

Oxidation Ditch Process Design Calculator

Blue block is the design datameter : be filled in
Brown: calculate process data
Red : last result for your process

1. Oxidation Ditch Process Design parameters:

Design treatment water volume Q =	300	m ³ /d=	12.50	m ³ /h		
Intake water quality:			Water quality of effluent:			
Inlet water CODCr=	1620	mg/L		COD _{Cr} =	324	mg/L
BOD5=S0=	840	mg/L		BOD ₅ =S ₂ =	126	mg/L
TN=	250	mg/L		TN=	30	mg/L
NH4+-N=	180	mg/L		NH ₄ ⁺ -N=	18	mg/L
Alkalinity SALK=	280	mg/L		pH=	7.2	
SS=	180	mg/L		SS=C _e =	20	mg/L
f=MLVSS/MLSS=	0.7			Mixture concentration X =	4000	mgMLSS/L
Minimum sludge age is used	30	d		Dissolved oxygen concentration of aeration tank effluent	2	mg/L
Attenuation factor Kd=	0.05	d-1		Activated sludge yield coefficient Y =	0.5	mgMLSS/mgBOD ₅
Average summer temperature T1=	25	°C		Denitrification rate constant q _{dn,20} at 20 °C =	0.07	kgNO ₃ ⁻ -N/kgMLVSS
Average winter temperature T2=	15	°C		Denitrification temperature correction factor =	1.09	
Residual alkalinity	100	mg/L		Nitrification reaction safety factor K =	2.5	
Required alkalinity	7.14	mg alkalinity/mgNH ₄ -N oxidation		Oxygen required for nitrification	4.6	mgO ₂ /mgNH ₄ -N
Output alkalinity	3.57	mg alkalinity/mgNO ₃ +N reduction		Oxygen available for denitrification	2.6	mgO ₂ /mgNO ₃ ⁻ -N
Dissolved oxygen concentration during denitrification	0.2	mg/L		If the biological sludge contains about	12.40%	Nitrogen for cellular synthesis

2.Design Calculation

(1) Aerobic zone volume calculation

$V_1 = \frac{YQ(S_0 - S_e)\theta_c}{X(1 + K_d\theta_c)} =$	459	m ³	Aerobic tank hydraulic retention time t1=	1.53	d	36.72	h
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3.Volume calculation of hypoxic zone

(1) Oxidation ditch biological sludge production

$W_v = \frac{YQ(S_0 - S_e)}{1 + K_d\theta_c} =$	42.84	kg/d					
(2)For cell synthesisTKN=	5.31	kg/d	That is, there are TKN x 1000/300 in TKN =	17.71	mg/L		
Therefore, the [NH ₄ -N] to be oxidized =	144.29	mg/L	Reduction required [NO ₃ +N]=	43.29	mg/L		
(3) Denitrification rate							
$q_D = q_{dn,20} \times 1.09^{T-20} (1 - DO) =$	0.036	kg/(kg.d)					
(4) Volume of hypoxic zone V2							
$V_2 = \frac{N_T}{q_D \times X_v} =$	425	m ³	Anoxic tank hydraulic retention time t ₂ =	1.42	d=	33.98	h

4.Total tank volume of oxidation ditch

V=V ₁ +V ₂ =	884	m ³	Total hydraulic retention time t=	2.95	d		
The design takes V=	900	m ³					
Design effective water depth h=	3.5	m	Design width b =	5.5	m		
Then the total length of the required ditch L =	46.75	m	Take the length of the linear trench section =	22.5	m		
Actual effective volume =	1198.87	m ³	Actual dwell time t'=	4.00	d		

5.Alkalinity balance calculation

(1) Nitrification consumes alkalinity =	1030.25	mg/L					
(2) Denitrification produces alkalinity=	154.54	mg/L					
(3) Removal of BOD5 produces alkalinity=	71.4	mg/L					
(4) Residual alkalinity =	175.69	mg/L					

6.Calculation of actual oxygen demand			7.Calculation of standard oxygen demand					
(1) Carbonation Oxygen Demand (COD)			Press set conditions α=	0.85	β=	1		
$D_1 = \frac{Q(S_0 - S_e)}{0.68} - 1.42W_v =$	254.17	kg/d	C _{S(20)} =	9.17	θ=	1		
			C _{S(25)} =	8.38				
(2) Nitrification Oxygen Demand (NOD)			$R_0 = \frac{DC_{S(20)}}{\alpha[\beta C_{S(T)} - C]} \times \theta^{(T-20)} =$	678.83	kg/d			
D ₂ =4.5×Q(N ₀ -N _e)=	218.7	kg/d						
(3) Oxygen production by denitrification			8. Sludge Return Flow Calculation					
D ₃ =2.6×Q×N _i =	33.76	kg/d	According to the set condition X ₀ =	250	mg/L	X _r =	10000	mg/L
			From QX ₀ +Q _r =(Q+Q _r)X we get					
(4) Nitrifying residual sludge NH ₄ -N oxygen demand			$Q_r = \frac{Q(X - X_0)}{X_r - X} =$	187.5	m ³ /d			
D ₄ =0.56×W _v ×f=	16.79	kg/d						
(5) Total Oxygen			9.Residual sludge volume					
D=D ₁ +D ₂ -D ₃ -D ₄ =	422.31	kg/d	W=W _v +X ₁ Q-X _e Q=	27.54	m ³ /d			
			Take the sludge water content P =	99.20%				
			$V_{剩} = \frac{W}{1000(1-P)} =$	3.44	m ³ /d			