

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

**BSc Environmental Health Science**

**MAIN EXAMINATION PAPER MAY 2014**

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

**DURATION** : 2 HOURS

**TOTAL MARKS** : 100

**INSTRUCTIONS** : THERE ARE FIVE QUESTIONS IN THIS EXAM  
: ANSWER ANY FOUR OF THE FIVE QUESTIONS  
: EACH QUESTION CARRIES A MAXIMUM OF 25 MARKS

EHS 554  
MAY 2014

## QUESTION ONE (25 Marks)

(Note: each question below carries five marks)

- A. Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of waste from cement manufacturing industries.
- B. It is suspected that a ground water supply may have been contaminated by industrial wastewater containing arsenic.
- Estimate the incremental risk of Arsenic toxicity for an adult associated with drinking 2L per day of ground water containing 0.2 mg/L arsenic.
  - To limit arsenic exposure to acceptable risk of 1 in 1,000,000, determine the concentration of arsenic that can be allowed in the extracted groundwater.
- C. The rate of substrate utilization  $r_{su}$  for anaerobic processes can be expressed in terms of the well-known Monod equation:

$$r_{su} = \frac{-kSX}{K_s + S}$$

Where  $k$  is the maximum specific substrate utilization rate,  $S$  is the effluent substrate concentration (COD),  $X$  is the biomass concentration and  $K_s$  is the half saturation constant.

- Discuss the variation of the rate of substrate utilization with i) substrate concentration and ii) biomass present.
  - Indicate which of two would be the limiting variable for maximum substrate utilization and state the reason.
  - Make an approximate sketch of the rate of substrate utilization with the substrate concentration ( $S$ ) present.
- D. Given the formula for solids retention time below, indicate:
- What each symbol in the formula represents
  - How the solids retention time is increased
  - A constant biomass concentration in the tank is minimized.

$$SRT = \frac{VX}{Q_w X_R + Q_e X_e}$$

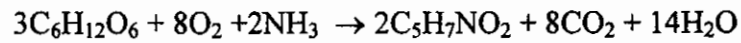
- E. Discuss the process requirement with respect to the following factors for composting processes for stabilization of sludge: i) carbon to nitrogen ratio ii) volatile solids iii) pH and iv) temperature.

**QUESTION TWO (25 Marks)**

(Note: each question below carries five marks)

**A.** Define the following terms: i) heterotrophs ii) autotrophs iii) chemoautotrophs iv) fermentative metabolism v) respiratory metabolism.

**B.** Given the chemical reaction equation for the conversion of glucose to cell mass below, compute the cell yield and chemical oxygen demand for this reaction.



**C.** Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from textile industries.

**D.** List the five characteristics into which hazardous industrial waste may be classified.

**E.** Describe the three mechanisms for the removal of organics in biological treatment processes namely i) sorption, ii) stripping and iii) biodegradation.

**QUESTION THREE (25 Marks)**

(Note: each question below carries five marks)

- A. Compare and contrast the suitability of percolating filters for industrial wastewater treatment with that of activated sludge? Discuss the application of percolating filters for industrial wastewater treatment and the suitable media type suitable for such treatment.
- B. Discuss suitable treatment regimes and the associated wastewater treatment issues for the treatment of wastewater from pulp and paper industries.
- C. Determine the liquid volume before and after digestion and the percent reduction of 430 kg (dry basis) of primary sludge with the following characteristics:

Parameter	Primary	Digested
Solids (%)	7	12
Volatile volume (%)	55	40
Specific gravity of fixed solids	2.65	2.65
Specific gravity of volatile solids	≈ 1.0	≈ 1.0

- D. List the causes of possible toxicity in activated sludge processes and state the means of reducing or controlling toxicity in activated sludge processes.
- E. Describe the possible causes of sludge bulking in activated sludge processes.

**QUESTION FOUR (25 Marks)**

(Note: each question below carries five marks)

- A. Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from electroplating industries.
  
- B. List the four groups of anaerobic bacteria that are involved in the degradation of organic matter in anaerobic process and state in each category the conversion of organic matter that takes place.
  
- C. Compare the performances of anaerobic processes with aerobic biological processes for the treatment of industrial wastes that may contain pesticides, surfactants, benzene and high molecular weight hydrocarbons.
  
- D. Indicate possible remedial action for the following operational problems in industrial wastewater treatment: i) poor BOD removal in trickling filters ii) bulking sludge.
  
- E. List the methods used for the removal of odorous gases from industrial wastewater treatment plants.

**QUESTION FIVE (25 Marks)**

(Note: each question below carries five marks)

- A. Discuss a suitable treatment regime and the associated wastewater treatment issues for the treatment of wastewater from brewery industries.
  
- B. Indicate the limitations of currently practiced industrial wastewater effluent risk assessment methods.
  
- C. Discuss the purpose/objective of each of the following management measures on open reservoirs used to store industrial wastewater effluents: i) copper sulfate addition ii) recirculation iii) filtration iv) wetland treatment and v) precipitation with aluminum sulphate.
  
- D. Discuss common water quality problems encountered in the reuse of cooling waters and indicate how these problems may be overcome.
  
- E. Describe the problems caused by the following constituents present in boiler feed water and also indicate their method of removal: i) iron and manganese ii) oil and grease iii) silica iv) sulfate.