QASIM BNR BOYUTLANDIRMA YÖNTEMİ

Ref: *QASIM '99, page 475,* ***13-11*** *Design Example*

GİRİŞ

Qasım (Wastewater Treatment Plants, 1999) da verilen BNR boyutlandırma yöntemi karbon giderimi nitrifikasyon ve denitrifikasyon için kullanılabilecek θ_{CA}, θ_{CDN}, $Y_{obsBOD5}$, Y_{obsN}, Y_{obsDN} değerlerinin Kinetik parametreler kullanılarak hesaplanmasına dayanır. Bu değerler bilindiği takdirde karbon gidermesi, nitrifikasyon ve denitrifikasyon, bakteri üretim hızları: (P_{XBOD5}, P_{XN}, P_{XDN})

$P_{XBOD5} = QYobs_{BOD5} (S_0 - S)$

denklemi kullanılarak ve gerekli, oksik ve anoksik hacımlar ise;

$$\theta_C = \frac{\forall X}{P_X}$$

denklemlerini kullanarak hesaplanır. Bu metodda Lawrence & McCarthy metodunda olduğu gibi, deneme ve yanılma metodu kullanılmaz.

BESİ KÜTLE KORUNUMU (NUTRIENT MASS BALANCES)

1. Nitrojen Kütle Korunumu

TN to be Nitrified= TN to N = TKNin-TKNeff-OrgN-assim

$$OrgN - assim = \underbrace{0.122}_{\text{g OrgN/g VSS}} \; Yobs_{BOD5}(S_o - S)$$

Hücrenin %12.2'si azot kabul edilir (12.2 % of the microbial cell $C_{60}H_{87}O_{23}N_{12}P$ is assumed to be N.)

$$NO_3N \text{ to } DN = TN \text{ to } N - (NO_3N_{eff})$$

2. Karbon Kütle Korunumu

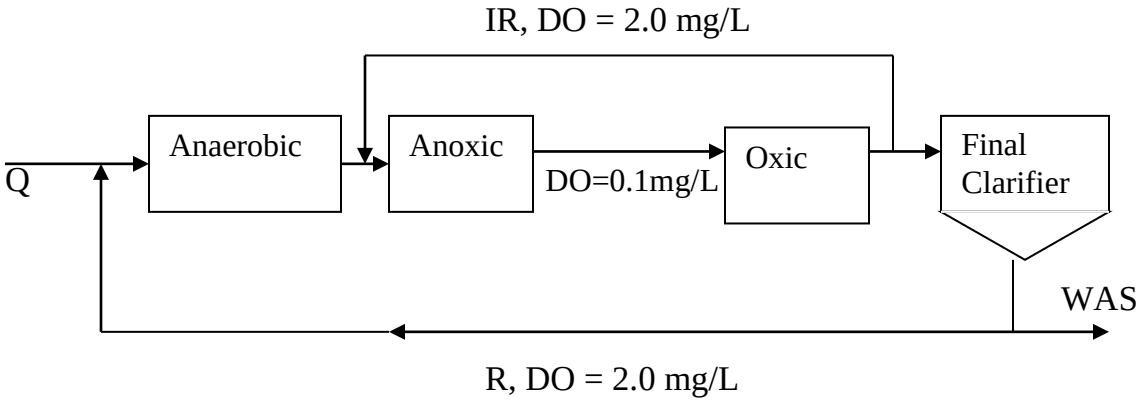
$$BOD_5 \text{ to be satisfied} = (S_o - S) - \left(\begin{array}{c}BOD_5 \\ \text{consumed} \\ \text{due to DN}\end{array}\right) - \left(\begin{array}{c}BOD_5 \\ \text{consumed due to} \\ \text{deoxygenation}\end{array}\right)$$

$$\left(\begin{array}{c}BOD_5 \\ \text{consumed} \\ \text{due to DN}\end{array}\right) = (\underbrace{0.68}_{\frac{gBOD_L}{gNO_3 - N}})(3.7)(NO_3\text{-N to be DN})$$

Artık çözünmüş oksijen giderilmesi için gerekli BOD_5 miktarı (BOD_5 consumed due to De-oxygenation) az olduğu halde kütle korunumuna ilave edilecektir.

$$\left(\begin{array}{c}BOD_5 \\ \text{consumed due to} \\ \text{deoxygenation}\end{array}\right) = (0.68)\underbrace{(1.3)}_{\substack{gBOD_L/gDO \text{ in} \\ \text{return flow}}}[(IR+R)DO_{maxN} - (1+IR+R)DO_{maxDN}]$$

$$DO_{maxDN} = 0.1 \text{ mg/L} \qquad DO_{maxN} = 2.0 \text{ mg/L}$$



HETEROTROF VE OTOTROFLARIN ÜREME HIZLARI (ProductIon (P) of Heterotrophs and Autotrophs)

$$\theta_{cA} = \frac{SF_{kinetic} SF_{process}}{\mu'_{\max A} - k_{dA}}$$

$$\mu'_{\max A} = \mu_m e^{0.098(t-15)} \frac{DO}{DO + K_{DO}} \left[1 - 0.833(7.2 - pH)\right]$$

$SF_{kinetic}$ = 2.0 μ_m = 0.47 (0.3 – 3.0d^{-1}) DO = 2.0 mg/L

$SF_{process}$ = 1.5 K_{DO} = 1.0 (1.0 – 1.3 mgDO/L)

$$Yobs_N = \frac{Y_N}{1 + k_{dN}(\theta_{cA})}$$

Y_N=Range 0.1 – 0.3, Typical 0.2

k_{dN}= 0.05d^{-1} (0.03-0.06d^{-1})

$$Yobs_{BOD_5} = \frac{Y_{BOD_5}}{1 + k_{dBOD_5}(\theta_{cA})}$$

$$\frac{1}{\theta_{c,A}} = \frac{\mu'_{\max A}(NH_4 - N)_e}{K_N + (NH_4 - N)_e}$$

$K_N=10^{0.051t-1.158}$

Px_N = $Yobs_N$ Q (TN to be DN) → kg/day, Production rate of Autotrophs (Nitrifiers)

Px_{BOD5} = $Yobs_{BOD5}$ Q (BOD_5 to be Satisfied) → kg/day, Production rate of carbonaceous bacteria

$$\theta_{c,DN} = \frac{SF_{DN}}{\mu_{maxDN}\,\theta_{DN}^{\,t-20}\,(1-DO_{maxDN})-k_{dDN}}$$

SF_{DN} = 1.5

μ_{maxDN} = Range - 0.2-0.4, Typical = 0.3

θ_{DN} = Range – 1.03-1.20, Typical = 1.03

DO_{maxDN} = 0.1 mg/L

kd_{DN} = Range 0.02- 0.08, Typical 0.04

$$Yobs_{DN} = \frac{Y_{DN}}{1+k_{dDN}(\theta_{c,DN})}$$

Y_{DN}=Range 0.5 – 0.7, Typical 0.6

$Px_{DN} = Y_{obsDN}\ Q\ (NO_3\text{-N to be DN})$ → kg/day, Production rate of denitrifiers

$P_{XH} = Px_{BOD5} + Px_{DN}$ Heterotrophic → kg/day, (Production rate of heterotrophs) Heterotrof üreme hızı

$Px_A = Px_N$ Autotrophic → kg/day, (Production rate of autotrophs) Ototrof üreme hızı

Sonuç (Result):

Increase in MLVSS = $Px_T = Px_{BOD5} + Px_{DN} + Px_A$

$WAS = Px_T / fvss$

$f_{VSS} = \frac{MLVSS}{MLSS}$

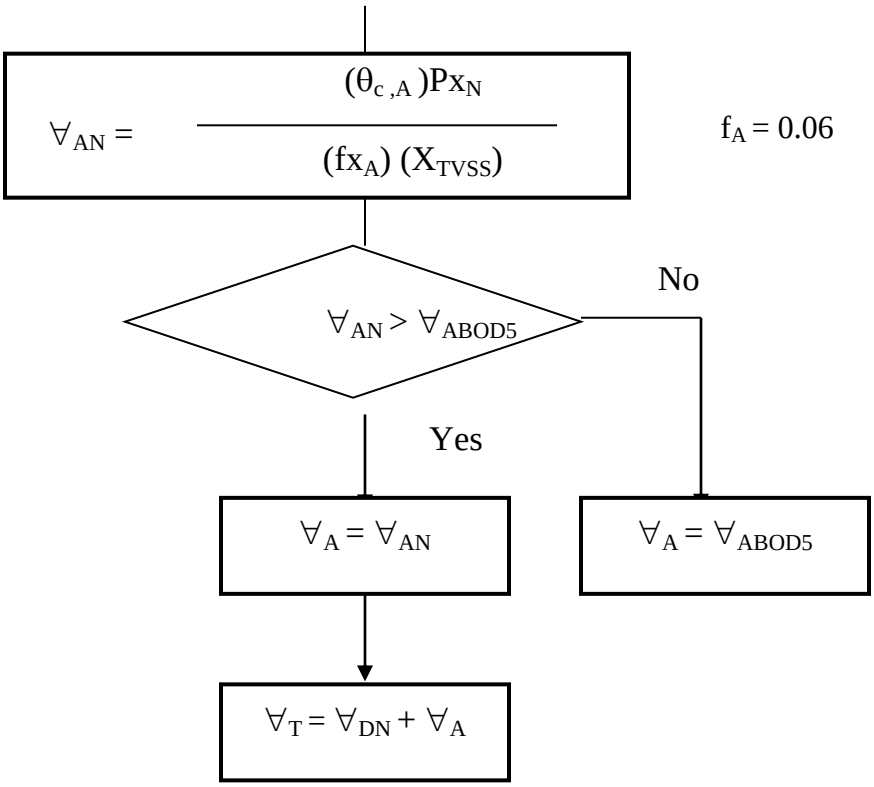
REAKTÖR HACMİ HESAPLARI (REACTOR VOLUME CALCULATIONS)

Heterotrofların denitrifiye edilebilen yüzdesi = 50%
fx_{DN} : Fraction of heterotrophs that can DN ≈ 0.5

$fx_{DN} = X_{DN} / X_H$

$$\forall_{DN} = \frac{(\theta_{c,DN})Px_{DN}}{(f_{XDN})(X_{TVSS})}$$ $f_{XDN} = 0.5$

$$\forall_{ABOD5} = \frac{(\theta_{c,A})Px_{BOD5}}{(fx_H)(X_{TVSS})}$$ $f_H = 0.94$


$\forall_{AN} = \frac{(\theta_{c,A})Px_N}{(fx_A)(X_{TVSS})}$
$f_A = 0.06$
$\forall_{AN} > \forall_{ABOD5}$
No
Yes
$\forall_A = \forall_{AN}$
$\forall_A = \forall_{ABOD5}$
$\forall_T = \forall_{DN} + \forall_A$