



University Of Technology  
Building and Construction Eng. Dept.  
Final Exam-First Attempt-2013/2014

Branch :Structural Eng.  
subject : Sanitary Engineering  
Examiner : Lec. Rana J.Kadhim

Class: Third  
Time : 3 Hours  
Date : 29/5/2014



Answer Four questions only

**Q1:-A/** Compare the contact times necessary to give E. coli kills of 99.99 percent in water with free chlorine residual of 0.2 mg/l and combined chlorine residual of 1 mg/l , k values are  $10^{-2}$  and  $10^{-5}$  /s respectively.  
(13marks)

**B/ Explain in details two of the following:**

- 1- The methods used for population forecastings.
- 2- The types and sources of water impurities.
- 3- The characteristics of sand and gravel used in filter media.

(12marks)

**Q2:- A/** Determine the maximum daily consumption and fire demand in ( l/c/d) for a community of 22000 capita, has an average Consumption is 600 l/c/d and fire flow dictated by a 6 story ordinary construction building of a floor area of 1000m<sup>2</sup>/story.

(13marks)

**B/ Explain briefly of the following:**

- 1- Biochemical oxygen demand (BOD).
- 2- The factors that affect process of self – purification of stream.
- 3- Breakpoint chlorination.

(12marks)

**Q3:-A/** In a rectangular sed. Tank , inlet velocity 25 cm/ min , L:W 2:1 , effluent weir length 60 m, detention time 2 hr , the smallest particle to be removed 100% is 0.06 mm in diameter , S.G.= 1.2 ,  $\rho_w = 1 \text{ gm/ cm}^3$  ,  $\mu = 1.03 * 10^{-2} \text{ gm/ cm.s.}$  find:

- 1- SOR (m/d).
- 2- Dimension of tank (m).
- 3- Weir loading (m<sup>3</sup>/m/d).

(13marks)

**B/** Draw a sketch showing physical and biological processes (units) of conventional waste water treatment plant and describe the benefits of each unit.

(12 marks)

**Q4:- A/** A stream with BOD 2 mg/l and saturated with DO has a normal flow of  $2.26 \text{ m}^3/\text{s}$  and receives a sewage effluent, also saturated with DO, of  $0.755 \text{ m}^3/\text{s}$  with BOD 30 mg/l. Determine the DO deficits over the next five days and hence plot the sag curve. Calculate the critical DO deficit and the time at which it occurs. Assume temperature is  $20^\circ\text{C}$  throughout. Saturation DO at  $20^\circ\text{C}$  is  $9.17 \text{ mg/l}$ ,  $K_1$  for effluent / water mixture is  $0.17 / \text{day}$ ,  $K_2$  for stream is  $0.4 / \text{day}$ .

(13marks)

**B/** Write short notes on the following :-

- 1- The factors that affect the coagulation process.
- 2- The common methods used for disinfection of water.
- 3- The method of filtration and backwashing of filters and show it by drawings of rapid sand filter.

(12marks)

**Q5:-A/** Rapid sand filter  $L=9\text{m}$ ,  $W=4.5\text{m}$  after filtering  $20000 \text{ m}^3 / \text{d}$  in 24 hr period, the filter is backwash at a rate  $0.6 \text{ m} / \text{min}$ . The filter is designed with 4 trough find :-

- 1- Filtration rate.
- 2- Quantity of wash water flow in each trough.
- 3- Dimension of trough of square cross section.

(13marks)

**B/** Draw a sketch showing bacterial growth curves based on (number and mass of organisms).

(12marks)

Q1/A/ Sol. :

$$a) t^2 = \frac{2}{k} \log \frac{N_0}{N_t}$$

$$kill = 1 - \frac{N_t}{N_0}$$

$$0.9999 = 1 - \frac{0.2}{N_0}$$

$$N_0 = 2000 \text{ mg/l}$$

$$t^2 = \frac{2}{10^{-2}} \log \frac{2000}{0.2}$$

$$t = 285$$

$$b) 0.9999 = 1 - \frac{1}{N_0}$$

$$\frac{1}{N_0} = 10^{-4} \Rightarrow N_0 = 10000$$

$$t^2 = \frac{2}{10^{-5}} \log \frac{10000}{1}$$

$$t = 894 \text{ s}$$

Q1/B/

① ① Graphical method, Arithmetic method

$$\frac{dp}{dt} = k_a$$

$$dp = k_a dt$$

$$P_f = P_i + k_a (t_f - t_i)$$

$$\therefore k_a \frac{P_f - P_i}{t_f - t_i} = \frac{P_i - P_e}{t_i - t_e}$$

- Geometrical method:  $\frac{dp}{dt} = k_g P$

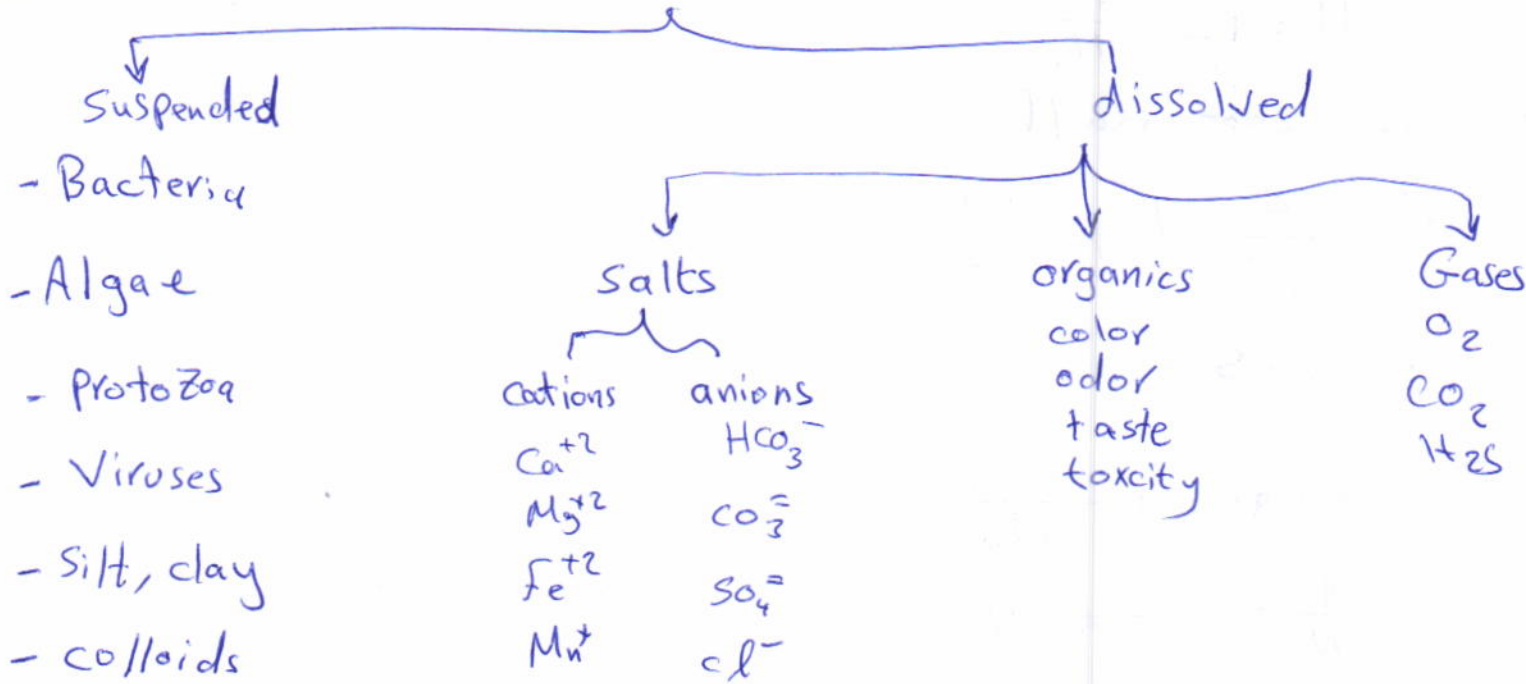


Comparative method

Ratio and Correlation method:

$$\frac{P_f}{P_f'} = \frac{P_i}{P_i'} = k \text{ (constant)}$$

## 2/ Impurities of water



## 3/ صفات الرمل والحصى

**الرمل:** أ، لها مادة كوية للتدريج، خالي من الأوساخ، هلب، مقاوم بلوري، لا يفقد أكثر من 5% من الوزن بعد غسلها بحامض HCl نسبة 40% طرية في ساحة، تحق الرمل 60 - 70 سم ولحم مؤثر 0.45 - 0.55 mm حاصل التقياس لا يتأثر  $1.7 \leq U.C. \leq 1.2$

**الحصى:** يوضع الحصى تحت أو ستة طبقات حيث تكون الطبقات العليا حاوية على الحصى (الطبقة)، هلب، صلب، مقاوم، الوزن التقريبي 1600 كغم/م<sup>3</sup> خالي من الشوائب، غير حاوي على الألياف، الرمال، تراب زجاجية، قواقع أو أي مواد غريبة، تحف 400 - 600 mm

Q2/A/ sol.

$$\text{Average domestic demand} = 22000 \times 600 = 13.2 \times 10^6 \text{ l/d}$$

$$\text{Maximum daily demand} = 1.8 \times \text{ave.} = 23.76 \times 10^6 \text{ l/d}$$

$$F = 18 C \sqrt{A}$$

$$= 18(1) \sqrt{1000 \times 10.76 \times 6}$$

$$\approx 4574 \text{ gpm} = 17288 \text{ l/min} = 24.89 \times 10^6 \text{ l/d}$$

$$\text{Maximum Rate} = 23.76 \times 10^6 + 24.89 \times 10^6$$

$$= 48.65 \times 10^6 \text{ l/d}$$

$$\approx 2211 \text{ l/c/d For 10 hours}$$

The total flow required during this day would be: -

$$23.76 + 24.89 \times \frac{10}{24} = 34.13 \times 10^6 \text{ l}$$

$$= 1551 \text{ l/c/d}$$

Q2) B/

1- BOD: Bacteria placed in contact with organic material. will utilize it as a food source. In the utilization the organic material oxidized to stable end product such as  $\text{CO}_2$  & water. The amount of oxygen used in this process is called BOD and is considered to be a measure of the organic content of the water.

2) 1- Dilution

2- Current assist in dispersion

3- Sedimentation - Suspended solids are removed by settling if the stream velocity is less than the scour velocity

4- Bottom deposits and runoff

5- Sunlight.

6- Temperature.

3) The chlorine demand of water depends upon the organic and inorganic substance present --- chloramine & other chloroorganics compounds, the oxidation complete rise in the chlorine residual, free chlorine, the point at which this take place is called "break point"

