

# 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
<b>Some Relevant Parameters/Data/Information</b>		
<b>Primary Settling Tank</b>		
Surface Overflow Rate for PST	=	32 - 48 m <sup>3</sup> /m <sup>2</sup> /d
Outlet Weir Loading Rate	=	<125 m <sup>3</sup> /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
<b>Activated Sludge</b>		
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, $\theta$	=	4-12 h
Oxygen Required in Aeration Tank, kg/d] = [BOD <sub>u</sub> Removed, in kg/d] – 1.42.[Sludge Wasted, kg/d		
<b>Aerator Rating:</b>		
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 <sub>2</sub> transfer efficiency (SOT)	=	2.0 kg O <sub>2</sub> /h/KW
Actual O <sub>2</sub> transfer efficiency (AOT)	=	80 % of Under Standard Conditions

energy requirements for maintaining  
completely mixed conditions in the aeration  
tank

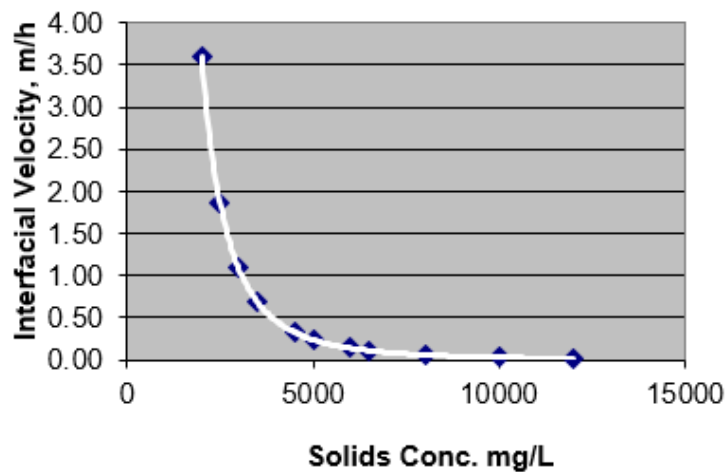
$$= 15 - 20 \text{ W/m}^3$$

**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 <sup>2</sup> /hr	u m/hr	Underflow Flux Kg/m <sup>2</sup> /hr	Total Flux kg/m <sup>2</sup> /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

### Interfacial Settling Velocity



$$y = (2E+10).x^{-2.9521}$$

### Solids Flux

