

UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Science

BSc Environmental Health Science

MAIN EXAMINATION PAPER MAY 2013

TITLE OF PAPER : INDUSTRIAL WASTE MANAGEMENT II
COURSE CODE : EHS.554

DURATION : 2 HOURS

MARKS : 100

INSTRUCTIONS : THERE ARE FIVE QUESTIONS IN THIS EXAMINATION
: ANSWER ANY FOUR OF THE FIVE QUESTIONS
EACH QUESTION CARRIES 25 MARKS
: NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE
EXAMINATION ROOM

EPH/13
MAY 2013

QUESTION ONE (25 Marks)

- A. What are the advantages of having a mixture culture of microorganisms for the biological treatment of industrial wastewaters?[5 Marks]
- B. Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from pharmaceutical industries. These industries produce wastewater with high BOD (10,000 mg/L), low suspended solids (10 mg/L) , frequent use of organic solvents such as methanol and ethanol constituting a large portion of the wastewater stream, wide variation of pH and some process streams having heavy metals in their wastewater discharge.....[5 Marks]
- C. What is the effect of long solids retention time, SRT, value leading to low F/M ratio on the settleability of sludge? What is the implication of these factors on the volume requirement of the settling tank in extended aeration plants such as the oxidation ditches?[5 marks]
- D. Given below the formula for the solids retention time (SRT) in the activated sludge process, indicate the mechanism(s) by which SRT value of the reactor may be increased?[5 marks]

$$SRT = \frac{VX}{(Q_W X_R + Q_e X_e)}$$

- E. Describe to what condition and types of biological growth processes the following substrate utilization rates apply i) $r_{su} = -k$ ii) $r_{su} = -kS$ iii) $r_{su} = -kXS$ and iv) $r_{su} = -kX\left(\frac{S}{S_p}\right)$[5 marks]

QUESTION TWO (25 Marks)

- A.** Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from piggery farms. These farms produce highly organic waste and are managed (collected) at intermittent rates when the pig pens are washed and flushed twice a day during working hours. The BOD can be as high as 5000 mg/L, suspended solids of 20,000 mg/L, TKN of 900 mg/L and PO_4^{3-} of 200 mg/L. The wastewater is sometimes highly coloured due to the feed formulation used (such as molasses).[5 Marks]
- B.** The amount of sludge produced from activated sludge can be increased by manipulating the solids retention time (SRT) of the process. Explain how this variable affects the solids production rate in activated sludge processes.[5 Marks]
- C.** Discuss the suitability of composting and soil conditioning as a final disposal option for industrial waste water solids after stabilization.[5 marks]
- D.** Characterize the solids or sludge produced from the following wastewater unit processes:
- i. Screenings
 - ii. Sludge from primary treatment tank
 - iii. Anaerobically digested biosolids.....[5 Marks]
- E.** Briefly describe the following process of solids thickening:
- i. Gravity thickening
 - ii. Flootation thickening
 - iii. Centrifugal thickening.[5 Marks]

QUESTION THREE (25 Marks)

A. Describe :

- i. Sources of industrial wastewaters that can give rise to foaming problems in activated sludge process treatment.[1.5 Mark]
- ii. Process operational factors that can give rise to foaming problems in activated sludge process treatment.[1.5 Mark]
- iii. What are the problems associated with the presence of foaming and what methods are employed to eliminate foams?[2 Marks]

B. Discuss suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from palm oil mill effluent. The wastewater has high oil content (10,000 mg/L of oil), high BOD (23,000 mg/L) and BOD:N:P ratio of 100:3.5:0.5. It has low pH (pH = 4 -5) and high temperature (hot discharge).[5 Marks]

C.

- i. Discuss the suitability of sequencing batch reactors for the treatment of industrial wastewaters with respect to the industries operational schedule.[3 Marks]
- ii. How do you compare the oxygen supply requirement of sequencing batch reactors with that of continuous flow activated sludge reactors?[2 marks]

D.

- i. Describe the advantages of plastic media over the traditional rock media used for percolating filters in industrial wastewater treatment.[2 marks]
- ii. How do you compare the operational requirements of trickling filters with that of activate sludge?[3 marks]

E. Discuss the causes and remedies to the following problems that may occur in the operation of trickling filters: i) High suspended solids ii) ponding iii) odour iv) flies[5 marks]

QUESTION FOUR (25 Marks)

- A. Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from slaughterhouse. Slaughter house operates mostly during morning hours. The wastewater from throat cutting and bloodletting is very strong. The BOD can be as high as 3000 mg/L. The COD/BOD ratio is typically 2:1. Suspended solids can be as high as 2000 mg/L with hairs and feathers included depending on housekeeping in the slaughter house.
.....[5 Marks]
- B. Describe the operation problem of the presence of facultative organisms in anaerobic treatment of industrial waste water containing sulphates.[5 Marks]
- C. Explain why anaerobic sludge digesters and sludge thickeners may not be so common in industrial wastewater treatment.[5 Marks]
- D. The return sludge in a certain activated sludge processes plant is being controlled on the basis of volumetric rate of flow.
- i. Describe the changes in process variable that occur inside the activated sludge reactor as a result of sludge bulking problems when sludge return is being controlled by volumetric flow rate.[3 marks]
 - ii. State how the volumetric flow control of sludge return contributes to such changes in process variables.[2 marks]
- E. List the different mechanisms used for odour control of wastewater treatment plants.
.....[5 Marks]

QUESTION FIVE (25 Marks)

A. The table below shows the characteristics of wastewater generated during rubber manufacturing. Describe the sequence of treatment needed for treating the wastewater from this particular industry.[5 Marks]

Processing unit	Source	Nature of wastewater contaminants
Caustic soda scrubber	Spent caustic solution	High pH, alkalinity and color, extremely low average flow rate
Excess monomer stripping	Decant water layer	Dissolved and particulate organics
Tanks, reactors and strippers	Cleanout rinse water	Dissolved organics, suspended and dissolved solids. High quantities of uncoagulated latex
Tank cars and tank trucks	Cleanout rinse water	Dissolved organics, suspended and dissolved solids. High quantities of uncoagulated latex
All plant areas	Area wash-downs	Dissolved and particulate organics. Dissolved and suspended inorganic solids.

B. State the two most important operational factors contributing to the failure of anaerobic process treatment of industrial wastewaters
[5 Marks]

C. How do you compare the cell mass yield of anaerobic process treatment with that of aerobic processes? What are the implications of such differences in cell yield in terms of the requirements for nutrient and hydraulic retention time?
[5 Marks]

D. Describe With the help of a diagram:

- i. the principle of operation of a fluidized bed bioreactor (FBBR)
- ii. The advantages of a fluidized bed bioreactor

.....[5 Marks]

E. What are the problems associated with anaerobic lagoons? Why would anaerobic lagoon be more appropriate for the treatment of agro-industrial wastes?

.....[5 Marks]