

Membrane Bio Reactor (MBR)

Nov, 2006



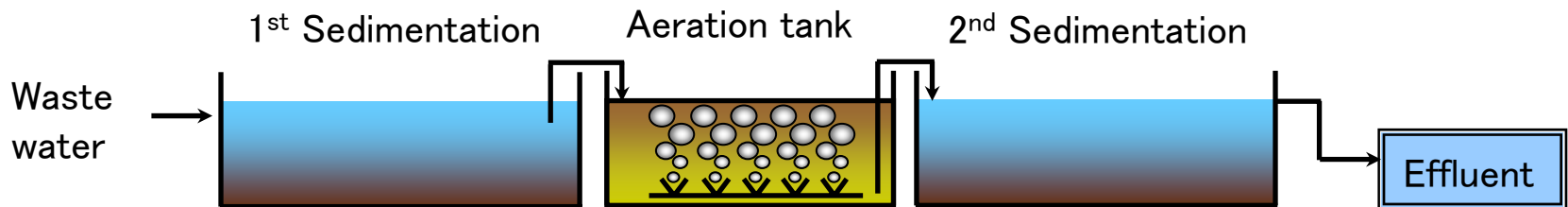
SUIDO KIKO ME

What is MBR?

Conventional STP

Before we talk about MBR, we define conventional STP system.

Conventional system is the following;



Conventional type is

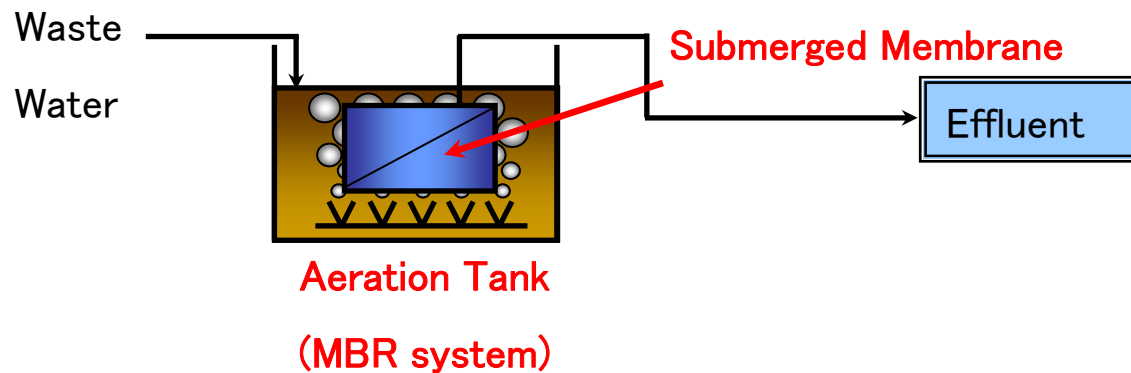
- * Need big space
- * Not easy to control effluent water quality

Sludge higher density $\Rightarrow$ SV worse $\Rightarrow$ Worse water quality

MBR

MBR can solve problem in conventional STP.

Conventional system is the following;



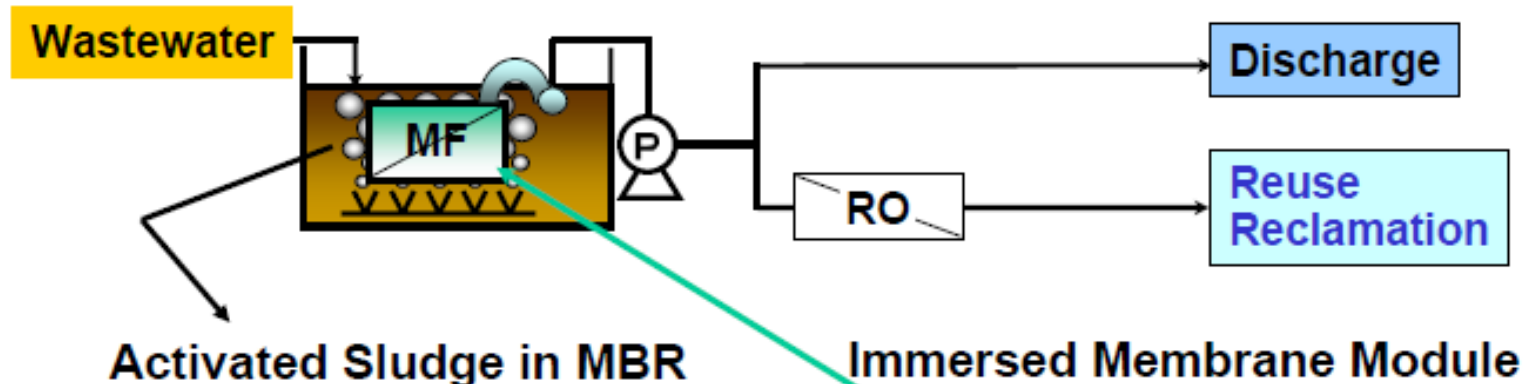
MBR system can

- * reduce space
- * easy to control effluent water quality

Sludge higher density $\Rightarrow$ No effect $\Rightarrow$ Good water quality

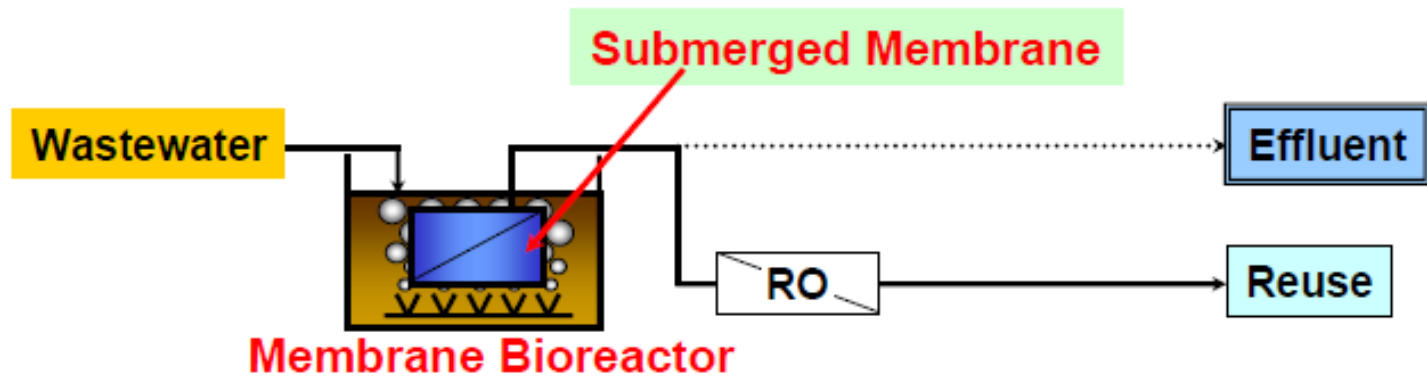
Flat Sheet Submerged Membrane System for MBR

MBR (Membrane Bioreactor)

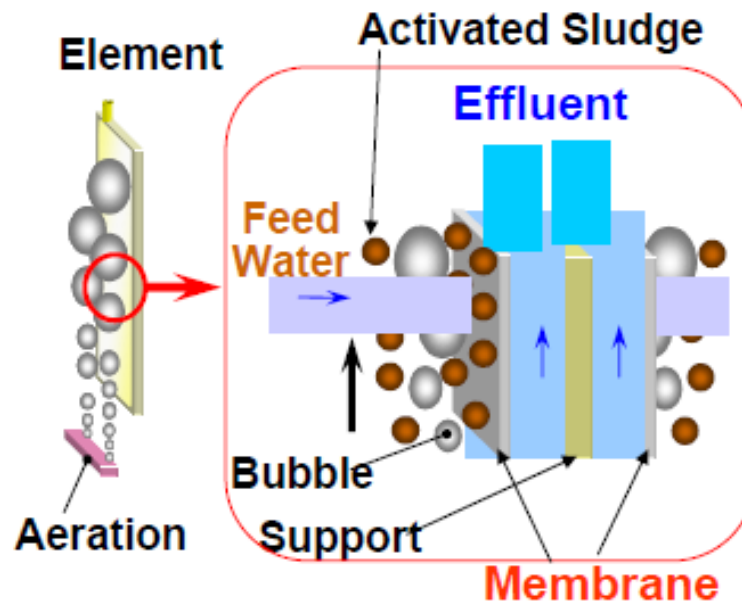


**Good Water quality, Small Footprint, Reduce Excess Sludge,
Dawning of the Market**

Flat Sheet Membrane Bioreactor

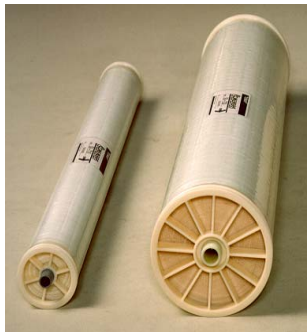
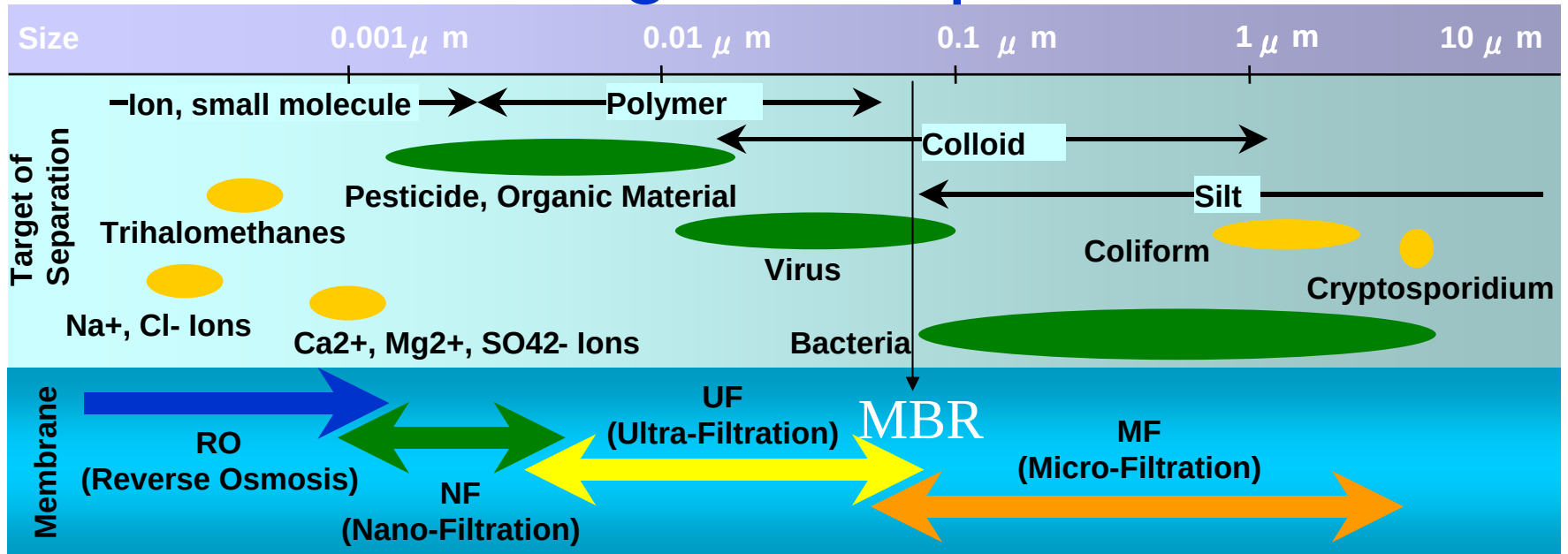


Feed Water
(Activated Sludge)

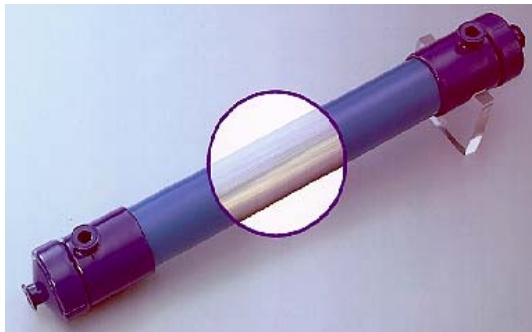


Effluent

MBR target of separation



RO/NF
"ROMEMBRA"



UF
"Torayfil"



MF
"Torayfil"

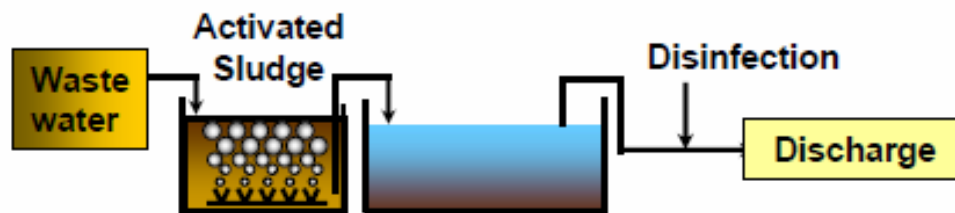


MF for MBR
"MEMBRAY"
7

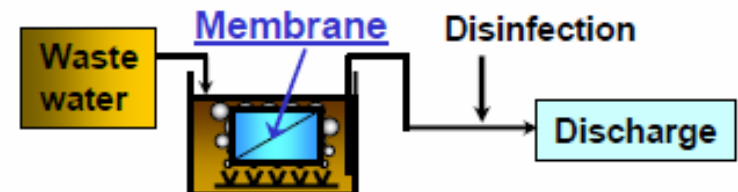
MBR can remove Turbidity & Bacteria

Merit of Membrane Bio-reactor

1. Good permeate quality
 - 1) Low COD concentration
 - 2) Low total nitrogen and total phosphorous
 - 3) No suspended solid
 - 4) Removal of bacteria
 2. Very space efficient design
 3. Considerable reduction of excess sludge
 4. Reclamation of wastewater
- Integrated system with RO membrane



Conventional Wastewater Treatment



MBR

Flat Sheet Submerged Membrane

New Type Module TMR140 Series

Type No.		100S
Number of Membrane Elements		100
Total Membrane Area (m ²)		140
Housing Size	Width (mm)	810
	Length (mm)	1,620
	Height (mm)	2,100
Material	Housing	304SS
	Permeate Water Manifold	304SS
	Aeration Diffuser	304SS



Membrane Element

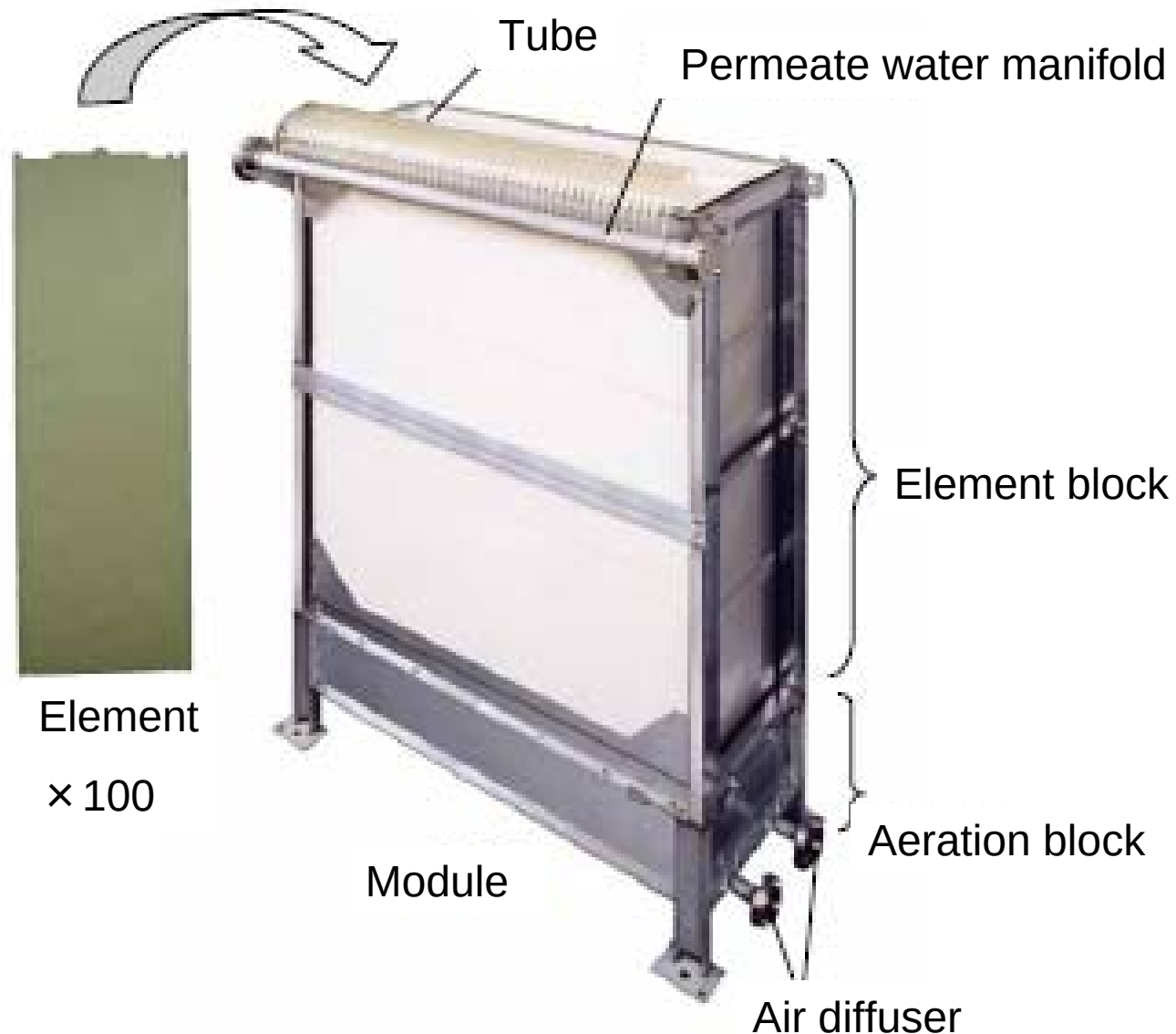
Type No.	TSP-50150
Membrane Area (m ²)	1.40
Width (mm)	515
Height (mm)	1608
Thickness (mm)	13.5
Scouring Air (NL/min/EL)	13 - 18

1608

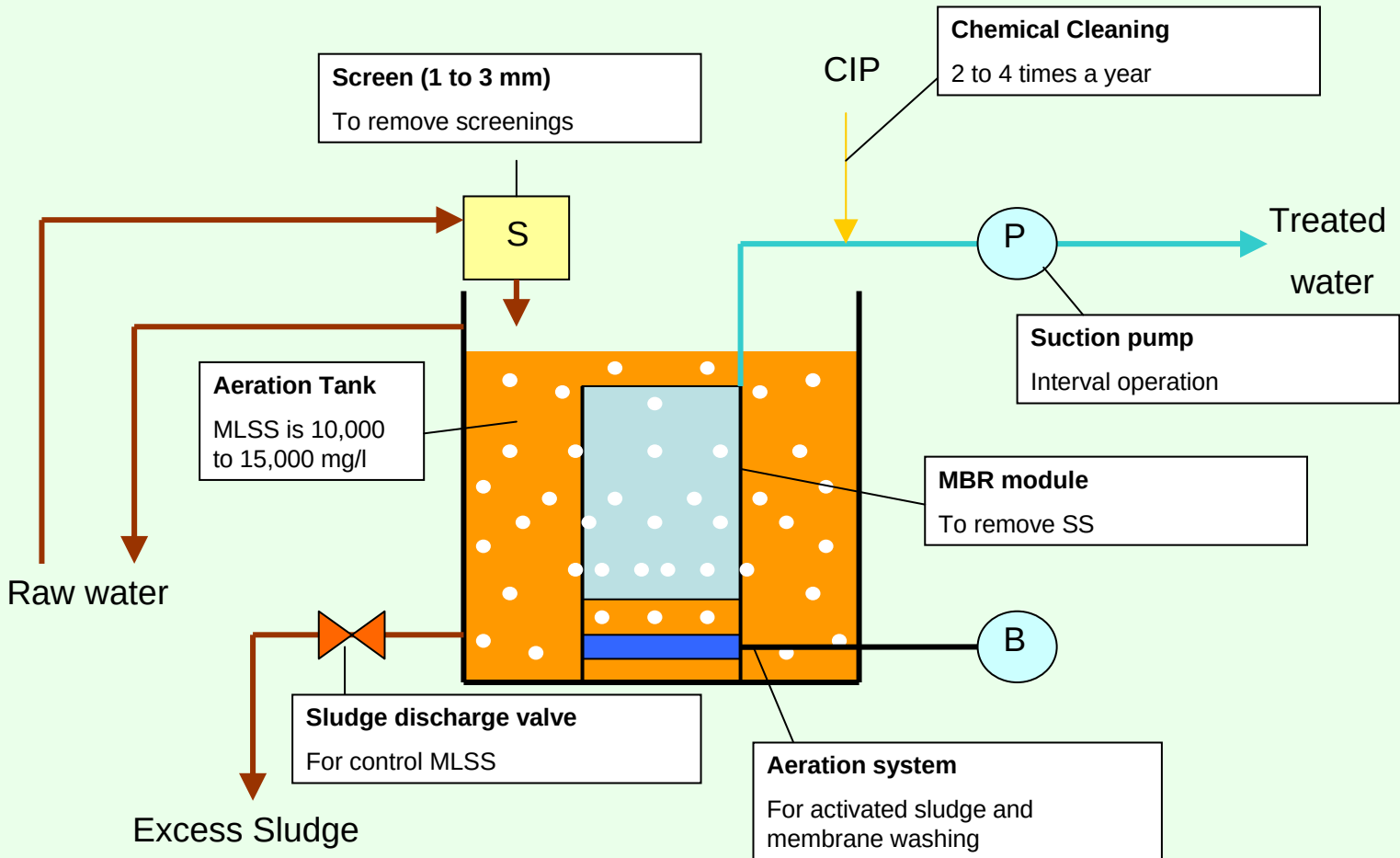


515

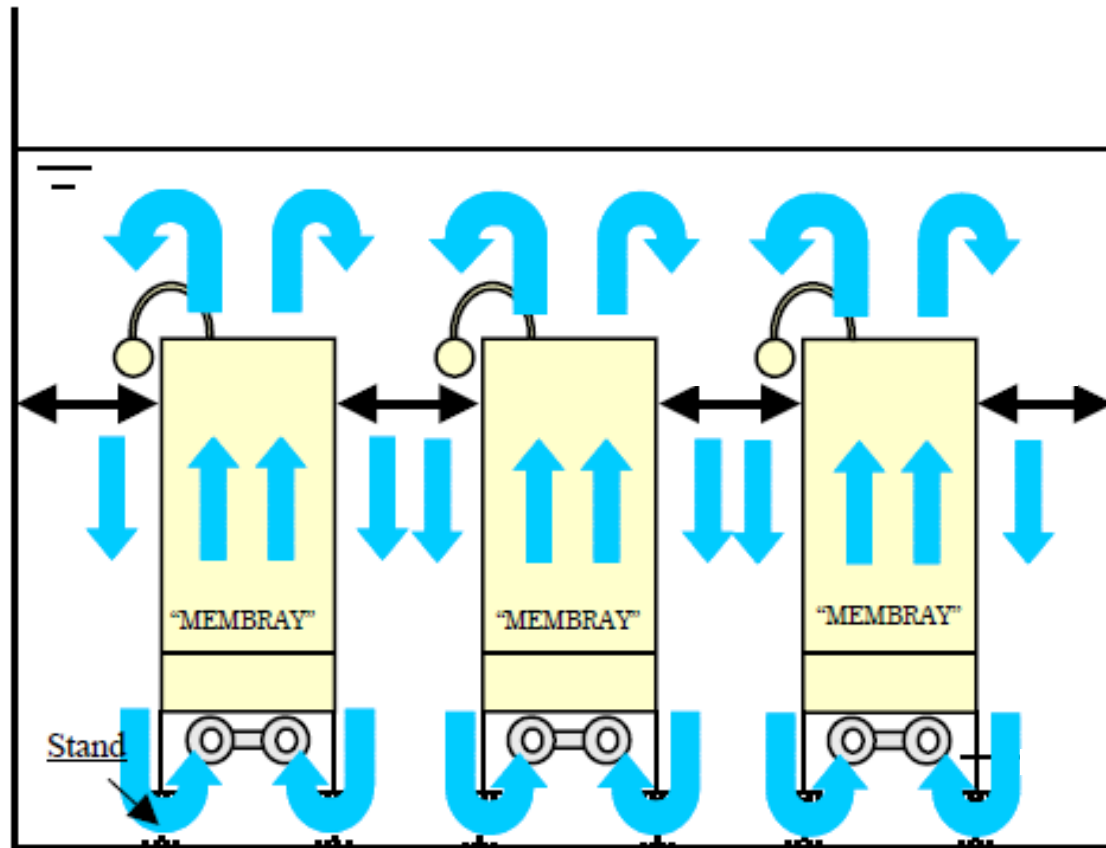
Appearance of MEMBRAY



Flow diagram of MBR system



Layout example & circulation



The features of Our Flat Sheet membrane

- Flat sheet type is easier maintenance than Hollow fiber type. Hollow fiber type is possible to cut the membrane by itself because it is easy to catch hair and clog.
- PVDF can endure the repeated chemical washing.
- The smallest pore size ($0.08 \mu\text{m}$) . That means treated water quality is better than others.
- Off line washing is NOT needed.

Actual MBR Plant for Municipal WWT in Europe



Small Foot Print



Actual MBR Plant for Industrial WWT in Japan

**Increase Capacity of
Existing WWTP**



MBR Applications to STP

Comparison of STP system 1/3

System	ASM+SF	OD+SF	MBR
BOD SS Load (kg/kg/day)	0.2~0.4	0.05~0.3	0.1~0.15
BOD Capacity Load (kg/m ³ /day)	0.32~0.64	0.08~0.48	0.8~1.5
MLSS (mg/l)	1500~2000	3000~6000	10000~ 18000
Return Sludge Ratio (%)	25~100	75~150	—

Comparison of STP system 2/3

System	ASM+SF	OD+SF	MBR
Aeration Tank (hr)	4~8	8~36	3~6
1 st Sediment. Surface Load (m ³ /m ² /day)	35~50	—	—
2 nd Sediment Surface Load (m ³ /m ² /day)	20~25	8~12	—
Load change	Balancing Tank (If needed)	Aeration Tank absorbed change	Balancing Tank (If needed)

Comparison of STP system 3/3

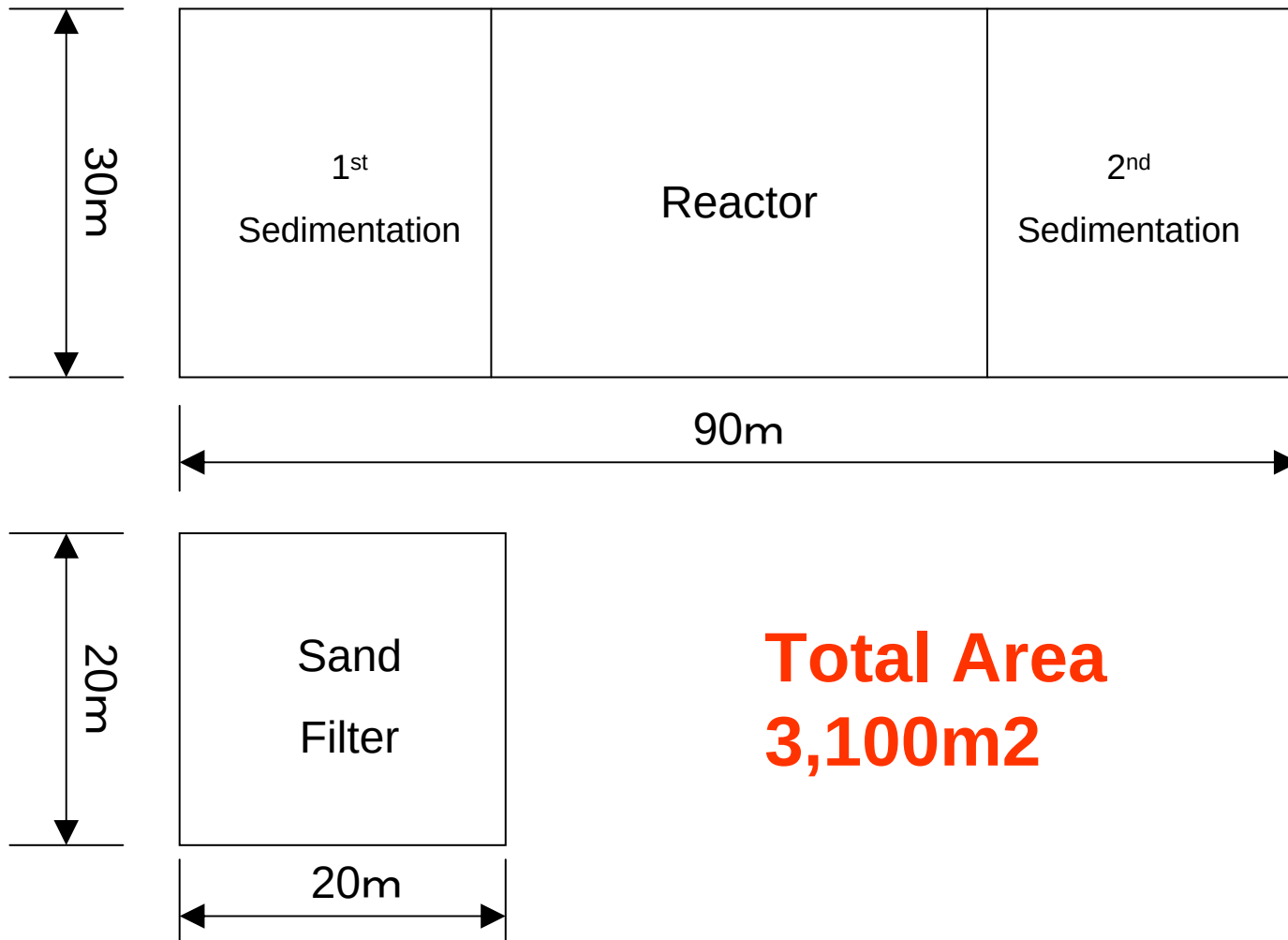
System	ASM+SF	OD+SF	MBR
Maintain- ance	Difficult	Easy	Easy
Slurry Volume	1.0 per SS	1.3 per SS	0.8 per SS
Area ^(*1)	○	×	◎
Cost	○	×	◎

◎ : very good ○ : good × : not good

Case study1 : Comparison of New STP

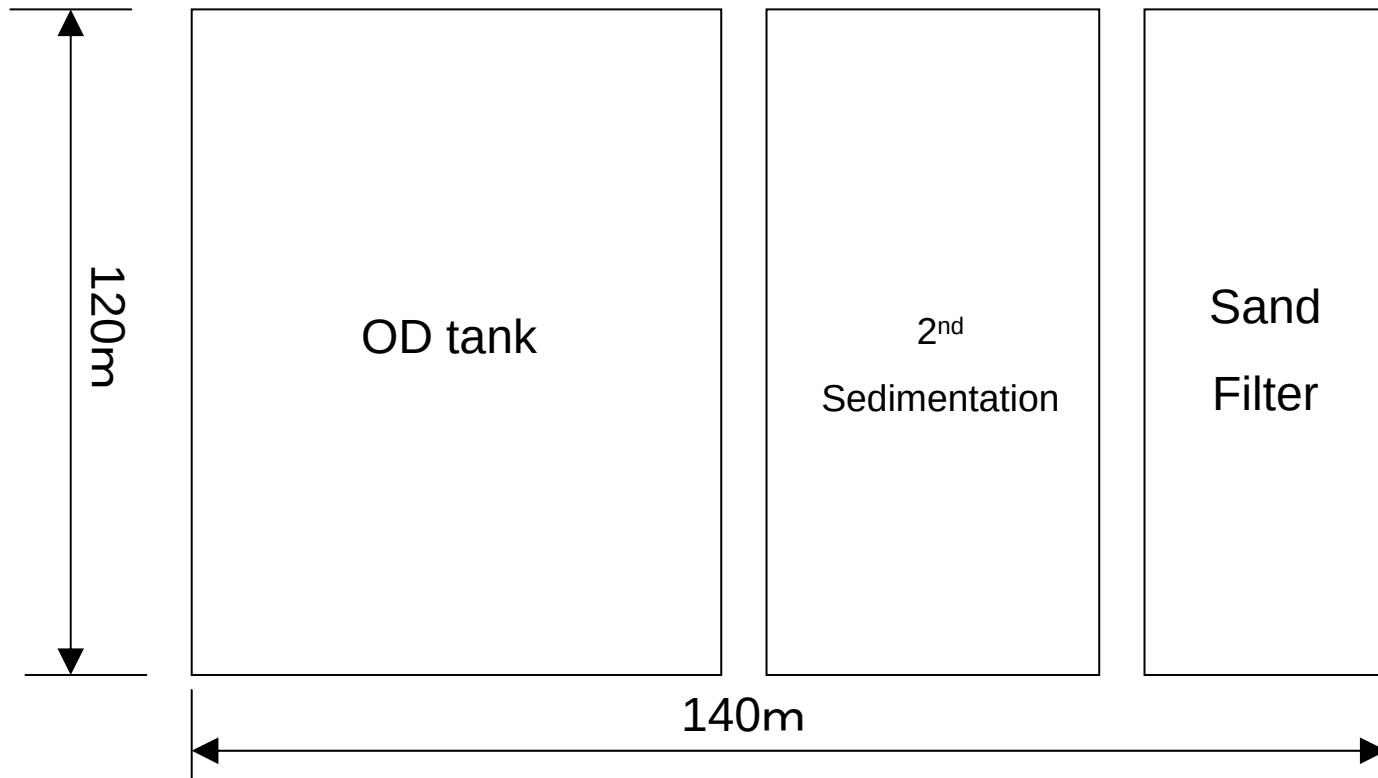
- Evaluation of construction area by 3 STP systems
(Q = 10,000 CMD)

Construction area for ASM+SF



Note : Volume of each tank depends on raw water quality and condition of flow rate of raw water²²

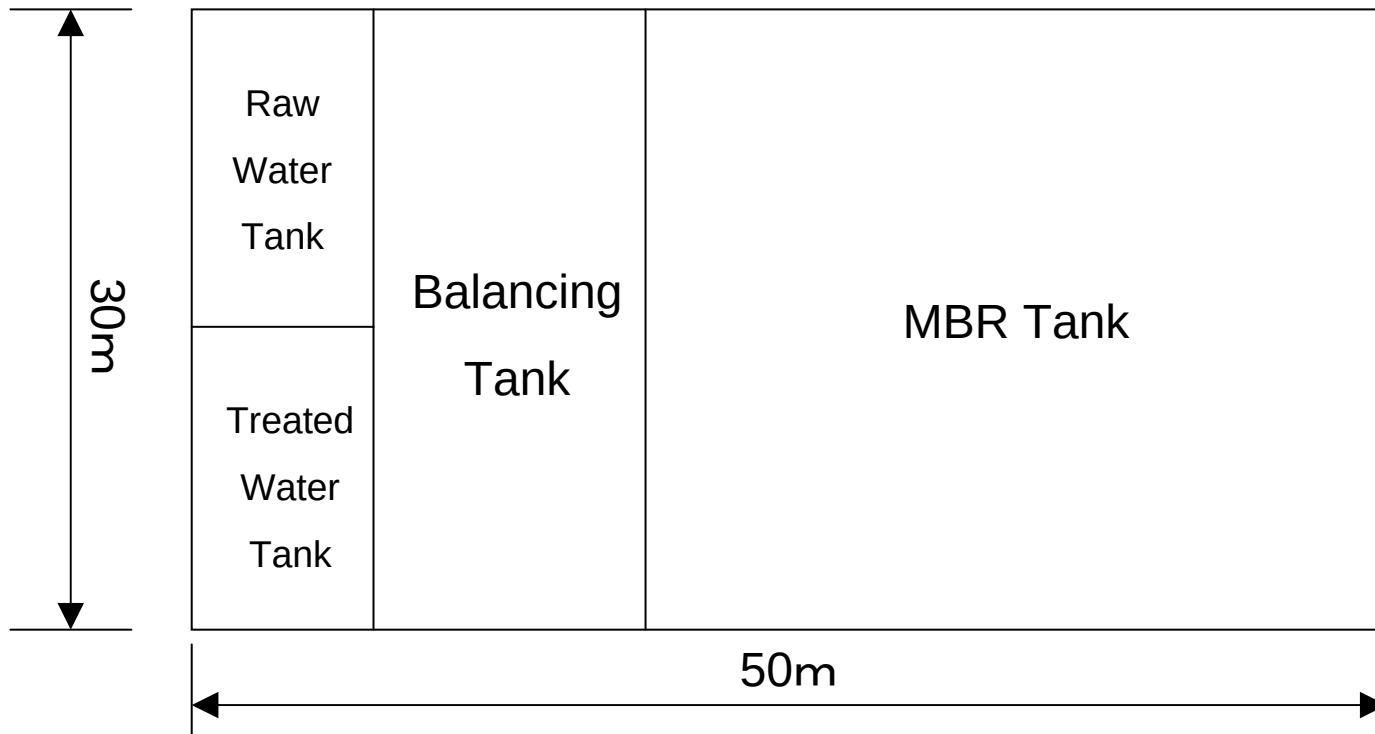
Construction area for OD+SF



Total Area
16,800m²

Note : Volume of each tank depends on raw water quality and condition of flow rate of raw water²³

Construction area for MBR



**Total Area
1,500m²**

Note : Volume of each tank depends on raw water quality and condition of flow rate of raw water²⁴

Result

System	ASM+SF	OD+SF	MBR
Area(m ²)	3100	16800	1500
	○	×	◎

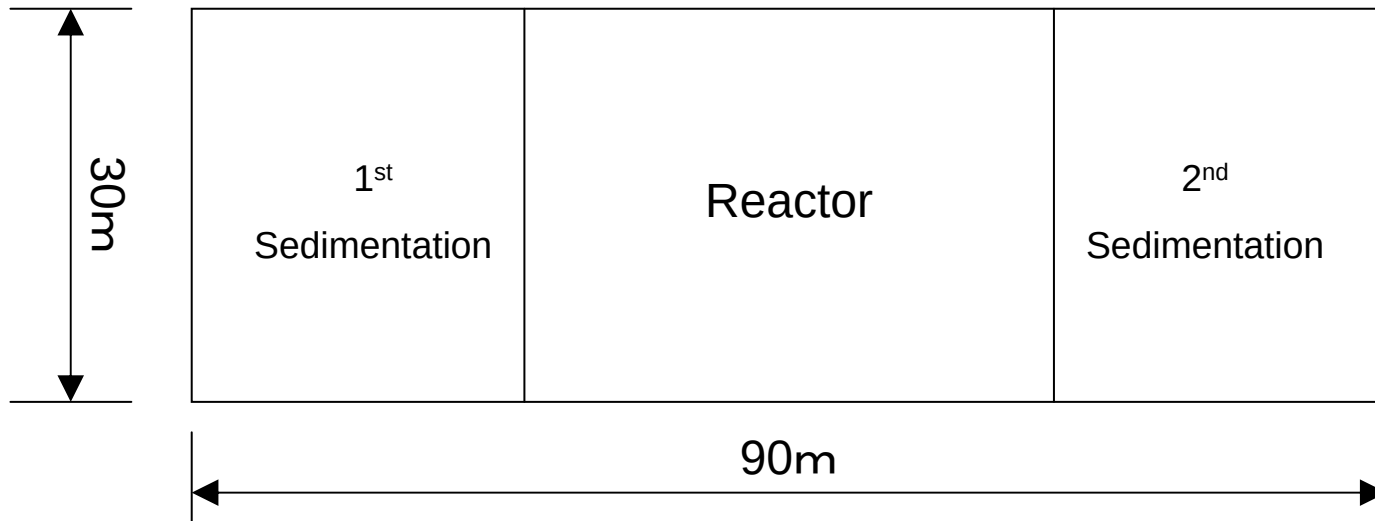
MBR system can reduce space

- **Half** as ASM method
- **1 / 10** as OD method

Case study2 : Expansion existing STP

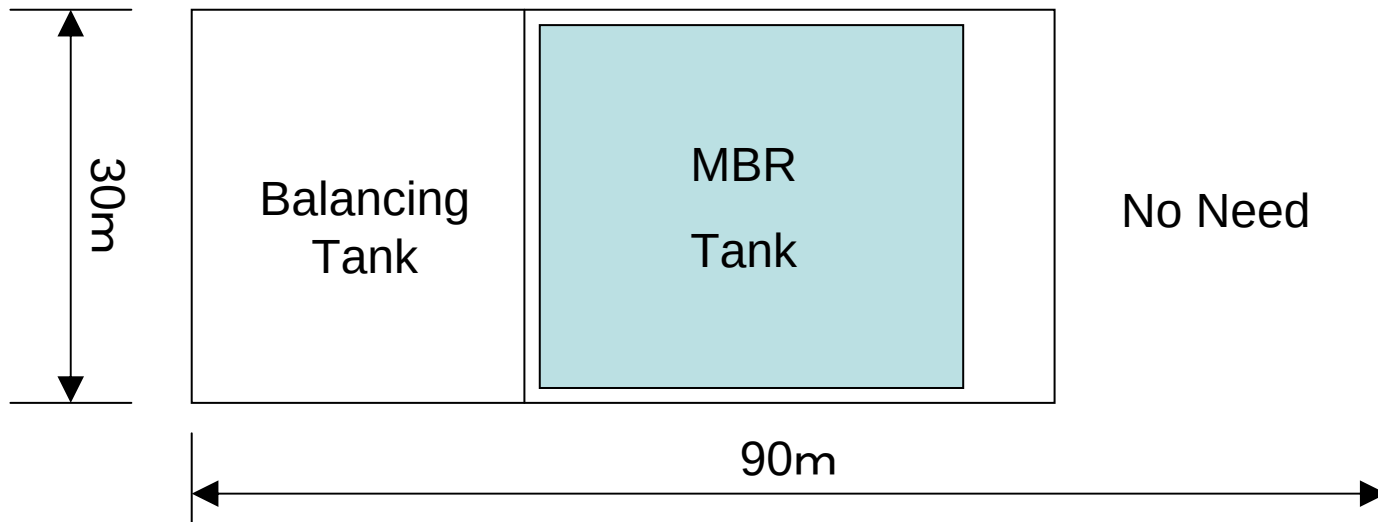
- Evaluation of construction area to expand the treatment capacity to double by MBR.
(Q = 10,000 CMD → 20,000 CMD)

Expansion by MBR (Before)



Note : Volume of each tank depends on raw water quality and condition of flow rate of raw water²⁷

Expansion by MBR (After)



Capacity Up 10000CMD to 20000CMD

Even smaller space than 10000CMD

Note : Volume of each tank depends on raw water quality and condition of flow rate of raw water²⁸

MBR Other Applications

- Food factory waste (Dairy, Sugar ...)
- Pharmaceutical
- Carwash
- Laundry waste
- Paper processing
- Others

Reuse water quality

Water quality and Usage for Reuse

	Raw Water	ASM and OD Treatment Water	After SF Treatment Water	MBR Treatment Water	MBR+RO Treatment Water
pH	7.0	7.0	7.0	7.0	6.5
BOD	200	20	2.0	1.0	<1.0
COD _{Mn}	120	35	20	8.0	<1.0
SS	250	30	2.0	<0.5	<0.5
TDS					50
NH4-N	20.0	0.3	0.3	0.3	<0.1
Coliform	3.50E+05	1500	ND	ND	ND
Usage	–	–	Irrigation Toilet		Semiconductor and Liquid crystal washing Boiler & Process water (Drinking)