

# ANNEX

## 1. Paràmetres de l'aigua d'entrada al reactor biològic SBR

	entrada	F/Q	desengreix	
Flow	<b>1000</b>	<b>1000</b>	<b>1000</b>	m <sup>3</sup> -dia-1
TSS	<b>4300</b>	<b>1400</b>	<b>1700</b>	gTSS.m-3
%SSV	75	75	75	%
BOD	4205	423	685	gO <sub>2</sub> .m-3
Soluble BOD	1529	154	249	gO <sub>2</sub> .m
COD	<b>5720</b>	<b>576</b>	<b>932</b>	gO <sub>2</sub> .m
Soluble COD	3445	347	561	gO <sub>2</sub> .m
TKN	320	320	320	gN.m-3
TKN soluble	224	224	224	gN.m
Amonia	<b>200</b>	<b>200</b>	<b>200</b>	gN.m
phosphorus	50	50	50	

## 2. Alternativa 2. Aigua d'entrada sense tractament

Construction	Oper(/yr)	Maint(/yr)	Mat(/yr)	Chem(/yr)	Energy(/yr)
<b>\$927,000</b>	\$92,900	\$47,800	\$32,400	\$0	<b>\$269,000</b>

### User Input Data

Description Value Units  
 Process Design Carbon, Nitrogen And Phosphorus Removal  
 Aeration Bubble Size Course Bubble  
 Design Basis Specify Design SRT  
 Design SRT 10 d  
 Effluent Soluble BOD 10 g/m<sup>3</sup>  
 Effluent Nitrogen 10 gN/m<sup>3</sup>  
 Effluent Total Phosphorus 1 gP/m<sup>3</sup>  
 Biomass Yield- 0.5  
 Maximum Heterotrophic Specific Growth Rate -  $\mu_{maxhet20}$  6 1/d  
 Heterotrophic Decay Rate-Kd- 0.24 1/d  
 Maximum Autotrophic Specific Growth Rate -  $\mu_{max20}$  0.5 1/d  
 Autotrophic Decay Rate -  $ba_{20}$  0.04 1/d  
 Aerated Period 4 hr  
 Un aerated Period 2 hr  
 Settle And Decant Time 1.5 hr  
 Exchange Volume/Cycle 50 %  
 Number Of SBRs 2  
 Alpha Factor For Oxygen Transfer In Wastewater 0.7  
 Beta Factor For Oxygen Saturation In Wastewater 0.95  
 Minimum Air Flow 20 N m<sup>3</sup>/min/1000 m<sup>3</sup>  
 Standard Oxygen Transfer Efficiency 6 %  
 Underflow Concentration 0.8 %  
 Decant Suspended Solids 25 g/m<sup>3</sup>  
 Override Design FALSE  
 Length To Width Ratio 1  
 Tank Depth 5 m  
 Pipe Gallery Width 6.12 m

Excavation Depth	1.3	m		
Required Air Flow - Diffused Aeration	1180	N m <sup>3</sup> /min/1000 m <sup>3</sup>		
Number Of Mixers Per SBR	1			
Override Database Costs	FALSE			
Standard 2 scfm Fine Bubble Diffuser	\$60		\$	
Standard 12 scfm Coarse Bubble Diffuser	\$40		\$	
Standard 550 scfm Swing Arm Diffuser	\$7,970		\$	
5 hp Vertical Turbine Mixer	\$8,860		\$	
Standard 3000 gpm Pump and Driver Unit	\$37,900		\$	
Fine Bubble Diffuser	10	years		
Coarse Bubble Diffuser	20	years		
Swing Arm Diffuser	20	years		
Turbine Mixer	20	years		
Pump	25	years		
Structural	40	years		

### Design Output Data

Description	Value	Units		
Sequencing Batch Reactor				
Carbon, Nitrogen and Phosphorus Removal Design				
Design SRT for design at winter temperature	10	d		
Aerated cycle time	4	hr		
Un-aerated cycle time	2	hr		
Suggested anoxic cycle time	1.2	hr		
Suggested anaerobic cycle time	0.75	hr		
Settle and decant time	1.5	hr		
Total cycle time	7.5	hr		
Total exchange volume required	1000	m <sup>3</sup>		
Total volume of SBRS	625	m <sup>3</sup>		
Volume of one SBR	312	m <sup>3</sup>		
Hydraulic retention time	15	hr		
F/M ratio	0.208	kg BOD/kg MLSS/d		
Calculated SS	60800	g/m <sup>3</sup>		
Calculated VSS	43600	g/m <sup>3</sup>		
Calculated VSS:TSS ratio	0.717	mg VSS/mg SS		
Amount of sludge generated	3800	kg/d		
Nitrogen requirement for biomass growth	284	g/m <sup>3</sup>		
Phosphorus requirement for biomass growth	49	g/m <sup>3</sup>		
Oxygen requirement to meet average demand	4250	kg/d		
Air flow required to meet average demand	44100	N m <sup>3</sup> /hr		
Operation labor required	4450	pers-hrs/yr		
Maintenance labor required	2800	pers-hrs/yr		
Electrical energy required	3340000	kWh/yr		
Volume of earthwork required	622	m <sup>3</sup>		
Volume of slab concrete required	128	m <sup>3</sup>		
Volume of wall concrete required	135	m <sup>3</sup>		
Handrail length	36	m		
Number of diffusers per train	1080			
Number of swing arm headers per train	2			
<b>Construction and equipment cost</b>	<b>\$595,000</b>		<b>\$</b>	

O&M material and supply cost	\$30,100	\$/yr
Energy cost	\$268,000	\$/yr
Amortization cost	\$52,600	\$/yr
<b>SBR Pumping</b>		
Average daily pumping rate	7500	m <sup>3</sup> /d
Total pumping capacity	7500	m <sup>3</sup> /d
Design capacity per pump	3750	m <sup>3</sup> /d
Number of pumps	6	
Number of batteries	1	
Firm pumping capacity	7500	m <sup>3</sup> /d
Operation labor required	339	pers-hrs/yr
Maintenance labor required	267	pers-hours/yr
Electrical energy required	8840	kWh/yr
Volume of earthwork required	54.2	m <sup>3</sup>
Area of pump building	22.2	m <sup>2</sup>
Construction and equipment cost	\$332,000	\$
O&M material and supply cost	\$2,320	\$/yr
Energy cost	\$1,410	\$/yr

### Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	1000	527	473	m <sup>3</sup> /d
Minimum flow	1000	527	473	m <sup>3</sup> /d
Average flow	1000	527	473	m <sup>3</sup> /d
Suspended solids	4300	25	8000	g/m <sup>3</sup>
% volatile solids	75	71.7	71.7	%
BOD	3790	11.8	580	g/m <sup>3</sup>
Soluble BOD	1380	10	10	g/m <sup>3</sup>
COD	5300	41.9	8620	g/m <sup>3</sup>
Soluble COD	3300	15	15	g/m <sup>3</sup>
TKN	320	0.932	1.53	gN/m <sup>3</sup>
Soluble TKN	224	0.93	0.93	gN/m <sup>3</sup>
Ammonia 200	0.93	0.93		gN/m <sup>3</sup>
Nitrite	0.0	0.0	0.0	gN/m <sup>3</sup>
Nitrate	0.0	35.4	35.4	gN/m <sup>3</sup>
Total phosphorus	50	1	1	gP/m <sup>3</sup>
pH 6.8	6.8	6.8	-	
Cations	160	160	160	g/m <sup>3</sup>
Anions	160	160	160	g/m <sup>3</sup>
Settleable solids	10	0.0	0.0	mL/L
Oil and grease	100	0.0	0.0	g/m <sup>3</sup>
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

### 3. Alternativa3. Aigua d'entrada amb tractament físico-químic

Construction	Oper(/yr)	Maint(/yr)	Mat(/yr)	Chem(/yr)	Energy(/yr)
<b>\$685,000</b>	\$54,500	\$24,600	\$20,100	\$0	<b>\$84,700</b>

#### User Input Data

Description	Value	Units
Process Design	Carbon, Nitrogen And Phosphorus Removal	
Aeration Bubble Size	Course	Bubble
Design Basis	Specify Design	SRT
Design SRT	10	d
Effluent Soluble BOD	10	g/m3
Effluent Nitrogen	10	gN/m3
Effluent Total Phosphorus	1	gP/m3
Biomass Yield-	0.5	
Maximum Heterotrophic Specific Growth Rate - $\mu_{max}$	20	6 1/d
Heterotrophic Decay Rate-Kd-	0.24	1/d
Maximum Autotrophic Specific Growth Rate - $\mu_{max}$	20	0.5 1/d
Autotrophic Decay Rate - $\mu_{ba}$	20	0.04 1/d
Aerated Period	4	hr
Unaerated Period	2	hr
Settle And Decant Time	1.5	hr
Exchange Volume/Cycle	50	%
Number Of SBRs	2	
Alpha Factor For Oxygen Transfer In Wastewater	0.7	
Beta Factor For Oxygen Saturation In Wastewater	0.95	
Minimum Air Flow	20	N m3/min/1000 m3
Standard Oxygen Transfer Efficiency	6	%
Underflow Concentration	0.8	%
Decant Suspended Solids	25	g/m3
Override Design	FALSE	
Length To Width Ratio	1	
Tank Depth	5	m
Pipe Gallery Width	6.12	m
Excavation Depth	1.3	m
Required Air Flow - Diffused Aeration	366	N m3/min/1000 m3
Number Of Mixers Per SBR	1	
Override Database Costs	FALSE	
Standard 2 scfm Fine Bubble Diffuser	\$60	\$
Standard 12 scfm Coarse Bubble Diffuser	\$40	\$
Standard 550 scfm Swing Arm Diffuser	\$7,970	\$
5 hp Vertical Turbine Mixer	\$8,860	\$
Standard 3000 gpm Pump and Driver Unit	\$37,900	\$
Fine Bubble Diffuser	10	years
Coarse Bubble Diffuser	20	years
Swing Arm Diffuser	20	years
Turbine Mixer	20	years
Pump	25	years
Structural	40	years

## Design Output Data

Description	Value	Units
Sequencing Batch Reactor		
Carbon, Nitrogen and Phosphorus Removal Design		
Design SRT for design at winter temperature	10	d
Aerated cycle time	4	hr
Unaerated cycle time	2	hr
Suggested anoxic cycle time	2.6	hr
Suggested anaerobic cycle time	40.6	hr
Settle and decant time	1.5	hr
Total cycle time	7.5	hr
Total exchange volume required	1000	m <sup>3</sup>
Total volume of SBRS	625	m <sup>3</sup>
Volume of one SBR	312	m <sup>3</sup>
Hydraulic retention time	15	hr
F/M ratio	0.0998	kg BOD/kg MLSS/d
Calculated SS	14600	g/m <sup>3</sup>
Calculated VSS	8990	g/m <sup>3</sup>
Calculated VSS:TSS ratio	0.616	mg VSS/mg SS
Amount of sludge generated	912	kg/d
Nitrogen requirement for biomass growth	28.1	g/m <sup>3</sup>
Phosphorus requirement for biomass growth	5.61	g/m <sup>3</sup>
Oxygen requirement to meet average demand	1320	kg/d
Air flow required to meet average demand	13700 N	m <sup>3</sup> /hr
Operation labor required	2470	pers-hrs/yr
Maintenance labor required	1380	pers-hrs/yr
Electrical energy required	1040000	kWh/yr
Volume of earthwork required	622	m <sup>3</sup>
Volume of slab concrete required	128	m <sup>3</sup>
Volume of wall concrete required	135	m <sup>3</sup>
Handrail length	36	m
Number of diffusers per train	337	
Number of swing arm headers per train	2	
<b>Construction and equipment cost</b>	<b>\$353,000</b>	<b>\$</b>
O&M material and supply cost	\$17,800	\$/yr
Energy cost	\$83,300	\$/yr
Amortization cost	\$31,000	\$/yr
SBR Pumping		
Average daily pumping rate	7500	m <sup>3</sup> /d
Total pumping capacity	7500	m <sup>3</sup> /d
Design capacity per pump	3750	m <sup>3</sup> /d
Number of pumps	6	
Number of batteries	1	
Firm pumping capacity	7500	m <sup>3</sup> /d
Operation labor required	339	pers-hrs/yr
Maintenance labor required	267	pers-hours/yr
Electrical energy required	8840	kWh/yr
Volume of earthwork required	54.2	m <sup>3</sup>
Area of pump building	22.2	m <sup>2</sup>
Construction and equipment cost	\$332,000	\$

O&M material and supply cost \$2,320 \$/yr  
 Energy cost \$1,410 \$/yr

### Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	1000	889	111	m <sup>3</sup> /d
Minimum flow	1000	889	111	m <sup>3</sup> /d
Average flow	1000	889	111	m <sup>3</sup> /d
Suspended solids	1400	25	8000	g/m <sup>3</sup>
% volatile solids	75	61.6	61.6	%
BOD	381	10.7	245	g/m <sup>3</sup>
Soluble BOD	139	10	10	g/m <sup>3</sup>
COD	534	38.1	7410	g/m <sup>3</sup>
Soluble COD	332	15	15	g/m <sup>3</sup>
TKN	320	0.931	1.18	gN/m <sup>3</sup>
Soluble TKN	224	0.93	0.93	gN/m <sup>3</sup>
Ammonia	200	0.93	0.93	gN/m <sup>3</sup>
Nitrite	0.0	0.0	0.0	gN/m <sup>3</sup>
Nitrate	0.0	291	291	gN/m <sup>3</sup>
Total phosphorus	50	1	1	gP/m <sup>3</sup>
pH	6.8	6.8	-	
Cations	160	160	160	g/m <sup>3</sup>
Anions	160	160	160	g/m <sup>3</sup>
Settleable solids	10	0.0	0.0	mL/L
Oil and grease	100	0.0	0.0	g/m <sup>3</sup>
Summer temperature	23	23	23	deg C
Winter temperature	10	10	10	deg C

#### 4. Alternativa 4. Aigua d'entrada amb tractament de desengreix

Construction	Oper(/yr)	Maint(/yr)	Mat(/yr)	Chem(/yr)	Energy(/yr)
<b>\$707,000</b>	\$58,100	\$26,600	\$21,300	\$0	<b>\$97,500</b>

### User Input Data

Description	Value	Units
Process Design	Carbon, Nitrogen And Phosphorus Removal	
Aeration Bubble Size	Course Bubble	
Design Basis	Specify Design SRT	
Design SRT	10	d
Effluent Soluble BOD	10	g/m <sup>3</sup>
Effluent Nitrogen	10	gN/m <sup>3</sup>
Effluent Total Phosphorus	1	gP/m <sup>3</sup>
Biomass Yield-	0.5	
Maximum Heterotrophic Specific Growth Rate - $\mu_{max20}$	6	1/d
Heterotrophic Decay Rate-Kd-	0.24	1/d
Maximum Autotrophic Specific Growth Rate - $\mu_{max20}$	0.5	1/d
Autotrophic Decay Rate - $\mu_{ba20}$	0.04	1/d
Aerated Period	4	hr
Unaerated Period	2	hr

Settle And Decant Time	1.5	hr
Exchange Volume/Cycle	50	%
Number Of SBRs	2	
Alpha Factor For Oxygen Transfer In Wastewater	0.7	
Beta Factor For Oxygen Saturation In Wastewater	0.95	
Minimum Air Flow	20	N m3/min/1000 m3
Standard Oxygen Transfer Efficiency	6	%
Underflow Concentration	0.8	%
Decant Suspended Solids	25	g/m3
Override Design	FALSE	
Length To Width Ratio	1	
Tank Depth	5	m
Pipe Gallery Width	6.12	m
Excavation Depth	1.3	m
Required Air Flow - Diffused Aeration	422	N m3/min/1000 m3
Number Of Mixers Per SBR	1	
Override Database Costs	FALSE	
Standard 2 scfm Fine Bubble Diffuser	\$60	\$
Standard 12 scfm Coarse Bubble Diffuser	\$40	\$
Standard 550 scfm Swing Arm Diffuser	\$7,970	\$
5 hp Vertical Turbine Mixer	\$8,860	\$
Standard 3000 gpm Pump and Driver Unit	\$37,900	\$
Fine Bubble Diffuser	10	years
Coarse Bubble Diffuser	20	years
Swing Arm Diffuser	20	years
Turbine Mixer	20	years
Pump	25	years
Structural	40	years

### Design Output Data

Description	Value	Units
Sequencing Batch Reactor		
Carbon, Nitrogen and Phosphorus Removal Design		
Design SRT for design at winter temperature	10	d
Aerated cycle time	4	hr
Un-aerated cycle time	2	hr
Suggested anoxic cycle time	2.6	hr
Suggested anaerobic cycle time	40.6	hr
Settle and decant time	1.5	hr
Total cycle time	7.5	hr
Total exchange volume required	1000	m3
Total volume of SBRS	625	m3
Volume of one SBR	312	m3
Hydraulic retention time	15	hr
F/M ratio	0.123	kg BOD/kg MLSS/d
Calculated SS	18700	g/m3
Calculated VSS	11900	g/m3
Calculated VSS:TSS ratio	0.635	mg VSS/mg SS
Amount of sludge generated	1170	kg/d
Nitrogen requirement for biomass growth	45.7	g/m3



Phosphorus requirement for biomass growth	9.15	g/m <sup>3</sup>
Oxygen requirement to meet average demand	1530	kg/d
Air flow required to meet average demand	15800 N	m <sup>3</sup> /hr
Operation labor required	2650	pers-hrs/yr
Maintenance labor required	1510	pers-hrs/yr
Electrical energy required	1200000	kWh/yr
Volume of earthwork required	622	m <sup>3</sup>
Volume of slab concrete required	128	m <sup>3</sup>
Volume of wall concrete required	135	m <sup>3</sup>
Handrail length	36	m
Number of diffusers per train	389	
Number of swing arm headers per train	2	
<b>Construction and equipment cost</b>	<b>\$375,000</b>	<b>\$</b>
O&M material and supply cost	\$18,900	\$/yr
Energy cost	\$96,100	\$/yr
Amortization cost	\$32,900	\$/yr
<b>SBR Pumping</b>		
Average daily pumping rate	7500	m <sup>3</sup> /d
Total pumping capacity	7500	m <sup>3</sup> /d
Design capacity per pump	3750	m <sup>3</sup> /d
Number of pumps	6	
Number of batteries	1	
Firm pumping capacity	7500	m <sup>3</sup> /d
Operation labor required	339	pers-hrs/yr
Maintenance labor required	267	pers-hours/yr
Electrical energy required	8840	kWh/yr
Volume of earthwork required	54.2	m <sup>3</sup>
Area of pump building	22.2	m <sup>2</sup>
Construction and equipment cost	\$332,000	\$
O&M material and supply cost	\$2,320	\$/yr
Energy cost	\$1,410	\$/yr

### Water Quality Data

Parameter	Influent	Effluent	Sludge	Units
Maximum flow	1000	857	143	m <sup>3</sup> /d
Minimum flow	1000	857	143	m <sup>3</sup> /d
Average flow	1000	857	143	m <sup>3</sup> /d
Suspended solids	1700	25	8000	g/m <sup>3</sup>
% volatile solids	75	63.6	63.6	%
BOD	617	10.9	309	g/m <sup>3</sup>
Soluble BOD	224	10	10	g/m <sup>3</sup>
COD	864	38.8	7640	g/m <sup>3</sup>
Soluble COD	536	15	15	g/m <sup>3</sup>
TKN	320	0.931	1.24	gN/m <sup>3</sup>
Soluble TKN	224	0.93	0.93	gN/m <sup>3</sup>
Ammonia 200	0.93	0.93		gN/m <sup>3</sup>
Nitrite	0.0	0.0	0.0	gN/m <sup>3</sup>
Nitrate	0.0	273	273	gN/m <sup>3</sup>
Total phosphorus	50	1	1	gP/m <sup>3</sup>
pH 6.8	6.8	6.8	-	

Cations	160	160	160	g/m3	
Anions	160	160	160	g/m3	
Settleable solids	10	0.0	0.0	mL/L	
Oil and grease	100	0.0	0.0	g/m3	
Summer temperature	23	23	23	deg C	
Winter temperature	10	10	10	deg C	

## 5. Esquema del tractament biològic SBR simulat pel Software CAPDEWORKS

