University Of Technology
Building and Construction Eng. Dept.
Sanitary and Environmental Branch.
Final Examination 2014/2015

subject : Treatment 1
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Time : 3 hour
Date :10/6/2015
Class: 3rd year

Answer five Question only

Q1 Lab test results were obtain from settling column as shown in table below if the initial concentration Ç= 025mg/l.

- Find the removal efficiency depending on the available data.
- Find the removal efficiency for sediment basin with depth 2m and detention time 100 min.

Depth	**Settling time (min.)**			
	30(min.)	**60(min.)**	**90(min.)**	**120(min.)**
0.5	133 mg/l	83 mg/l	50 mg/l	38 mg/l
1.5	203 mg/l	150 mg/l	118 mg/l	93 mg/l
2.5	220 mg/l	180 mg/l	145 mg/l	123 mg/l

Q2 a flocculator is 4.88m deep , 12.2m wide and 24.4m long the flow of the water plant is 0.566 m3/s .rotating paddles are supported parallel to four horizontal shafts. The rotating speed is 2.0rpm. the center line of the paddles is 1.68m from the shaft (mid-depth of the basin).each shaft equipped with six paddles each paddle blade is 25cm wide and 11.6m long. Assuming the mean velocity of the water is 28 percent of the velocity of the paddles and their drag coefficient is 1.9 estimate:

- The difference in velocity between the paddles and water.
- The useful power input.
- The energy consumption per million gallons.

- The detention time.
- The value of G and Gt at 60f with $\mu = 2.359 * 10^{-5}$.
- The loading rate of the flocculator.

Q3 A: what are the differences between coagulation and flocculation .

B: what are keys required for the intake structure list them.

Q4 A :compute the velocity through a rack bar type (rectangular with semicircular face with B= 1.83 and w/b= 1) when the approach velocity is 0.6 m/s and the measured head loss is 38mm.

B: draw typical water treatment process.

Q5 A: there are two types of filter list them and what are the design criteria for the filtration process.

B

Define the following :

1. Stokes law. **2.** Losses during filtration. **3.** Weir overflow rate.

Q6 A: draw flow diagram of trickling filter used in wastewater treatment.

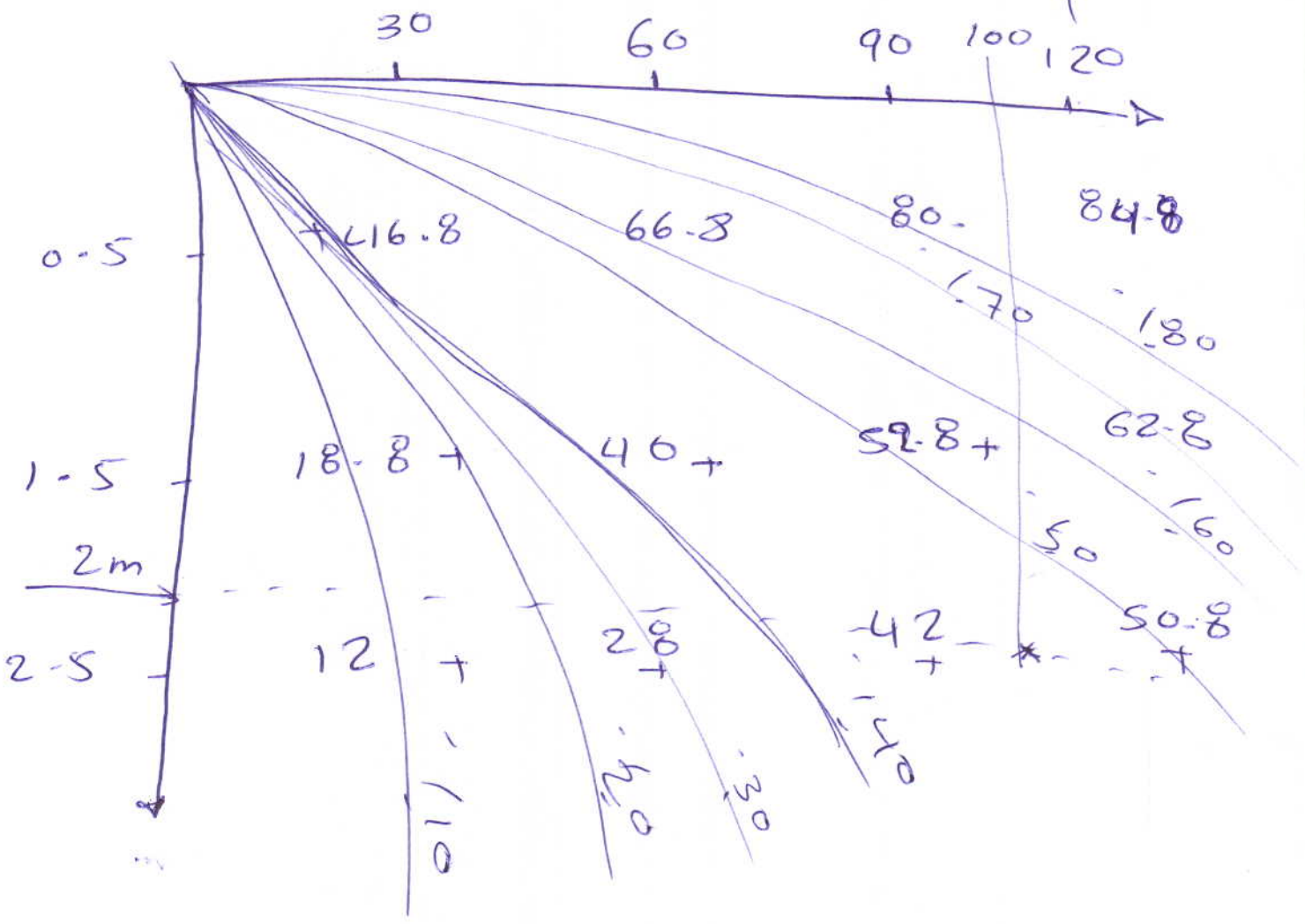
B: what are the advantages and disadvantage of using ozone in the disinfection.

C: the monthly average grit removal is 2.5 ft3/mg. if the monthly average flow is 2500000 gpd, how many cubic yards must be available for grit disposal if the disposal pit has a 90day capacity?

(dr. Zainab Bahaa) Treatment ① solutions ⑦

Q. sol:-

depth \ settling time (min)	30	60	90	120
0.5	46.8	66.8	80	84.8
1.5	18.8	40	52.8	62.8
2.5	12	28	42	50.8



$$\% \text{ Removal} = \frac{100+80}{2} * \frac{\Delta h_1}{H} + \frac{80+70}{2} * \frac{\Delta h_2}{H}$$

$$+ \frac{70+60}{2} * \frac{\Delta h_3}{H} + \frac{60+50}{2} * \frac{\Delta h_4}{H} + \frac{50+44}{2} * \frac{\Delta h_5}{H}$$

$$= \frac{100+80}{2} * \frac{17}{80} + \frac{80+70}{2} * \frac{5}{80} + \frac{70+60}{2} * \frac{17}{80} +$$

$$\frac{60+50}{2} * \frac{22}{80} + \frac{50+44}{2} * \frac{19}{80} = 44.71$$

Q2 solution

1. $U_p = \frac{2\pi rn}{60} = \frac{2 * 3.14 * 5.5 * 2}{60} = 1.15 \text{ fps}$

$$U = U_p (1 - 0.28) = 1.15 * 0.72 = 0.83 \text{ fps}$$

2. A = paddle area $= 4 * 6 * 38 * \frac{10}{12} = 760 \text{ ft}^2$

$$\rho = \frac{\gamma}{g} = \frac{62.4}{32.2} = 1.938 \text{ lb s}^2/\text{ft}^4$$

$$P = 0.5 C_d \rho A v^3$$

$$= 0.5 * 1.9 * 1.938 * 760 * 0.83$$

$$= 800 \text{ ft lb/s} = \frac{800}{550 \text{ hp}} = 1.45 \text{ hp}$$

3. $E = \frac{1.45 \text{ hp}}{13 \text{ Mgal/d}} * \frac{24 \text{ h}}{\text{d}} = 2.68 \text{ hp h / Mgal}$

$$= \frac{1.08 \text{ kw}}{13 \text{ Mgal/d}} * \frac{24 \text{ h}}{\text{d}} = 1.99 \text{ kwh / Mgal}$$

④

$$V = 16 * 40 * 80 = 5.12 * 10^4 \text{ ft}^3$$

$$= 5.12 * 10^4 * 7.48 \text{ gal/ft}^3$$

$$= 3.83 * 10^5 \text{ gal}$$

$$t = \frac{V}{Q} = \frac{3.83 * 10^5 \text{ gal}}{13 * 10^6 \text{ gal/d}} = 0.0295 \text{ d}$$

$$= 42.5 \text{ min}$$

⑤ $$G = (P/\mu V)^{0.5}$$

$$= (800 / 2.359 * 10^{-5} * 5.12 * 10^4)^{0.5}$$

$$= 25.7 \text{ fps/ft or } s^{-1}$$

$$Gt = 25.7 \text{ s}^{-1} * (42.5 * 60.)$$

$$= 65\,600$$

⑥ $$\text{Loading} = \frac{Q}{V} = \frac{13 * 10^6 \text{ gpd}}{5.12 * 10^4 \text{ ft}^3}$$

$$= 254 \text{ gpd/ft}^3$$

Q3. (A)

- coagulation :- is the addition of chemical coagulant in order to prepare for flocculation and the objective depends on the source of water and the nature of the suspended colloidal and dissolved organic

- flocculation :- is the aggregation of destabilized particales (which the electrical charge surface has been reduce) and precip-ilation products formed by the addition of coagulants into large partic known as flo

(B)

(1) Relaible .
(2) size to provide the Quantity of water.
(3) located to obtain the best quality water.
(4) proteded from objects.
(5) easy to inspect and maintain.
(6) minimize the damage to aquatic life.
(7) minimize navigational Hazards.

Q④

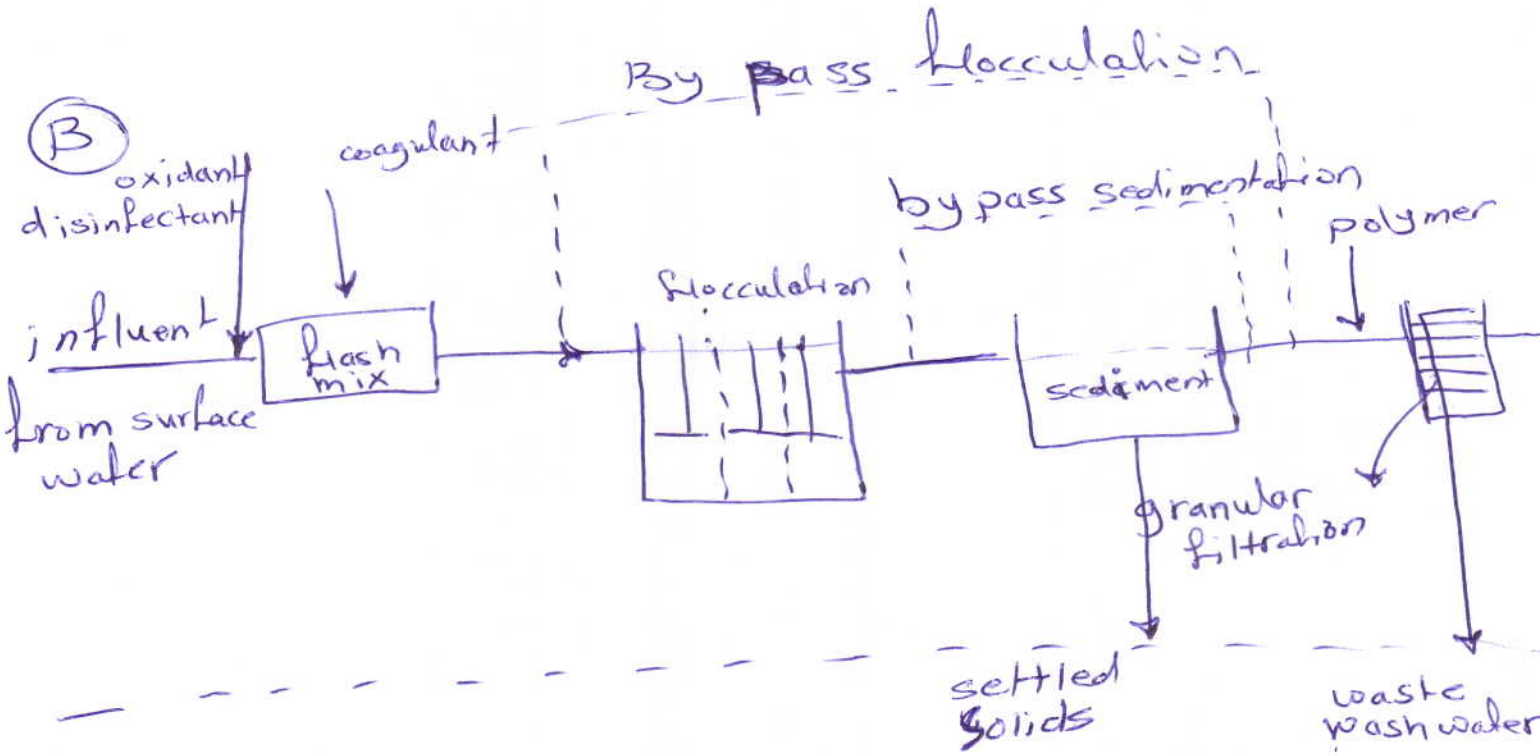
(A)

$$h = \frac{V^2 - v^2}{0.7(2g)}$$

$$0.038 = \frac{V^2 - 0.6}{0.7(2 * 9.81)} \longrightarrow V^2 = 0.882$$

$$\therefore V = 0.94 m/s$$

(B)



Q5

(A)

- there are two types of filters
  1. Rapid sand filter.
  2. Slow sand filter.

- the design criteria for filtration
  1. filtration rate V_f

$$V_f = \frac{Q}{A}$$

  2. depth of the media ranging between (0.6 - 1 m)
  3. depth of water top of the sand ranging between (1 - 1.5m)
  4. effective diameter d_{10} ranging between (0.45 - 0.55)

(1) stokes law :- = stokes law is a law for a settling velocity and is valid for spherical particles and laminar flow ($Re \leq 1$).

$$Vs = \frac{g(\rho s - \rho) d^2}{18 M}$$

(2) losses during filtration :- occure due to dissolved air in water under negative pressure. to avoid this backwash necessary.

(3) weir over flow rate :- is the amount of water leaving the settling tank per linear foot of water.

$$\text{weir over flow rate} = \frac{\text{flow gal/d}}{\text{weir length ft}}$$

(6)

- (B) Advantages :-
  - excellent disinfectant.
  - does not form THMs.
  - effective against taste and odor.
  - required short contact time.

disadvantages :-
- short contact time.
- more costly than Cl_2.
- does not create disinfecting residual
- gas is potentially explosive.

(C) (a)

- $\frac{2.5\ ft^3}{MGD} \times 2.5 = 6.25\ ft^3$ each day

- $\frac{6.25}{day}(90d) = 562.5\ ft^3$

- convert to cubic yards of grit:-

$$\frac{562.5}{27} = 21\ Yd^3$$

(A)