# Membrane Bioreactor (MBR)

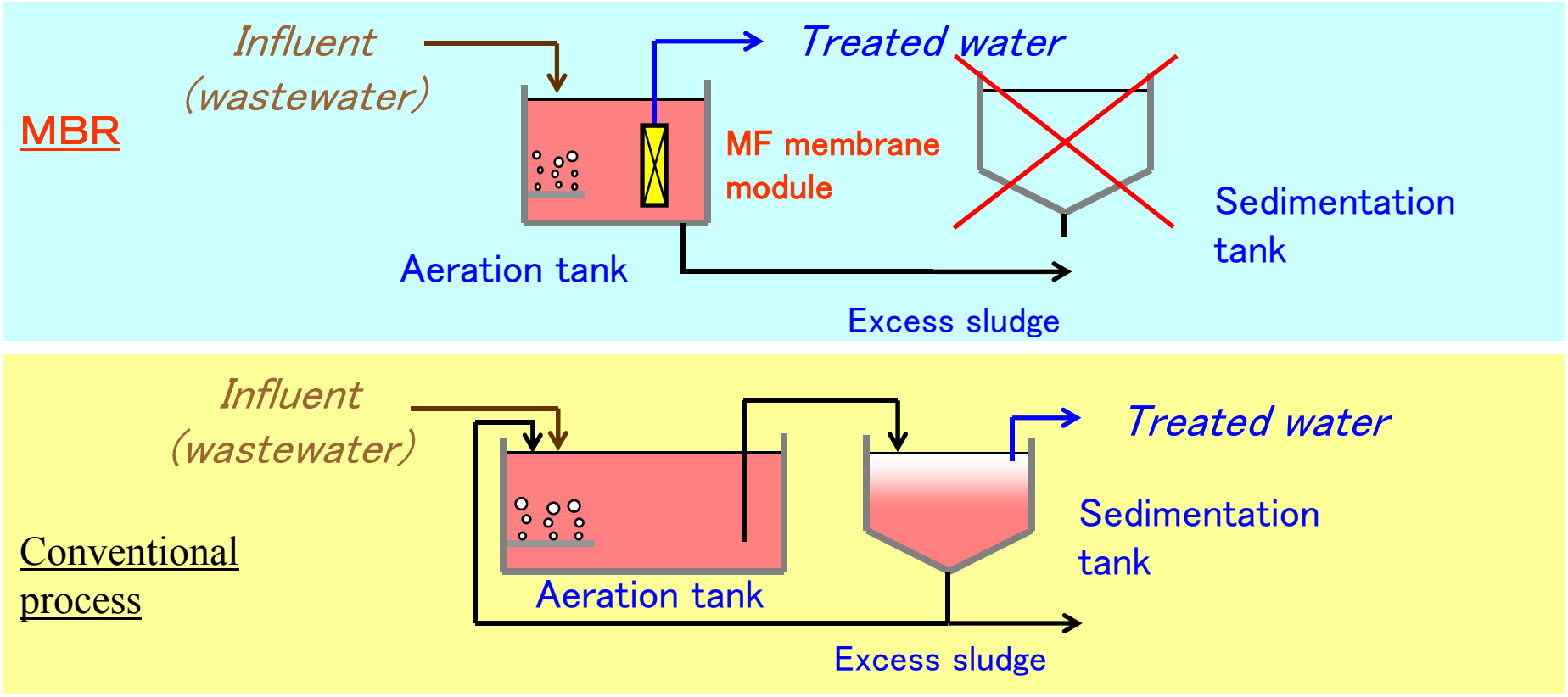

**Asahi Kasei Chemicals Corporation**
**Microza & Water Processing Division**
**Technical Marketing Department**

# *Basic concept of MBR*

# Advantages of MBR process

MBR system can

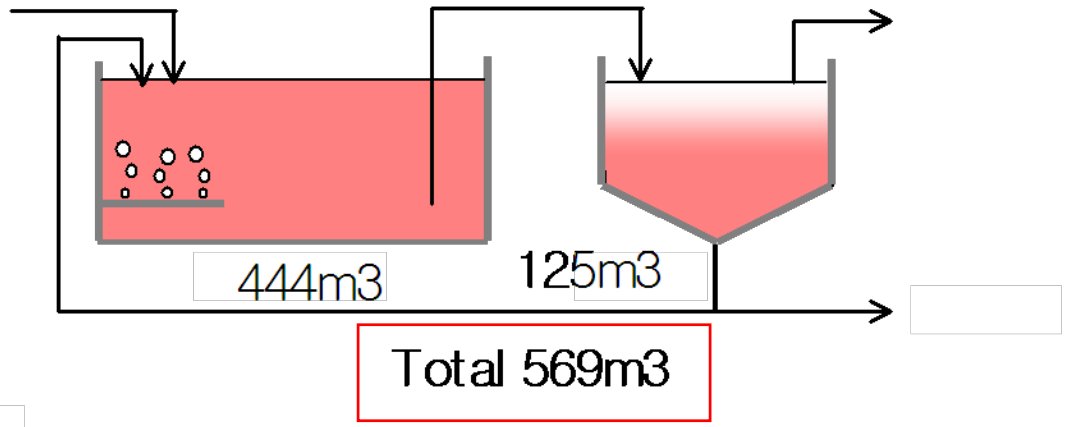
- dispenses sedimentation tank by using MF membranes
- diminishes aeration tank by higher MLSS concentration
- discharges treated water without SS and colon bacillus and recycle water
- dissolves bulking problem



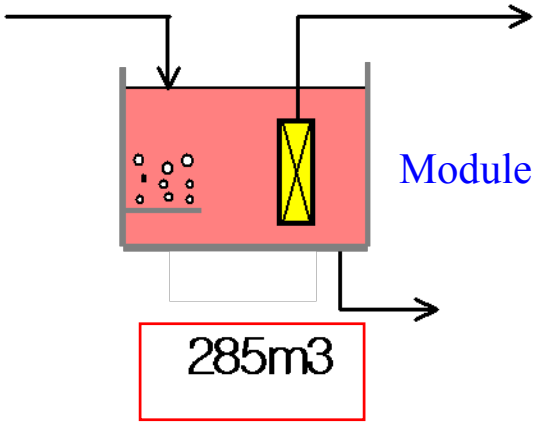
# *Calculation example -Required tank capacity-*

Influent Water : BOD 200mg/l, Treatment capacity 1,000m3/day

**Activated sludge**
**MLSS:3000**
**F/M ratio: 0.15**
(BOD･SS loading)

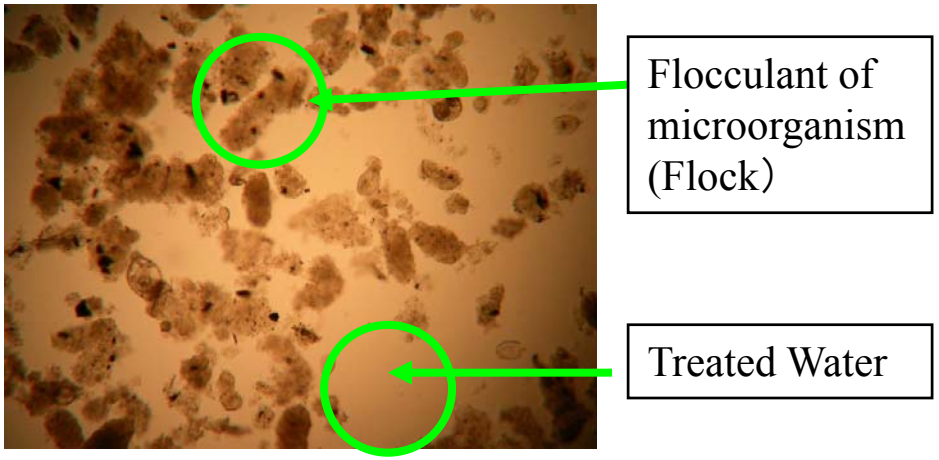



**MBR**
**MLSS:10000**
**F/M ratio: 0.07**




MBR system can perform space saving at WWT facilities.

# *Activated sludge*




Aeration tank

Photomicrograph of Activated sludge (*100)

*Activated sludge is mixed liquor of microorganism and treated water.*

**＜Reaction formula＞**

**BOD component of Waste water** + **$O_2$（Aeration）**

⟶ **CO2＋H2O＋ΔE＋Cell growth of microorganism**

**Microorganism**

**（Excess sludge）**

# *Bulking problem at sedimentation tank*

Normal condition

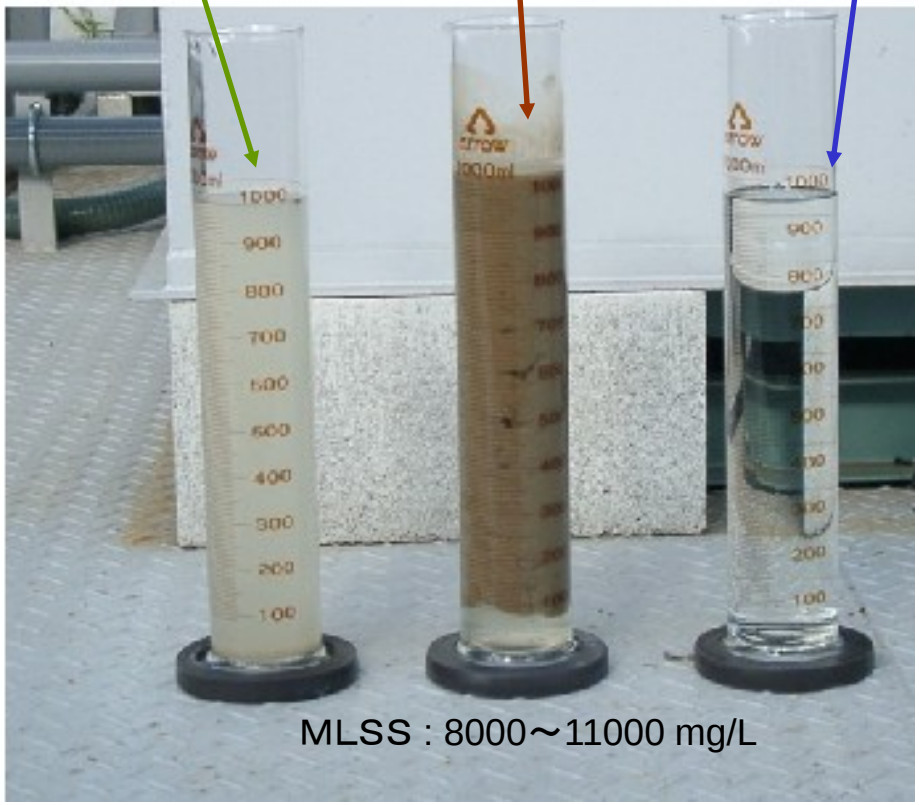
Carry over of activated sludge

# Treated water quality of MBR system (Sewage wastewater)

Sewage water

Activated sludge

Treated water




Water quality of MBR and CAS

(mg/l)

| | Influent | Effluent | |
|---|---|---|---|
| | | MBR | Typical CAS |
| BOD | 160 | 0.7 | 5-10 |
| COD-Mn | 90 | 4.5 | 7-13 |
| SS | 180 | <0.4 | 3-5 |
| T-N | 35 | 5.5 | 10-15 |
| T-P | 4 | 0.2 | 0.4-0.7 |
| E.coil (Number /ml) | $2.3 \times 10^5$ | <0.3 | 3-5 |

# *Commercial application of Asahi-kasei MBR Module*

# Microza Reference for MBR

| No. | Raw Water | Capacity (m3/day) | Year Installed | Location |
|---|---|---|---|---|
| 1 | Food plant wastewater | 600 | 2004 | Japan |
| 2 | Food plant wastewater | 300 | 2005 | Japan |
| 3 | Petrochemical wastewater | 25,000 | 2006 | China |
| 4 | Sewage | 260 | 2006 | Korea |
| 5 | Domestic Sewage (Black Water) | 1,500 | 2006 | China |
| 6 | Petrochemical wastewater | 10,800 | 2006 | China |
| 7 | Sewage | 35,000 | 2007 | China |
| 8 | Petrochemical wastewater | 6,000 | 2007 | China |
| 9 | Food plant wastewater | 720 | 2007 | Netherlands |
| 10 | Sewage | 200 | 2007 | Korea |
| 11 | Sewage | 1,000 | 2007 | Korea |
| 12 | LCD wastewater | 4,200 | 2007 | Korea |
| 13 | Sewage | 1,375 | 2007 | Japan |
| 14 | Sewage (River water) | 100,000 | 2007 | China |

This list excludes less than 200m3/day plants.

microza

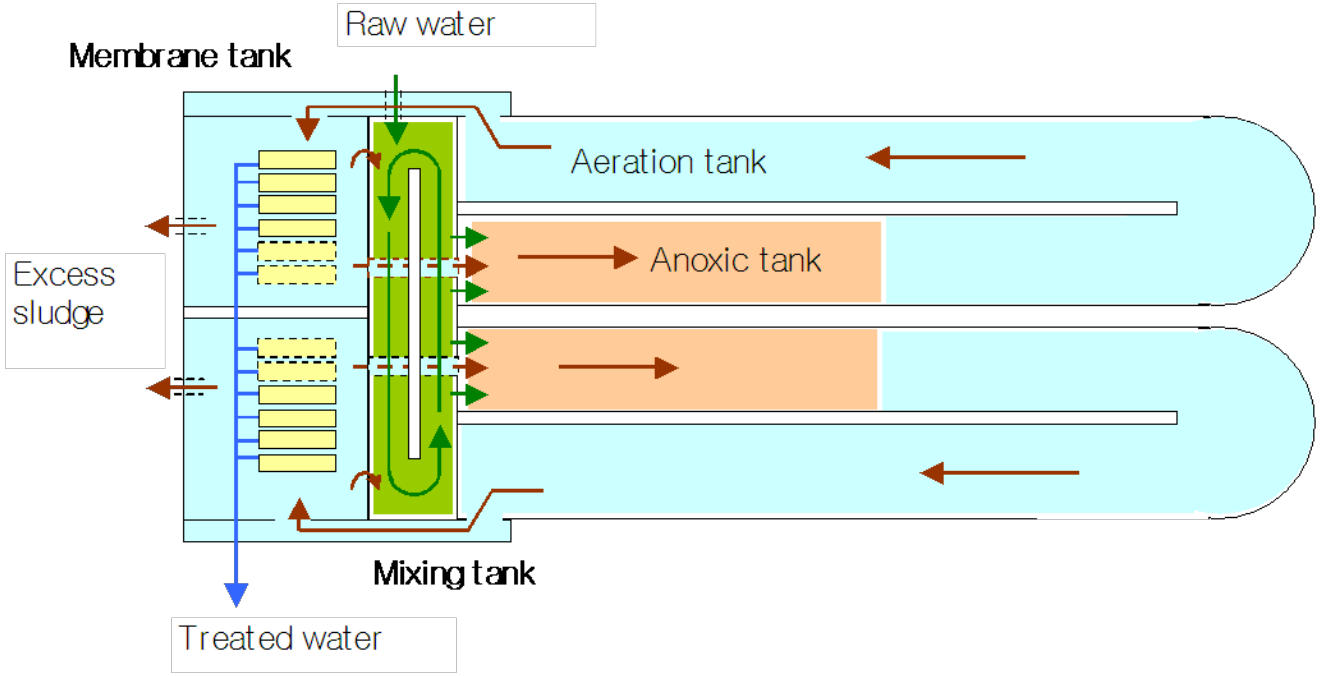
# MBR projects for Petrochemical waster water

( China 10,800 m3/d, 25,000 m3/d)

Hainan

# MBR project in China

| | Hainan | Daya Bay |
|---|---|---|
| Type of waste water | Oily waste water | Oily waste water |
| Capacity(m3/day) | 10,800 | 25,000 |
| Module Number | 864 | 2000 |
| Flux(m3/m2/day) | 0.5 | 0.5 |
| Star of system operation | 2006.8 | 2007.1 |



# Hainan project (10,800m3/day)

# Daya Bay project (25,000m3/day)

microza

# Installed example

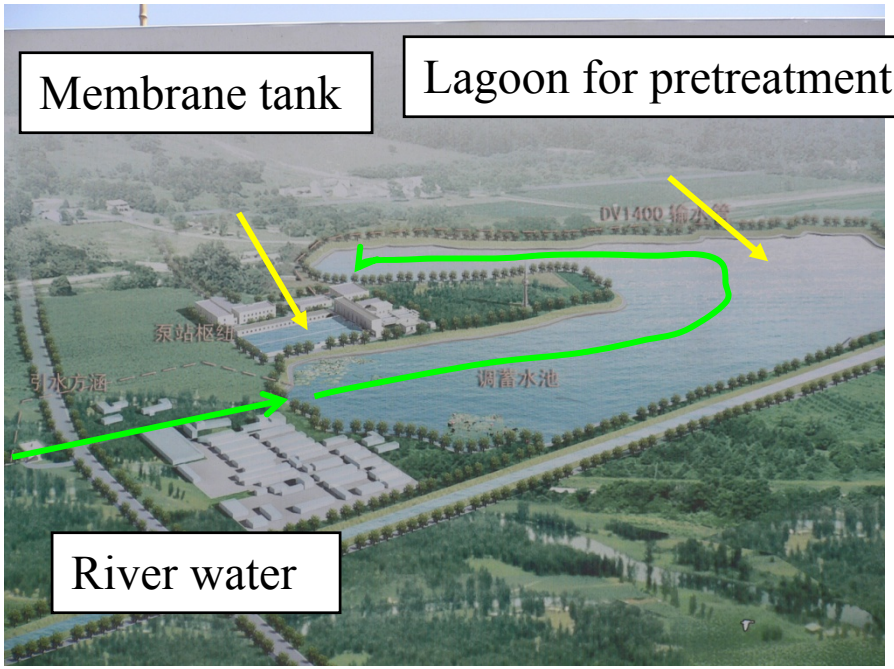
## Sewage water treatment ( 1500m3/d ) in China

Flux: 0.5m/d Number of module: 120

Reconstruction of conventional SBR system

Installed date 2006.4

# Sewage plant under construction in China (35,000 and 100,000m3/day)




Sewage treatment plant
(35,000m3/day)
Start schedule : ’07.8

River water treatment plant
by MBR (100,000m3/day)
Start schedule : ’07.10

# Technical Meeting with Chinese customer

# Small scaled MBR system in Australia

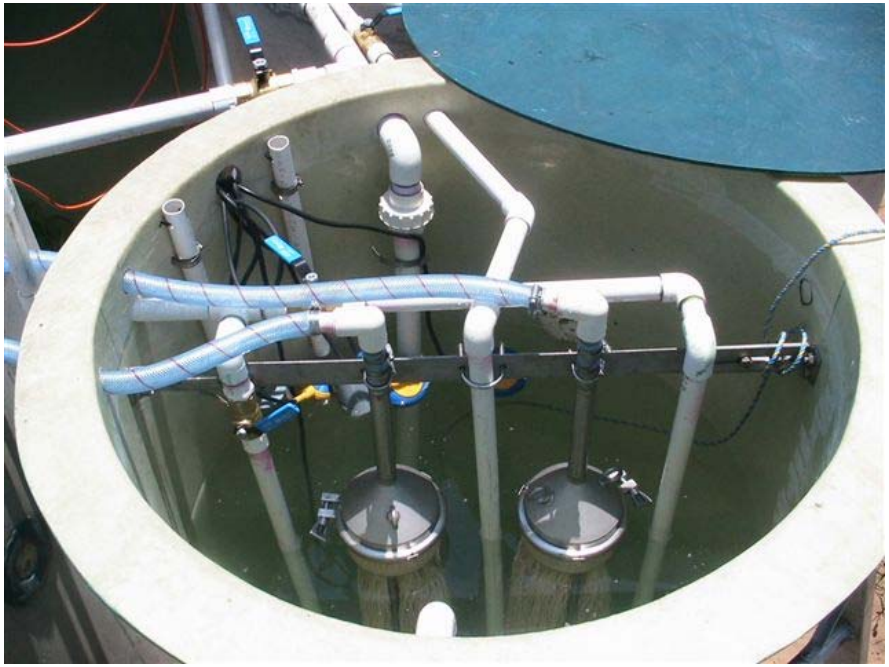
microza

Amity point Stradbroke Island

| Place | Scale | Module number |
|---|---|---|
| Amity point Stradbroke Island | 14m3/day | MUNC-620A |
| Moor Park Bundaberg | 25m3/day | MUNC-620A * 2 |
| Caravan Park | 40m3/day | MUNC-620A * 3 |

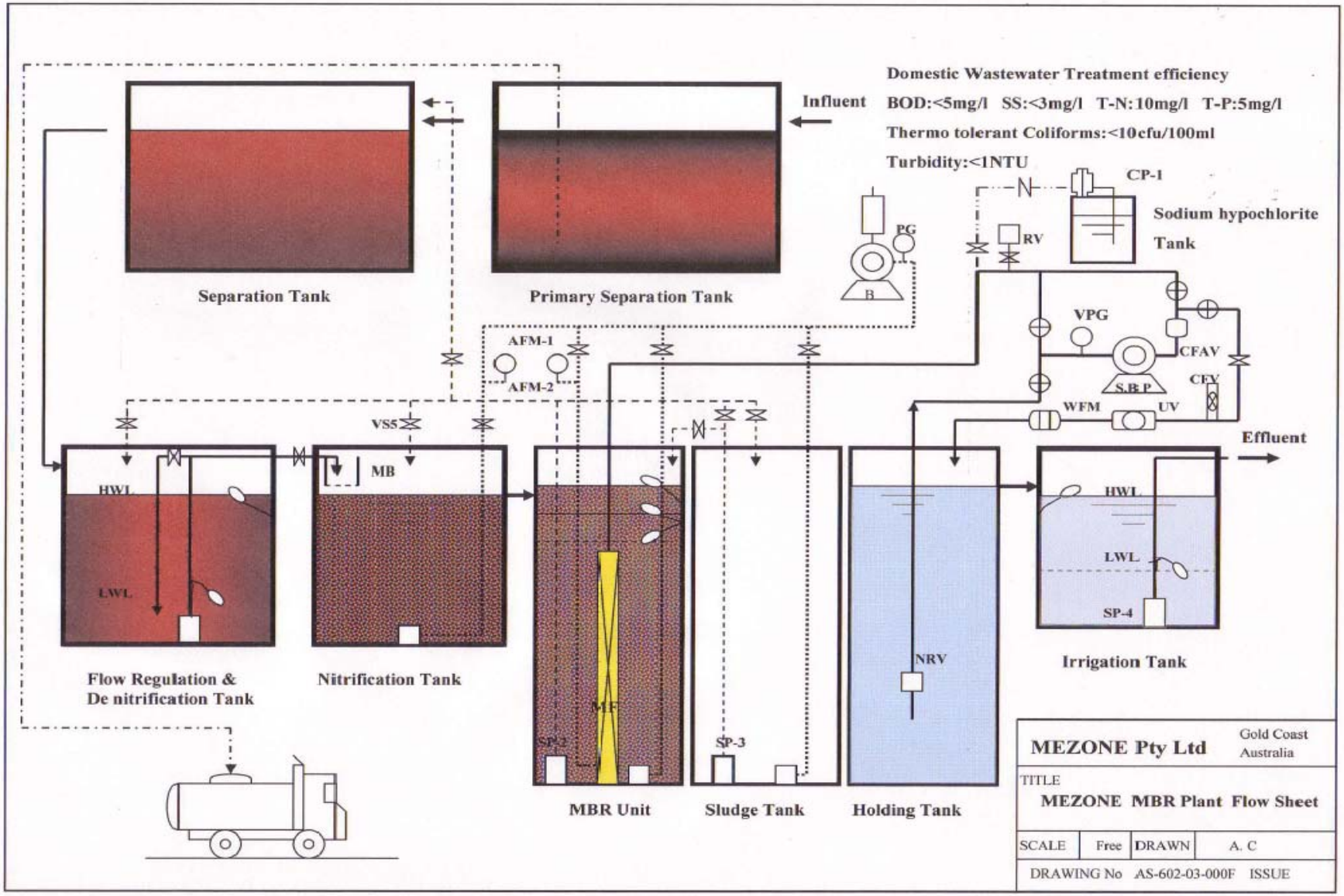
# Small scaled MBR system in Australia

Moor Park Bundaberg



# Small scaled MBR system in Australia

microza



# Installed example

## *Apelbaum villa in Giheung Korea (260m3/d)*


Outlook of Apelbaum villa



WWT plant at Apelbaum constructed underground

# Installed example

## *Fuel chemistry plant in Netherlands (720m3/d)*

Vegetable debris ( Raw material)

Methane fermentation tank

A/O treatment for Residue

MBR tank

# *Introduction Asahi-kasei MBR module for Food factory (900m3/d)*

Food factory aspect

Aeration tank

Asahi-kasei MBR rack

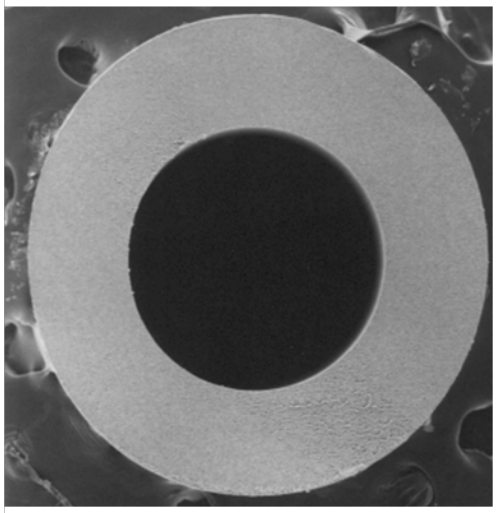
Soaking Asahi-kasei MBR rack in aeration tank

# Appearance of module

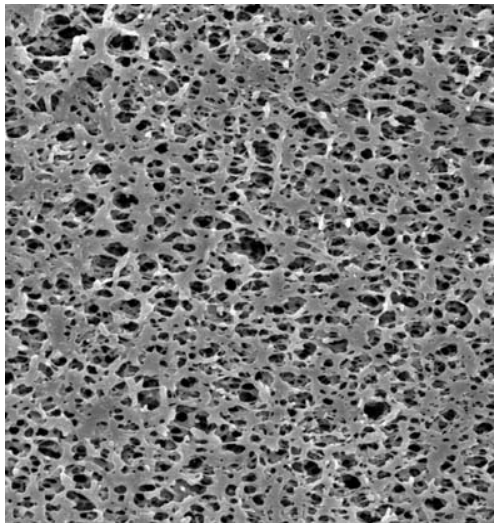
# *Specification of ASAHI-KASEI MBR*

# Specification of MBR module ( MUNC-620A)

microza



Cross-section of Hollow fiber



Surface of Hollow fiber

| Type of Module | Submerged module |
|---|---|
| | MUNC-620A |
| Membrane materia | PVDF |
| Pore size | 0.1μm |
| Membrane area | 25m2 |
| Figure | 6inch dia × 2mL |
| Weight (WET) | 14kg |

Aspect of MBR module

microza

## *The dependence of crystallinity on Ozone resistance*

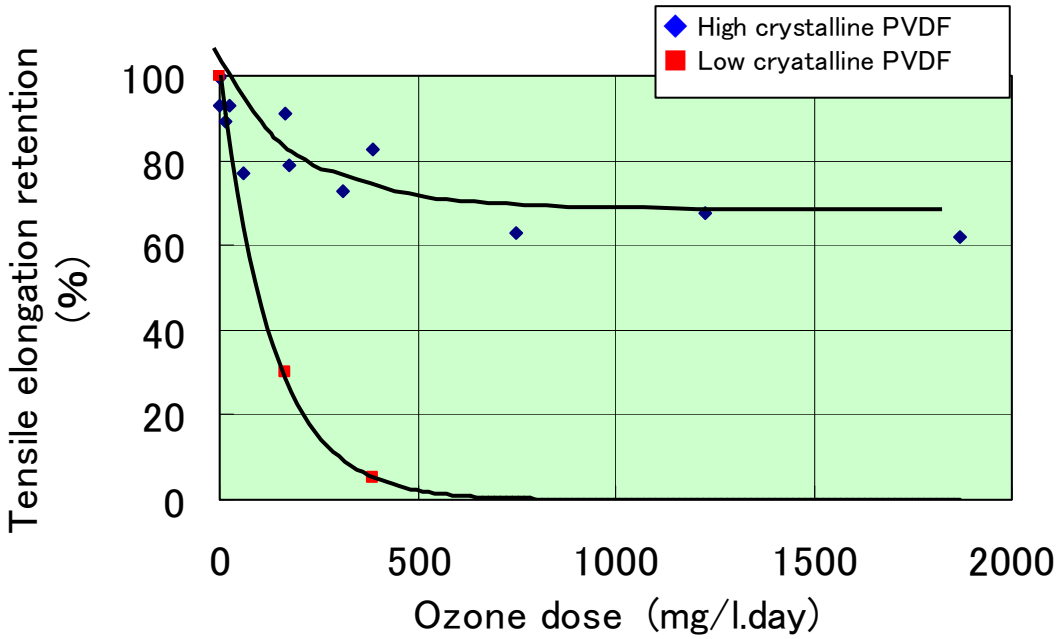
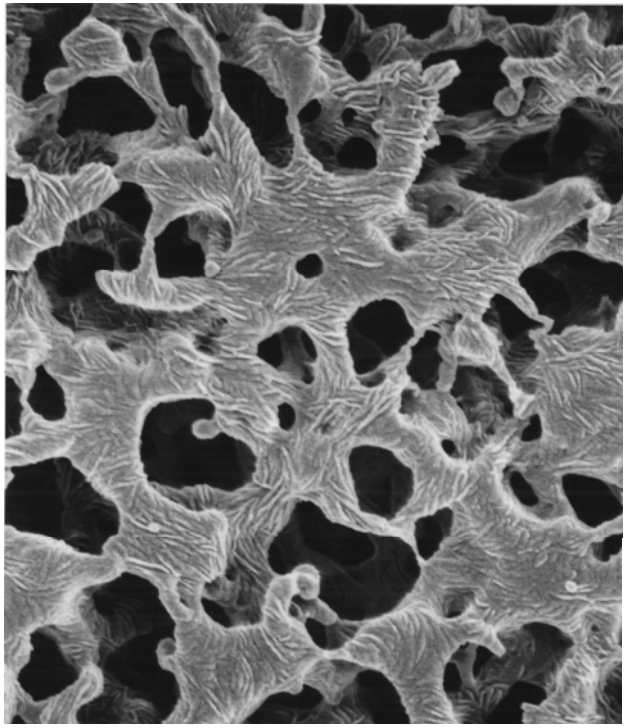



Fig. Ozone resistance of PVDF hollow fiber

## *SEM images of Microza PVDF H.F. (High Crystalline)*



Only ASAHI membrane has ozone resistant.

# Specification of MBR module ( MUNC-640A,600A)

XMUNC-640A

（Membrane length：1.4m）

MUNC-620A （25m$^2$）

Membrane length：2.0m

Total length：2.2m Weight：14kg

XMUNC-640A （17.5m$^2$）

Membrane length：1.4m

Total length：1.6m weight：11kg

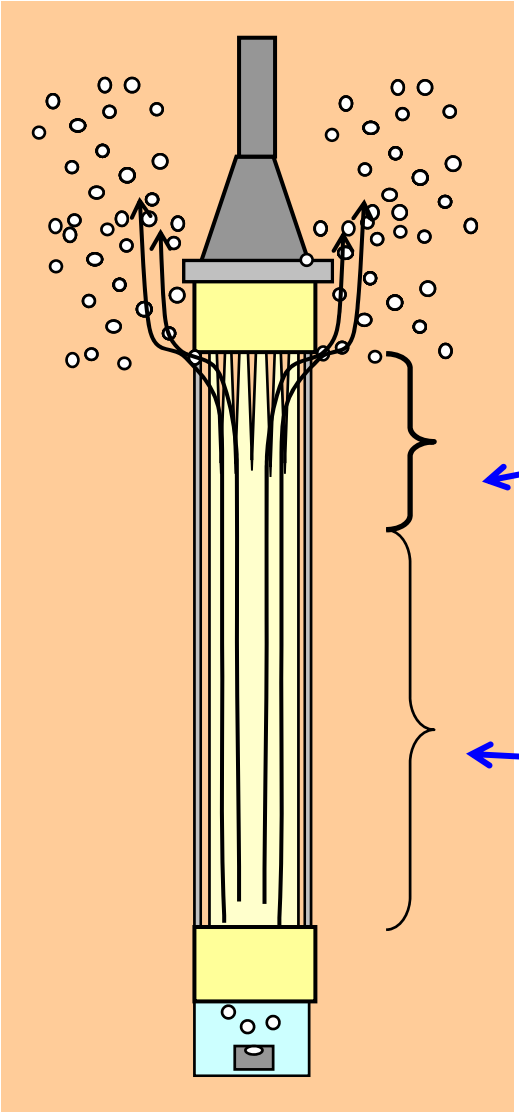
XMUNC-600A （12.5m$^2$）

Membrane length：1.0m

Total length：1.2m Weight：9kg

# *Hollow fiber alignment of Asahi-kasei MBR module*

microza



Dividing multiple bundles of hollow fibers to make path to outside of module

**Upper part of module**

**Middle and lower part of module**

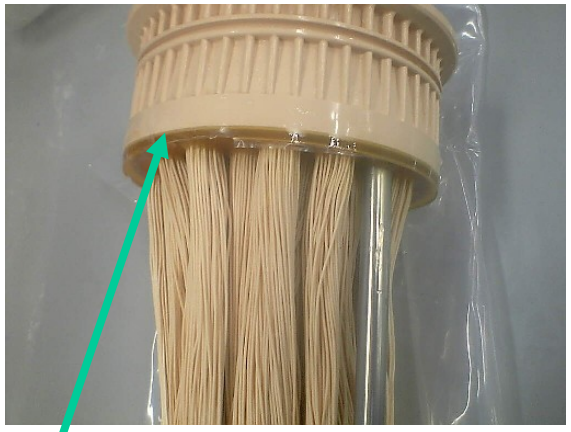
Uniform dispersion of hollow fibers for not to dissipate aeration and to swing hollow fibers effectively

PCT/JP2004/112944

# Parts name of MBR module (Munc-620A)

Header

Skirt



Multiple bundles of hollow fibers

Aeration holes

Low hardness resin

# *Accessories of MBR units*

Reducer

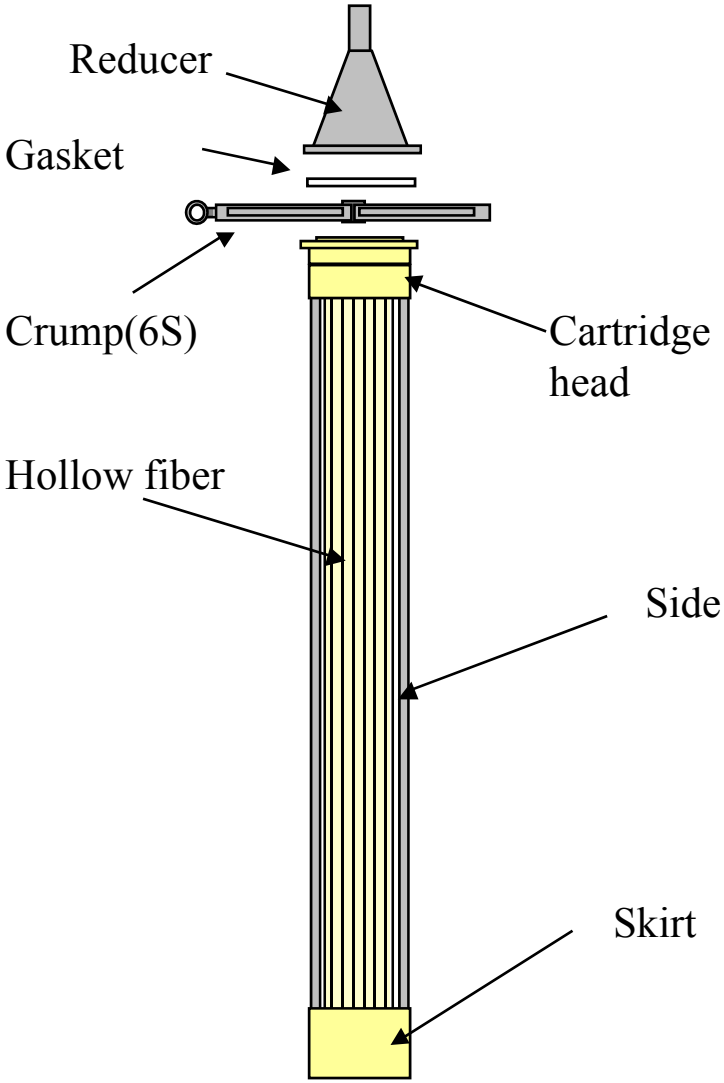
Gasket

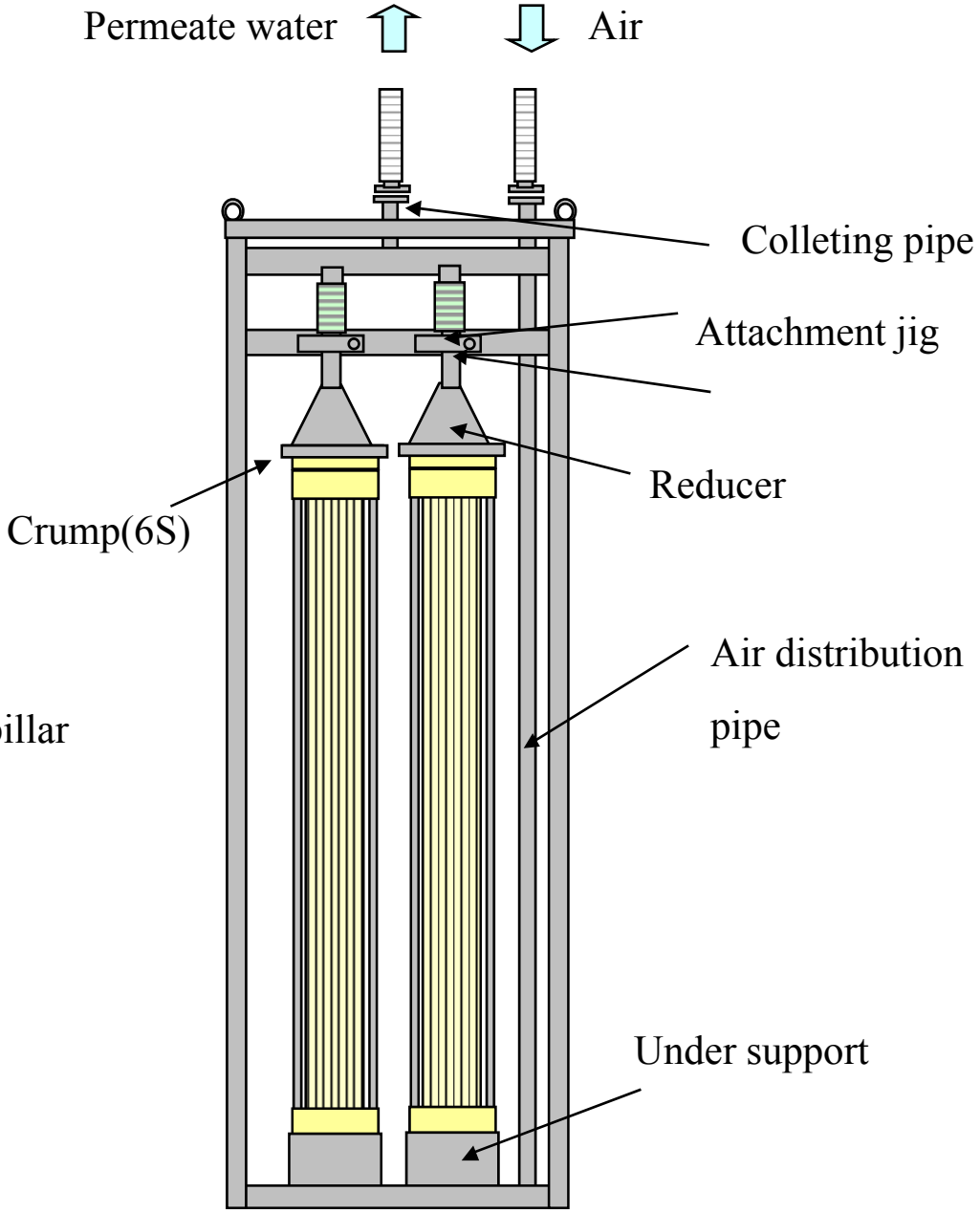
Crump

# *Parts of MBR units*

microza

## Reducer, Crump, Gasket



# *Asahi-kasei MBR rack unit (100m² type)*

microza

Specific design

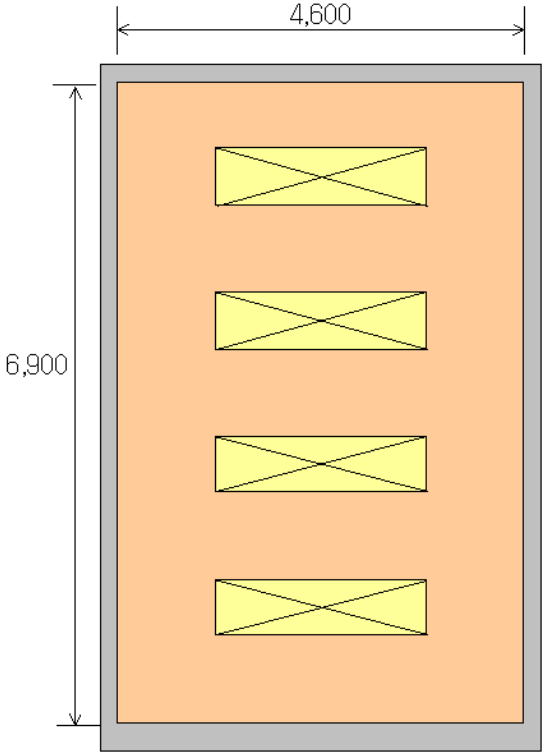
- Unit size 0.52*0.46*H2.7m
- Total membrane area 100m²
- Weight (wet) 185kg

Advantage of Asahi-kasei MBR rack system

- Less aeration volume for membrane
  (60-70% aeration volume of conventional MBR system)
- Space saving
  (about 50% space of conventional MBR system)

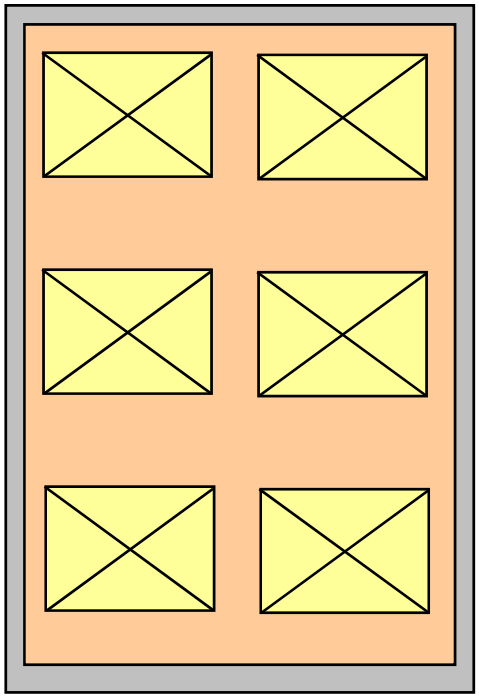
# *From Design manual of Japan Sewage Works Agency*

## *Aeration tank and MBR unit for 1000m³/d sewage system - tank depth 4m-*



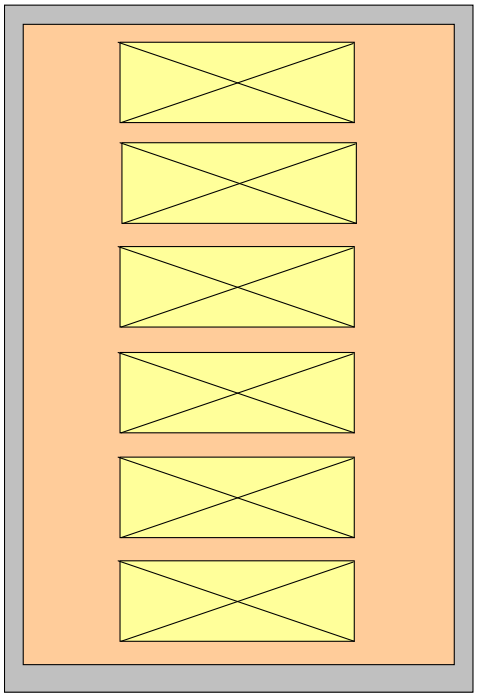

Asahi-kasei
(Foot print 5.8m²)

Aeration volume
625Nm3/hr



M company
(Foot print 11.5m²)

Aeration volume
958Nm3/hr

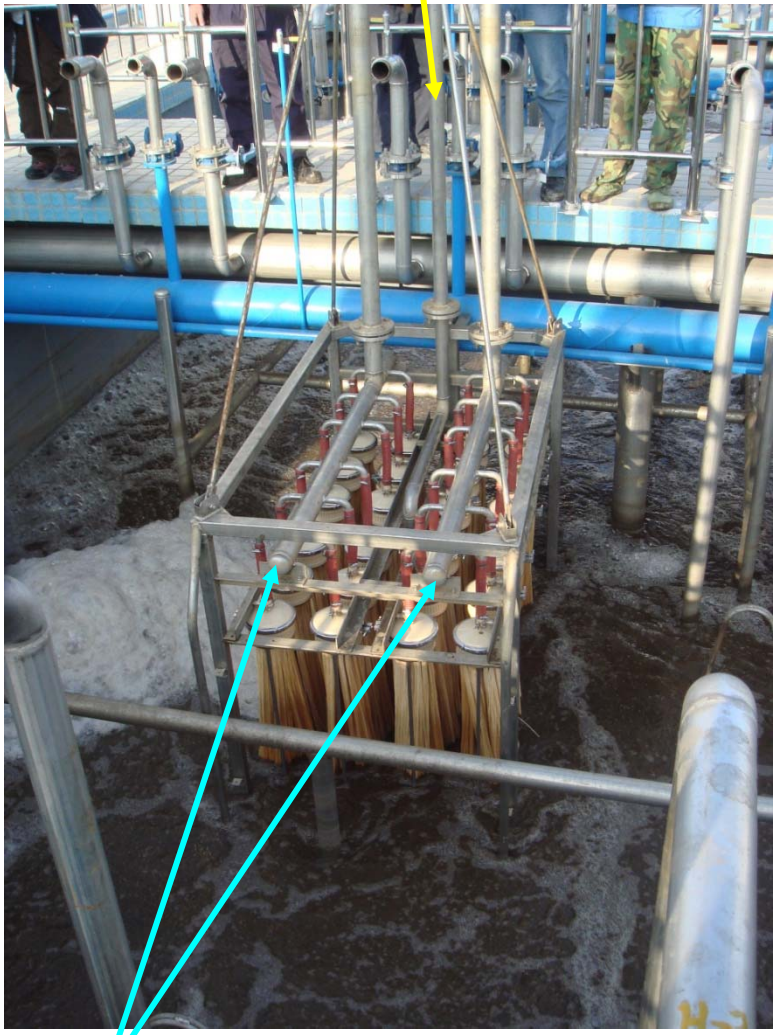


K company
(Foot print 12.5m²)

Aeration volume
792Nm3/hr

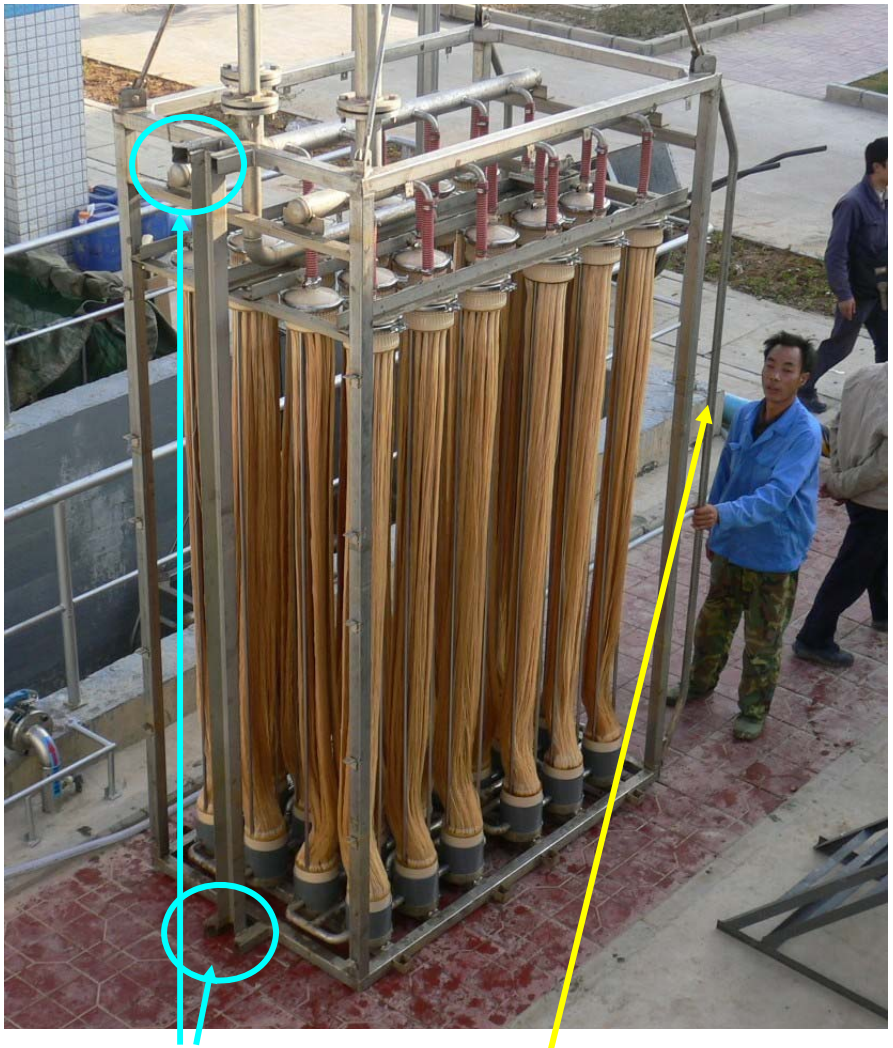
# *MBR Rack unit (24 Module type)*

microza

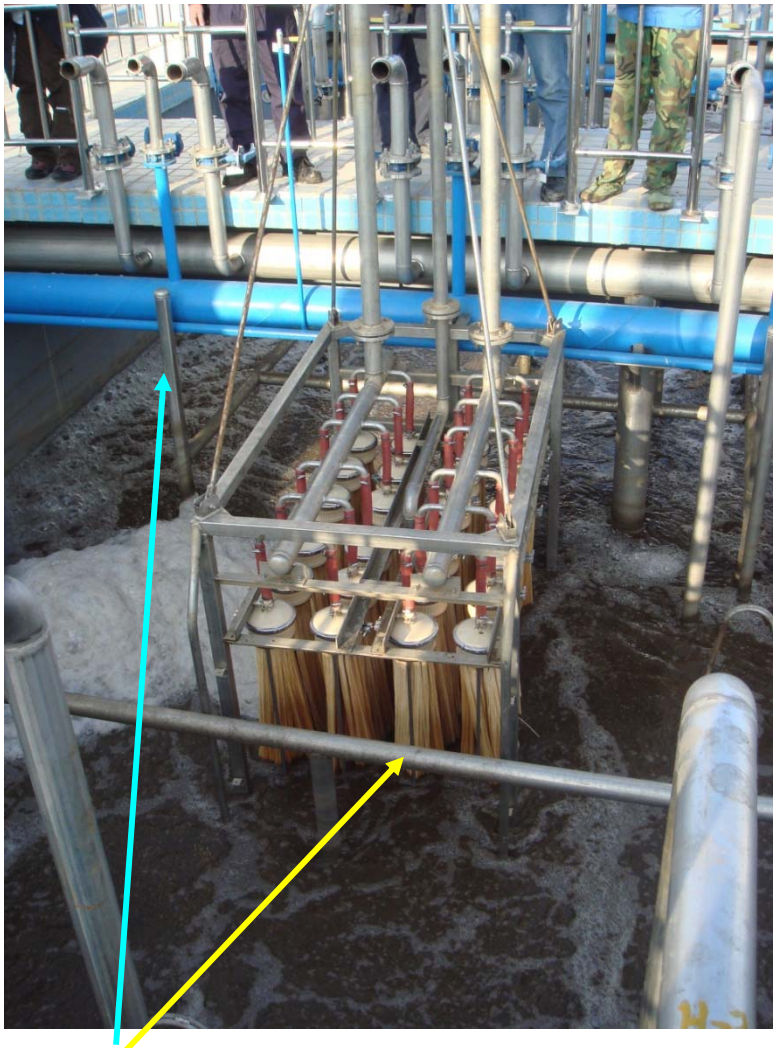


# *MBR Rack unit (24 Module type)*

microza



Guide Part of rack



Guide Pipe at membrane tank

# *MBR Rack unit*

microza

microza

# *Installation and setting of MBR modules*

**Installation**

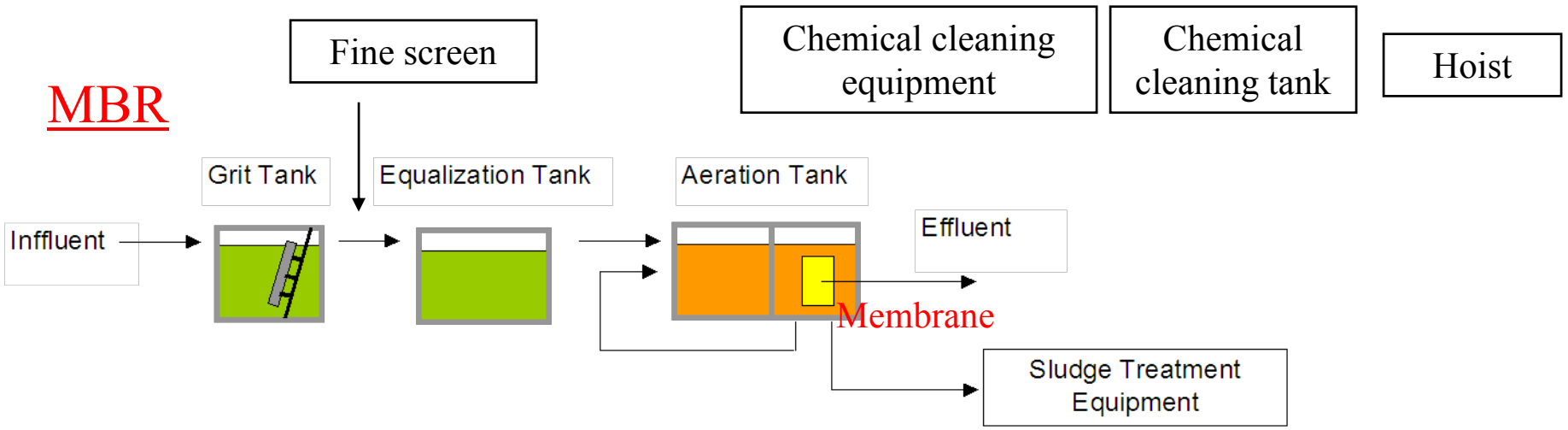
**Leak check**

**Submerging**

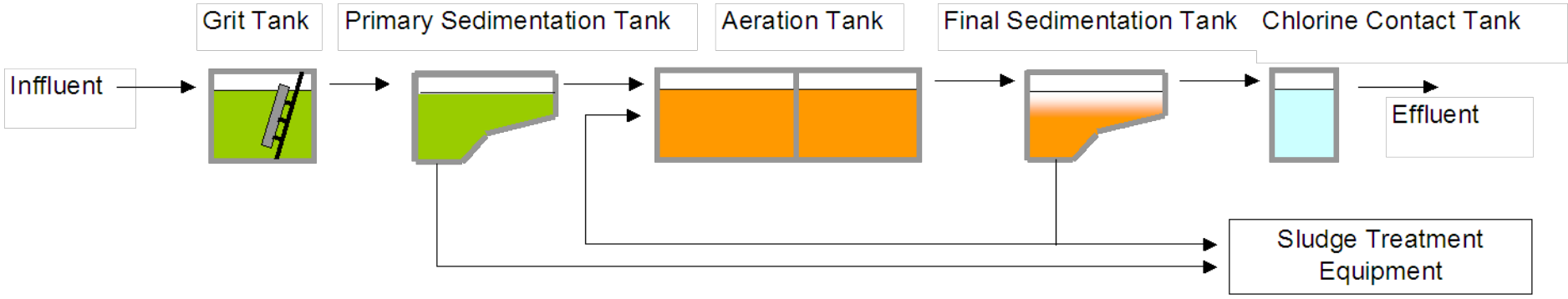
# *Operation Mode and considerations of MBR Module*

# Comparison of MBR and CAS in sewage process

## MBR




## CAS (Conventional Activated Sludge)



# *MBR operating condition*

microza

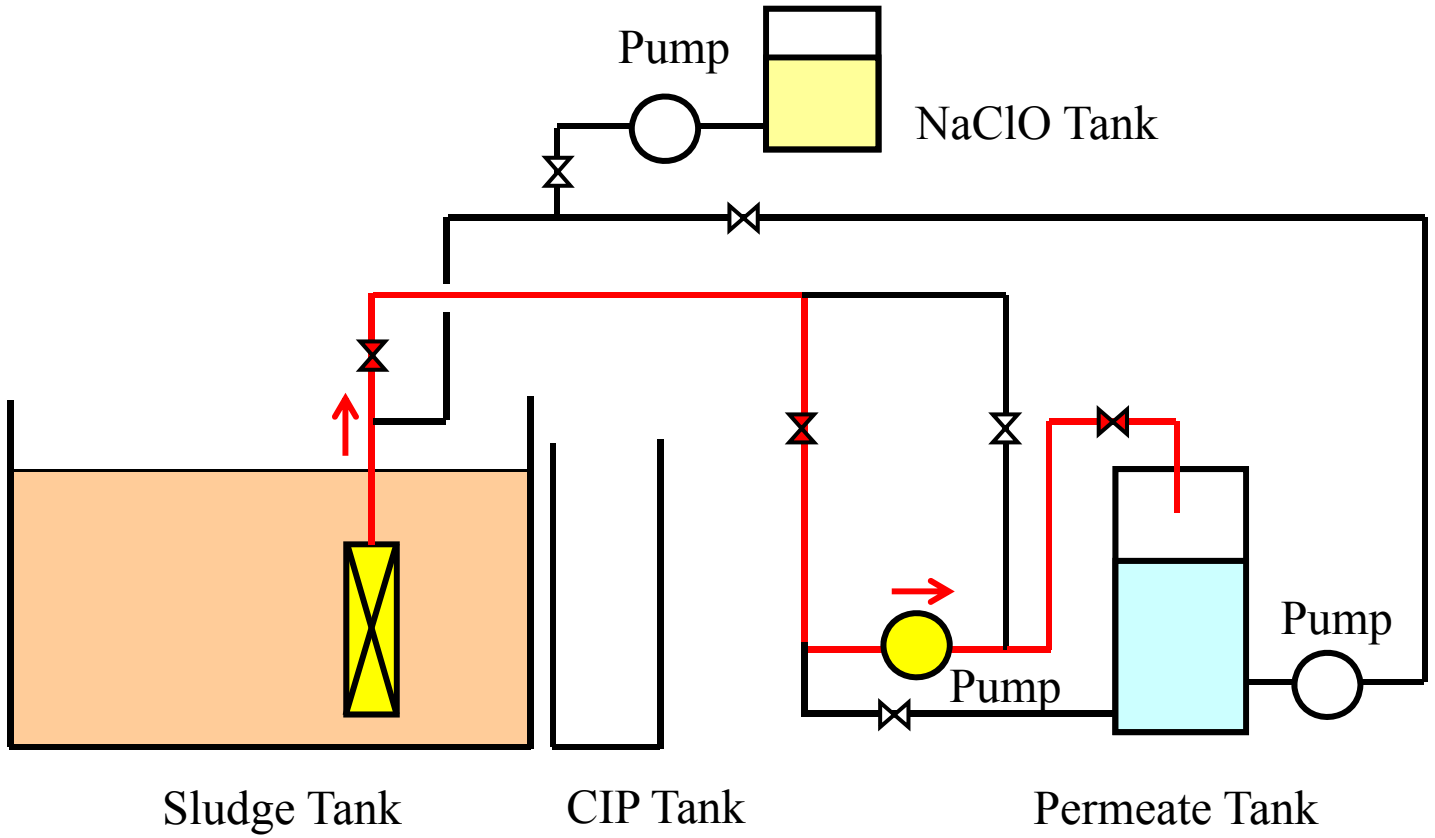
1. Flux 0.4 - 0.7 $m^3/m^2/d$ (Municipal water)
   0.2 - 0.6 $m^3/m^2/d$ (Industrial water)
2. Filtration / Reverse filtration time
   F : 9 min. RF : 1min. (Standard condition)
3. Aeration flow rate
   For Module : 5 $m^3$/hr/Mo
   For Aeration Tank : to keep DO level 1 –2 mg/l
4. EFM
   Case1 : When TMP reaches 30(or 40)KPa
   Case2 : Frequency 1-2 month
   0.3% NaClO sol. 2L/$m^2$(membrane) 90min
5. CIP
   Case : When effect of In Line Cleaning become smaller
   Soak modules in chemical solution tank
   0.3% NaClO sol. , 8hr< (Standard condition)
   0.5-1% Oxalic acid , 1hr< (Additional condition)

# *Operation mode 1*

microza

## Filtration

9min.

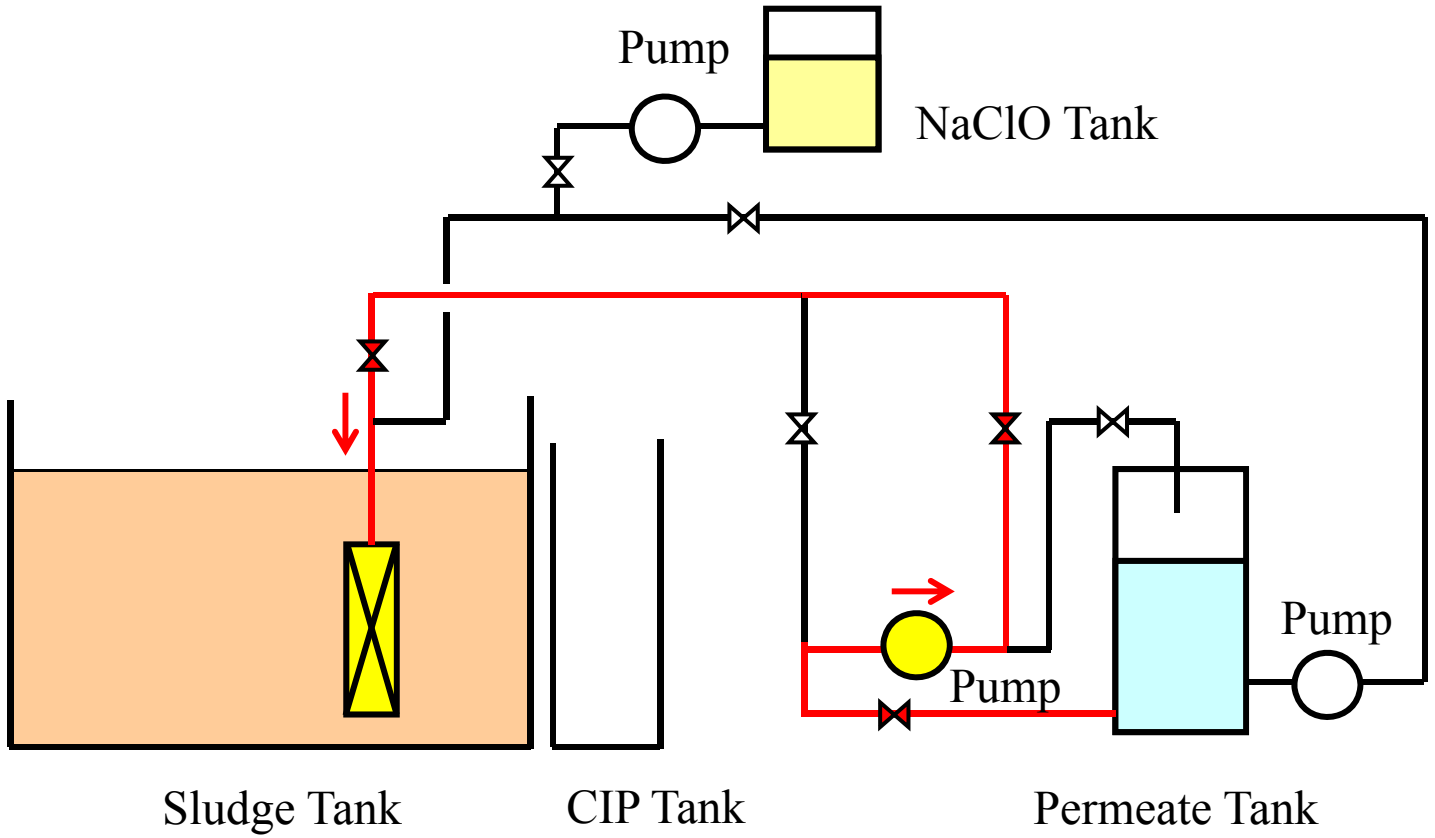


# *Operation mode 2*

microza

Filtration ⇔ RF

9min.- 1min.



# *Operation mode 3*

microza

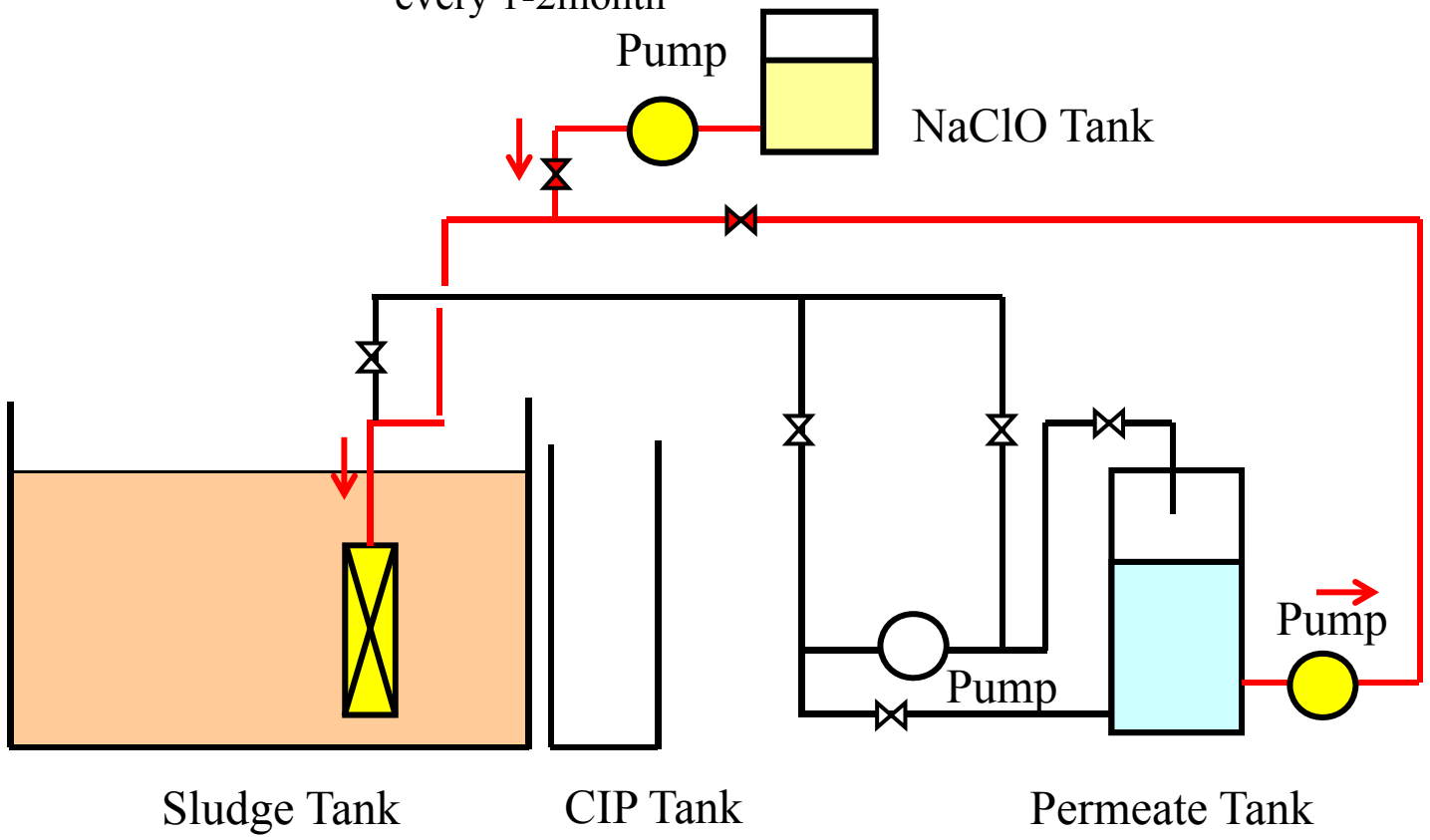
Filtration ⇔ RF

9min.- 1min.

EFM

0.3% NaClO sol.
50L/module

every 1-2month



# *Operation mode 4*

Filtration ⇔ RF → CIP

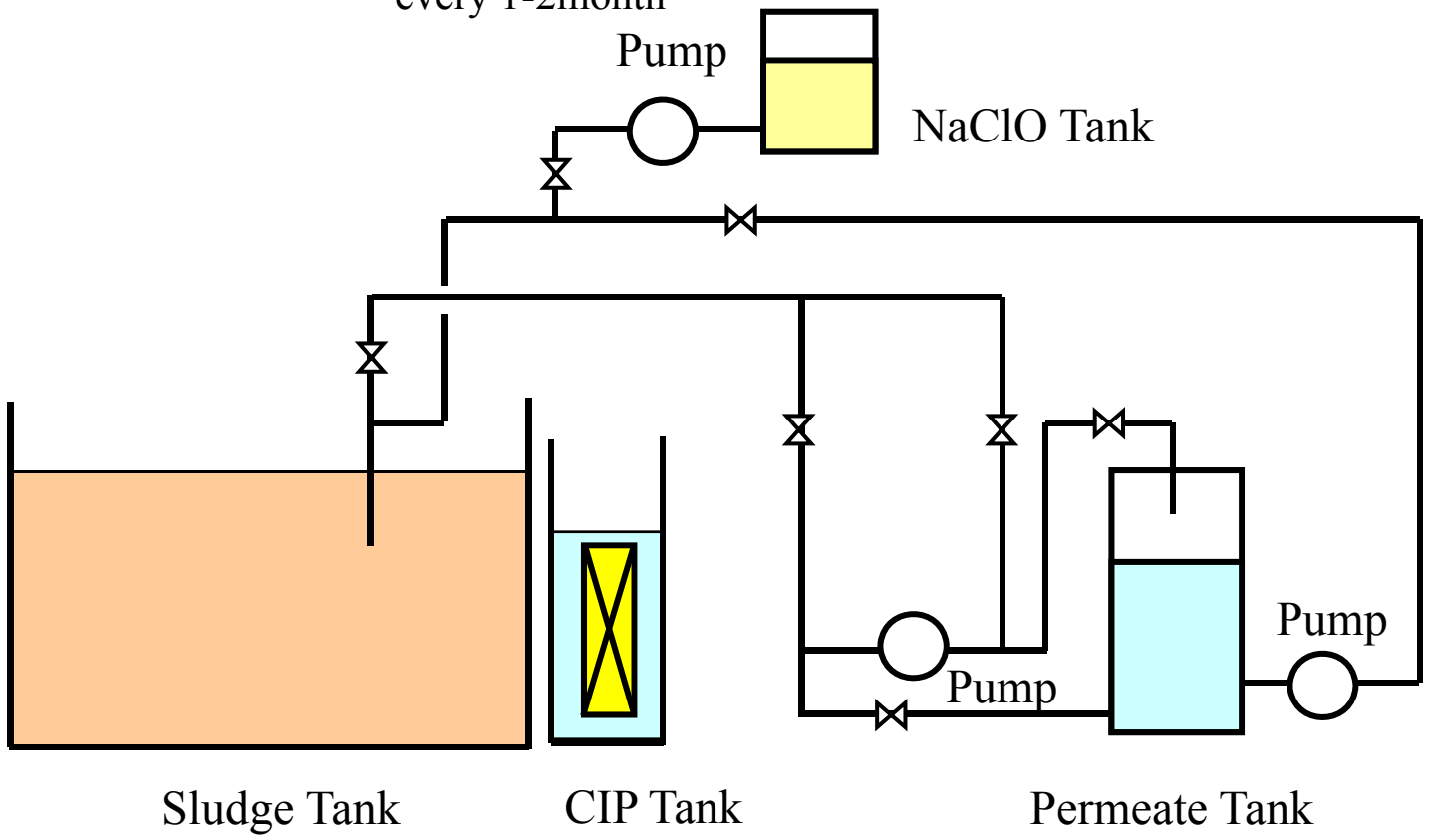
0.3% NaClO sol.
Soaking time 5hr<

9min.- 1min.

every 6-12month

EFM

every 1-2month



# *Operation mode 1*

microza

Filtration ⇔ RF → CIP → Filtration ⇔ RF

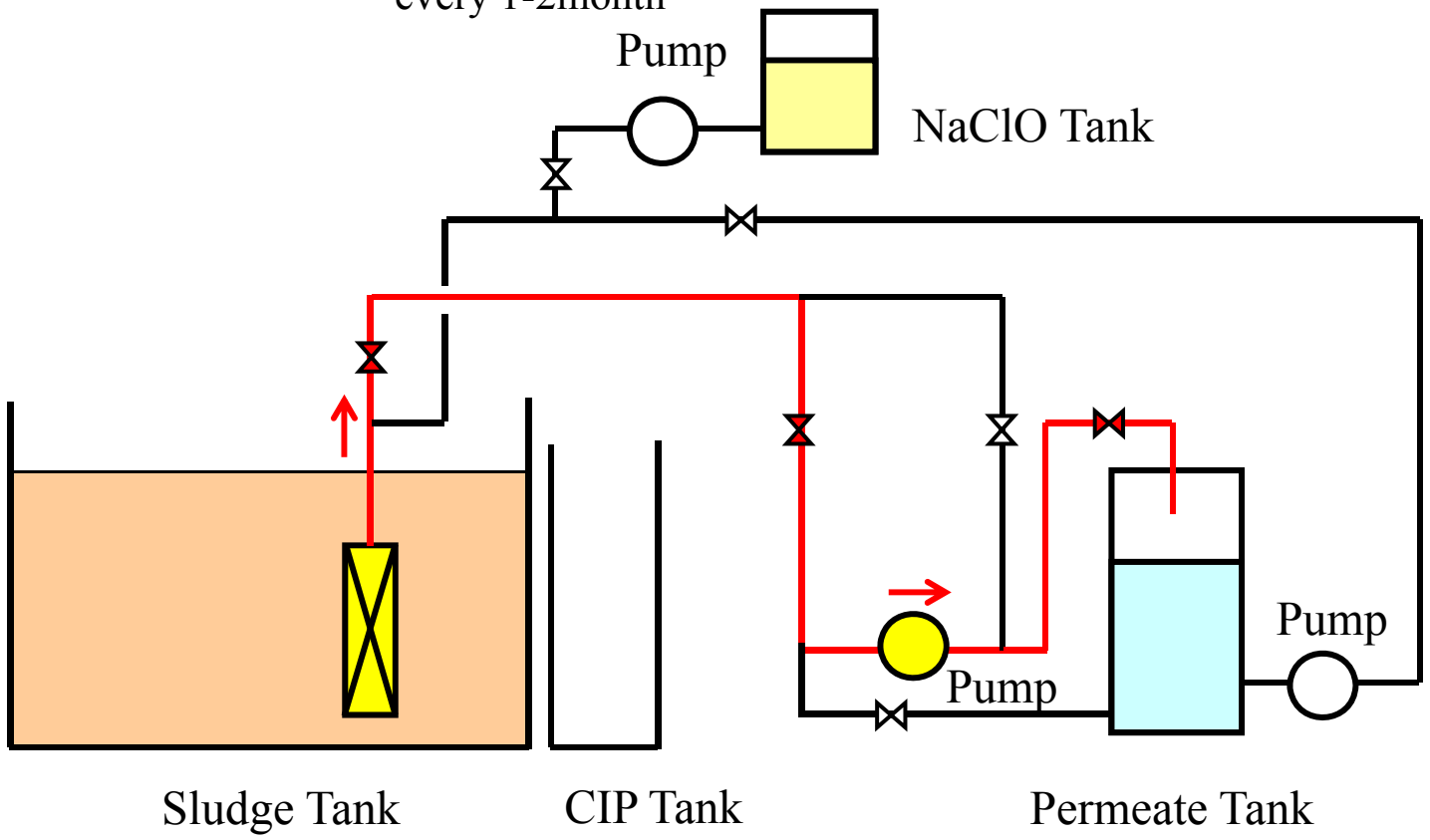
9min.- 1min.

EFM

every 1-2month

every 6-12month

9min.- 1min.



## *Operating and maintenance considerations*

microza

### Design

/ Elimination of foreign substances by Grid tank and Screen

/ Appropriate BOD loading （< 1 BOD-kg/m3/day ）

/ MLSS ( 8000 – 12000mg/l)

/ Feed water considerations

Oil content （ Fat oil < 50mg/l, Mineral oil < 3mg/l ）

Antifoam agent ( Silicone based antifoam agents are not recommended)

Inorganic material deposition ( pretreatment or PH control)

Toxic substance for microorganism (heavy metal, insecticide etc.)

# *Operating and maintenance considerations*

## Operations

/ Do not filter with clogging membrane under high vacuum pressure

Appropriate cleaning membrane is required for stable filtration.

/ Do not dry membrane during operation

/ Do not filter without aeration

It is recommended that filtration be stopped when aeration for membrane is not provided.

/ Do not freeze membrane during storage

# *Operating and maintenance considerations*

microza

## Maintenance

/ Daily checking by check list

Filtration pressure, Flow rate, Water temp., MLSS, DO, PH

It is recommended to make up time series graph

/ Periodical maintenance by maintenance contractor

Discussion about condition by using daily check list

Do not leave situation when any conditions are abnormal

# COD removal ratio at various waste water field

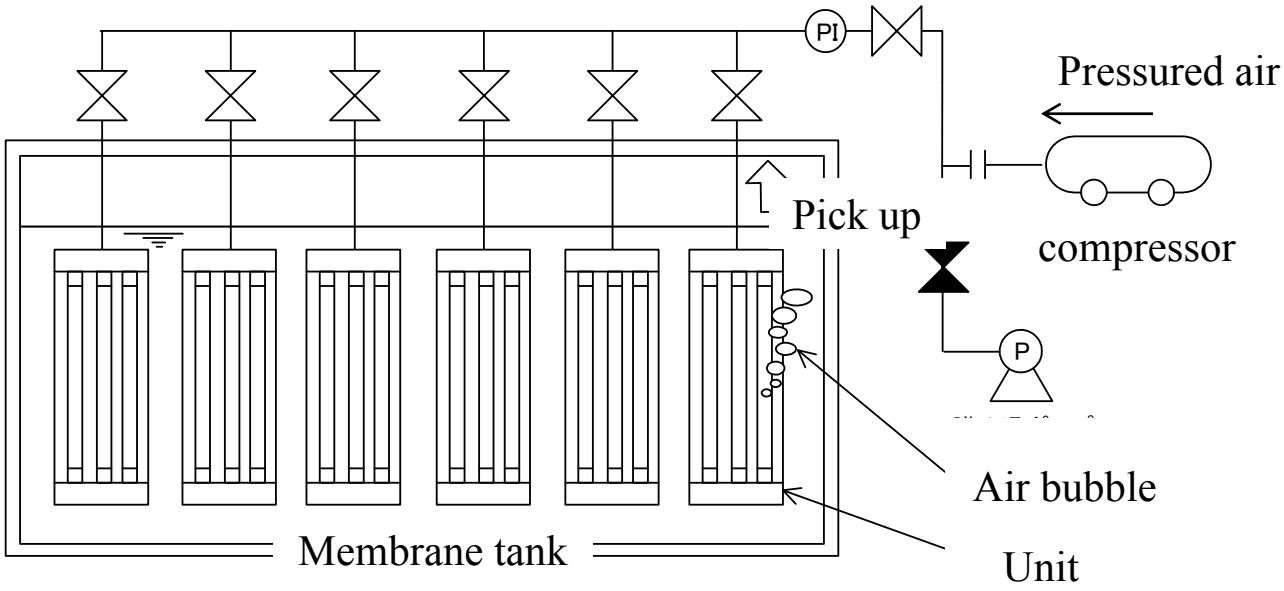
| | Influent COD (mg/l) | Effluent COD (mg/l) | Removal ratio (%) | Remarks |
|---|---|---|---|---|
| Municipal | 330 | 8.4 | 97.5 | $COD_{Cr}$ |
| Petrochemical factory | 679 | 99.7 | 85.3 | $COD_{Cr}$ |
| LCD factory | 450 | 3.6 | 99.2 | $COD_{Cr}$ |
| Chemical factory | 194 | 40.9 | 78.9 | $COD_{Mn}$ |
| Coolant factory | 512 | 56.8 | 88.9 | $COD_{Mn}$ |
| Chemical factory (including PEG) | 654 | 33.2 | 94.9 | $COD_{Mn}$ |
| Food factory (sea food) | 324 | 6.8 | 97.9 | $COD_{Mn}$ |
| Food factory (Japanese pickle) | 3490 | 51.4 | 98.5 | $COD_{Mn}$ |
| Food factory (soybeans) | 368 | 10.9 | 97.0 | $COD_{Mn}$ |
| Food factory (sugar) | 778 | 33 | 95.8 | $COD_{Mn}$ |
| Food factory (tofu) | 629 | 3.4 | 99.5 | $COD_{Mn}$ |

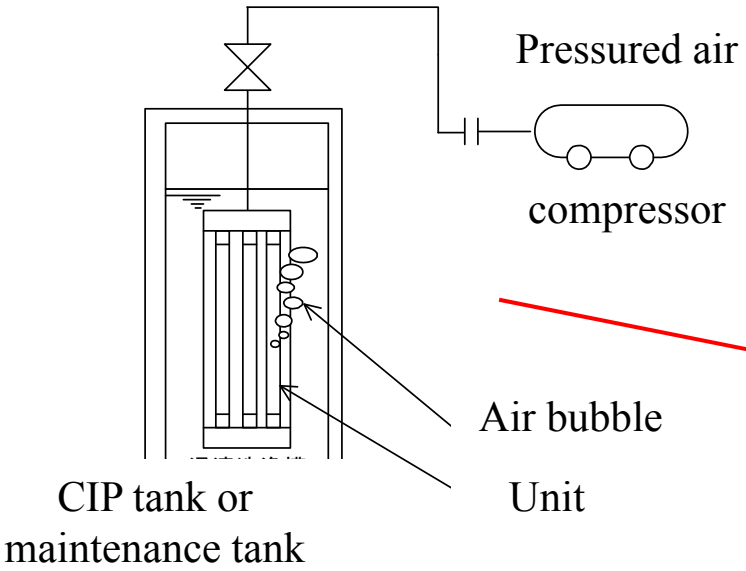
COD removal ratio of treated water depends on raw water quality.

Sewage and food factory wastewater are mostly easy to reduce.

Chemical waste water show various removal ratio.

# Repairing of hollow fiber breakage (detecting leaked module)

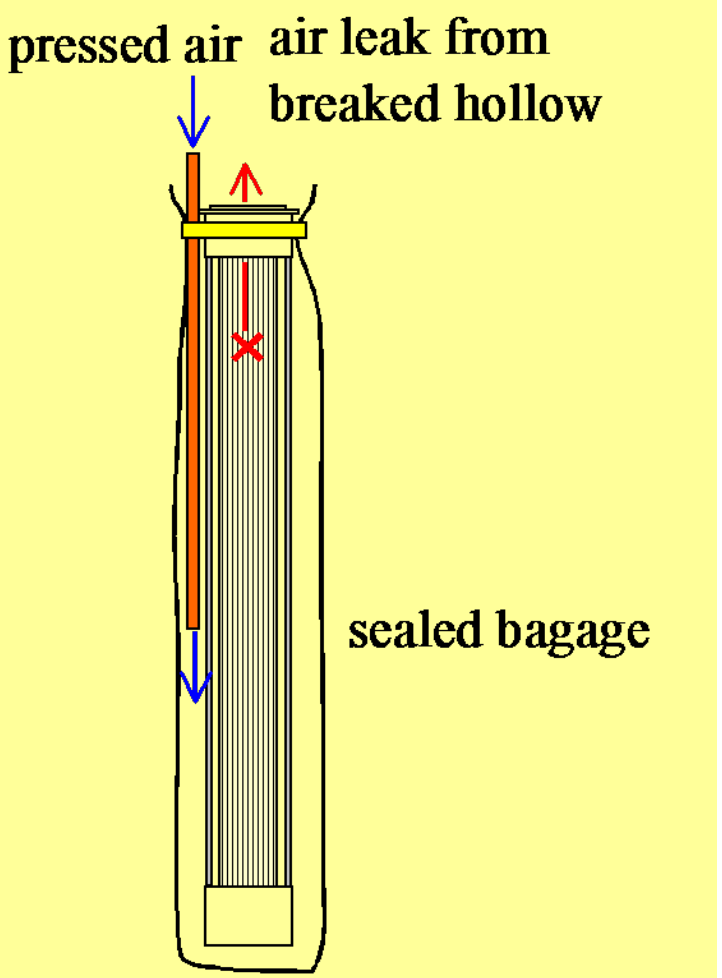


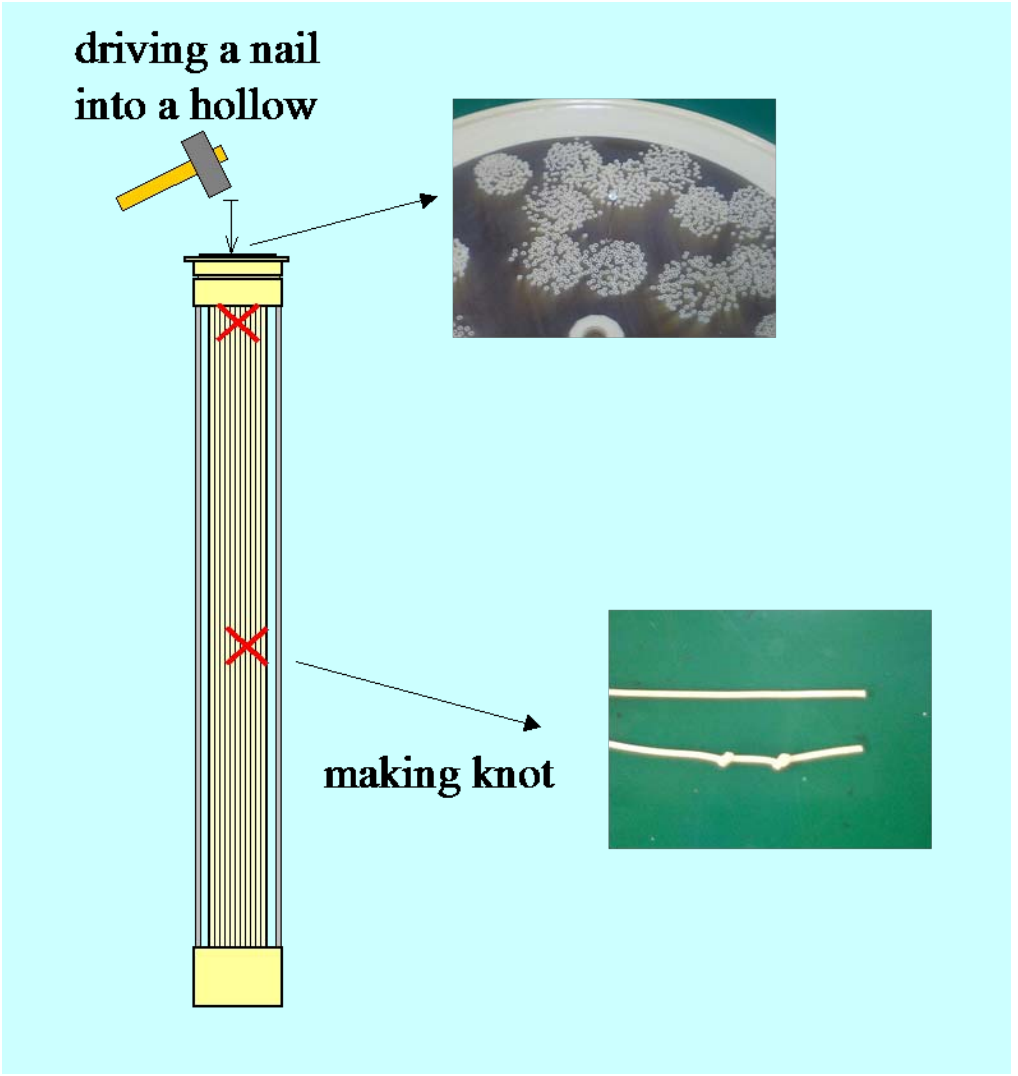

1. Detection of leakage by turbidity or IT test
2. Find leaking unit
3. Find leaking module

Leaking module

# Repairing of hollow fiber breakage




Detecting of leaked hollow fiber




Repairing

# Field test result

## - Title 22 test result at USA, CA-

# What is Title22 ?

- Qualification test by California state in USA for membrane but it affects not only CA but also whole of USA.
- Permeate turbidity (less than 0.1NTU) and Virus removal are examined.
- Some public tender need Title 22 in order to distinguish from unknown membrane.
- Many MBR membrane supplier had passed

  First period ：ZENON、Kubota、USFilter、Mitsubishi rayon

  Second period ：Koch、Kruger、Huber、Dynalift、Asahi-kasei

# Title22 test in U.S.A

Test site location: Point Loma WWTP, San Diego, CA, USA

Test period : 2006.9 – 2007.2

Aspect of Sewage plant

Test rig.

Existing process ( San Diego city WWTP )

Sewage ⇒ Dozing FeCl3 ⇒ Sedimentation ⇒ Discharge to Ocean (clear upper portion)

→ MBR raw water

microza

<Test condition>

Treatment capacity : 15m3/day (normal), 30m3/day (2Q test)

Flux : 0.6m3/m2/d (normal), 1.2m3/m2/day (2Q test)

Treatment system : Anoxic(1.9m3), Aerobic(1.9m3), Membrane tank(1m3)

Analytical item : permeate turbidity, rejection ratio of virus (2Q*6days test)

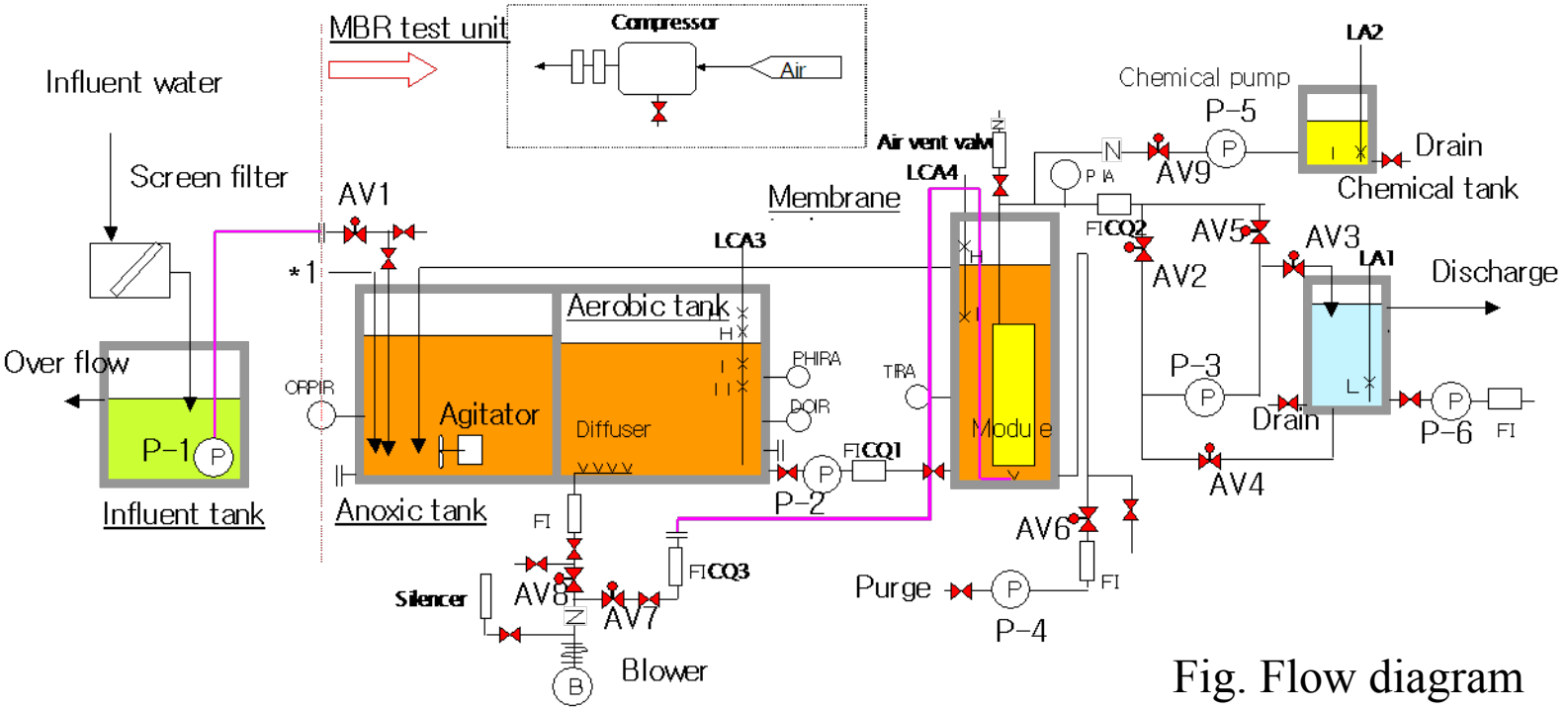



Fig. Flow diagram

Before use

After 40 days

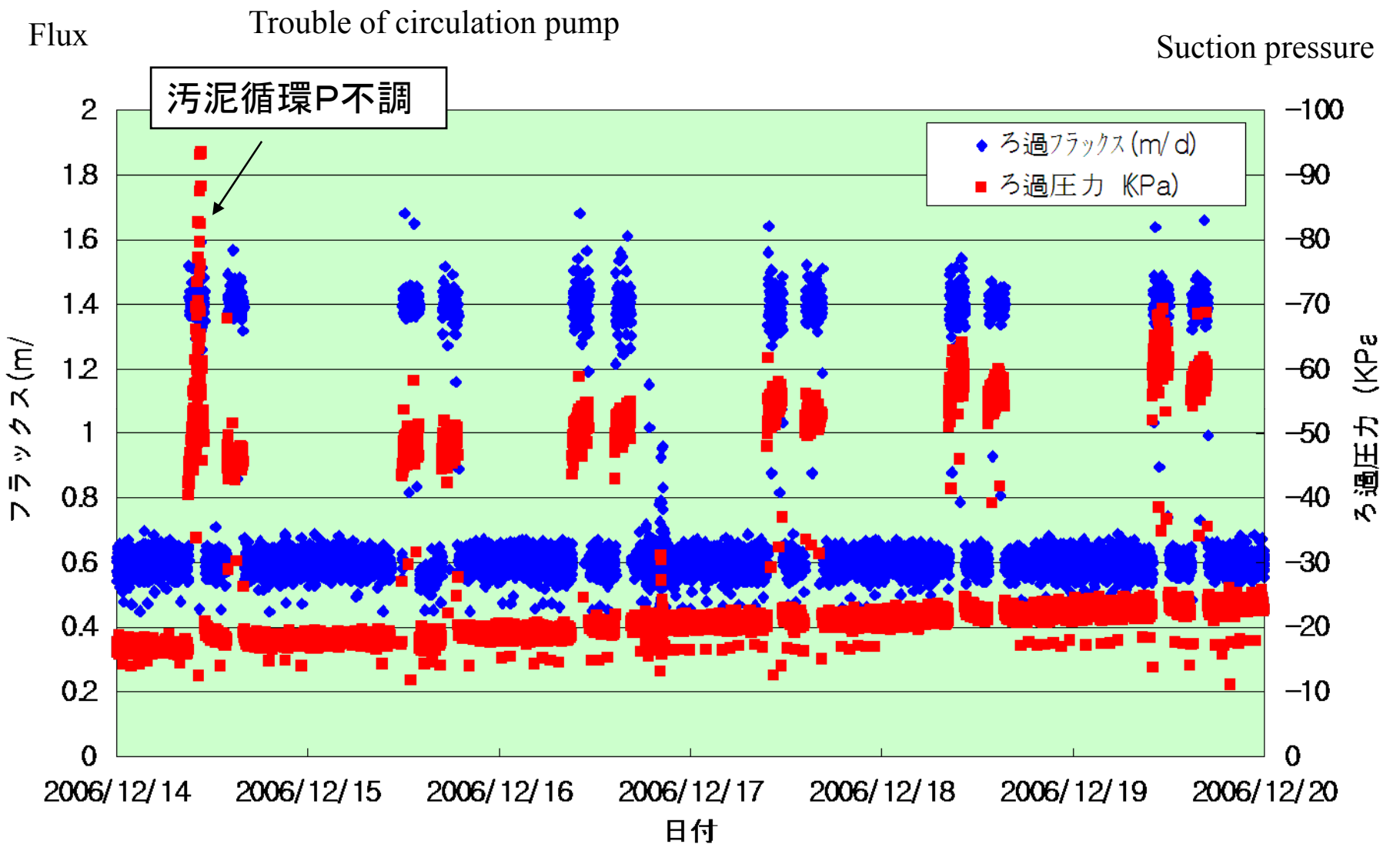
# After 4months use

Flashing by 0.1% NaClO
from B.K. side

Average Water quality of Influent and Treated water (06.9～07.1)

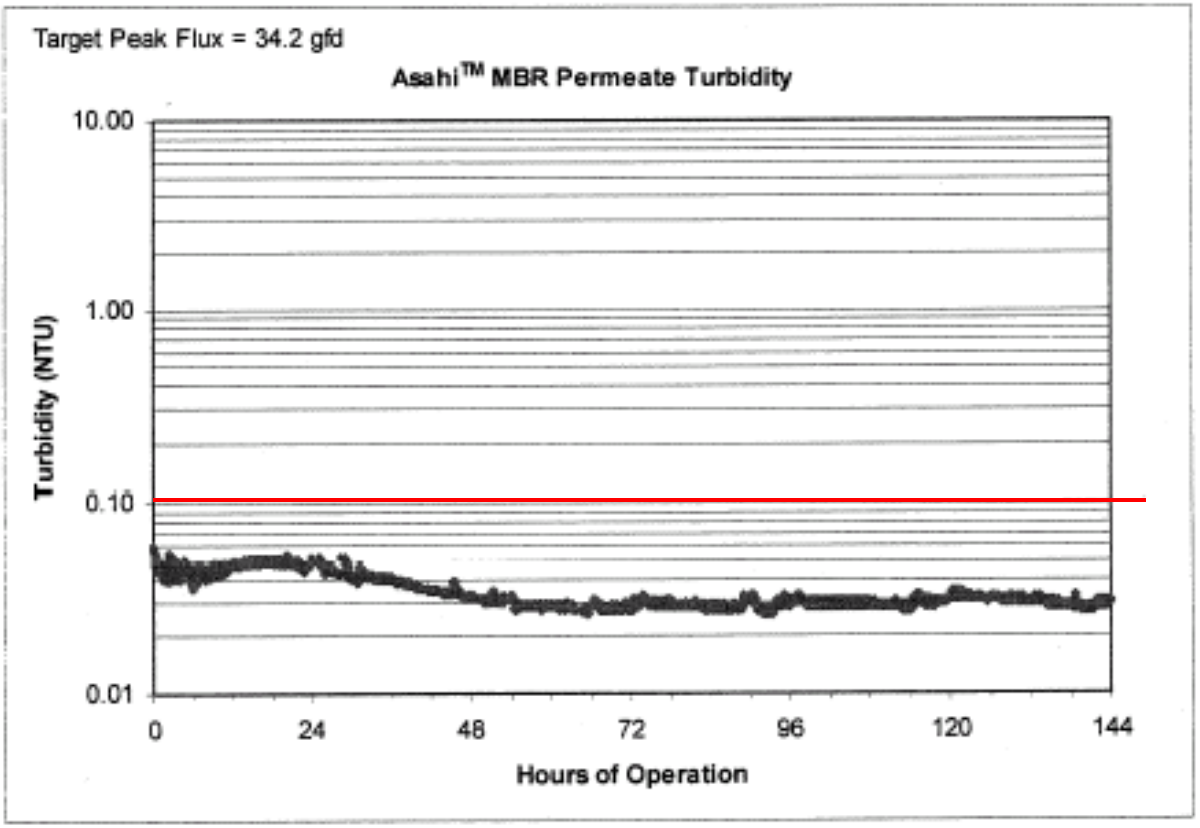
| | | Influent | Treated water |
|---|---|---|---|
| BOD | mg/l | 141 | <2 |
| SS | mg/l | 128 | --- |
| TOC | mg/l | 60 | 5 |
| T-N | mg/l | 21 | 5.2 |
| Total Coliforms | CFU/100mL | 6.40E+07 | <10 |
| Fecal Coliforms | CFU/100mL | 5.10E+06 | <10 |

# Peak Flow test



# Test result of permeate turbidity

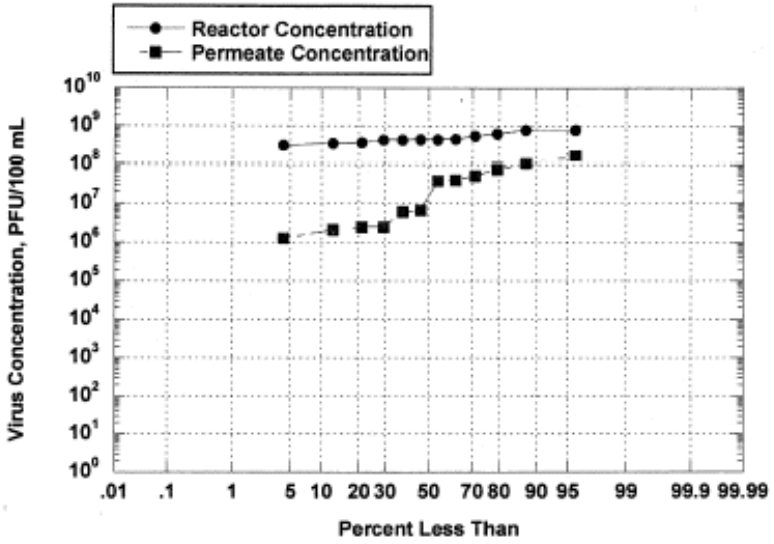
MUNC-620A passed Title 22.



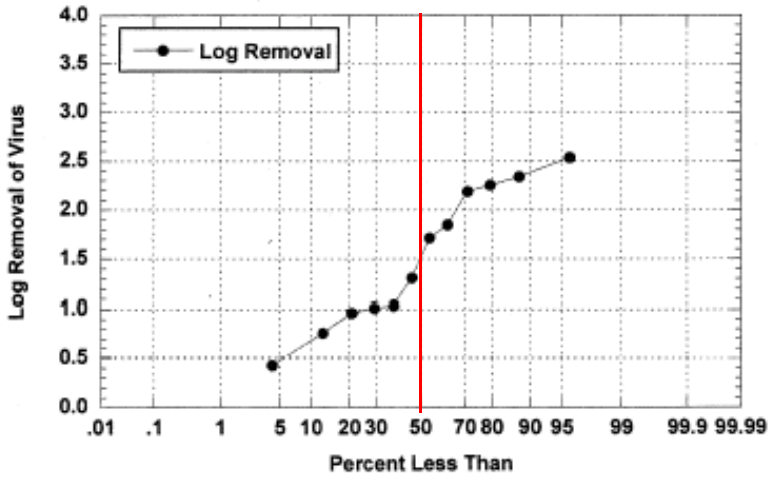

**Permeate Turbidity during Peaking Study**

# Virus removal (Challenge test)

1.5log, it is good as MF membrane.




MS-2 Phage Concentration in the Reactor and Permeate of Asahi MBR duri Virus Seeding Experiments




Log Removal of MS-2 Phage by Asahi MBR during Virus Seeding Experiments

No criteria for Virus removal, but membrane with less than 1log is evaluated 'insufficient filtration ability'.

Kubota and Mitsubishi membranes are about 0.5log.

State of California—Health and Human Services Agency
Department of Health Services

California Department of Health Services
SANDRA SHEWRY
Director

ARNOLD SCHWARZENEGGER
Governor

May 8, 2007

Asahi-Kasei Chemicals Corporation
Microza Sales & Marketing Department 1
Microza & Water Processing Division
Hibiya-Mitsui Bldg., 1-2, Yurakucho 1 - chome,
Chiyoda-Ku, Tokyo 100-8440, Japan

Attn. Mr. Atsuo Kubota
Deputy General Manager

Subject: Use of the Asahi-Microza™ Membrane Bioreactor to comply with California Water Recycling Criteria

Gentlemen:

By transmittal e-mail dated March 20, 2007, Montgomery Watson Harza, Consulting Engineers, requested Departmental acceptance of the Asahi-Microza™ Membrane Bioreactor (MBR) treatment unit as an acceptable filtration technology for compliance with the State of California Water Recycling Criteria (Title 22). Accompanying this request was a report prepared by Montgomery Watson Harza entitled "Assessing the Ability of the Microza™ Membrane Bioreactor to Meet Existing Water Reuse Criteria", dated March 2007. The report was prepared under a grant from the U.S. Bureau of Reclamation and outlines findings from a study conducted in the City of San Diego, California. The Department has reviewed this report and offers the following comments.

Division of Drinking Water and Environmental Management
Technical Programs Branch, Recycled Water Unit
1180 Eugenia Place, Suite 200, Carpinteria, CA 93013-2000
(805) 566-1326; (805) 745-8196 fax
Internet Address: jstone1@dhs.ca.gov

The Asahi-Microza™ MBR treatment system evaluated utilizes hollow fiber PVDF ultrafiltration membranes with a nominal pore size of 0.1 micron. The membrane piloted during this study is identified as the Microza™ MUNC-620A membrane module. The Asahi-Microza™ MBR configuration consists of an anoxic tank, aerobic tank and the submerged membrane tank. The membranes are operated under vacuum (-11.6 psi max.) with a maximum transmembrane pressure differential ranging 6.0 psi and an average design flux of 14.6 gallons per square foot per day (gfd).

The California Water Recycling Criteria recognize membrane filtration as an acceptable filtration technology provided prescribed performance requirements (i.e. turbidity) are reliably met. The turbidity performance criteria require that the filtered wastewater not exceed any of the following:

1. 0.2 NTU more than 5 percent of the time within a 24-hour period; and
2. 0.5 NTU at any time.

The demonstration studies conducted using the Asahi-Microza™ MBR treatment system which utilizes the PVDF hollow fiber membrane with a nominal pore size of 0.1 micron have sufficiently demonstrated the ability to produce an oxidized wastewater and the membranes ability to comply with the above stated turbidity performance requirements. In addition, virus seeding experiments demonstrated the processes ability to achieve 1.5-log removal of inherent Total Coliphage at the 50$^{th}$ percentile level. Therefore, the Department of Health Services accepts the use of this membrane, identified as the Asahi-Microza™ MBR filtration treatment system utilizing a hollow fiber membrane with a nominal pore size of 0.1 micron (identified as the Microza™ MUNC-620A) as a filtration technology for use in compliance with the Water Recycling Criteria.

The acceptance of this technology is specific to the Asahi-Microza™ MBR filtration treatment system utilizing MUNC 620A hollow fiber membrane. Any proposed changes made in the physical attributes or character of this membrane shall be reviewed in advance by the Department to determine whether the modifications will require additional testing.

The Department will continue to review all proposed projects on a case-by-case basis to determine full compliance with all applicable treatment and reliability features required by the

Water Recycling Criteria. This will include the collective review of all treatment unit processes, operational controls (e.g. loading rates, TMP, type and frequency of integrity tests), 'O&M' procedures, etc.

If you have any questions concerning this letter, please contact the undersigned at (805) 566-9767.

Sincerely,

Jeffrey L. Stone, Chief
Recycled Water Unit
Division of Drinking Water

cc: Montgomery Watson - James DeCarolis
City of San Diego - Larry Wasserman
Recycled Water Committee

techlist/KrugerNeosepapprltr.doc

# Point Loma Tilte22 Test Summary (1)

microza

| | Asahi Kasei | GE/Zenon* | Siemens/ Memcor | Kubota* | Mitsubishi Rayon |
|---|---|---|---|---|---|
| Membrane Type | HF | HF | HF | FS | HF |
| Membrane Material | PVDF | PVDF/R | PVDF | PE | PE |
| Nominal pore size | 0.1um | 0.04um | 0.04um | 0.4um | 0.4um |
| Membrane area/module (ft2) | 269 | 340 | 409 (B30R) | 8.6 | 269 (SADF2590A) |
| Module Type | Submerged | Submerged | Submerged | Submerged | Submerged |
| Flux (gfd) Q | 15 – 24 | (22)* | | (15)* | |
| Peak Flux (gfd) | 30 – 39 | | | | |
| Average Flux (gfd) | 20 – 27 | | 14 – 24 | | 12 – 15 |
| Operation Cycle | 9.5min F→ 0.5min BW | 10min F→ 0.5min RL | 12min F→ 0.75 min RL→ 0.25 min BW | 9 min F→ 1 min RL | 12 min F→ 2 min RL |
| Cleaning cycle (Hr) (CIP) | N/A | 1,350 | 1,608 | 0 | 1,176 |
| EFM cycle (Hr) | 336 | 56 | None | None | None |
| Required Air Flow (SCFM/ft2) | 0.013 | 0.028 (10/10) | 0.021 | 0.033 | 0.049 |
| Membrane damage during test period | None so far | No. Info. | No. Info. | No. Info. | No. Info. |
| Rack foot print (Membrane area/rack area) | 430 (Latest design) | 341 (500d) | | 166 (EK400) | 223 (SADF2590A) |
| Comments | | 10/30 air cycle now | | | SADF2590A is PVDF |

* Feed water of Zenon & Kubota test was after coagulation and sedimentation
(These two suppliers already had tested on raw waste water at different site (San Pasqual))

# Point Loma Tilte22 Test Summary (2)

microza

| | Asahi Kasei | Koch/Puron | Kruger/Toray | Huber | Dynalift/ Norit/X-Flow |
|---|---|---|---|---|---|
| Membrane Type | HF | HF | FS | FS | Tubular |
| Membrane Material | PVDF | PES/R | PVDF | PES | PVDF/R |
| Nominal pore size | 0.1um | 0.04um | 0.08um | 0.038 um | 0.03um |
| Membrane area/module (ft2) | 269 | 323 | 15 | 8.1 | 312 |
| Module Type | Submerged | Submerged | Submerged | Submerged | Side stream |
| Flux (gfd) Q | 15 - 24 | 11 | 18 | 15 | 30 |
| Peak Flux (gfd) | 34 - 39 | 35 | 35 | 33 | 45 |
| Average Flux (gfd) | 20 - 27 | 14 | 21 | 18 | 32 |
| Operation Cycle | 9.5min F→ 0.5min BW | | | | |
| Cleaning cycle (Hr) (CIP) | N/A | ? | 920 | ? | ? |
| EFM cycle (Hr) | 336 | 191 | None | 207 | 332 |
| Required Air Flow (SCFM/ft2) | 0.013 | 0.019 | 0.04 | 0.026 | 0.019 |
| Membrane damage during test period | None so far | After 500 hrs | After 2200 hrs | None | None |
| Comments | | | | | |

# Test result of permeate turbidity

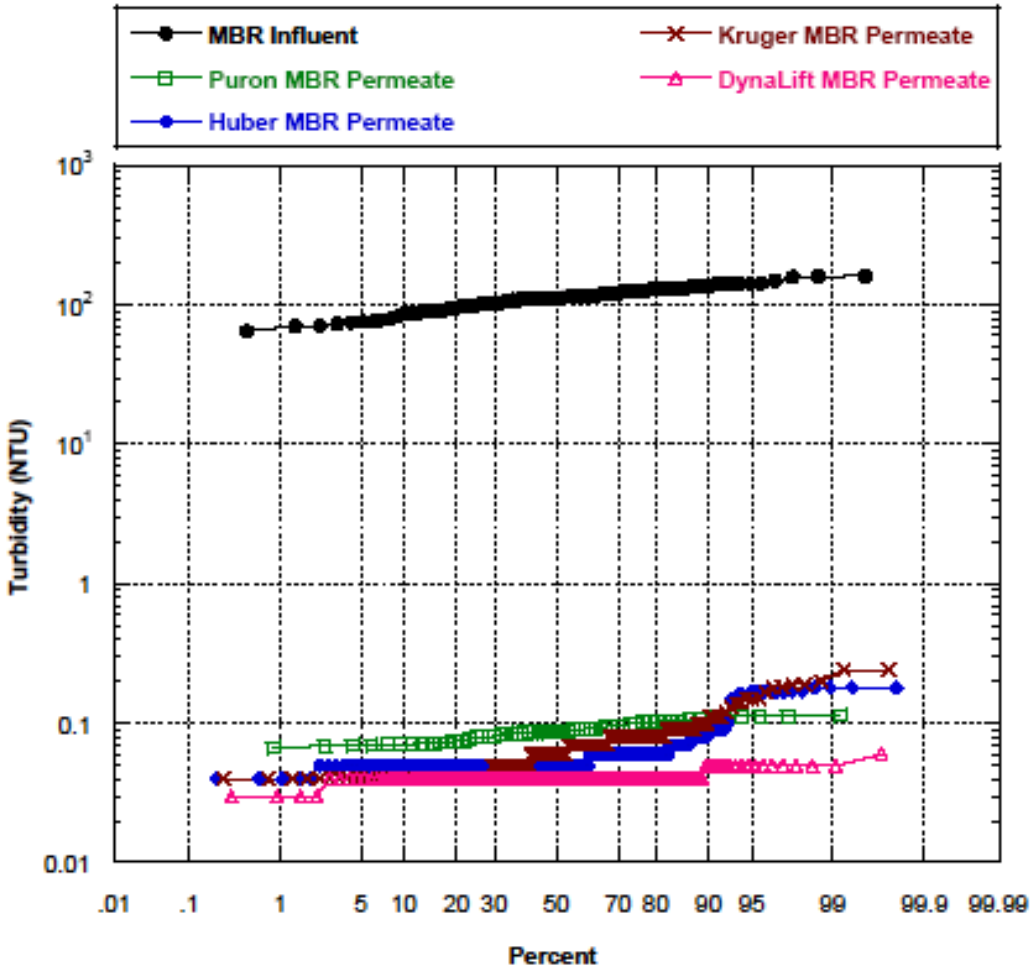



**Figure 3 – Particulate Removal by Newly Developed MBR Systems**

<Reference> 4th of IWWA conference

# Test result of Total coliform concentration

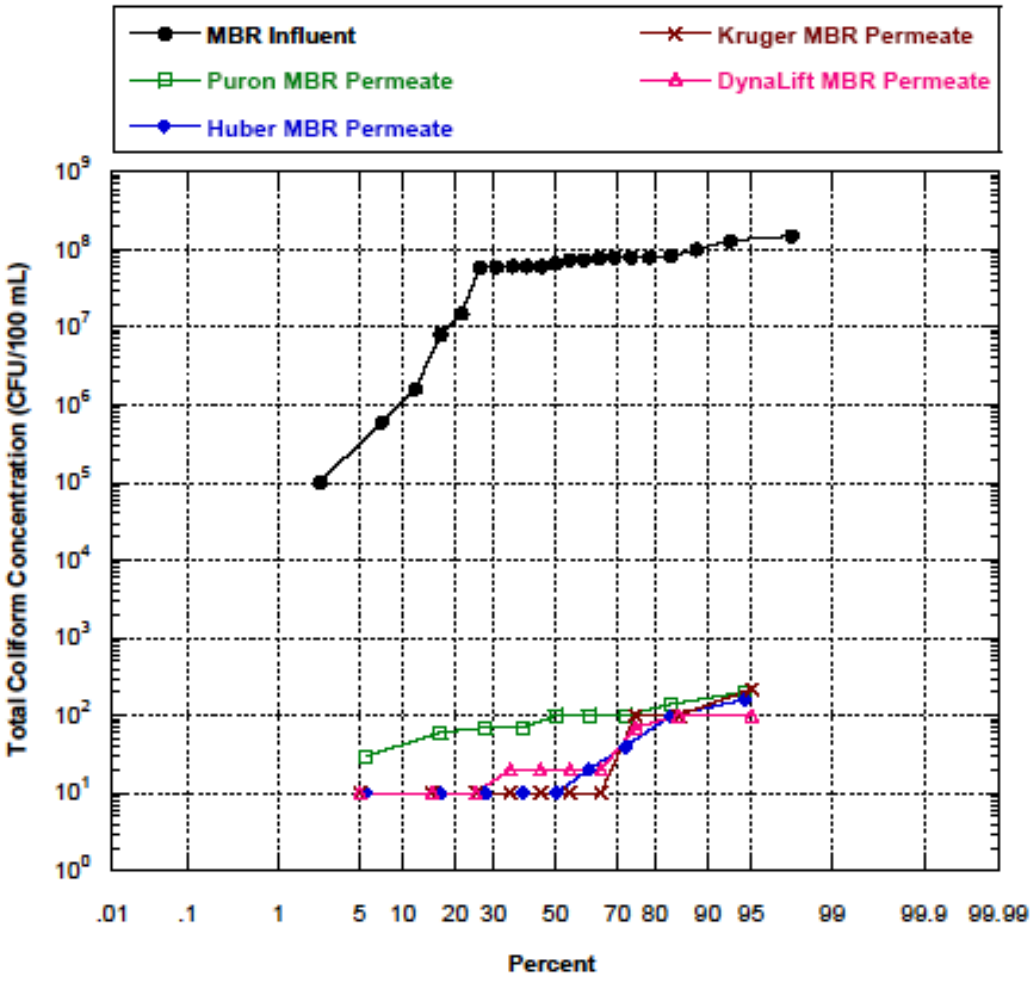



**Figure 5 – Microbial Contaminants Removal by Newly Developed MBR Systems**

<Reference> 4th of IWWA conference

# Field test result

# Sewage research with JSWA 2002-2004

# *Asahi-kasei MBR system development (No.1)*

## *Municipal wastewater treatment*

( Co-operation with Japan Sewage Works Agency at Mooka pilot plant )

- Operation Flux : 0.8m3/m2/d (19.7GFD)
  (average Flux : 0.72m3/m2/d, 17.7GFD) : TMP stable
- Ratio of aeration volume / permeate water volume
  reduce to 13.3 (conventional MBR 20)
- The water quality, BOD,T-N,T-P,SS are less than the criteria of permeate water.
- T-P of permeate water is reduced without adding coagulants by biological elimination.

- RO test starting for MBR treated water from ’04.8.

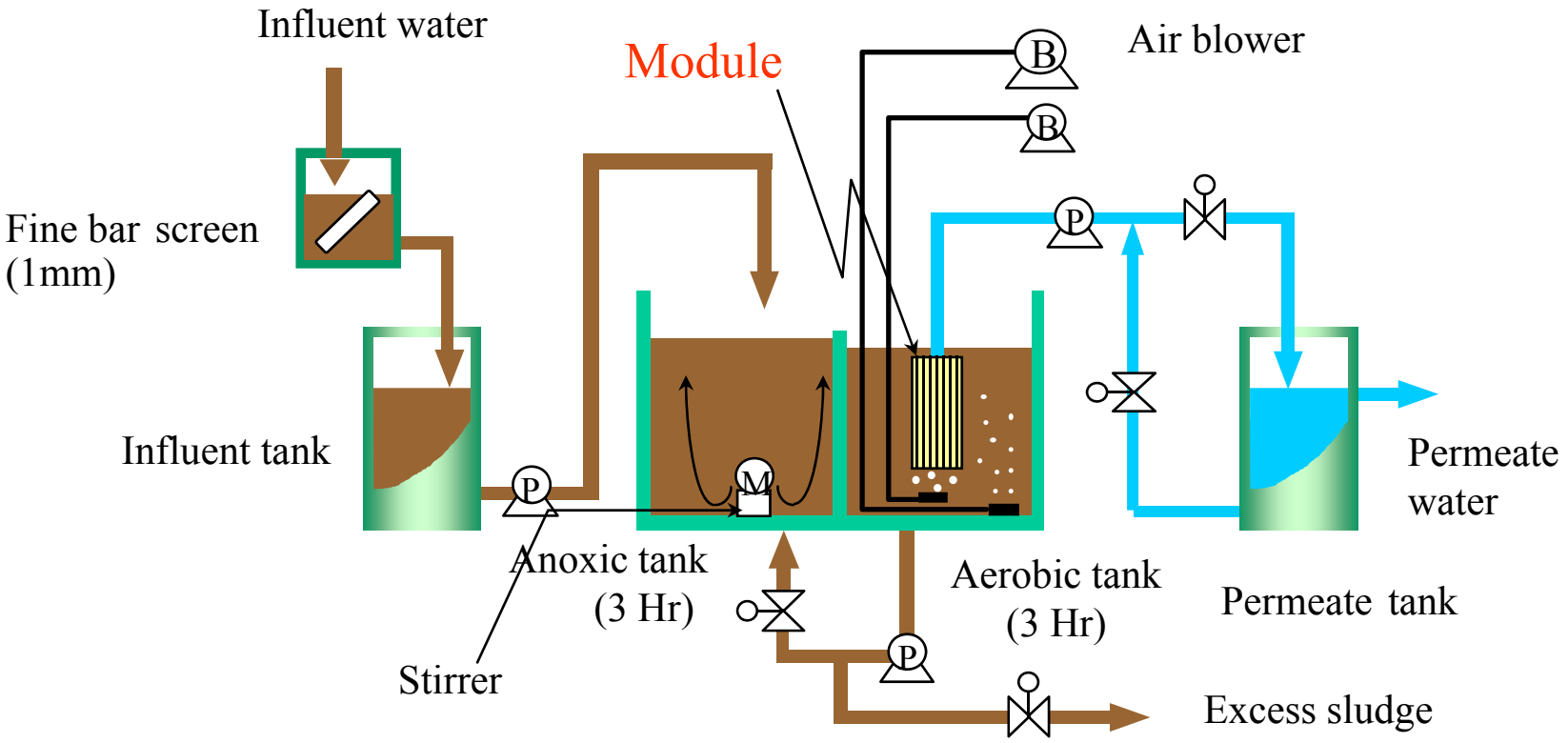
# *Photograph of Asahi-kasei MBR Pilot Plant*

(a) Cooperative influent tank

(b) Asahi-kasei MBR Pilot Plant

microza

# *Flow diagram of Asahi-kasei MBR Pilot Plant*




**Treatment water capacity : 36m3/day**

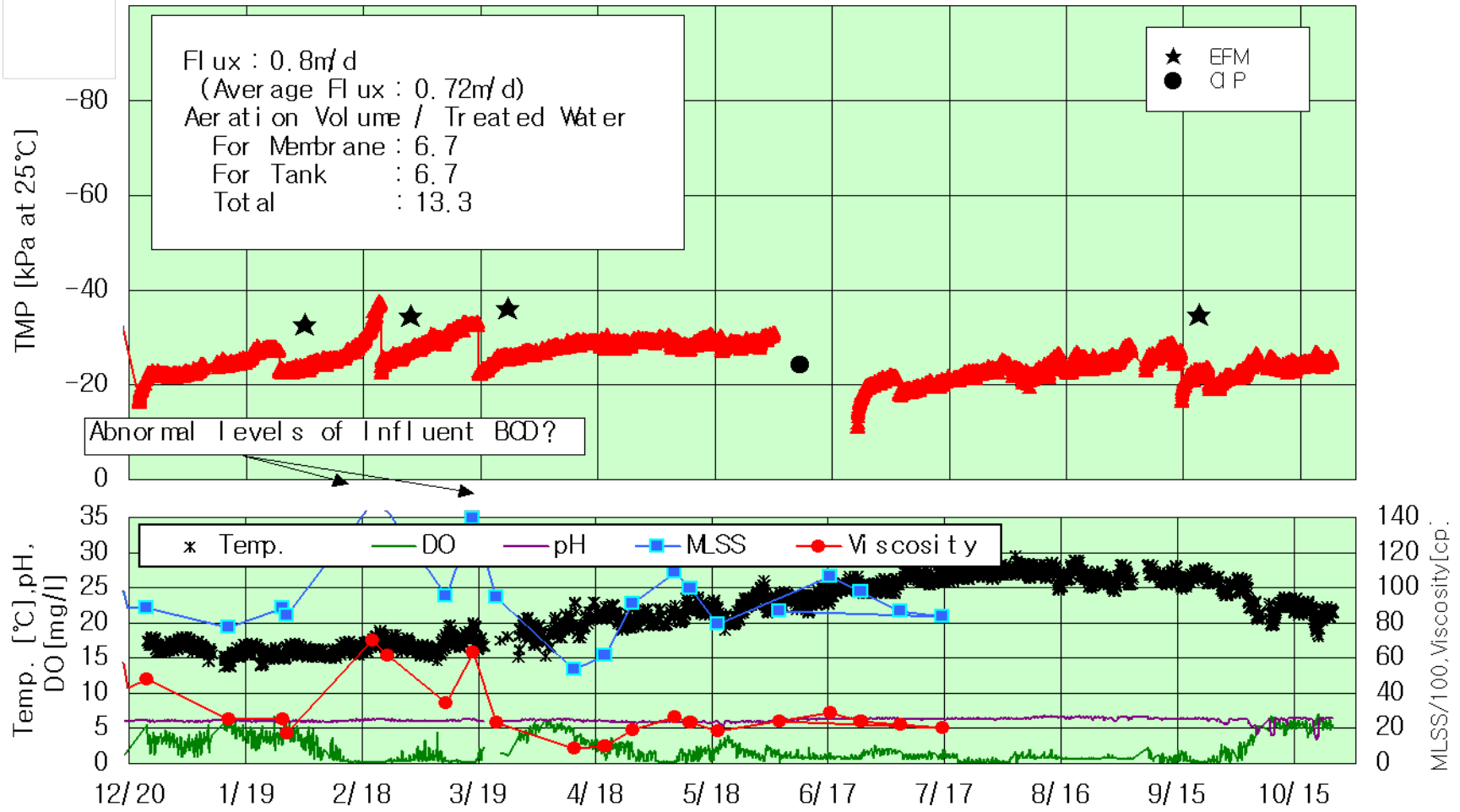
**Tank volume : 9m3 Water level : 4.5m**

**HRT : 6hr (anaerobic 3hr, aerobic 3hr)**

# TMP data

## ( Long period demonstration)

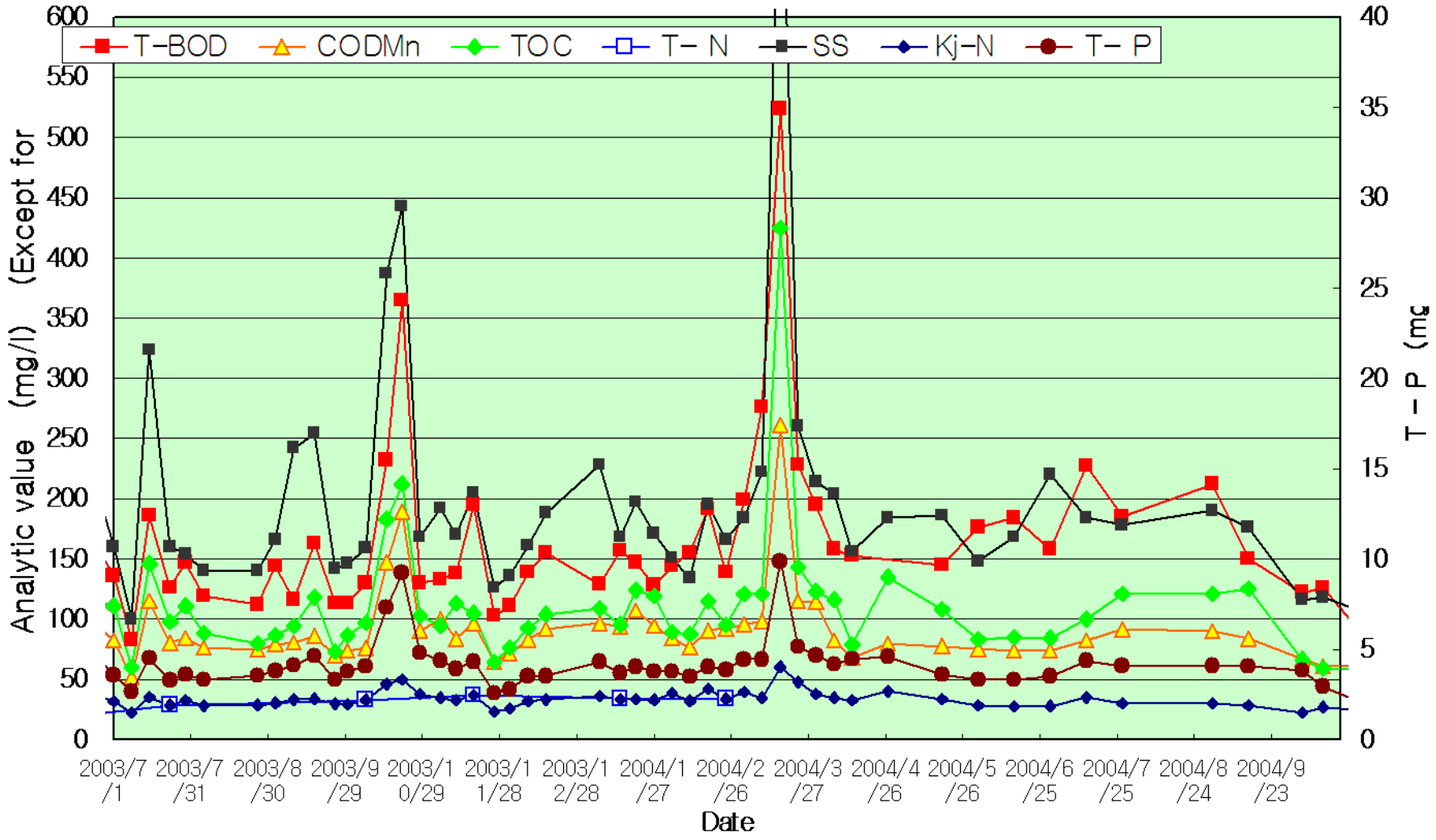
F:9.5min(Q),RF:0.5min(2Q)



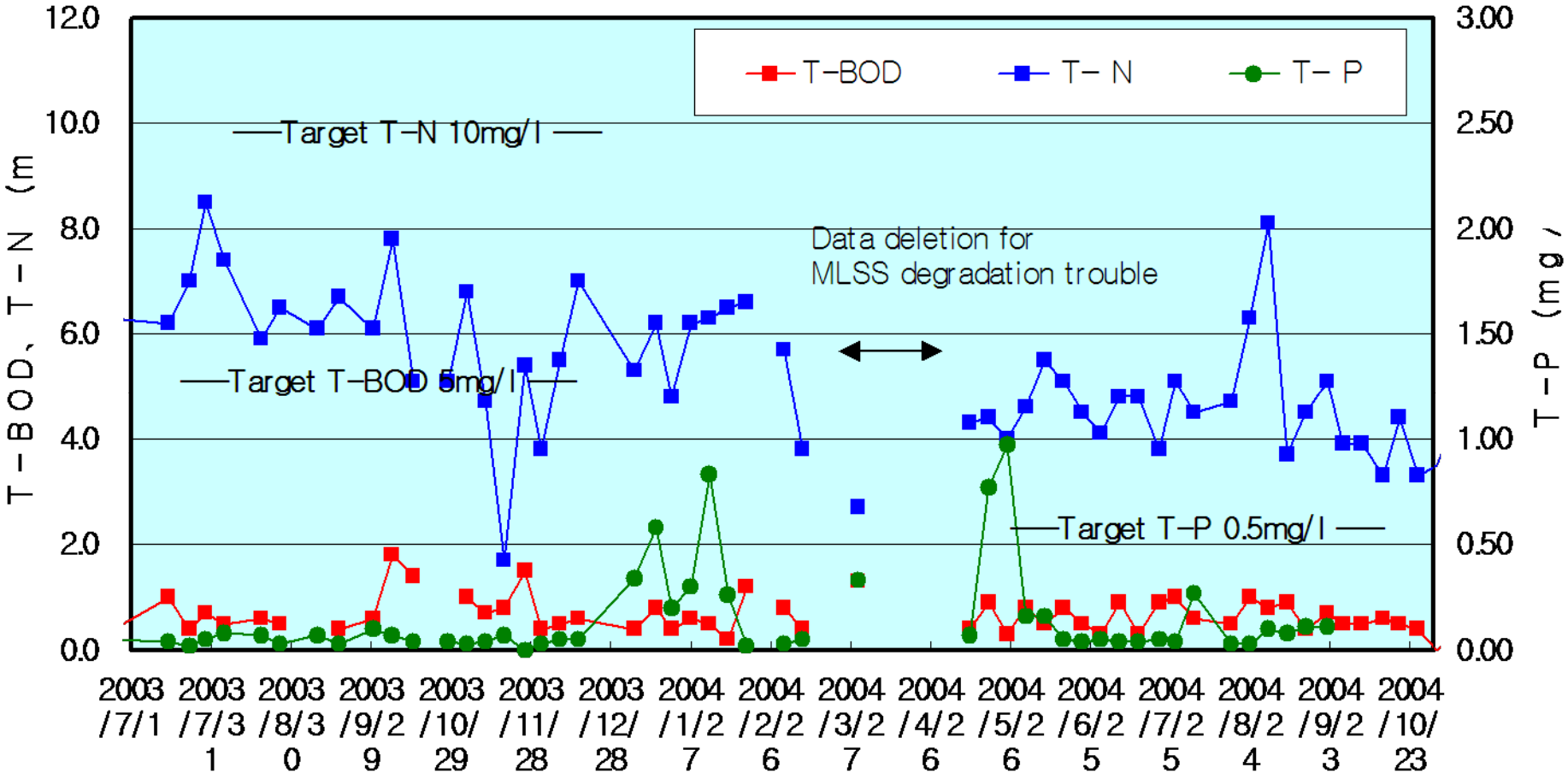

★ 3000 or 5000 mg/l NaClO * 90min ( EFM)

● 5000mg/l NaClO+ 1% NaOH * 5hr → 2% HNO3 *1hr

# Water quality of Influent water



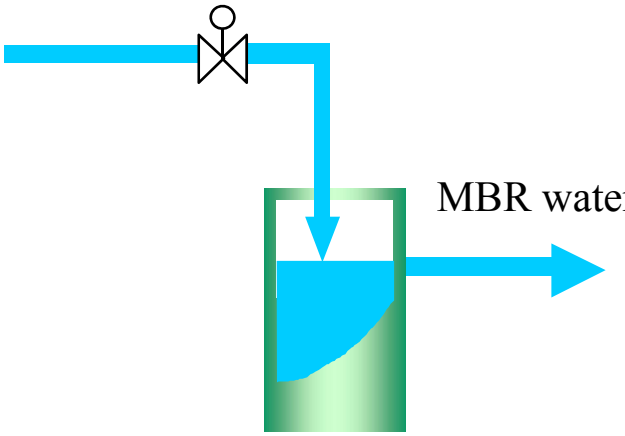
# Water quality of treated water



# Performance and specification of MBR
## (Municipal Waste Water)

| | Asahi-kasei | Mitsubishi Rayon | | Kubota | Zenon |
|---|---|---|---|---|---|
| Membrane Specification | Hollow Fiber | Hollow Fiber | | Sheet | Hollow Fiber |
| Membrane Pore Size | 0.1μm | 0.4μm | | 0.4μm | 0.1μm |
| Membrane Material | PVDF | Hydrophlic PE | PVDF +Reinforceme | Chlorinated PE | PVDF+Brade |
| O/I diameter (mm) | 1.2/0.7 | 0.54/0.36 | 2.8/1.1 | | 2.0/1.5 |
| Module Structure | Cylinder | Cage & Shroud | | Box | Cage & Shroud |
| Membrane Area (m2/Element) | 25 | 15 | 25 | 0.8 | 46 |
| Total membrane area / Module foot | 1243 | 274 | 667 | 272 | 669 |
| Total membrane area / Unit rack | 465 | 377 | 243 | 180 | 343 |
| Average Flux (m/d) | 0.72 | 0.4 | 0.8 | 0.7 | 0.73 |
| Ratio of Aeration/Treated wate | 13.3 | 20 | 13-15 | 19.3 | 15 |
| for Module | 6.7 | 20 | 13-15 | 15.4 | 9.5 |
| for Tank | 6.7 | 0 | 0 | 3.8 | 5.5 |

# *RO combination test*



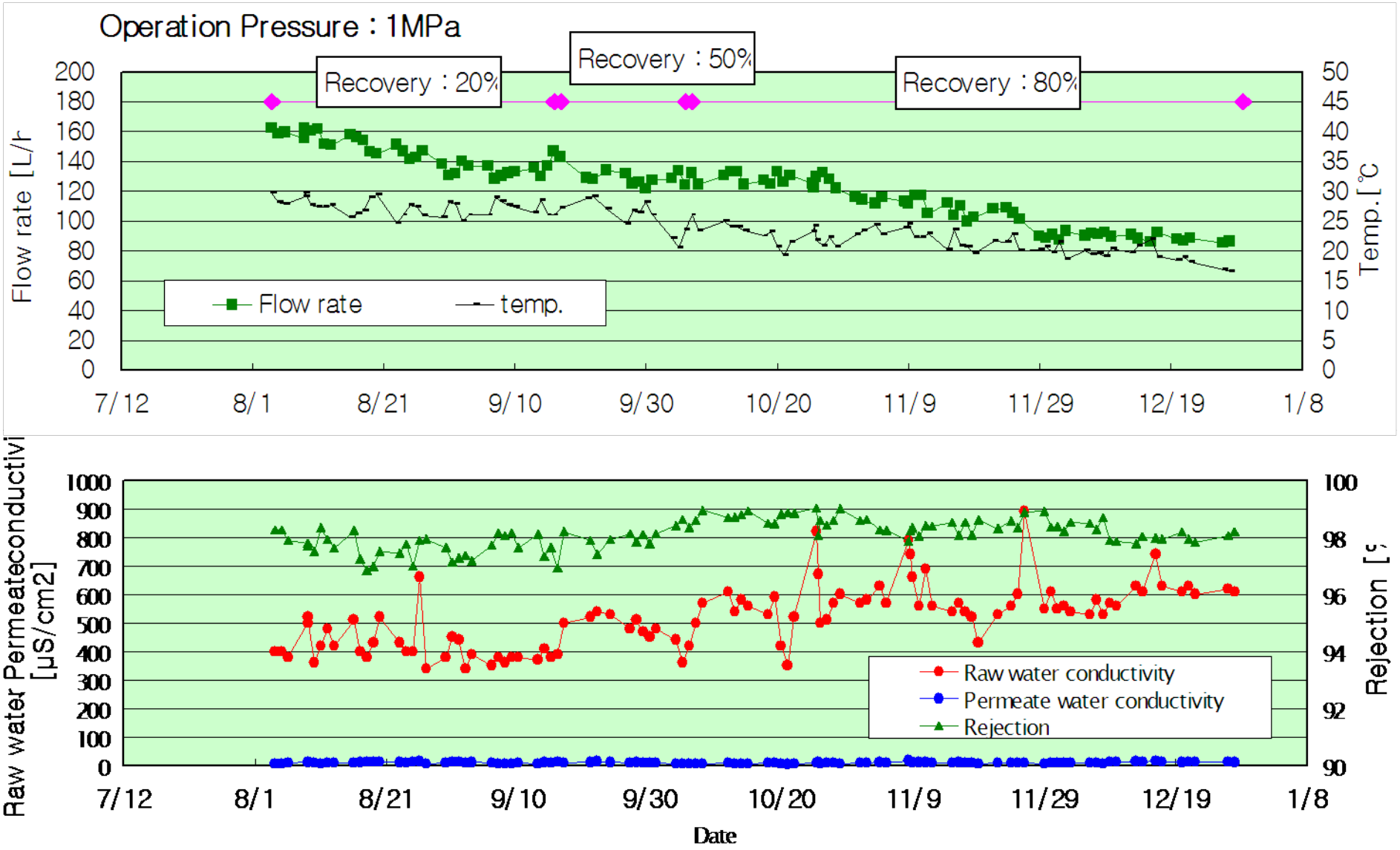
MBR water

MBR Permeate tank

RO water

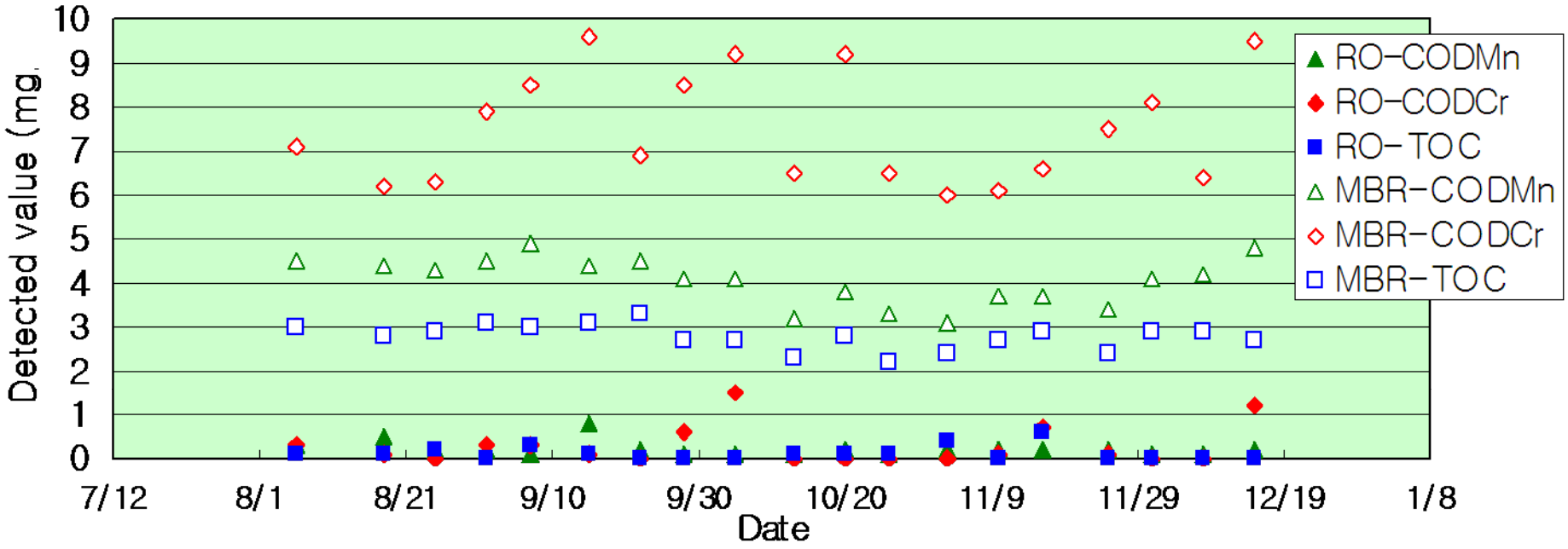
RO : FILMTEC
BW30-404FR

# RO operating date and water conductivity



microza

## Water quality of MBR water and RO water




Other date of RO water

| | | | |
|---|---|---|---|
| BOD | < 0.1mg/l | Coliform bacteria count | < 0.02 MPN |
| T-P | 0.01 | Standard plate count bacteria | ave. 277 (Min.2 Max.507) cfu |
| T-N | < 0.1 | Turbidity | < 0.1 |
| | | Chroma | < 0.1 |
| | | Total dissolved solid (TDS) | 6.9 mg/l |

# *Asahi-kasei MF modules*

Asahi-kasei Chemicals manufactures MF membrane 1,500,000 $m^2$/year for drinking water at MF plant. MBR modules are also applied MF membranes manufactured this plant.


Microza MF plant

(Fuji city, Shizuoka, Japan)


microza
Thank you for your kind attention.