

# Public Sewage Treatment Facilities Applying the DF-MBR Process

Paju Geumchon Sewage Treatment Plant

## 1. Introduction



Paju, is located in the northwest Gyeonggi Province the population is growing rapidly and currently has reached 408,905 people in September 2013 due to a new residential district development and of large-scale industrial complex since 2000.

Accordingly, there was a rapid increase in the city support facilities and also increase in establishment and expansion of the sewage treatment plants. As a result, Gwangtan STP (Sewage Treatment Plant), Unjeong STP and Tongildongsan STP, etc has been newly established and expanded.

applied. DF-MBR process has high level of nitrogen and phosphorus treatment and takes up smaller footprint comparing with other process.

Geumchon STP is located in Paju Geumchon used to be operated at a capacity of 27,000 m<sup>3</sup> / day. However, due to the enhanced effluent water quality standards, the annual average 9% of the population growth in the targeted water treatment plan area where has about 40% of the city, Paju's population. Since the population in the targeted area has been foreseen to grow more due to Geumchung residential district development plan, therefore, they started to expand the plant since March, 2009 with a plan to expand up to 17,000m<sup>3</sup>/day until 2015 and they have started to operate the expanded plant. As of June 2014, the plant is being operated at a capacity of 8,500m<sup>3</sup>/day.

Some of the major design requirements were BOD 217 mg / L, COD 155 mg / L, SS 203 mg / L, TN 49.8 mg / L, and TP 5.47 mg / L based on the inflow water quality analysis and pollutant load of previous plant.

**Table 1. Water Quality and Performance Assurance Plan Geumchon STP Water**

Parameter	Planned Quality	Discharged Water Quality	
		Guarantee Standard	Guarantee
BOD	217	≤ 10	≤ 5
COD	155	≤ 40	≤ 15
SS	203	≤ 10	≤ 5
T-N	49.8	≤ 20(60)	≤ 15(20)
T-P	5.47	≤ 2(8)	≤ 2(2)
Coli form bacillus	250,000	≤ 3,000	≤ 100

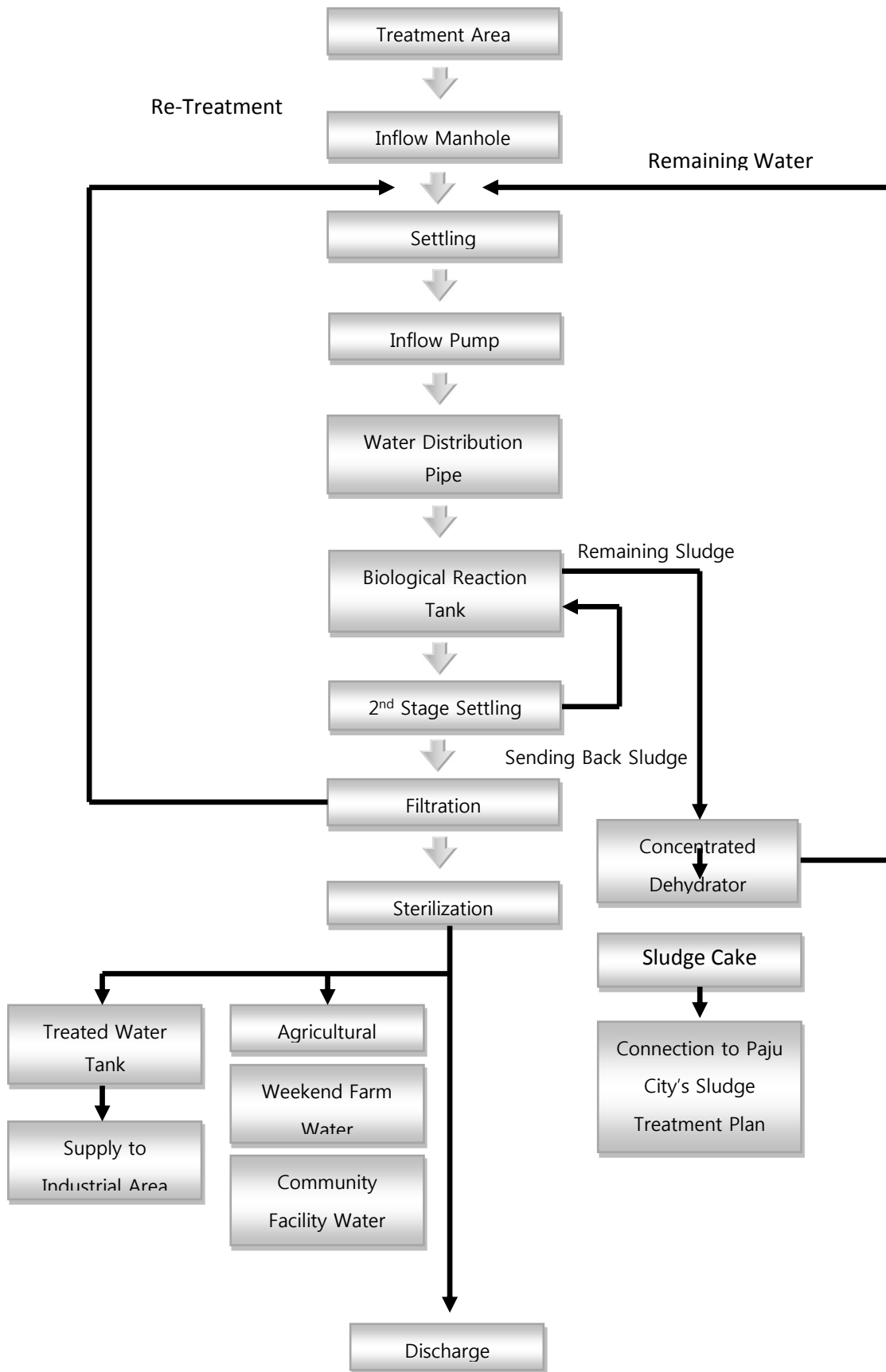
**Note:** Values in parentheses winter performance guarantee water quality

In addition, the performance guarantee is are stricter than the legal standards of discharged water quality, which is BOD 5mg / L, COD 15 mg / L, SS 5 mg / L, TN 15 mg / L and TP ≤ 2mg / L was applied. The water is discharged to Geumchon River through the Imjin River into the Yellow Sea.

## 2. Process and Facilities

A durable and economical facility that can be easily maintained by facility manager with guaranteed performance was selected for Geumchon STP (Facilities area 39,487 m<sup>2</sup>). It is consisted with the preprocess plant, equalization tank for proper flow, Bio reactor

(DF-MBR) to get stabilized amount of treated water, and the system to dewater sewage generated during the process as well as the system to recycle water from the sewage. The overall process is shown in Figure 1.



<Figure 1> Process Flow Chart

### 3. Membrane Specification



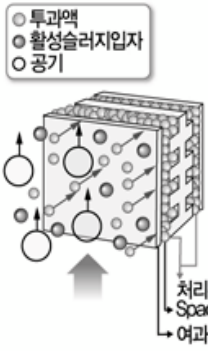
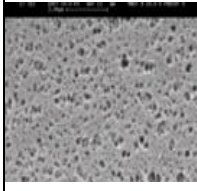
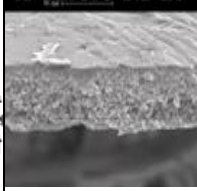
For the large facility like STP, it is necessary to increase the density of membrane per installed area as it requires large quantity of membrane. Pure Envitech's SBM the 9S16L cassette-type was applied to Geumchon STP as they needed to minimize the site area at the same time. As shown in Figure 2, They used 34 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 2.



<Figure 2> SBM Flat Membrane Module

Table 2. 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 <sup>2</sup> /block				
MBR Element	C-PVC				
Pore Size	0.4μm				
Max Differential Pressure on Membrane	5kgf/cm <sup>2</sup>				
Operating pressure	0.10~0.45kgf/cm <sup>2</sup>				
Max. operating temperature	40°C	<ul style="list-style-type: none"> <li>· Block consisted with 15 membrane sheets of 0.3m<sup>2</sup> membrane area</li> <li>· Thermal welding to enhance the chemical resistance</li> </ul>	<ul style="list-style-type: none"> <li>· C-PVC material has high chemical resistance</li> <li>· Internal supporting frame and fixing plate lead higher tensile strength</li> <li>· Long lasting membrane lifespan</li> <li>· Low pressure operation and cyclic aerobic cleaning to reduce fouling</li> </ul>		
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 5,390 ~ 11,350 mg / L, DO 0.52 ~ 2.94 mg / L, less than TMP 40 Kpa, Flux 20 l / m<sup>2</sup> · hr

**Table 3. Membrane bioreactor tank operation conditions**

Item	Operating Conditions	Average
Temperature (°C)	13.1~25.8	18.5
pH	6.4~7.0	6.6
DO(mg/L)	0.52~2.94	1.3
MLSS(mg/L)	5,390~11,350	9,586
TMP(Kpa)	< 40	< 40
Flux(l/m <sup>2</sup> ·hr)	20	-

The most important factor is permeation flux of the membrane tank and it was operated 20 l / m<sup>2</sup> · hr. Depending on the operating conditions and type of water, the permeation flux tends 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 261.0mg / L, 125.0mg / L, 223.5mg / L, 51.79mg / L, 5.3mg / L, and BOD was 20% higher and SS was 10% higher compared to the designed water quality. However, the quality of the discharged water is showing the same or less number than the guaranteed quality.

**Table 4. Water Quality Analysis**

Item	Influent	Effluent	Plan Water Inflow	Performance Warranty
BOD(mg/L)	261.0	2.4	217	≤ 5
COD(mg/L)	125.0	11.6	155	≤ 15
SS(mg/L)	223.5	0.9	203	≤ 5
T-N(mg/L)	51.79	11.2	49.8	≤ 15
T-P(mg/L)	5.343	0.3	5.47	≤ 2
E. coli (개/100mL)	240,77	-	250,000	≤30