

Incheon Unbuk Sewage Treatment Plant

1. Introduction



Incheon unbuk sewage treatment plant is operated using A₂O method to remove SS as well as nutritive salts from the wastewater, at a capacity of 12,000m³ / day. However, the existing treatment plant needed improvement to follow water treatment policy change such as enhanced designed inflow water quality standard as well as effluent water quality standard. They have started the improvement process of partial reactor and secondary clarifier in the existing A₂O process. In addition, DF-MBR process with 11,000m³/day capacity was additionally built, which increased the total capacity up to 23,000m³/day.

Table 1. Unbuk STP

Item	Content
1. Location	Within Incheon Sudogwon Landfill Facility
2. Coverage	Residential area
3. Plant Area	37,251m ²
4. Capacity	12,000(A ₂ O) + 11,000(expanded)m ³ /day
4. Process Method	DF-MBR (applied in expansion part)
6. Construction Period	Jan. 2010 ~ Jan. 2012
6. Commission	Feb. 2012
7. Discharge	Northern ocean of Incheon Airport

Unbuk STP DF-MBR plant has been designed to have a capacity of 11,000m³/day until 2025, and it is currently being operated at the average of approximately 6,000m³/day.

Some of major design requirements were BOD 220 mg/L, COD 170mg/L, SS 255mg/L, TN 57.0mg/L and TP 6.0mg/L based on the inflow water quality analysis and analysis of unit pollutant load of previous plant.

Table 2. Water Quality and Performance Assurance Plan Unbuk STP Water

		Discharged Water Quality	
Parameter	Design Requirements	Guarantee Standard	Guaranteed Water Quality for Unbuk
BOD	220	≤ 10	≤ 7
COD	170	≤ 40	≤ 20
SS	255	≤ 10	≤ 5
T-N	57	≤ 20	≤ 20
T-P	6	≤ 2	≤ 2
Coliform bacillus	500,000	≤ 3,000	Not Detected

Note:

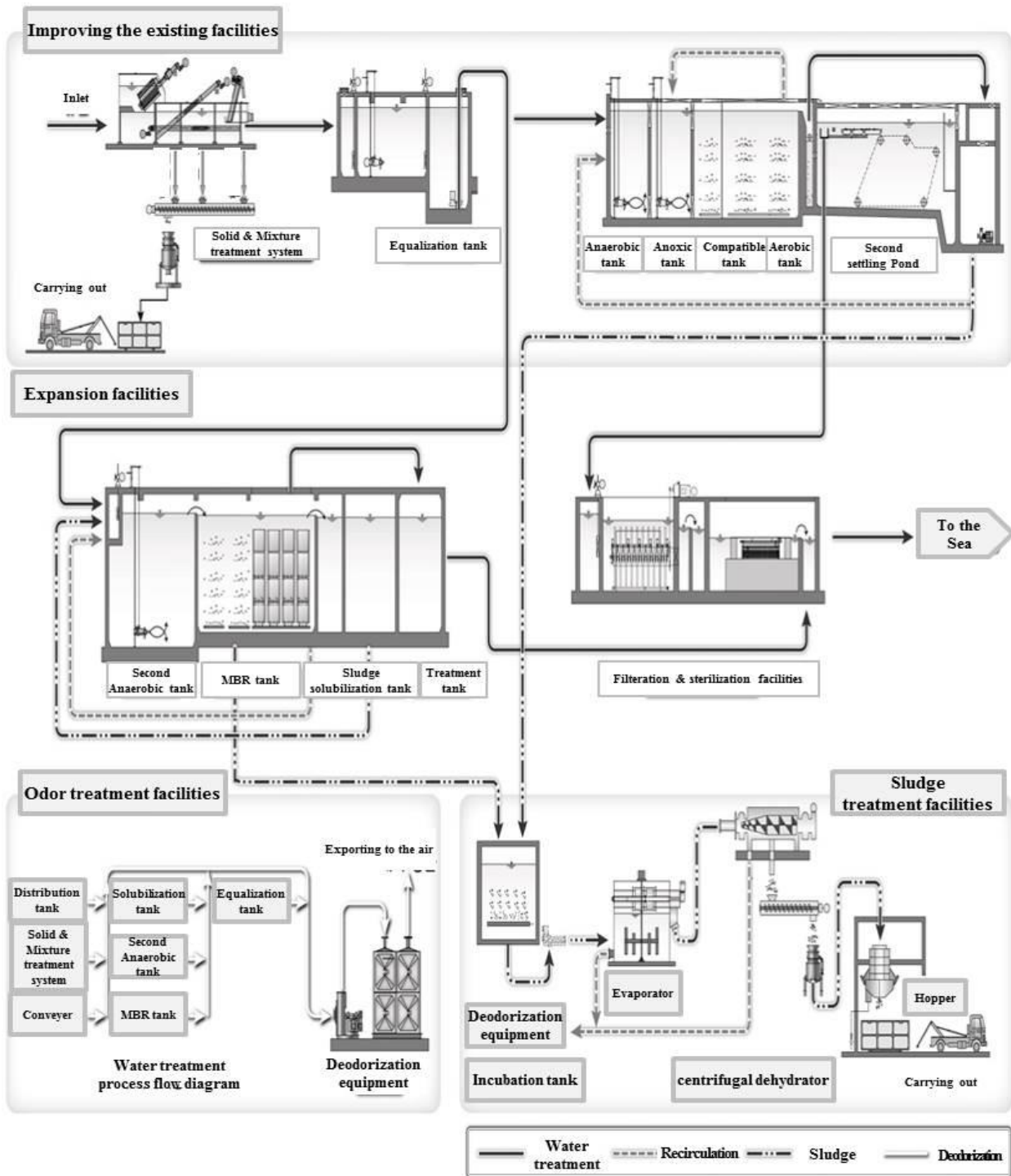
- 1) Unit: mg / L, more / mL
- 2) "Not detected" means they are ≤ 30 / mL

In addition, the performance guarantee is stricter than the legal standard of discharged water quality, which is BOD 7mg/L, COD 20 mg/L, SS 5 mg/L, T-N 20 mg/L and ≤T-P 2mg/L. The water is discharged to northern shore of Incheon Airport.

2. Process and Facilities

A durable and economical facility that can be easily maintained by facility manager with guaranteed performance was selected for

Incheon Unbuk STP (Facilities area 37,251 m²). It is consisted with the preprocess plant, control tank for proper flow, Bio reactor (DF-MBR) to get stabilized amount of treated water, and the dewatering system for the sewage generated during the process as well as the system to recycle water from the sewage. The overall process is shown in Figure 1. In addition, the bio reactor, which is the main part of the process, is consisted with anaerobic bioreactor for denitrification and releasing phosphorus, 2 non-oxygen tanks, and MBR tank that generates oxidation of both organic substance and phosphorus.



<Figure 1> Process Flow Chart

3. Membrane Specification

For the large facility like STP, it is necessary to increase the density of membrane per installed area as it requires large quantity of membrane. Pure Envitech's SBM the 10S16L cassette-type was applied to Unbuk STP as they needed to minimize the site area at the same time. As shown in Figure 2, They used 40 cassettes that have 160 SBM blocks per cassette which is consisted with 15 C-PVC flat sheets (634W × 300H × 5T (mm) per block, for

1 cassette. Detailed specifications are listed in Table 3.



<Figure 2> SBM Flat Membrane Module

Table 3. SBM Type Block Specification

Item	Spec. Details	Shape	Advantage of the MBR Material		
Structure	Submerged Membrane Block		External Pressure Filtration	Fine and Stable Sheet	Supporting frame for higher tensile strength
Block Size	W600 x L 194x H300				
MBR Surface Area	4.5m ² /block				
MBR Element	C-PVC				
Pore Size	0.4μm				
Max Differential Pressure on Membrane	0.5kgf/cm ²				
Operating pressure	0.10~0.45kgf/cm ²	<ul style="list-style-type: none"> · Block consisted with 15 membrane sheets of 0.3m² membrane area · Thermal welding to enhance the chemical resistance 	<ul style="list-style-type: none"> · C-PVC material has high chemical resistance · Internal supporting frame and fixing plate lead higher tensile strength · Long lasting membrane lifespan · Low pressure operation and cyclic aerobic cleaning to reduce fouling 		
Max. operating temperature	40°C below				
Operating pH	2~10				
Cleaning pH	2 ~ 10(≤40 °C)				
Max. OCl-	1,000,000ppm-hr				

4. Operation of the Membrane Separation Tank

Operating condition of the membrane bioreactor tank is shown in Table 3. It indicates the plant is being operated under the condition of MLSS 8,873~12,017 mg / L, DO 3.2~4.3 mg / L, TMP \leq 40 Kpa, Flux 20 ℓ / m² • hr.

Membrane separation tank operating conditions play a major role in bioreactor case, as shown in Table 4 MLSS 8,873 ~ 12,017 mg / L, DO 3.2 ~ 4.3 mg / L, TMP 40 Kpa or less, in terms of Flux 20 ℓ / m² • hr is being operated.

Table 4. Membrane Separation Tank Driving Conditions

Item	Operating Conditions	Average
Temperature (°C)	13.9~26.4	19.4
pH	6.7~7.2	6.8
DO(mg/L)	3.2~4.3	3.6
MLSS(mg/L)	8,873~12,017	8,912
TMP(Kpa)	< 40	< 40
Flux(ℓ /m ² •hr)	20	-

The most important factor is permeation flux of the membrane tank and it was operated 20 ℓ /m² • hr. Depending on the operating conditions and type of water, the permeation flux tend to be reduced due to contamination, but the permeation flux is able to be maintained through cleaning using NaOCl citric acid.

5. Facility Operation Results

Geumchon, STP has been operating since August 2013 the influent water quality BOD, COD, SS, TN, TP are 0.9mg/L, 6.2mg/L, \leq 0.1mg/L, 8.06mg/L, 0.86mg/L and it was 60% higher guaranteed water quality

Table 5. Water Quality Analysis (2013 Operational Status of Incheon Unbuk STP)

Item	Influent	Effluent	Plan Water Inflow	Performance Warranty
BOD(mg/L)	195.6	0.9	220.0	\leq 5
COD(mg/L)	126.8	6.2	170.0	\leq 20
SS(mg/L)	235.7	<0.1	255.0	\leq 2
T-N(mg/L)	44.667	8.06	57.0	\leq 15
T-P(mg/L)	4.92	0.86	6.0	\leq 2
E. coli (개/100mL)	139,32	Not Detected	500,000	Not Detected