CE 412 A: Water Supply & Wastewater Disposal Systems

Tutorial – 2022-23 II ● Part II: Wastewater Management

TUTORIAL 4 ● Tuesday, March 28, 2023

Design Primary Settling Tank(s) followed by Secondary Treatment Process consisting of an Activated Sludge Process for a locality with following information for which Preliminary Treatment Operations (Screen Chamber, Grit Chamber and Equalization Tank) were designed in Tutorial 3.

Water Supply	=	250 lpcd
Population density	=	350 person per hectare
Area served	=	690 hectares
Wastewater reaching sewers	=	80% of W/S
Peak Factor	=	3.0
Infiltration Rate	=	7391 L per day per hectare
Design Flow Reaching Sewage Treatment Plant (STP)	=	50 MLD
Some Relevant Parameters/Data/Information		
Primary Settling Tank		
Surface Overflow Rate for PST	=	32 - 48 $m^3/m^2/d$
Outlet Weir Loading Rate	=	<125 $m^3/m/d$
HRT in PST	=	< 4 h
BOD Removal in PST	=	25 – 40 %
Suspended Solids Removal	=	50 – 75 %
Solids Concentration in Settled Sludge	=	4000 – 6000 mg/L
Activated Sludge		
Design Value of BOD	=	350 mg/l
Concentration of Fixed Suspended Solids	=	50 mg/L
Effluent Total BOD	=	30 mg/L
Effluent Soluble BOD	=	5 mg/L
Maximum Specific Substrate Utilization Rate, q_{max}	=	4 /d
K_s	=	25 mg/L
True Yield Coefficient, Y_T	=	0.5
Endogenous Respiration Coefficient, k_d	=	0.05 /d
Mixed Liquor Suspended Solid Concentration, X	=	1,500 – 3,000 mg/L
Suspended Solids Concentration in Settled Sludge from SST, X_r	=	8,000 – 10,000 mg/L
Hydraulic Retention Time, θ	=	4-12 h
Oxygen Required in Aeration Tank, kg/d] = [BOD_u Removed, in kg/d] – 1.42.[Sludge Wasted, kg/d		
Aerator Rating:		
1, 2, 5 KW	=	Area of Influence: 5m x 5m x 3m (depth)
10, 25, 50 KW	=	Area of Influence: 6m x 6m x 4m (depth)
Standard O_2 transfer efficiency (SOT)	=	2.0 kg O_2/h/KW
Actual O_2 transfer efficiency (AOT)	=	80 % of Under Standard Conditions

nergy requirements for maintaining completely mixed conditions in the aeration tank	=	15 – 20 W/m^3

Nutrient Requirement/Removed: 0.121 g N and 0.022 g P per g biomass produced (or wasted)

Secondary Sedimentation Tank Design

Solids mg/L	V m/hr	Gravity Flux kg/m^2/hr	u m/hr	Underflow Flux Kg/m^2/hr	Total Flux kg/m^2/hr
2000	*3.60*	7.196	0.100	0.200	7.396
2500	*1.86*	4.655	0.100	0.250	4.905
3000	*1.09*	3.261	0.100	0.300	3.561
3500	*0.69*	2.414	0.100	0.350	2.764
4500	*0.33*	1.478	0.100	0.450	1.928
5000	*0.24*	1.203	0.100	0.500	1.703
6000	*0.14*	0.843	0.100	0.600	1.443
6500	*0.11*	0.721	0.100	0.650	1.371
8000	*0.06*	0.481	0.100	0.800	1.281
10000	*0.03*	0.311	0.100	1.000	1.311
12000	*0.02*	0.218	0.100	1.200	1.418