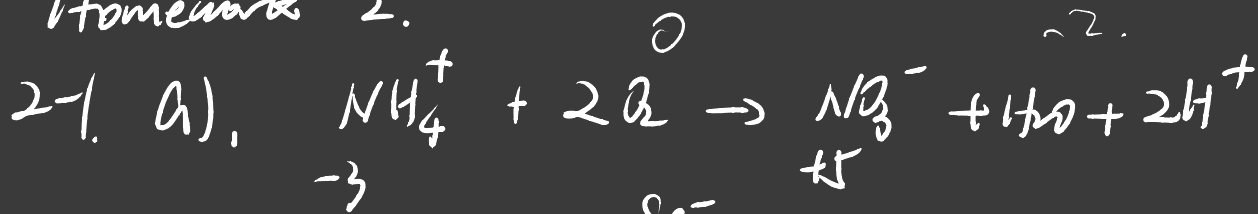


Homework 2.



$$C_n = 50 - 12.5 = 37.5 \text{ mg/L.}$$

$$C_c = 80 - 17.5 = 62.5 \text{ mg/L.}$$

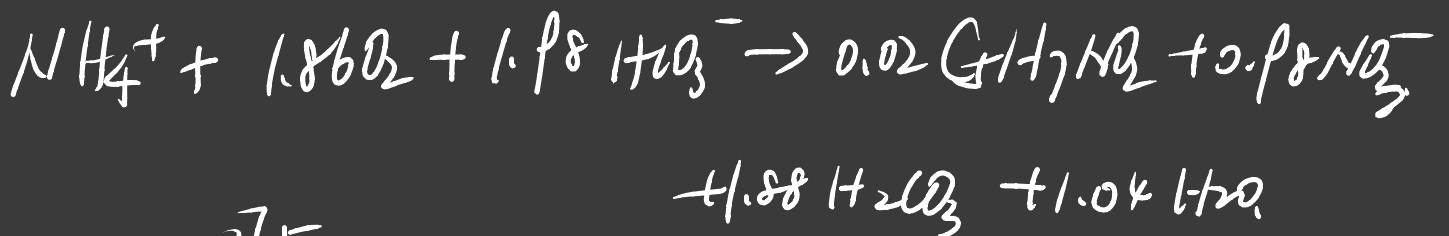
$$C_d = 30 - 7.5 = 22.5 \text{ mg/L.}$$

$$\text{NOD}_n = \frac{37.5}{14} \times 2 \times 32 = 171.4 \text{ mg/L.} \quad 68.56\% \text{ BOD}_5$$

$$\text{NOD}_c = \frac{62.5}{14} \times 2 \times 32 = 285.7 \text{ mg/L.} \quad 81.63\% \text{ BOD}_5$$

$$\text{NOD}_d = \frac{22.5}{14} \times 2 \times 32 = 102.9 \text{ mg/L.} \quad 68.57\% \text{ BOD}_5$$

b). NOD ↓↓↓.



$$\text{NOD}_n = \frac{37.5}{14} \times 1.86 \times 32 = 159.43 \text{ mg/L.}$$

$$\text{NOD}_c = \frac{62.5}{14} \times 1.86 \times 32 = 265.71 \text{ mg/L.}$$

$$\text{NOD}_d = \frac{22.5}{14} \times 1.86 \times 32 = 95.66 \text{ mg/L.}$$

$$\left(1 - \frac{1.86}{2}\right) \times 100\% = 7\% \text{ ↓↓}$$

$$2-2. \quad T = 15^\circ\text{C}, \quad C_{O_2} = 2.8/\text{m}^3, \quad \theta_x = 5 \text{ d}, \quad \text{pH} = 7.0-7.5$$

$$\mu_{\text{max}}(T_{20}) = 0.85 \text{ d}^{-1} \quad K_{O_2} = 0.5-1.0 \text{ mg O}_2/\text{L.}$$

$$\theta_T = 0.106, \quad pK_{a1} = 7.2, \quad [NH_4^+] = 2 \text{ mg/L.}$$

$$\begin{aligned} \mu_{\max}(T) &= \mu_{\max}(T_{20}) \cdot \theta_T^{(T-20)} \\ &= 0.85 \cdot e^{0.106 \times (-5)} \text{ d}^{-1} \\ &= 0.85 \times 0.59 \text{ d}^{-1} = 0.5 \text{ d}^{-1} \end{aligned}$$

$$\mu = \mu_{\max} \frac{[NH_4^+]}{10^{0.051T - 1.58} + [NH_4^+]} \cdot e^{0.098(T-15)} \frac{[DO]}{K_2 + [DO]}$$

$$\begin{aligned} \text{if } K_2 = 1, \text{ pH} = 7.5 & \quad [1 - 0.833 \cdot |pK_{a1} - \text{pH}|] \\ &= 0.5 \times \frac{2}{10^{0.051 \times 15 - 1.58} + 2} \cdot e^0 \cdot \frac{2}{1+2} \cdot (1 - 0.833 \times 0.3) \\ &= 0.5 \times \frac{2}{0.4 + 2} \cdot 1 \cdot \frac{2}{3} \cdot 0.71 \\ &= 0.208 \text{ d}^{-1} \end{aligned}$$

$$\begin{aligned} \text{if } K_2 = 0.5, \text{ pH} = 7.0 & \\ &= 0.5 \times \frac{2}{0.4 + 2} \times 1 \times \frac{2}{0.5 + 2} \times (1 - 0.833 \times 0.2) \\ &= 0.278 \text{ d}^{-1} \end{aligned}$$

$$\therefore Sf = \mu \cdot \theta_x = 1.09 \text{ or } 1.389 > 1.$$

So WWTP does nitrify.

$$2-3. \text{ COD} = 340 \text{ g/m}^3, \quad \text{BOD} = 170 \text{ g/m}^3$$

$$\text{TKN} = 30 \text{ g/m}^3 \quad Y = 0.5 \text{ g/g OM}$$

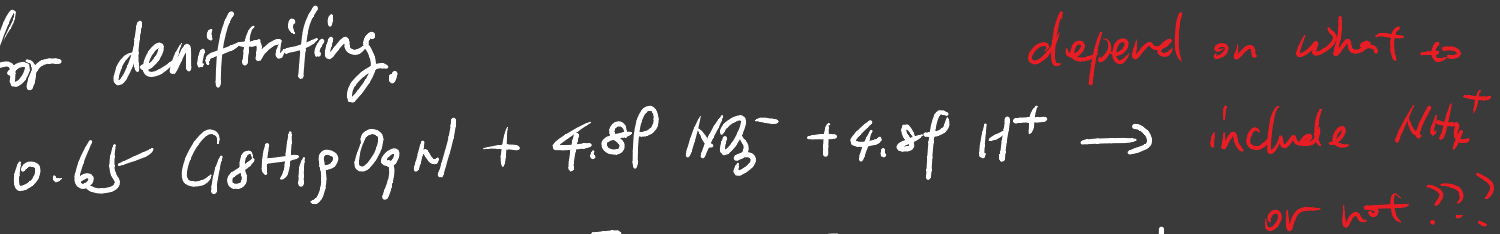
for aerobic.

$$M_{COD} = 1.425 \text{ g/gOM.}$$

$$\therefore OM = \frac{340}{1.425} = 238.6 \text{ gOM/m}^3.$$

$$\therefore Y = 0.5 \times 238.6 = \underline{119.3 \text{ g/m}^3}.$$

for denitrifying.



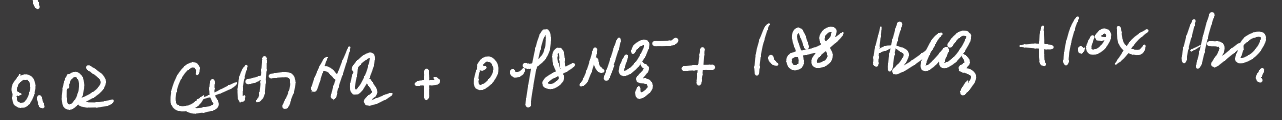
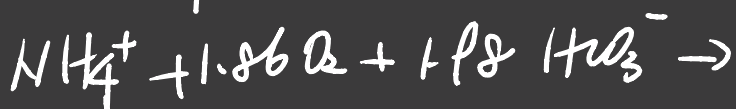
$$M_{an} = 18 \times 12 + 17 \times 1 + 17 \times 16 + 14 = 393 \text{ g/mol}$$

$$C_{OM} = \frac{238.6}{393} \text{ mol/m}^3 = 0.607 \text{ mol}$$

$$M_{biomass} = 5 \times 12 + 7 \times 1 + 14 + 2 \times 16 = 113 \text{ g/mol}$$

$$m_{biomass} = \frac{0.607}{0.65} \times 113 \text{ g/m}^3 = \underline{105.5 \text{ g/m}^3}.$$

for nitrifier.



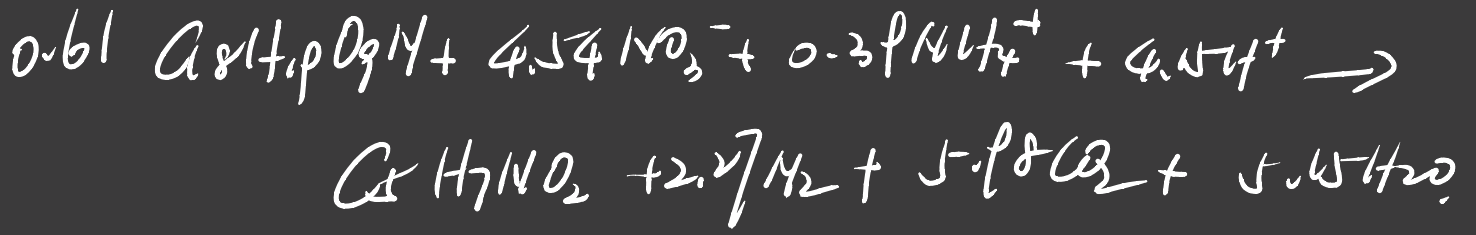
$$\Delta C_{NH_4^+} = 30 - 0.045 \text{ g N/g } NO_3^- \times 170 \text{ g/m}^3.$$

$$= 30 - 7.65 \text{ g/m}^3.$$

$$= 22.35 \text{ g/m}^3.$$

$$\therefore M_{biomass} = \frac{22.35}{14} \times 0.02 \times 113 = \underline{3.6 \text{ g/m}^3}.$$

$$2-4. \quad \text{TAL}_0 = 4.1 \text{ eqv/m}^3. \quad \Delta C_{\text{N-NO}_3} = 25 \text{ g/m}^3.$$

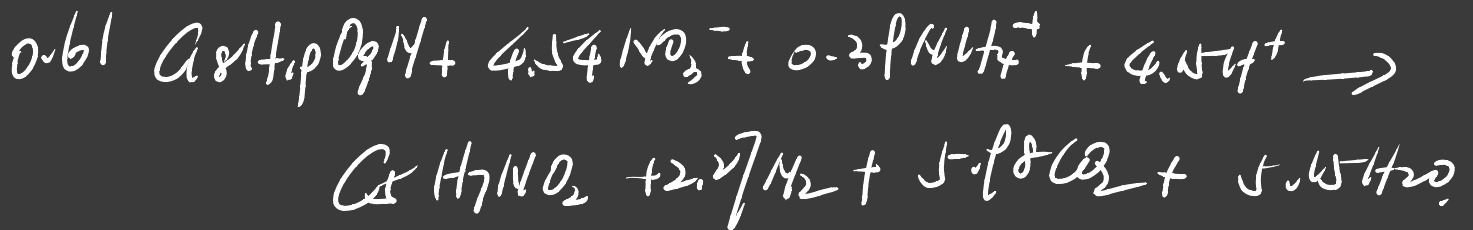


$$\therefore \Delta C_{\text{H}^+} = \frac{25}{14} \times \frac{4.15}{4.54} = 1.63 \text{ mol/m}^3.$$

$$\therefore \text{TAL} = \text{TAL}_0 + \Delta C_{\text{H}^+} = 4.1 + 1.63 = 5.73 \text{ eqv/m}^3. \quad > 5$$

$$2-5 \quad \Delta C_{\text{N-NO}_3} = 20 \text{ g/m}^3.$$

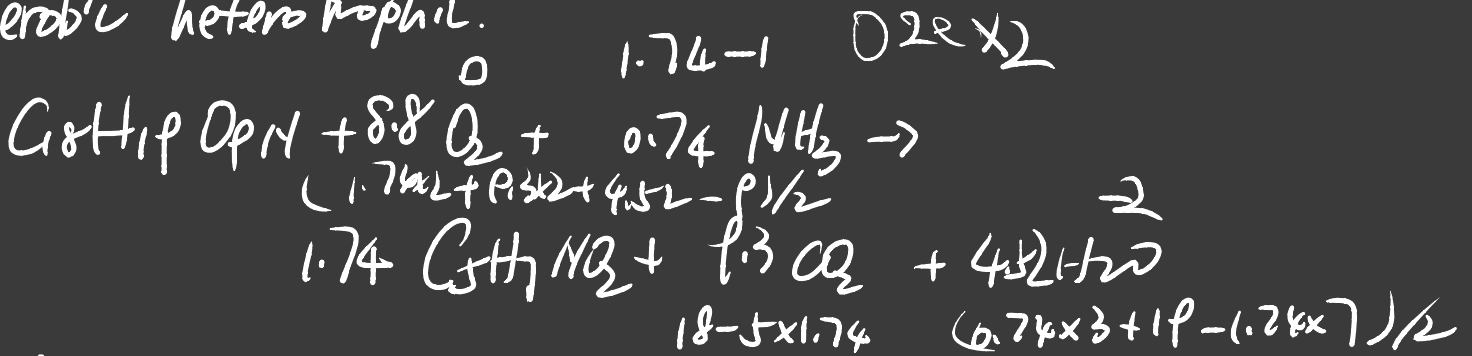
$$M_{\text{biomass}} = 393 \text{ g/mol.} \quad Y = 0.5 \text{ g/g OM.}$$



$$\Delta C_{\text{biomass}} = \frac{20}{14} \times \frac{0.61}{4.54} \text{ mol/m}^3$$

$$= 0.19 \text{ mol/m}^3 = \underline{75.43 \text{ g/m}^3}.$$

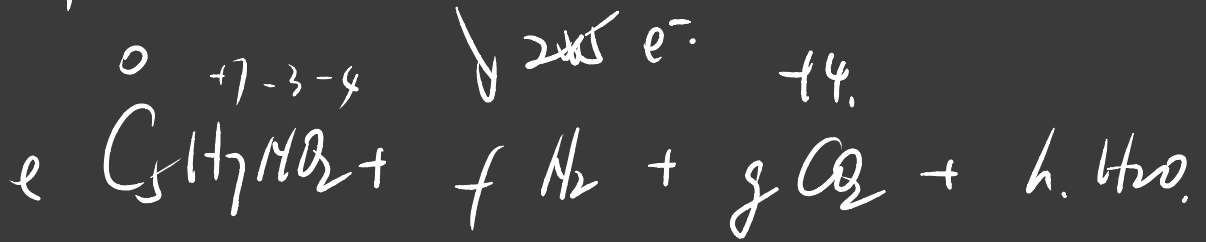
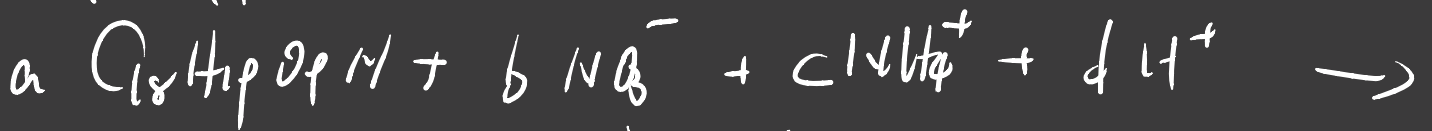
aerobic heterotrophil.



$$\frac{M_{\text{biomass}}}{m_{\text{OM}}} = 0.5 = \frac{113x}{393} \quad \therefore x = 1.74$$

$$\Delta \text{BOD}_5 = \frac{75.43}{393} \times 8.8 \times 32 = \underline{54.05 \text{ g/m}^3}.$$

+2 +9 -18 -3



0 +1 -3 -4 \downarrow 2x5 e⁻ +4.

C: $18a = 5e + g$

$18a = 5 + g$

H: $19a + 4c + d = 7e + 2h$

$19a + 4c + d = 7 + 2h$

O: $2a + 3b = 2e + 2g + h$

$2a + 3b = 2 + 2g + h$

N: $a + b + c = e + 2f$

$a + b + c = 1 + 2f$

e: $5b = 4g - 2a$ $2a + 5b = 4g$

g: $b = c + d$

if $e = 1$. $g = 18a - 5$

$5b = 4g - 2a = 72a - 20 - 2a = 70a - 20$

$b = 14a - 4$

$19a + 4(14a - 4) = 7 + 2(14a - 4) + h$

$h = 15a - 4 = b + a$

$= g - 3a + 1$

$19a + b + 3c = 7 + 30a - 8$

$c = 1 - a$

$$a + 14a - 4 + 1 - a = 1 + 2f.$$

$$f = 7a - 2$$

$$b = 2f$$

$$19a + 4 - 4a + d = 7 + 30a - 8.$$

$$d = 15a - 5 = 5(3a - 1) = h - 1$$

$$\therefore b = 14a - 4$$

$$e = 1$$

$$g = 18a - 5$$

$$c = 1 - a.$$

$$f = 7a - 2$$

$$h = 15a - 4.$$

$$d = 15a - 5$$

$$b = 2f.$$

$$5(g - h) = d.$$

$f = 2.27$ depend on how much $N_2 \Rightarrow$ biomass.

$$\therefore a = 0.61 \quad b = 4.54 \quad c = 0.39 \quad d = 4.15$$

$$e = 1 \quad f = 2.27 \quad g = 5.92 \quad h = 5.15.$$