UNIVERSITI SAINS MALAYSIA

First Semester Examination

2012/2013 Academic Session

January 2013

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 : This paper contains **SIX (6)** questions. Answer **FIVE (5)** questions.

All questions must be answered in English.

Each question **MUST BE** answered on a new page.

1. (a) With the aid of a sketch, draw a typical process flow diagram for non-hazardous wastewater treatment.

[5 marks]

(b) Cleaner Production (CP) is one of the models that can be implemented by industries for better environmental management in their premises. By giving a suitable example, describe the concept of product modifications in waste minimization.

[5 marks]

(c) In order to design the industrial wastewater treatment, it is necessary to perform the analysis of manufacturing processes. There are 10 steps to be fulfill for decision of the design, explain briefly.

[10 marks]

2. (a) Briefly, explain the influence parameters for wastewater flow rate.

[5 marks]

(b) A sample of 97 mL of an industrial wastewater is used for BOD test in the 300 mL of BOD bottles (without seeding) with 3 duplications. The initial DO in the bottles are 6.79, 6.45 and 6.67 mg/L respectively. The DO level after 5 days (20 °C) are 3.56, 3.32 and 3.43, mg/L, respectively. Determine BOD_5 of the wastewater.

[9 marks]

(c) Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are used to determine the oxygen demand in a wastewater sample. Describe the differences between COD and BOD.

[6 marks]

3. (a) Wastewater treatment plant (WWTP) is essential in the modern society. Based on your understanding, describe a standard WWTP with necessary sketches.

[6 marks]

(b) A treatment plant receives wastewater from a population of 25,000 persons in a community and daily water use is 225 L/day per person. Wastewater losses due to infiltration and evaporation are 20% before reaching the treatment plant. After treating the wastewater, the plant discharges effluents of BOD of 200 mg/L for land treatment. The slow-rate land treatment area is 5 ha/day. The land treatment effluent application cycle time is 5 days between two applications. Determine the daily effluent flow rate to treatment plant and cycle average BOD loading rate.

[8 marks]

(c) Reuse potentially of treated wastewater as irrigation water increases in the world-wide, mostly in arid region. Derive wastewater reuse index (WRI).

[6 marks]

4. (a) Activated sludge is one of the main biological processes in wastewater treatment. With the aid of illustration, prove that the return sludge ratio (R) in an activated sludge process can be related as follows:

$X_a = X_R [R/(1+R)]$; where X refers to sludge concentration.

[6 marks]

(b) A conventional activated sludge process (ASP) is to be used for the treatment of organic rich wastewater. Derive the kinetic modelling of substrate concentration in ASP.

[8 marks]

(c) Calculate the suitable volume of aeration tank for the following data in activated sludge process :

F:M $\quad$ = 0.3 kg BOD5/kg MLSS.day
MLSS $\quad$ = 2000 mg/L
Organic load = 300 kg/day

[6 marks]

5. (a) Explain the process of Nitrification and Denitrification by using two step reaction.

[6 marks]

(b) A million gal/d (3.79 x 10^3 m^3/d) wastewater treatment plant is to achieve nitrification at 30^oC. The BOD is 850 mg/l and the NH_3-N is 150 mg/l. The alkalinity is 380 mg/l. Design the facility for the following conditions:

Effluent BOD = 30 mg/l
MLVSS= 3500 mg/l
a=0.55
b=0.1 day^{-1}
X_d =0.60
a_N =0.15
θ = 1.05

[14 marks]

6. (a) Wastewater flow from a small housing complex with 5000 peoples, the average temperature 30° C. The average BOD_5 is 200 mg/l with 70 % being soluble. The reaction coefficient k is 0.23 d^{-1} at 20^oC, and the value of $\Phi=1.06$. A facultative pond system with the depth 1.8 m will be prepared for the treatment in order to remove 90% of the soluble BOD. Determine the area of the pond, the retention time and surface loading rate.

[9 marks]

(b) A concrete channel (n=0.013) trapezoidal shape and 1.25 m bottom wide, must carry water a uniform rate of flow 2000 l/s with the side slope 1: 1.5 and a depth of 0.75 m. Determine the required Channel bottom slope for this channel and please check type of flow using Froude number, compare the velocity to the minimum permissible velocity of the channel.

[6 marks]

(c) Determine the two equal size of concrete pipes will carry the flow with the same velocity and Manning coefficient from above trapezoidal shape channel.

[5 marks]

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