

UKLANJANJE DUŠIKA POSTUPKOM NITRIFIKACIJE I DENITRIFIKACIJE

Pokazatelji kakvoće otpadnih voda:

Uglate zgrade znače koncentracije u mg/L, ili g/m³

$$Q_{24} := 0.200$$

$$Q_{Sp} := 0.200$$

$$T := 10$$

$$[TS_R] := 3.3$$

$$[KH] := 4$$

$$[S_0] := 210$$

$$[TS_0] := 170$$

$$[TKN_0] := 50$$

$$[TKN_{0m}] := [TKN_0]$$

$$[TKN_{0Sp}] := 100$$

$$[TKN_{zSp}] := 0$$

$$[N_{US}] := [TKN_0]$$

$$[NO_3 - N_0] := 0$$

$$[NH_4 - N_{eSp}] := 5$$

$$[N_{FK}] := 0$$

Pokazatelji kakvoće efluenta:

$$\eta := 0.95$$

$$[\text{NH}_4 - \text{N}_{\text{em}}] := 1$$

$$[\text{NO}_3 - \text{N}_e] := 7$$

$$[\text{org} - \text{N}_e] := 2$$

Konstante brzine reakcije:

$$r_x := 0.55$$

$$f_D := 0.75$$

$$b_A := 0.05$$

$$b_H := 0.08$$

$$K_N := 1$$

$$f_c := 1.25$$

$$\mu_{\text{maxA}} := 0.52$$

$$f_I := 0.1$$

$$f_P := 0.6$$

$$f_{\text{TA}} := 1.103^{(T-15)}$$

$$f_{\text{TbA}} := 1.09^{(T-15)}$$

$$f_{\text{TbH}} := 1.073^{(T-15)}$$

$$i_B := 0.12$$

$$i_I := 0.01$$

$$Y_A := 0.15$$

$$Y_H := 0.6$$

Kapacitet kiselosti, [SK], u jedinicama mmol/L:

$$[SK] := [KH] + \frac{1}{14} \cdot ([NH_4 - N_{em}] + [NO_3 - N_0] - [NO_3 - N_e])$$

$$[SK] = 3.57143$$

Izračunavanje faktora varijabilnosti:

$$[N_{nSp}] := [TKN_{0Sp}] + [TKN_{ZSp}] - [org - N_e] - [N_{US}]$$

$$[N_{nm}] := [TKN_{0m}] + r_x \cdot [N_{US}] + [N_{FK}] - [org - N_e] - [N_{US}]$$

$$[N_{nSp}] = 48$$

$$[N_{nm}] = 25.5$$

$$S := \frac{([N_{nSp}] - [NH_4 - N_{eSp}]) \cdot Q_{Sp}}{([N_{nm}] - [NH_4 - N_{em}]) \cdot Q_{24}}$$

$$S = 1.755$$

$$S := 1.7$$

6. Starost aerobnog mulja u danima:

$$t_{TSA} := fc \cdot \frac{1}{\frac{\mu_{maxA}}{S} \cdot \frac{[NH_4 - N_{eSp}]}{(K_N + [NH_4 - N_{eSp}])} \cdot f_{TA} - b_A \cdot f_{TbA}}$$

$$t_{TSA} = 10.11026$$

Iterativni blok izračunava početnu vrijednost $PP_{1,4}$:

PP =	0	1	2	3	4	5
0	"n"	"N.US"	"Ndma"	"NdmB"	"VNV"	"VVN"
1	7	9.45075	29.29685	29.29641	0.67485	1.48183

$$PP_{1,4} = 0.67485$$

7. Izračunavanje omjera volumena za nitrifikaciju V(N) i denitrifikaciju V(D)

7.0 Izbor početne vrijednosti omjera V(N)/V=VNV i V(D)/V=VDV:

$$\text{VNV} := \text{PP}_{1,4} \quad \text{VDV} = 0.32515 \quad \text{VDV} := 1 - \text{VNV} \quad \text{VVN} := \frac{1}{\text{VNV}}$$

7.1 Izračunavanje parametra a:

$$a := 2.95 \cdot (100 \cdot \text{VDV})^{-0.235}$$

7.2 Izračunavanje vrijednosti N_{dma}:

$$N_{\text{dma}} := a \cdot \frac{f_D}{2.86} \cdot \eta \cdot [S_0] \cdot \text{VDV} \cdot \left(0.5 + \frac{0.24 \cdot Y_H \cdot t_{\text{TSA}} \cdot \text{VVN} \cdot f_{\text{TbH}}}{1 + b_H \cdot f_{\text{TbH}} \cdot t_{\text{TSA}} \cdot \text{VVN}} \right)$$

$$N_{\text{dma}} = 29.29643$$

7.3 Izračunavanje vrijednosti N_{dmb}:

$$P_I := i_I \cdot f_P \cdot [TS_0]$$

$$P_H := \frac{(i_B + i_I \cdot f_I \cdot b_H \cdot f_{\text{TbH}} \cdot t_{\text{TSA}} \cdot \text{VVN})}{(1 + b_H \cdot f_{\text{TbH}} \cdot t_{\text{TSA}} \cdot \text{VVN})} \cdot Y_H \cdot \eta \cdot [S_0]$$

$$P_A := \frac{(i_B + i_I \cdot f_I \cdot b_A \cdot f_{\text{TbA}} \cdot t_{\text{TSA}})}{(1 + b_A \cdot f_{\text{TbA}} \cdot t_{\text{TSA}})} \cdot Y_A$$

$$P_I = 1.02$$

$$P_H = 7.85003$$

$$P_A = 0.01359$$

$$[N_{US}] := \frac{P_I + P_H + P_A \cdot ([TKN_{0m}] + [N_{FK}] - [NH_4 - N_{em}] - [org - N_e])}{1 + P_A \cdot (1 - r_x)}$$

$$[N_{US}] = 9.45078$$

$$N_{dmb} := [TKN_{0m}] + r_x \cdot [N_{US}] + [N_{FK}] \cdot -[NH_4 - N_{em}] \dots \\ + -[NO_3 - N_e] - [org - N_e] - [N_{US}]$$

$$N_{dma} = 29.29643$$

$$N_{dmb} = 36.74715$$

9. Izračunavanje ukupne starosti mulja (dani):

$$t_{TSG} := VVN \cdot t_{TSA}$$

$$t_{TSG} = 14.98155$$

10. Izračunavanje proizvodnje viška mulja:

$$US_R := \frac{[TS_R]}{t_{TSG}}$$

$$US_R = 0.22027$$

11. Izračunavanje aerobnog i anaerobnog volumena (m³):

$$[N_{nm}] := [TKN_{0m}] + r_x \cdot [N_{US}] + [N_{FK}] \cdot -[org - N_e] - [N_{US}]$$

$$[N_{nm}] = 45.74715$$

$$P1 := f_P \cdot [TS_0] + \frac{(1 + f_I \cdot b_H \cdot f_{TbH} \cdot t_{TSG})}{(1 + b_H \cdot f_{TbH} \cdot t_{TSG})} \cdot Y_H \cdot \eta \cdot [S_0]$$

$$P2 := \frac{(1 + f_I \cdot b_A \cdot f_{TbA} \cdot t_{TSA})}{(1 + b_A \cdot f_{TbA} \cdot t_{TSA})} \cdot Y_A \cdot ([N_{nm}] - [NH_4 - N_{em}])$$

$$P := P1 + P2$$

$$P = 177.65283$$

$$q_R := \frac{US_R}{P} \quad q_R = 1.2399 \times 10^{-3}$$

$$V_{ww} := \frac{Q_{24}}{q_R} \quad Q_{24} = 0.2$$

$$V = 161.30389$$

$$V_N := VNV \cdot V$$

$$V_D := VDV \cdot V$$

$$V_N = 108.85556$$

$$V_D = 52.44834$$

12. Izračunavanje koncentracije biomase

Heterotrofna biomasa:

$$X_H := \frac{Y_H \cdot \eta \cdot [S_0] \cdot q_R \cdot t_{TSG}}{1 + b_H \cdot f_{TbH} \cdot t_{TSG}}$$

Autotrofna biomasa:

$$X_A := \frac{Y_A \cdot ([N_{nm}] - [NH_4 - N_{em}]) \cdot q_R \cdot t_{TSG}}{1 + b_A \cdot f_{TbA} \cdot t_{TSA}}$$

Inertna biomasa:

$$X_I := f_P \cdot [TS_0] \cdot q_R \cdot t_{TSG} + f_I \cdot b_H \cdot f_{TbH} \cdot X_H \cdot t_{TSG} \dots \\ + f_I \cdot b_A \cdot f_{TbA} \cdot X_A \cdot t_{TSA}$$

$$X_H = 1.20668$$

$$X_A = 0.09385$$

$$X_I = 1.99947$$

$$X := X_H + X_A + X_I$$

$$X = 3.3$$

13. Proizvodnja viška mulja:

$$US_{RE} := V \cdot US_R$$

$$US_{RE} = 35.53057$$

14. Izračunavanje muljnog opterećenja:

$$B_{TS} := \frac{Q_{24} \cdot [S_0]}{V \cdot [TS_R]}$$

$$B_{TS} = 0.0789$$