Homework 1

1. $C_5H_7O_2N + 5O_2 \rightarrow 5CO_2 + 2H_2O + 1\,NH_3$

$5\times12 + 7\times1 + 2\times16 + 1\times14 = 113$ g/mol.

$COD = 1 \div 113 \times 160 \approx 1.416$ g / g cells.

$C_{18}H_{19}O_9N + 17.5O_2 \rightarrow 18CO_2 + 8H_2O + 1\,NH_3$

$18\times12 + 19\times1 + 9\times16 + 14\times1 = 393$ g/mol.

$COD = 1 \div 393 \times 17.5\times32 \approx 1.425$ g / g OM.

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2. a) $C_{18}H_{19}O_9N$.

$18\times12 + 19\times1 + 9\times16 + 14\times1 = 393$ g/mol.

$C_{(VSS)} = \frac{150}{18\times12} = 0.69$ mol/m^3.

$m_{(VSS)} = 0.69 \times 393 \approx 272.12$ g/m^3

b) $ON = 0.69 \times 14 = 9.66$ g/m^3.

$NH_4\text{-}N = 35 - 9.66 = 25.34$ g/m^3.

c) $C_{18}H_{19}O_9N + 17.5O_2 \rightarrow 18CO_2 + 8H_2O + 1\,NH_3$

$COD = 17.5\times32 \times \frac{150}{18\times12} \approx 388.89$ g/m^3 °C. (K)

d) 6% SS => 60 kg/m^3 VSS. density ≈ 1000 kg/m^3.

$TOC = 150 \times \frac{60.000}{270.92} = 32.18\ kg/m^3$.

$DOC = 0\ g/m^3$.

$NH_4\text{-}N = 24.34\ g/m^3$.

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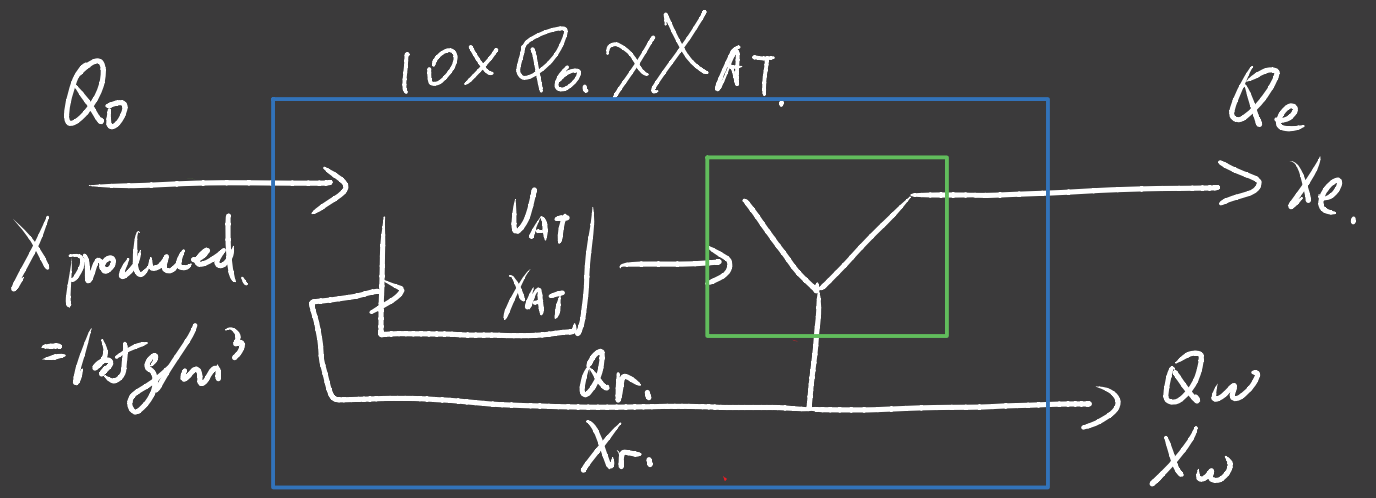
3. TOC > VS. TLC > TS COD too high.

N-NH4 > TKN.

4.



$Q_0 = Q_e = 17500\ m^3/d$. $Q_r = 17000\ m^3/d$.

$X_{AT} = 3.5\ kg/m^3$. $X_e = 45\ g/m^3$.

a). $m_w = (Q_0 \times X_{produced}) - (Q_e \times X_e)$ $\because Q_0 = Q_e$

$= Q_0 \times (X_{produced} - X_e)$

$= 17500\ m^3/d \times (135 - 45)\ g/m^3$

$= 2100\ kg/d$.

$X_r = X_w$. $Q_r \doteq Q_r + Q_w$

$(Q_o + Q_r) X_{AT} = Q_e X_e + Q_r X_r$.

$X_r = [(Q_o + Q_r) X_{AT} - Q_e X_e] / Q_r$.

$= [(17500 + 17000) \times 3.5 - 17500 \times 0.015] / 17000$

$= 7.087 \text{ kg/m}^3$

$Q_w = \frac{m_w}{X_w} = \frac{2100 \text{ kg/d}}{7.087 \text{ kg/m}^3} = 296.3 \text{ m}^3/\text{d}$

$Q_w \ll Q_r$. confirmed.

b). $m_r = (Q_{pump} - Q_w) X_r$

$= (17000 - 296.3) \times 7.087 \text{ kg/d}$

$= 118387 \text{ kg/d}$.

$m_{produced} = Q_o \cdot X_{produced}$

$= 17500 \times 0.135 \text{ m}^3/\text{d} \times \text{kg/m}^3$

$= 2362.5 \text{ kg/d}$.

$\therefore \frac{m_r}{m_{produced}} = \frac{118387}{2362.5} \approx 50.11$ turns.