki.
     (xi)   1.0 g oksigen terlarut diserakkan ke dalam air sisa tercampur bagi setiap 55.6 liter udara
     (xii) $BOD_{mutlak} = 1.67 \, BOD_5$

Nyatakan andaian anda.

(30 markah)

BAHAGIAN B

S2   (a)   Apakah fungsi kebuk gersik dalam rawatan air sisa?

(2 markah)

(b)   Apakah rasional di sebalik keperluan memastikan halaju ufuk 0.3 m/s dalam rekabentuk kebuk gersik dalam rawatan air sisa? Bagaimanakah ini boleh tercapai?

(3 markah)

(c)   Tentukan panjang dan lebar satu kebuk gersik segi empat bujur jika kadar alir rekabentuk ialah 8550 m^3/hari, halaju ufuk 0.33 m/s dan lebar saliran 1.5 kali kedalaman. Tentukan juga masa penahanan jika partikel rekabentuk mempunyai halaju enapan 0.02 m/saat.

(15 markah)

S3 (a) Apakah fungsi tangki pemendapan primari dalam rawatan air sisa?

(4 markah)

(b) Dua (2) buah tangki pemendapan primari (berbentuk bulat) direkabentuk untuk merawat kadar alir 8550 m^3/hari. Jika kadar alir limpahan maksimum yang dibenarkan ialah 40 m^3/hari per m^2, kira diameter, kedalaman dan panjang weir (limpahan) setiap tangki jika beban weir dihadkan kepada 250 m^3/hari per meter.

(16 markah)

S4 (a) Apakah fungsi tangki pemendapan sekunder?

(5 markah)

(b) Dua (2) tangki pemendapan sekunder (berbentuk bulat) direkabentuk untuk kadar alir kumbahan 8550 m^3/hari dan pepejal terampai bakteria 2500mg/L. Tentukan diameter setiap tangki pemendapan jika:

(i) Kadar beban pepejal tidak melebihi 100 kg pepejal /hari per m^2
(ii) Kadar beban hidraulik tidak melebihi 30 m^3/hari per m^2
(iii) Masa tahanan ialah 2 jam

(15 markah)

S5 (a) Lakar rajah kolam pengoksidaan lazim dengan menunjukkan simbiosis antara bakteria aerobik dan bakteria anaerobik dalam penguraian bahan organik. Namakan semua komponen kolam.

(10 markah)

(b) Kumbahan dari komuniti 1000 orang penduduk dirawat dalam dua (2) kolam fakultatif bersiri. Jika beban BOD terhad kepada 0.03 kg BOD/hari per m^2 bagi setiap kolam, tentukan keluasan permukaan (m^2) setiap kolam. Andaikan penyingkiran BOD adalah masing-masing 70% dan 60% dalam kolam pertama dan kedua. Nyatakan semua andaian anda.

(10 markah)

SECTION A

Q1 (a) Sketch a flow diagram showing an activated sludge plant for wastewater treatment. Name all the important components of the plant.

(10 marks)

(b) Unsettled raw sewage is to be treated in an activated sludge plant for a community whose population presently stands at 500 people. Determine the volume (in m^3) of an aeration tank and the oxygen requirements (in million litres/day) based on the following information:

(i) Design period = 20 years
(ii) Population growth rate = 4.0% annually
(iii) Per capita soluble BOD_5 = 55 gm per day
(iv) Per capita flowrate = 225 litres per day
(v) Biological kinetics: Y=0.6; k_d = 0.05 per day
(vi) MLVSS = $[\theta_c\ Y\ (S_o - S_e)]/[\theta\ (1 + k_d\ \theta_c)]$
(vii) Design MLVSS=2500 mg/L
(viii) θ_c = 10 days
(ix) Effluent quality, S_e = 10 mg/L
(x) Use two (2) circular aeration tanks and depth of each tank is 3m.
(xi) 1.0 gm of dissolved oxygen is diffused into the mixed liquor for every 55.6 litres of air blown
(xii) Ultimate BOD = 1.67 BOD_5

State any assumptions made.

(30 marks)

SECTION B

Q2 (a) What is the function of a grit chamber in wastewater treatment?

(2 marks)

(b) What is the rationale behind the need to maintain a horizontal (flow-through) velocity of 0.3 m/s for the design of a grit chamber in wastewater treatment? How is this achieved in practice?

(3 marks)

(c) Determine the width and length of a rectangular grit chamber if the design flow is 8550 m^3/day, the horizontal velocity is 0.33 m/s, and the channel width is 1.5 times the depth. Determine also the detention time assuming the design particle has a settling velocity of 0.02 m/s.

(15 marks)

Q3 (a) What is the function of a primary settling tank in wastewater treatment?

(4 marks)

(b) Two (2) similar circular primary settling tanks are to be designed for a sewage flow of 8550 m^3/day. If the maximum overflow rate allowable is 40 m^3/d per m^2, determine the diameter and depth of each tank, and also the length of the weir if the weir loading is not to exceed 250 m^3/d per metre.

(16 marks)

Q4 (a) What is the function of a secondary clarifier?

(5 marks)

(b) Two final circular clarifiers are to be designed for a sewage flow of 8550 m^3/day and mixed liquor suspended solids (MLSS) of 2500 mg/L. Determine the diameter of each of the clarifiers, assuming the following:

(i) Design solids loading rate should not exceed 100 kg/day per m^2
(ii) Hydraulic loading rate should not exceed 30 m^3/d per m^2
(iii) Retention time is 2 hours.

(15 marks)

Q5 (a) Sketch a typical oxidation pond showing the symbiosis between the aerobic and anaerobic bacteria in the decomposition of organic matter. Name all the important parts of the pond.

(10 marks)

(b) Sewage from a community of 1000 people is to be treated in two facultative ponds in series. If the BOD load is restricted to 0.03 kg BOD/day per m^2 for each pond, calculate the area of each pond required. Assume BOD removals are 70% and 60% in the first and second ponds respectively. State all your assumptions.

(10 marks)