8 CHAPTER

Biochemical Reactions in Treatment of Waste Water

Q.1 Consider the following statements:
1. The aerobic reactions take place in the presence of free oxygen and produce reasonably stable inorganic end products with relatively high energy contents.
2. The acid-forming bacteria initially convert complex organics into organic acids and alcohols.

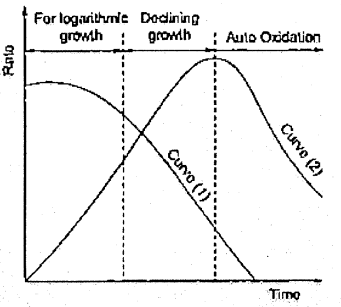
Which of these statement/s is/are true?
(a) 1 only (b) 2 only
(c) 1 and 2 both (d) Neither 1 nor 2

Q.2 Consider the following statements:
Assertion (A): There is less sludge formation from anaerobic stabilisation of waste water than from aerobic stabilisation of the same waste water.
Reason (R): Because of lower release of energy in aerobic reactions, the synthesis of new cells is very less than in aerobic reactions.
(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not a correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

Q.3 Which of the following statement/s is/are incorrect?
1. In all biological reactions, the energy in the organic substrate is used up in new microorganisms.
2. Catabolic reactions are those in which food is broken down to release energy.
3. In autolysis, synthesized microbial cells are themselves oxidised and energy is released.
4. Enzymes are low molecular weight substance.

Select the correct answer using the codes given below:
(a) 2 and 3 (b) 1 and 4
(c) 1 and 3 (d) 2 and 4

Q.4 In the diagram below, curve 1 and curve 2 are respectively for:



(a) Bacterial numbers and food
(b) Food and bacterial numbers
(c) Oxygen content and food
(d) Bacterial numbers and oxygen content

Q.5 Which of the following statement is incorrect?
(a) If free dissolved oxygen is not available to the sewage, then putrefaction will occur.
(b) Nitrogeneous organic matter get oxidised to ammonia, then the nitrates and finally to nitrites.
(c) Nitrates on denitrification may get converted into free nitrogen.
(d) Blue green algae causes nitrogen fixation.

Q.6 Consider the following statements:

1. Energy released in aerobic oxidation is 484-674 k cal while in anaerobic oxidation is only 26 k cal.
2. BOD_5 of effluent in aerobic oxidation is low while in anaerobic oxidation is high.
3. Bacteria are primary decomposers of organic material.

Which of the above statement/s is/are correct?

(a) 1 and 2 (b) 2 and 3
(c) 1 and 3 (d) 1, 2 and 3

Q.7 A trickling filter plant treats 1500 m^3/day of sewage with BOD_5 of 220 mg/l and a suspended solid concentration of 250 mg/l. Assuming the primary clarification removes 30% of BOD and 60% of influent solids and solid production in trickling filter as a 0.5 kg/kg of applied BOD, the total solid production is;

(a) 314.21 kg/day (b) 284.60 kg/day
(c) 291.26 kg/day (d) 340.50 kg/day

Q.8 A rapid sand filter is to be provided in water treatment plant. The porosity of bed is 0.50. Specific gravity of bed material = 2.5. Assuming depth of bed = 0.60, the head loss required to initrate expansion is

(a) 0.35 m (b) 0.40 m
(c) 0.45 m (d) 0.50 m

Q.9 The efficiency of 30 m diameter and 1 m deep single stage high rate trickling filter for following data

(i) Sewage flow = 4.5 MLD
(ii) Recirculation ratio = 1.4
(iii) BOD of raw sewage = 250 mg/L
(iv) BOD removed in primary classifier = 25%

(a) 63.81% (b) 81.00%
(c) 73.87% (d) 84.21%

Q.10 A rapid sand filter is proposed for water supply treatment plant for a town with population of 75000. The average rate of water supply is 150 litre/capita/day. Assuming 4% of filtered water is required for washing of filter everyday, the total number of filter beds to be provided is

(a) 4 (b) 5
(c) 7 (d) 8

Q.11 A dual medium filter is composed of 0.30 m anthracite (mean size of 2 mm) placed over a 0.60 m layer of sand (mean size 0.7 mm) with filtration rate of 9.78 m/hour. Assume grain sphericity is $\Psi = 0.75$ and porosity for both is 0.42. At $T = 15°C$, h_L data for filter at 1.131×10^{-6} m^2 sec.

(a) 0.0579 m (b) 0.0410 m
(c) 0.5579 m (d) 0.4101 m

Q.12 The EPA has calculated that unit lifetime risk from exposure to Ethylene Dibromide (EDB) in drinking water is 0.85 LFC per 10^5 persons. The risk experienced by drinking water with an average EDB concentration of 5pg/l for five years is

(a) 3×10^{-9} LCF (b) 5×10^{-9} LCF
(c) 4×10^{-9} LCF (d) 6×10^{-9} LCF

■■■■

Answers Biochemical Reactions in Treatment of Waste Water

1. (b) 2. (a) 3. (b) 4. (b) 5. (b) 6. (d) 7. (d) 8. (c) 9. (c) 10. (b)
11. (b) 12. (a)

Explanations Biochemical Reactions in Treatment of Waste Water

1. (b)

The aerobic reactions take place in presence of free oxygen and produce reasonably stable inorganic end products with relatively low energy contents.

3. (b)

In all biological reactions, energy in organic substrate is split into three ways, energy in new micro-organisms, energy in the end product and heat energy

Enzymes are high molecular weight substance which are introduced by microorganisms and which are highly specific for particular organic sustenance and types of reactions.

5. (b)

Nitrogeneous organic matter get oxidised to ammonia, then to nitrites and finally to nitrates.

7. (d)

Solids removed in primary clarification

$$= \frac{150 \times 10^{-6}}{10^{-3}} \text{ kg/m}^3$$

$\therefore$ Solids removed/day

$= 150 \times 10^{-3} \times 1500 = 225$ kg

BOD_5 removed is primary clarification = 30%

$\therefore$ BOD applied to filter

$= 100 - 30 = 70\%$

$\therefore$ Total BOD applied

$$= \frac{0.70 \times 220 \times 10^{-6}}{10^{-3}} = 231 \text{ kg/day}$$

Solid production

$= 0.5 \times 231 = 115.5$ kg/day

Total solid production

$= 225 + 115.5 = 340.50$ kg/day

8. (c)

We know,

$$h_{fb} = L(1-e)\frac{(\rho_m - \rho_w)}{\rho_w}$$

$$= \frac{0.60(1-0.5)\times(2500-1000)}{1000}$$

$\Rightarrow h_{fb} = 0.45$ m

9. (c)

Total BOD removed in primary classifier = 25%

BOD entering in filter

$= 0.75 \times 1125 = 843.75$ kg/day

$$F = \frac{1+\left(\frac{R}{I}\right)}{\left[1+0.1\left(\frac{R}{I}\right)^2\right]} = \frac{1+1.4}{(1+0.1\times1.4)^2}$$

$= 1.847$

$$\eta = \frac{100}{1+0.0044\sqrt{\frac{843.75}{0.0707\times1.847}}}$$

$= 73.87\%$

10. (b)

Maximum water demand/day

= Population × Maximum daily rate of supply

$= 75000 \times 1.8 \times 150 = 20.25 \times 10^6$ litres/day

$= 20.25$ MLD

Assuming 4% filtered water is required for washing

$$= 20.25 + \frac{4}{100} \times 20.25 = 21.06 \text{ MLD}$$

Number of filter beds

$= 1.22\sqrt{Q}$ (Morell and Wallace equation)

$= 1.22\sqrt{21.06} = 5.6 \simeq 5$ units

11. (b)

Using Kozeny equation

$$\frac{h}{L} = \frac{K\mu(1-\epsilon)^2}{g\rho\epsilon^3}\left(\frac{A}{V}\right)^2\mu$$

$$h = \frac{6\times1.131\times10^{-6}}{9.81}\times\frac{1-0.42^2}{(0.42)^3}$$

$$\times\left(\frac{8}{0.002}\right)^2(0.00272)(0.2)$$

$= 0.0410$ m

12. (a)

The risk may be estimated using either unit annual risk or unit lifetime risk.

Unit lifetime risk

$$= \frac{5\times10^{-12}g/L\times0.85LCF\times5yrs}{10^5\times10^{-9}g/l\times70\ yrs}$$

$= 3 \times 10^{-9}$ LCF