Test # 107 Key

1. If the concentration of TSS = 44 mg/L & the flow is 170,000 gpd, calculate the pounds per day of TSS.

$$\frac{44\ mg}{1E6\ mg} \left| \frac{170{,}000\ gal}{day} \right| \frac{8.34\ lb}{gal} = \boxed{62.38\ lb/day\ (b)}$$

2. Calculate the BOD_5 using the following:
   Initial DO: 7.4 mg/L
   Final D_5 = 4.5 mg/L
   Sample = 15 mL

$$DO = \frac{7.4 - 4.5}{(15/300)} = \boxed{58\ mg/L\ (d)}$$

3. What is the chlorine demand in mg/L of WW for the following:

Q = 5 mgd
Feed Rate = 90 lb/day
Chlorine Residual = 0.5 mg/L

$$\frac{90\ lb}{day} \left| \frac{gal}{8.34\ lb} \right| \frac{day}{5E6\ gal} \left| 1E6 \right. = 2.16\ mg/L - 0.5\ mg/L$$

$$= \boxed{1.66\ mg/L\ \ a)}$$

4. A tank that is 25'-wide, 100-ft long, & 12' deep with a flow of 2 mgd has a detention time of?

$$\frac{V}{Q} = \frac{(25)(100)(12)}{2E6\ gal} \left| \frac{day}{7.48\ gal} \right| \frac{7.48\ gal}{cf} \left| \frac{24\ hr}{day} \right.$$

$$\boxed{t_d = 2.7\ hrs\ \ (a)}$$

★ 5. What is the F/M ratio given the following:

MLSS = 2500 mg/L
Influent BOD_5 = 210 mg/L
Aeration tank Volume = 125,000 gallons
Primary Effluent BOD_5 = 102 mg/L
Flow = 235,000 gpd
Mixed Liquor is 75% Volatile

$$F/M = \frac{Q \times BOD}{V * MLVSS} \qquad F = \frac{235{,}000\ gal}{day} \left| \frac{8.34\#}{gal} \right| \frac{102\ mg}{1E6\ mg} = 200\ \frac{lb\ BOD}{day}$$

$$M = 125{,}000\ gal \left| \frac{8.34\#}{gal} \right| \frac{2500\ mg}{1E6\ mg} \Big| 0.75 = 1955\ \#\ MLSS$$

$$F/M = \frac{200\ lb\ BOD/day}{1955\ lb\ MLSS} = \boxed{0.1\ (a)}$$

6. What is the % removal of TSS given:

Influent TSS = 170 mg/L
Effluent TSS = 14 mg/L
Effluent BOD_5 = 21 mg/L
Flow = 3.7 mgd

$$\frac{170-14}{170} = \boxed{91.8\%\ (b)}$$

Test # 107

Given

Raw ww Flow 4 MGD
Influent TSS 180 mg/L
Influent BOD 200 mg/L
Primary Effluent BOD 180 mg/L

0.254 mg – Primary Clarifier Dimensions Ø = 60' Depth = 12'
0.2247 mg – Aeration Tank Dimensions 100' x 15' x 20' = (0.2247 mg) = 30,000 ft3 | 7.48 gal / ft3
0.01124 – Each secondary clarifier volume = 1500 ft3 → 0.01124 mg

Aeration MLVSS 2800 mg/L
Aeration MLSS 3500 mg/L

30 min Settling test volume 200 mL/L

WAS Flow .025 mg/L
WAS TSS 4500 mg/L

Effluent TSS 2.5 mg/L
Effluent BOD 5 mg/L

Rate of effluent flow = 4 − .025 = 3.975 mgd

Secondary system consists of 2 rectangular aeration tanks & 2 circular clarifiers.

7. What is the sludge volume index (SVI) of the plant aeration system?

$$SVI\ (mL/g) = \frac{\text{Settled Sludge volume (mL/L)}}{MLSS\ (mg/L)} * 1000$$

(mL | L | 1000 mg / L | mg | g)

$$= \frac{200}{3500} * 1000 = \boxed{57.1\ mL/g\ (C)}$$

8. What is the mean cell residence time of the aeration system?

$$\frac{MLSS * (\text{Volume of Tank + Clarifier})}{(\text{EFFL SS})(\text{Eff Flow}) + (\text{WAS SS} * \text{WAS Flow})} = \frac{(3500)(2)(0.2247)\ (1573)}{(2.5*4)\ (3.975\ \text{mgd}) + (4500)(.025\ \text{mgd})} = \frac{1652\ mg/L}{10 + 112\ mg/L} = 122\ \text{per day}$$

(3500)(2)(0.01124) + (78.7)

Sludge Age = 13.5 days C)

↑ check

(Also called sludge age (pg. 314 in book) → $\frac{MLSS \times V}{SS_e \times Q_e + SS_w \times Q_w}$

#8 MCRT (Sludge Age)

$$\frac{MLSS * (\text{Volume of Tank \& clarifier})}{(\text{Effl SS})(\text{Eff. Flow}) + (\text{WAS-TSS} * \text{WAS FLOW})}$$

$$= \frac{(3{,}500\ mg/L)\left[2*.2247\ mg + 2*.01124\right]}{(2.5\ mg/L)(3.975\ mgd) + (4500)(.025\ mgd)} = \frac{1652}{122}$$

(aeration tank: 2*.2247 mg; sec. clarifier: 2*.01124)

(3.975 mgd: 2/10; 4500: 1/2)

RAW WW FLOW = 4 mgd
− WAS flow = 0.025 mgd
Effluent FLOW = 3.975 mgd

$= 11$

13.5 days

$$\frac{(mg/L)(\text{Millin gallons})}{(mg/L)(\text{million gal/day})} = \text{days}$$

9. What is the percent removal of the BOD?

$$\frac{200-5}{200} = \boxed{97.5\%\ a}$$

★ 10. What is the F/M?

$$F/M = \frac{Q * BOD}{V * MLVSS} = \frac{(4\ mgd)(180\ mg/\ell)}{(2)(0.2247\ mg)(2800\ mg/\ell)}$$

$$\boxed{F/M = 0.57\ (d)}$$

11. What is the TSS removal?

$$\frac{180-2.5}{180} = \boxed{98.6\%\ d}$$

12. What is the detention time in the primary clarifier?

$$\frac{Vol}{Q} = \frac{\pi (30')^2 * 12' \mid day \mid 7.48\ gal \mid 24\ hr}{4E6\ gal \mid ft^3 \mid day}$$

$$t_d = \boxed{1.52\ hours\ (a)}$$