

山子坪水資源回收中心工程

質量平衡計算書(全期計畫平均日污水量)

99/6/28 第1.1版

一. 主要數據

1 污水水量

項目	進流流量	流量係數
計畫平均日流量	46,500 CMD	1.00
計畫最大日流量	65,100 CMD	1.40
計畫最大時流量	86,000 CMD	1.85

2 污水水質

水質項目	進流污水水質	放流水水質限值
BOD ₅	180 mg/L	20 mg/L
SS	180 mg/L	20 mg/L

3 各處理單元去除率

處理單元	BOD ₅	SS
渦流沉砂池	0%	0%
初步沉澱池	32%	55%
二級生物處理(含曝氣及二沉)	89%	86%
快濾槽	20%	60%

4 砂礫及固體物性質

項目	濃度	比重
砂礫單位重		1.500
初步沉澱池之污泥濃度	1.50% = 0.02	1.010
二沉池之污泥濃度	1.00% = 0.010	1.005
浮渣之污泥濃度	3.00% = 0.03	0.950
濃縮後之污泥濃度	5.00% = 0.05	1.020
脫水後之污泥濃度	20.00% = 0.20	1.070

5 回收用水量

渦流沉砂池	10 m ³ /d
初步沉澱池浮渣井	10 m ³ /d
曝氣池	150 m ³ /d
二次沉澱池浮渣井	10 m ³ /d
污泥濃縮(清洗濾布用)	326 m ³ /d
污泥脫水(清洗濾布用)	562 m ³ /d
其他回收用水量	3582 m ³ /d
合計	4650 m ³ /d

6 自來水量

污泥濃縮(稀釋Polymer用)	33 m ³ /d
污泥脫水(稀釋Polymer用)	54 m ³ /d
其他	30 m ³ /d
合計	117 m ³ /d

7 其餘設定值與功能計算所設相同

二. 初步試算

(一) 渦流沉砂池

1 進流量及水質

$$(1) \text{原污水BOD}_5 = 46500.0 \times 180 / 1000 = 8370.00 \text{ kg/d}$$

$$\text{原污水SS} = 46500.0 \times 180 / 1000 = 8370.00 \text{ kg/d}$$

(2) 假設回收用水水質

$$\text{BOD}_5 \text{ 濃度} = 15.0 \text{ mg/L}$$

$$\text{SS 濃度} = 15.0 \text{ mg/L}$$

(3) 清洗用水

清洗用水量	=	10.0	m ³ /d						
BOD ₅ 濃度	=	15.0	mg/L						
S S 濃度	=	15.0	mg/L						
BOD ₅ 總量	=	10	×	15.0	/	1000	=	0.15	kg/d
S S 總量	=	10	×	15.0	/	1000	=	0.15	kg/d

(4) 迴流至排水抽水池之水質水量

	流量	BOD ₅	SS
	(CMD)	(kg/day)	(kg/day)
快濾槽反沖洗排水	90.0	15.00	45.00
污泥濃縮機排水	1300.0	400.00	700.00
污泥脫水機排水	800.0	50.00	300.00
合計	2190.0	465.00	1045.00

(5) 則進入渦流沉砂池之流量	=	46500.0	+	10.0	+	2190.0	=	48700.0	m ³ /d
BOD ₅ 總量	=	8370.0	+	0.15	+	465.0	=	8835.15	kg/d
S S 總量	=	8370.0	+	0.15	+	1045.0	=	9415.15	kg/d
BOD ₅ 濃度	=	8835.15	×	1000	/	48700.0	=	181.4	mg/L
S S 濃度	=	9415.15	×	1000	/	48700.0	=	193.3	mg/L

2 計算

設渦流沉砂池之去除率為：

BOD ₅	=	0%	=	0.00					
S S	=	0%	=	0.00					
去除之 BOD ₅	=	8835.15	×	0	=	0.00	kg/d		
去除之 S S	=	9415.15	×	0	=	0.00	kg/d		

渦流沉砂池出水之流量	=	48700.0	-	0.5	=	48699.5	m3/d		
渦流沉砂池出水之 BOD ₅	=	8835.15	-	0.00	=	8835.15	kg/d		
渦流沉砂池出水之 S S	=	9415.15	-	0.00	=	9415.15	kg/d		
BOD ₅ 濃度	=	8835.15	×	1000	/	48699.5	=	181.4	mg/L
S S 濃度	=	9415.15	×	1000	/	48699.5	=	193.3	mg/L

設污水中之砂礫量	=	0.01	m ³ /1000m ³						
砂礫單位重	=	1500	kg/m ³						
砂礫體積	=	46500.0	×	0.01	/	1000	=	0.5	m ³ /d
砂礫重量	=	0.5	×	1500	=	697.50	kg/d		

(二) 初步沉澱池

1 進流量及水質

進初步沉澱池之流量	=	48699.5	m ³ /d
BOD ₅	=	8835.15	kg/d
S S	=	9415.15	kg/d

2 計算

(1) 設初級處理之去除率為：

BOD ₅	=	32%	=	0.32					
S S	=	55%	=	0.55					
去除之 BOD ₅	=	8835.15	×	0.32	=	2827.25	kg/d		
去除之 S S	=	9415.15	×	0.55	=	5178.33	kg/d		

(2) 則初沉污泥量	=	5178.33	kg/d						
初沉污泥流量	=	5178.33	/	(0.01	×	1.01	×	1000)= 515.3 m ³ /d

(3) 設浮渣濃度	=	3%	=	0.03						
浮渣比重	=	0.950								
設浮渣量	=	8	kg/1000m ³	=	0.008 kg/m ³					
則浮渣量	=	0.008	×	48699.5	= 389.60 kg/day					
浮渣流量	=	389.6	/ (0.03	×	0.95	×	1000)=	13.7	m3/d
初沉池浮渣井之回收用水量	=	10	m ³ /d							
BOD ₅ 濃度	=	15.0	mg/L							
S S 濃度	=	15.0	mg/L							
BOD ₅ 總量	=	10	×	15	/	1000	=	0.15	kg/d	
S S 總量	=	10	×	15	/	1000	=	0.15	kg/d	
浮渣流量	=	10.0	+	13.7	=	23.7	m3/d			
浮渣 S S	=	389.60	+	0.15	=	389.75	kg/d			
浮渣BOD5	=	0.00	+	0.15	=	0.15	kg/d			

(4) 初步沉澱池之出流水流量	=	48699.5	-	515.3	-	13.7	=	48170.6	m ³ /d
初步沉澱池之出流水 BOD ₅	=	8835.15			-	2827.25	=	6007.90	kg/d
初步沉澱池之出流水 S S	=	9415.15			-	5178.33	=	4236.82	kg/d
初步沉澱池之出流水BOD ₅ 濃度	=	6007.90	×	1000	/	48170.6	=	124.7	mg/L
初步沉澱池之出流水S S 濃度	=	4236.82	×	1000	/	48170.6	=	88.0	mg/L

(三) 二級生物處理(含曝氣及二沉)

1 進流量及水質

(1) 消泡用水量	=	150	m ³ /d							
BOD ₅ 濃度	=	15.0	mg/L							
S S 濃度	=	15.0	mg/L							
BOD ₅ 總量	=	150	×	15.0	/	1000	=	2.25	kg/d	
S S 總量	=	150	×	15.0	/	1000	=	2.25	kg/d	

(2) 迴流至二級生物處理之水質水量

	流量	BOD ₅	SS
	(CMD)	(kg/day)	(kg/day)
浮渣濃縮機排水	35.0	0.03	50.00
合計	35.0	0.03	50.00

(3) 故進入二級生物處理之流量	=	48170.6	+	150.0	+	35.0	=	48355.6	m ³ /d
BOD ₅	=	6007.90	+	2.25	+	0.03	=	6010.18	kg/d
S S	=	4236.82	+	2.25	+	50.00	=	4289.07	kg/d
BOD ₅ 濃度	=	6010.18	×	1000	/	48355.6	=	124.3	mg/L
S S 濃度	=	4289.07	×	1000	/	48355.6	=	88.7	mg/L

2 計算

(1) 設二級生物處理之去除率為：

BOD ₅	=	89%	=	0.89						
S S	=	86%	=	0.86						
去除之 BOD ₅	=	6010.18	×	0.89	=	5349.06	kg/d			
去除之 S S	=	4289.07	×	0.86	=	3688.60	kg/d			

(2) 廢棄污泥量估算:

MLVSS/MLSS係數	=	0.80								
BOD ₅ /BOD _L 係數	=	0.68								
VSS需氧量係數	=	1.42								

二級生物處理出水之S S 濃度	=	600.47	×	1000	/	47775.1	=	12.6	mg/L
-----------------	---	--------	---	------	---	---------	---	------	------

(四) 快濾槽(供回收用水使用)

1 進流量及水質

(1) 快濾槽進流水水量	=	4650.0	CMD						
快濾槽進流水 BOD ₅	=	4650	×	13.84	/	1000	=	64.35	kg/d
快濾槽進流水 S S	=	4650	×	12.57	/	1000	=	58.44	kg/d

(2) 設反沖洗水量	=	2%	×	進流處理量					
則反沖洗水量	=	4650	×	2%	=	93.00	CMD		
BOD ₅ 濃度	=	15	mg/L						
S S濃度	=	15	mg/L						
反沖洗水BOD ₅ 總量	=	93.00	×	15	/	1000	=	1.40	kg/d
反沖洗水S S 總量	=	93.00	×	15	/	1000	=	1.40	kg/d

2 計算

(1) 設過濾單元之去除率為：

BOD ₅	=	20%	=	0.20
S S	=	60%	=	0.60

去除之BOD ₅	=	64.35	×	0.20	=	12.87	kg/d
去除之S S	=	58.44	×	0.60	=	35.07	kg/d

反沖洗廢水中之BOD ₅	=	12.87	+	1.40	=	14.26	kg/d
反沖洗廢水中之S S	=	35.07	+	1.40	=	36.46	kg/d
反沖洗廢水量	=	93.0	CMD				

回收用水之流量	=	4650.0	-	0.0	=	4650.0	m ³ /d
回收用水之 BOD ₅	=	64.35	-	12.87	=	51.48	kg/d
回收用水之 S S	=	58.44	-	35.07	=	23.38	kg/d

回收用水之BOD ₅ 濃度	=	51.48	X	1000	/	4650.0	=	11.1	mg/L
回收用水之 S S濃度	=	23.38	X	1000	/	4650.0	=	5.0	mg/L

(2) 扣除回收用水流量合計	=	4650.0	m ³ /d						
回收用水BOD ₅ 總量	=	4650.0	×	15.0	/	1000	=	69.75	kg/d
回收用水S S 總量	=	4650.0	×	15.0	/	1000	=	69.75	kg/d

故處理廠排放水流量	=	47775.1	-	4650.0	-	93.0	=	43032.1	m ³ /d
處理廠排放水之BOD ₅ 濃度	=	13.8	mg/L						
處理廠排放水之S S 濃度	=	12.6	mg/L						
處理廠排放水之BOD ₅	=	43032.1	×	13.8	/	1000	=	595.49	kg/d
處理廠排放水之S S	=	43032.1	×	12.6	/	1000	=	540.86	kg/d

(五) 污泥濃縮單元

1 進流量及水質

(1) 污泥濃縮加藥之自來水量	=	33	m ³ /d
(2) 至污泥混合池之流量	=	初沉污泥 + 二沉污泥 + 加藥用水	
	=	515.3 + 577.1 + 33.1	
	=	1125.4	m ³ /d
至污泥混合池之S S	=	初沉污泥 + 二沉污泥	
	=	5178.33 + 5799.77	
	=	10978.10	kg/d
至污泥混合池之BOD ₅	=	初沉污泥 + 二沉污泥	
	=	2827.25 + 0.00	
	=	2827.25	kg/d

2 計算

(1) 設濃縮污泥SS回收率	=	90%	=	0.9	
設濃縮污泥BOD ₅ 回收率	=	90%	=	0.9	
濃縮污泥SS	=	10978.10	×	0.9	= 9880.29 kg/d
濃縮污泥流量	=	9880.29	/	(0.05 × 1.02 × 1000)	= 193.7 m ³ /d
濃縮污泥BOD ₅	=	2827.25	×	0.9	= 2544.52 kg/d
迴流至排水抽水池之流量	=	1125.4	-	193.7	= 931.7 m ³ /d
迴流至排水抽水池之SS	=	10978.10	-	9880.29	= 1096.81 kg/d
迴流至排水抽水池之BOD ₅	=	2827.25	-	2544.52	= 281.72 kg/d

(2) 設稀釋Polymer用水量	=	33.1	m ³ /d						
濾布清洗回收用水流量合計	=	326.4	m ³ /d						
回收用水BOD ₅ 總量	=	326.4	×	15.0	/	1000	=	4.90	kg/d
回收用水SS總量	=	326.4	×	15.0	/	1000	=	4.90	kg/d
濃縮污泥單元至排水抽水池迴流	=	931.7	+	10.0	+	326.4	=	1268.1	m ³ /d
迴流至排水抽水池之BOD ₅	=	281.72	+	0.00	+	4.90	=	286.62	kg/d
迴流至排水抽水池之SS	=	1096.81	+	0.00	+	4.90	=	1101.71	kg/d
迴流至排水抽水池之BOD ₅ 濃度	=	286.62	×	1000	/	1268.1	=	226.0	mg/L
迴流至排水抽水池之SS濃度	=	1101.71	×	1000	/	1268.1	=	868.8	mg/L

(六) 厭氧消化池

(1) 進流量及水質

至厭氧消化池之流量(= 濃縮污泥)	=	193.7	m ³ /d
至厭氧消化池之SS	=	9880.29	kg/d
至厭氧消化池之BOD ₅	=	2544.52	kg/d

(2) 計算

設 VS/TS	=	0.70
污泥 VS	=	0.70 × 9880.29 = 6916.20 kg/day
污泥 FS	=	0.30 × 9880.29 = 2964.09 kg/day
污泥消化池內VS減少率VSDR為	=	40.00 % = 0.40
則VS減少量	=	6916.20 × 0.40 = 2766.48 kg/day
消化後污泥VS	=	6916.20 - 2766.48 = 4149.72 kg/day
消化後污泥TS	=	4149.72 + 2964.09 = 7113.81 kg/day
消化後污泥VS	=	4149.72 / 7113.81 = 58.33 %
設瓦斯產生率	=	0.90 m ³ /kg減少之V(0.75~1.12m ³ /kg,M&E)
BIOGAS產生量	=	2766.5 × 0.9 = 2489.8 kg/day
則消化後污泥流量Q	=	193.7 m ³ /d
消化後污泥BOD ₅	=	2544.5 × 0.4 = 1017.8 kg/day

(七) 污泥脫水機

1 進流量及水質

進流污泥流量	=	193.7	m ³ /d
進流污泥SS量	=	7113.81	kg/d
進流污泥BOD ₅ 量	=	1017.81	kg/d

2 計算

(1) 設固體回收率	=	90%	=	0.90	
設脫水污泥BOD ₅ 回收率	=	90%	=	0.90	
污泥餅重	=	7113.81	×	0.90	= 6402.43 kg/d
脫水後之污泥濃度	=	20%	=	0.20	
污泥餅比重	=	1.07			
其流量	=	6402.43	/	(0.2 × 1.07 × 1000)	= 29.9 m ³ /d

脫水過濾液迴流量	=	193.7	-	29.9	=	163.8	m ³ /d
脫水污泥BOD ₅	=	1017.81	×	0.9	=	916.03	kg/d
迴流至排水抽水池之S S	=	7113.81	-	6402.43	=	710.38	kg/d
迴流至排水抽水池之BOD ₅	=	1017.81	-	916.03	=	100.78	kg/d

(2) 設清洗濾布用回收水量	=	561.6	m ³ /d						
回收用水BOD ₅ 總量	=	561.6	×	15.0	/	1000	=	8.42	kg/d
回收用水S S 總量	=	561.6	×	15.0	/	1000	=	8.42	kg/d
設稀釋Polymer用水量	=	53.5	m ³ /d						

污泥脫水至排水抽水池迴流量	=	163.8	+	561.6	+	53.5	=	779.0	m ³ /d
迴流至排水抽水池之BOD ₅	=	100.78	+	8.42	+	0.00	=	109.20	kg/d
迴流至排水抽水池之SS	=	710.38	+	8.42	+	0.00	=	718.80	kg/d
迴流至排水抽水池之BOD ₅ 濃度	=	109.2	×	1000	/	779	=	140.2	mg/L
迴流至排水抽水池之SS濃度	=	718.8	×	1000	/	779	=	922.8	mg/L

三. 第一次修正計算(略)

四. 第二次修正計算(略)

五. 第三次修正計算(略)

六. 第四次修正計算(略)

七. 第五次修正計算

(一) 主要數據

1 污水量

項目	進流流量	流量係數
計畫平均日流量	46,500 CMD	1.00
計畫最大日流量	65,100 CMD	1.40
計畫最大時流量	86,000 CMD	1.85

2 污水質

水質項目	進流污水水質	放流水水質限值
BOD ₅	180 mg/L	20 mg/L
SS	180 mg/L	20 mg/L

3 各處理單元去除率

處理單元	BOD ₅	S S
渦流沉砂池	0%	0%
初步沉澱池	32%	55%
二級生物處理(含曝氣及二沉)	89%	86%
快濾槽	20%	60%

4 砂礫及固體物性質

項目	濃度	比重
砂礫單位重		1.500
初步沉澱池之污泥濃度	1.50% = 0.02	1.010
二沉池之污泥濃度	1.00% = 0.010	1.005
浮渣之污泥濃度	3.00% = 0.03	0.950
濃縮後之污泥濃度	5.00% = 0.05	1.020
脫水後之污泥濃度	20.00% = 0.20	1.070

5 回收用水量

渦流沉砂池	10 m ³ /d
初步沉澱池浮渣井	10 m ³ /d
曝氣池	150 m ³ /d
二次沉澱池浮渣井	10 m ³ /d
污泥濃縮(清洗濾布用)	326 m ³ /d
污泥脫水(清洗濾布用)	562 m ³ /d
其他回收用水量	3582 m ³ /d

合計	4650	m ³ /d
----	------	-------------------

6 自來水量

污泥濃縮(稀釋Polymer用)	33	m ³ /d
污泥脫水(稀釋Polymer用)	54	m ³ /d
其他	30	m ³ /d
合計	117	m ³ /d

7 其餘設定值與功能計算所設相同

(二) 渦流沉砂池

1 進流量及水質

$$\begin{aligned} (1) \text{ 原污水BOD}_5 &= 46500.0 \times 180 / 1000 = 8370.0 \text{ kg/d} \\ \text{原污水S S} &= 46500.0 \times 180 / 1000 = 8370.0 \text{ kg/d} \end{aligned}$$

(2) 假設回收用水水質

$$\begin{aligned} \text{BOD}_5 \text{ 濃度} &= 11.0 \text{ mg/L} \\ \text{S S 濃度} &= 5.5 \text{ mg/L} \end{aligned}$$

(3) 清洗用水

$$\begin{aligned} \text{清洗用水量} &= 10.0 \text{ m}^3/\text{d} \\ \text{BOD}_5 \text{ 濃度} &= 11.0 \text{ mg/L} \\ \text{S S 濃度} &= 5.5 \text{ mg/L} \\ \text{BOD}_5 \text{ 總量} &= 10 \times 11.0 / 1000 = 0.11 \text{ kg/d} \\ \text{S S 總量} &= 10 \times 5.5 / 1000 = 0.06 \text{ kg/d} \end{aligned}$$

(4) 迴流至排水抽水池之水質水量

	流量	BOD ₅	SS
	(CMD)	(kg/day)	(kg/day)
快濾槽反沖洗排水	93.0	13.82	39.08
污泥濃縮機排水	1148.3	283.34	1185.50
污泥脫水機排水	791.9	106.25	769.78
合計	2033.2	403.41	1994.36

$$\begin{aligned} (5) \text{ 則進入渦流沉砂池之流量} &= 46500.0 + 10.0 + 2033.2 = 48543.2 \text{ m}^3/\text{d} \\ \text{BOD}_5 \text{ 總量} &= 8370.0 + 0.11 + 403.4 = 8773.52 \text{ kg/d} \\ \text{S S 總量} &= 8370.0 + 0.06 + 1994.4 = 10364.42 \text{ kg/d} \\ \text{BOD}_5 \text{ 濃度} &= 8773.52 \times 1000 / 48543.2 = 180.7 \text{ mg/L} \\ \text{S S 濃度} &= 10364.42 \times 1000 / 48543.2 = 213.5 \text{ mg/L} \end{aligned}$$

2 計算

設渦流沉砂池之去除率為：

$$\begin{aligned} \text{BOD}_5 &= 0\% = 0.00 \\ \text{S S} &= 0\% = 0.00 \\ \text{去除之 BOD}_5 &= 8773.52 \times 0 = 0 \text{ kg/d} \\ \text{去除之 S S} &= 10364.42 \times 0 = 0.00 \text{ kg/d} \end{aligned}$$

渦流沉砂池出水之流量	=	48543.2	-	0.5	=	48542.7	m ³ /d
渦流沉砂池出水之 BOD ₅	=	8773.52	-	0	=	8773.52	kg/d
渦流沉砂池出水之 S S	=	10364.42	-	0.00	=	10364.42	kg/d
BOD ₅ 濃度	=	8773.52	×	1000	/	48542.7	= 180.7 mg/L
S S 濃度	=	10364.42	×	1000	/	48542.7	= 213.5 mg/L

$$\begin{aligned} \text{設污水中之砂礫量} &= 0.01 \text{ m}^3/1000\text{m}^3 \\ \text{砂礫單位重} &= 1500 \text{ kg/m}^3 \\ \text{砂礫體積} &= 46500.0 \times 0.01 / 1000 = 0.5 \text{ m}^3/\text{d} \\ \text{砂礫重量} &= 0.5 \times 1500 = 697.5 \text{ kg/d} \end{aligned}$$

(三) 初步沉澱池

1 進流量及水質

$$\begin{aligned}\text{進初步沉澱池之流量} &= 48542.7 \text{ m}^3/\text{d} \\ \text{BOD}_5 &= 8773.52 \text{ kg/d} \\ \text{S S} &= 10364.42 \text{ kg/d}\end{aligned}$$

2 計算

(1) 設初級處理之去除率為：

$$\begin{aligned}\text{BOD}_5 &= 32\% = 0.32 \\ \text{S S} &= 55\% = 0.55 \\ \text{去除之 BOD}_5 &= 8773.52 \times 0.32 = 2807.53 \text{ kg/d} \\ \text{去除之 S S} &= 10364.42 \times 0.55 = 5700.43 \text{ kg/d}\end{aligned}$$

$$\begin{aligned}(2) \text{則初沉污泥量} &= 5700.43 \text{ kg/d} \\ \text{初沉污泥流量} &= 5700.43 / (0.02 \times 1.01 \times 1000) = 376.3 \text{ m}^3/\text{d}\end{aligned}$$

$$\begin{aligned}(3) \text{設浮渣濃度} &= 3\% = 0.03 \\ \text{浮渣比重} &= 0.950 \\ \text{設浮渣量} &= 8 \text{ kg/1000m}^3 = 0.008 \text{ kg/m}^3 \\ \text{則浮渣量} &= 0.008 \times 48542.7 = 388.34 \text{ kg/day} \\ \text{浮渣流量} &= 388.34 / (0.03 \times 0.95 \times 1000) = 13.6 \text{ m}^3/\text{d} \\ \text{初沉池浮渣井之回收用水量} &= 10 \text{ m}^3/\text{d} \\ \text{BOD}_5 \text{ 濃度} &= 11.0 \text{ mg/L} \\ \text{S S 濃度} &= 5.5 \text{ mg/L} \\ \text{BOD}_5 \text{ 總量} &= 10 \times 11 / 1000 = 0.1 \text{ kg/d} \\ \text{S S 總量} &= 10 \times 5.5 / 1000 = 0.1 \text{ kg/d} \\ \text{浮渣流量} &= 10.0 + 13.6 = 23.6 \text{ m}^3/\text{d} \\ \text{浮渣 S S} &= 388.34 + 0.06 = 388.40 \text{ kg/d} \\ \text{浮渣BOD}_5 &= 0.00 + 0.11 = 0.11 \text{ kg/d}\end{aligned}$$

$$\begin{aligned}(4) \text{初步沉澱池之出流水流量} &= 48542.7 - 376.3 - 13.6 = 48152.8 \text{ m}^3/\text{d} \\ \text{初步沉澱池之出流水 BOD}_5 &= 8773.52 - 2807.53 = 5965.99 \text{ kg/d} \\ \text{初步沉澱池之出流水 S S} &= 10364.42 - 5700.43 = 4663.99 \text{ kg/d} \\ \text{初步沉澱池之出流水BOD}_5 \text{濃度} &= 5965.99 \times 1000 / 48152.8 = 123.9 \text{ mg/L} \\ \text{初步沉澱池之出流水S S 濃度} &= 4663.99 \times 1000 / 48152.8 = 96.9 \text{ mg/L}\end{aligned}$$

(四) 二級生物處理(含曝氣及二沉)

1 進流量及水質

$$\begin{aligned}(1) \text{消泡用水流量} &= 150 \text{ m}^3/\text{d} \\ \text{BOD}_5 \text{ 濃度} &= 11.0 \text{ mg/L} \\ \text{S S 濃度} &= 5.5 \text{ mg/L} \\ \text{BOD}_5 \text{ 總量} &= 150 \times 11.0 / 1000 = 1.65 \text{ kg/d} \\ \text{S S 總量} &= 150 \times 5.5 / 1000 = 0.83 \text{ kg/d}\end{aligned}$$

(2) 迴流至二級生物處理之水質水量

	流量	BOD ₅	SS
	(CMD)	(kg/day)	(kg/day)
浮渣濃縮機排水	34.8	0.02	47.50
合計	34.8	0.02	47.50

$$\begin{aligned}(3) \text{故進入二級生物處理之流量} &= 48152.8 + 150.0 + 34.8 = 48337.6 \text{ m}^3/\text{d} \\ \text{BOD}_5 &= 5965.99 + 1.65 + 0.02 = 5967.66 \text{ kg/d}\end{aligned}$$

$$\begin{aligned}
 S S &= 4663.99 + 0.83 + 47.50 = 4712.31 \text{ kg/d} \\
 \text{BOD}_5 \text{ 濃度} &= 5967.66 \times 1000 / 48337.6 = 123.5 \text{ mg/L} \\
 S S \text{ 濃度} &= 4712.31 \times 1000 / 48337.6 = 97.5 \text{ mg/L}
 \end{aligned}$$

2 計算

(1) 設二級生物處理之去除率為：

$$\begin{aligned}
 \text{BOD}_5 &= 89\% = 0.89 \\
 S S &= 86\% = 0.86 \\
 \text{去除之 } \text{BOD}_5 &= 5967.66 \times 0.89 = 5311.22 \text{ kg/d} \\
 \text{去除之 } S S &= 4712.31 \times 0.86 = 4052.59 \text{ kg/d}
 \end{aligned}$$

(2) 廢棄污泥量估算：

$$\begin{aligned}
 \text{MLVSS/MLSS 係數} &= 0.80 \\
 \text{BOD}_5/\text{BOD}_L \text{ 係數} &= 0.68 \\
 \text{VSS 需氧量係數} &= 1.42 \\
 \text{S-BOD/T-BOD} &= 65\% \\
 \text{生長係數 } Y_h &= 0.650 \text{ g-VSS/g-BOD} \\
 \text{內衰減係數 } k_d &= 0.050 \text{ day}^{-1} \\
 \text{基質利用率 } K_s &= 90.000 \text{ g/m}^3 \\
 \text{最大比生長率 } \mu_m &= 2.000 \text{ day}^{-1} \\
 \text{二沉污泥濃度} &= 8,000.0 \\
 \text{S-BOD/T-BOD} &= 0.650 \\
 \theta_c &= 6.000 \\
 \text{進水 } \text{BOD}_5 \text{ 濃度} &= 123.5 \text{ mg/l (依質量平衡結果)} \\
 \text{進水 S-BOD}_5 \text{ 濃度} &= 80.2 \text{ mg/l} \\
 \text{出流水 S-BOD}_5 \text{ 濃度} &= K_s \times (1 + k_d \times \theta_c) / (\mu_m \times \theta_c - (1 + k_d \times \theta_c)) \\
 &= 10.9 \text{ mg/l} \\
 \text{出流水 } \text{BOD}_5 \text{ 濃度} &= 16.8 \text{ mg/l} \\
 \text{比生長率 } \mu &= 1 / (\theta_c + k_d) = 0.217 \\
 \text{淨生長係數 } Y_{nh} &= Y_h / (1 + k_d \times \theta_c) = 0.500 \\
 \text{廢棄污泥 MLVSS } (P_x) &= Y_{nh} \times Q \times (S - S_e) = 1675.21 \text{ kg/day} \\
 \text{廢棄污泥 MLSS} &= 2094.02 \text{ kg/day} \\
 \text{廢棄 SS} &= 4052.59 \text{ kg/day} \\
 \text{廢棄污泥} &= 2094.02 + 4052.59 = 6146.61 \text{ kg/day} \\
 \text{則污泥流量} &= 6146.61 / (0.01 \times 1.005 \times 1000) = 611.6 \text{ m}^3/\text{d} \\
 (3) \text{ 浮渣濃度} &= 3\% = 0.03 \\
 \text{浮渣比重} &= 0.95 \\
 \text{設浮渣量} &= 2 \text{ kg/1000m}^3 = 0.002 \text{ kg/m}^3 \\
 \text{則浮渣量} &= 0.002 \times 48337.6 = 96.68 \text{ kg/day} \\
 \text{浮渣流量} &= 96.68 / (0.03 \times 0.95 \times 1000) = 3.4 \text{ m}^3/\text{d} \\
 \text{二沉浮渣井之回收用水量} &= 10.0 \text{ m}^3/\text{d} \\
 \text{BOD}_5 \text{ 濃度} &= 11.0 \text{ mg/L} \\
 S S \text{ 濃度} &= 5.5 \text{ mg/L} \\
 \text{BOD}_5 \text{ 總量} &= 10 \times 11 / 1000 = 0.11 \text{ kg/d} \\
 S S \text{ 總量} &= 10 \times 5.5 / 1000 = 0.06 \text{ kg/d} \\
 \text{浮渣流量} &= 10.0 + 3.4 = 13.4 \text{ m}^3/\text{d} \\
 \text{浮渣 } S S &= 96.68 + 0.06 = 96.73 \text{ kg/d} \\
 \text{浮渣 } \text{BOD}_5 &= 0.00 + 0.11 = 0.11 \text{ kg/d} \\
 \text{至浮渣濃縮機之浮渣流量} &= \text{初沉浮渣} + \text{二沉浮渣} \\
 &= 23.6 + 13.4 = 37.0 \text{ m}^3/\text{d} \\
 \text{至浮渣濃縮機之浮渣之 } S S &= 388.40 + 96.73 = 485.13 \text{ kg/d} \\
 \text{至浮渣濃縮機之浮渣之 } \text{BOD}_5 &= 0.11 + 0.11 = 0.22 \text{ kg/d}
 \end{aligned}$$

設浮渣濃縮機固體回收率	=	90%	=	0.90	
設浮渣濃縮機BOD ₅ 回收率	=	90%	=	0.90	
浮渣餅重	=	485.13	×	0.90	= 436.61 kg/d
壓柵後之浮渣濃度	=	20%	=	0.20	
浮渣餅比重	=	1			
其流量	=	436.61	/ (0.2 × 1 × 1000) =	2.2	m ³ /d
壓柵過濾液迴流量	=	37.0	- 2.2	=	34.8 m ³ /d
壓柵浮渣餅BOD ₅	=	0.22	×	0.90	= 0.20 kg/d
迴流至生物處理池之S S	=	485.13	- 436.61	=	47.51 kg/d
迴流至生物處理池之BOD ₅	=	0.22	- 0.20	=	0.02 kg/d

(4) 二級生物處理出水之流量	=	48337.6	- 611.6	- 3.4	=	47722.6	m ³ /d
二級生物處理出水之 BOD ₅	=	5967.66	-	- 5311.22	=	656.44	kg/d
二級生物處理出水之 S S	=	4712.31	-	- 4052.59	=	659.72	kg/d
二級生物處理出水之 BOD ₅ 濃度	=	656.44	×	1000 / 47722.6	=	13.8	mg/L
二級生物處理出水之 S S 濃度	=	659.72	×	1000 / 47722.6	=	13.8	mg/L

(五) 快濾槽(供回收用水使用)

1 進流量及水質

(1) 快濾槽進流水水量	=	4650.0	CMD		
快濾槽進流水 BOD ₅	=	4650	×	13.8 / 1000	= 63.96 kg/d
快濾槽進流水 S S	=	4650	×	13.8 / 1000	= 64.28 kg/d

(2) 設反沖洗水量	=	2%	×	進流處理量	
則反沖洗水量	=	4650	×	2%	= 93.00 CMD
BOD ₅ 濃度	=	11.0	mg/L		
S S濃度	=	5.5	mg/L		
反沖洗水BOD ₅ 總量	=	93.00	×	11.0 / 1000	= 1.02 kg/d
反沖洗水S S 總量	=	93.00	×	5.5 / 1000	= 0.51 kg/d

2 計算

(1) 設過濾單元之去除率為：

BOD ₅	=	20%	=	0.20
S S	=	60%	=	0.60

去除之BOD ₅	=	63.96	×	0.20	=	12.79	kg/d
去除之S S	=	64.28	×	0.60	=	38.57	kg/d

反沖洗廢水中之BOD ₅	=	12.79	+	1.02	=	13.82	kg/d
反沖洗廢水中之S S	=	38.57	+	0.51	=	39.08	kg/d
反沖洗廢水量	=	93.0	CMD				

回收用水之流量	=	4650.0	- 0.0	=	4650.0	m ³ /d
回收用水之 BOD ₅	=	63.96	- 12.79	=	51.17	kg/d
回收用水之 S S	=	64.28	- 38.57	=	25.71	kg/d

回收用水之BOD ₅ 濃度	=	51.17	×	1000 / 4650.0	=	11.0	mg/L
回收用水之 S S濃度	=	25.71	×	1000 / 4650.0	=	5.5	mg/L

(2) 扣除回收用水量合計	=	4650.0	m3/d				
回收用水BOD ₅ 總量	=	4650.0	×	11.0	/	1000	= 51.15 kg/d
回收用水S S 總量	=	4650.0	×	5.5	/	1000	= 25.58 kg/d
故處理廠排放水流量	=	47722.6	-	4650.0	-	93.0	= 42979.6 m ³ /d
處理廠排放水之BOD ₅ 濃度	=	13.8	mg/L				
處理廠排放水之SS 濃度	=	13.8	mg/L				

處理廠排放水之BOD ₅	=	42979.6	×	13.8	/	1000	=	591.20	kg/d
處理廠排放水之SS	=	42979.6	×	13.8	/	1000	=	594.16	kg/d

(六) 污泥濃縮單元

1 進流量及水質

(1) 污泥濃縮加藥之自來水量	=	33	m ³ /d
(2) 至污泥混合池之流量	=	初沉污泥 + 二沉污泥 + 加藥用水	
	=	376.3	+ 611.6 + 33.1
	=	1020.9	m ³ /d
至污泥混合池之SS	=	初沉污泥 + 二沉污泥	
	=	5700.43	+ 6146.61
	=	11847.03	kg/d
至污泥混合池之BOD ₅	=	初沉污泥 + 二沉污泥	
	=	2807.53	+ 0.00
	=	2807.53	kg/d

2 計算

(1) 設濃縮污泥SS回收率	=	90%	=	0.9					
設濃縮污泥BOD ₅ 回收率	=	90%	=	0.9					
濃縮污泥SS	=	11847.03	×	0.9	=	10662.33	kg/d		
濃縮污泥流量	=	10662.33	/	(0.05 × 1.02 × 1000)	=	209.1	m ³ /d		
濃縮污泥BOD ₅	=	2807.53	×	0.90	=	2526.77	kg/d		
迴流至排水抽水池之流量	=	1020.9	-	209.1	=	811.9	m ³ /d		
迴流至排水抽水池之SS	=	11847.03	-	10662.33	=	1183.70	kg/d		
迴流至排水抽水池之BOD ₅	=	2807.53	-	2526.77	=	279.75	kg/d		

(2) 設稀釋Polymer用水量	=	33.1	m ³ /d						
濾布清洗回收用水流量合計	=	326.4	m ³ /d						
回收用水BOD ₅ 總量	=	326.4	×	11.0	/	1000	=	3.59	kg/d
回收用水SS總量	=	326.4	×	5.5	/	1000	=	1.80	kg/d
濃縮污泥單元至排水抽水池迴流	=	811.9	+	10.0	+	326.4	=	1148.3	m ³ /d
迴流至排水抽水池之BOD ₅	=	279.75	+	0.00	+	3.59	=	283.34	kg/d
迴流至排水抽水池之SS	=	1183.70	+	0.00	+	1.80	=	1185.50	kg/d
迴流至排水抽水池之BOD ₅ 濃度	=	283.34	×	1000	/	1148.3	=	246.8	mg/L
迴流至排水抽水池之SS濃度	=	1185.50	×	1000	/	1148.3	=	1032.4	mg/L

(七) 厭氧消化池

(1) 進流量及水質

至厭氧消化池之流量(= 濃縮污泥)	=	209.1
至厭氧消化池之SS	=	10662.33 kg/d
至厭氧消化池之BOD ₅	=	2526.77 kg/d

(2) 計算

設 VS/TS	=	0.70
污泥 VS	=	0.70 × 10662.33 = 7463.63 kg/day
污泥 FS	=	0.30 × 10662.33 = 3198.70 kg/day
污泥消化池內VS減少率VSDR為	=	40.00 % = 0.40
則VS減少量	=	7463.63 × 0.40 = 2985.45 kg/day
消化後污泥VS	=	7463.63 - 2985.45 = 4478.18 kg/day
消化後污泥TS	=	4478.18 + 3198.70 = 7676.88 kg/day
消化後污泥VS	=	4478.18 / 7676.88 = 58.33 %
設瓦斯產生率	=	0.90 m ³ /kg減少之V (0.75~1.12m ³ /kg, M&E)
BIOGAS產生量	=	2985.45 × 0.9 = 2686.91 kg/day

$$\begin{aligned}\text{則消化後污泥流量} Q &= 209.1 \text{ m}^3/\text{d} \\ \text{消化後污泥BOD}_5 &= 2526.77 \times 0.4 = 1010.71 \text{ kg/day}\end{aligned}$$

(八) 污泥脱水機

1 進流量及水質

$$\begin{aligned}\text{進流污泥流量} &= 209.1 \text{ m}^3/\text{d} \\ \text{進流污泥SS量} &= 7676.88 \text{ kg/d} \\ \text{進流污泥BOD}_5\text{量} &= 1010.71 \text{ kg/d}\end{aligned}$$

2 計算

$$(1) \text{ 設固體回收率} = 90\% = 0.90$$

$$\text{設脫水污泥BOD}_5\text{回收率} = 90\% = 0.90$$

$$\text{污泥餅重} = 7676.88 \times 0.90 = 6909.19 \text{ kg/d}$$

$$\text{脫水後之污泥濃度} = 20\% = 0.20$$

$$\text{污泥餅比重} = 1.07$$

$$\text{其污泥餅量} = 6909.19 / (0.2 \times 1.07 \times 1000) = 32.3 \text{ m}^3/\text{d}$$

$$\text{脫水過濾液迴流量} = 209.1 - 32.3 = 176.8 \text{ m}^3/\text{d}$$

$$\text{脫水污泥BOD}_5 = 1010.71 \times 0.9 = 909.64 \text{ kg/d}$$

$$\text{迴流至排水抽水池之SS} = 7676.88 - 6909.19 = 766.69 \text{ kg/d}$$

$$\text{迴流至排水抽水池之BOD}_5 = 1010.71 - 909.64 = 100.07 \text{ kg/d}$$

$$(2) \text{ 設清洗濾布用回收水量} = 561.6 \text{ m}^3/\text{d}$$

$$\text{回收用水BOD}_5\text{總量} = 561.6 \times 11.0 / 1000 = 6.18 \text{ kg/d}$$

$$\text{回收用水SS總量} = 561.6 \times 5.5 / 1000 = 3.09 \text{ kg/d}$$

$$\text{設稀釋Polymer用水量} = 53.5 \text{ m}^3/\text{d}$$

$$\text{污泥脫水至排水抽水池迴流量} = 176.8 + 561.6 + 53.5 = 791.9 \text{ m}^3/\text{d}$$

$$\text{迴流至排水抽水池之BOD}_5 = 100.07 + 6.18 + 0.00 = 106.25 \text{ kg/d}$$

$$\text{迴流至排水抽水池之SS} = 766.69 + 3.09 + 0.00 = 769.78 \text{ kg/d}$$

$$\text{迴流至排水抽水池之BOD}_5\text{濃度} = 106.2 \times 1000 / 792 = 134.2 \text{ mg/L}$$

$$\text{迴流至排水抽水池之SS濃度} = 769.8 \times 1000 / 792 = 972.0 \text{ mg/L}$$