Large Scale Membrane Filtration Plant for Removal of Cryptosporidium at Ogose-town: Design and Operation

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~Design and Operation~

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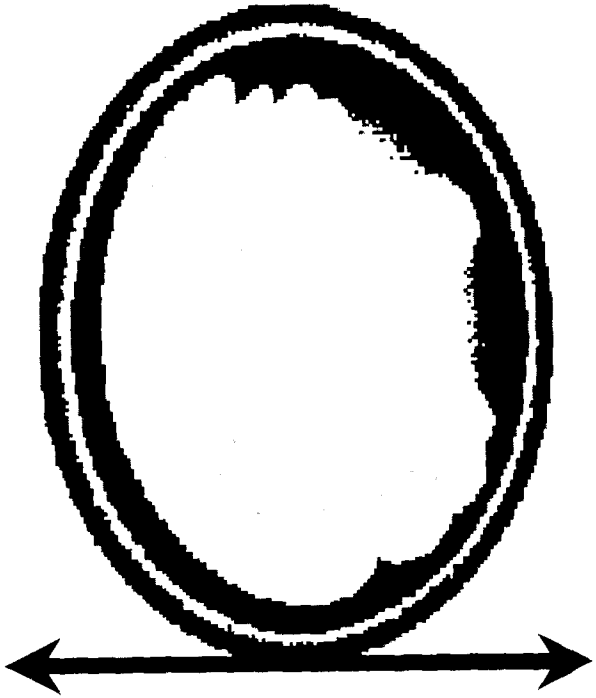
Cryptosporidium Oocyst



4.5 to 5.5 μ m

Complete removal with UF,MF

Cryptosporidium Outbreaks in the World

Year	City		No. of Cases
1984	Braun Station,Tex.	U.S.A.	2,000
1987	Carrollton, Ga.	U.S.A.	13,000
1989	Swindon,	England	516
1993	Milwaukee ,Wis.	U.S.A.	403,000
1996	Ogose, Saitama	Japan	8,812

Brief History of Ogose Town

1. In 1996, 70% of the inhabitants got diarrhea with C.Oocyst and drinking water service was stopped.
2. Mayer of Ogose Town decided to install Membrane Filtration Plant.
3. In 1998, the Membrane Plant started to supply safety drinking water.
4. The plant has been in operation with no trouble up to today.

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4. Maintenance

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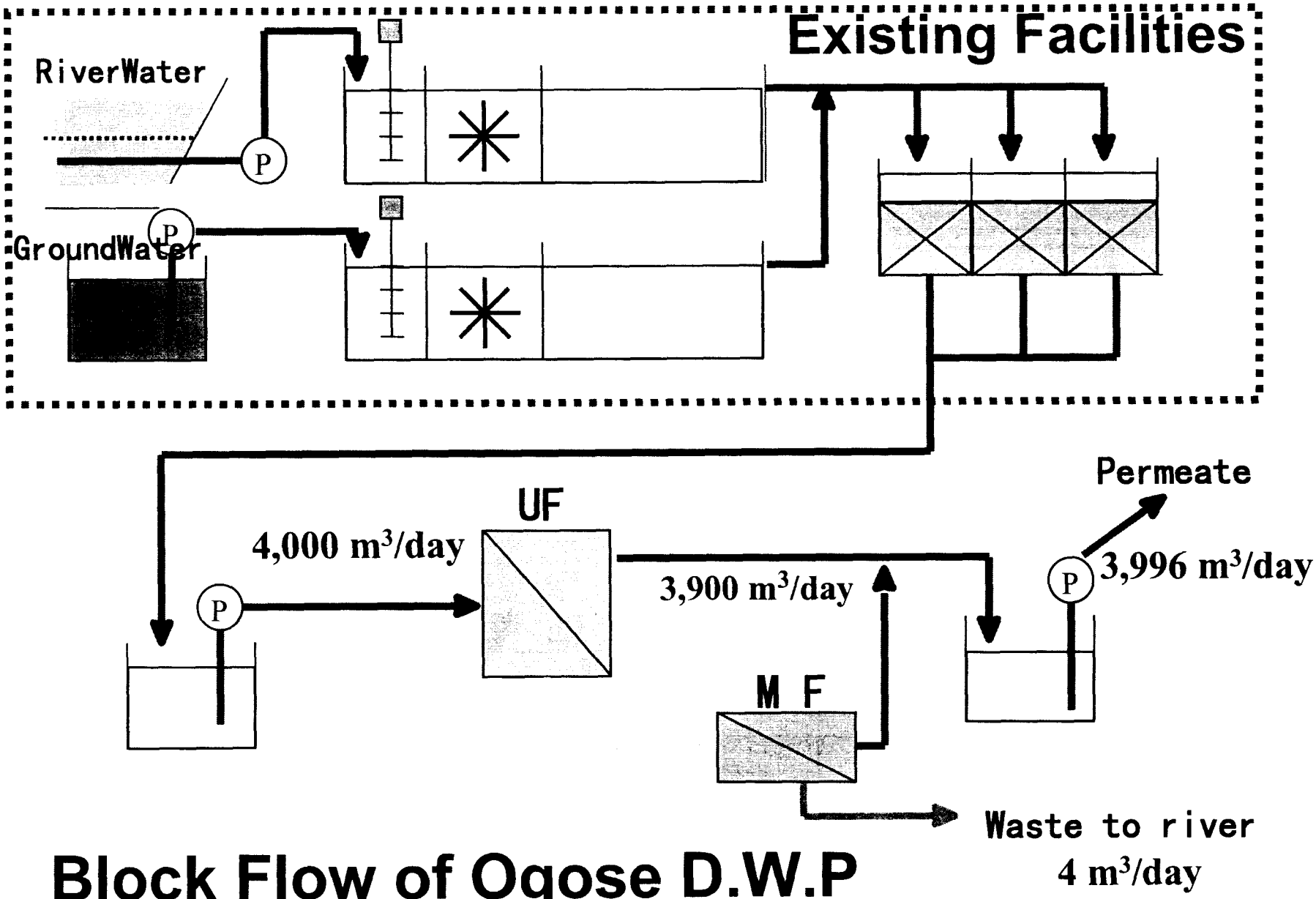
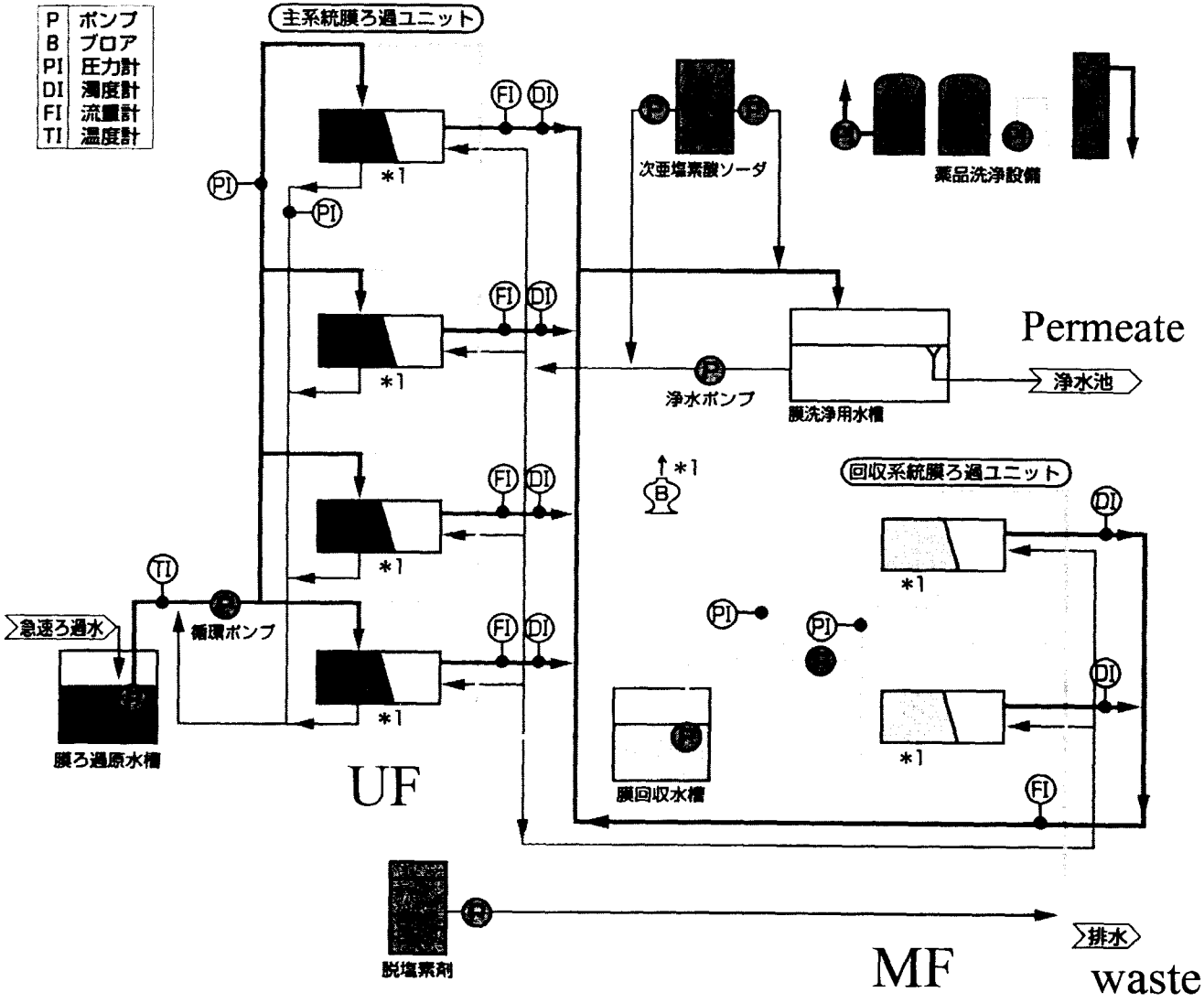
System Outline

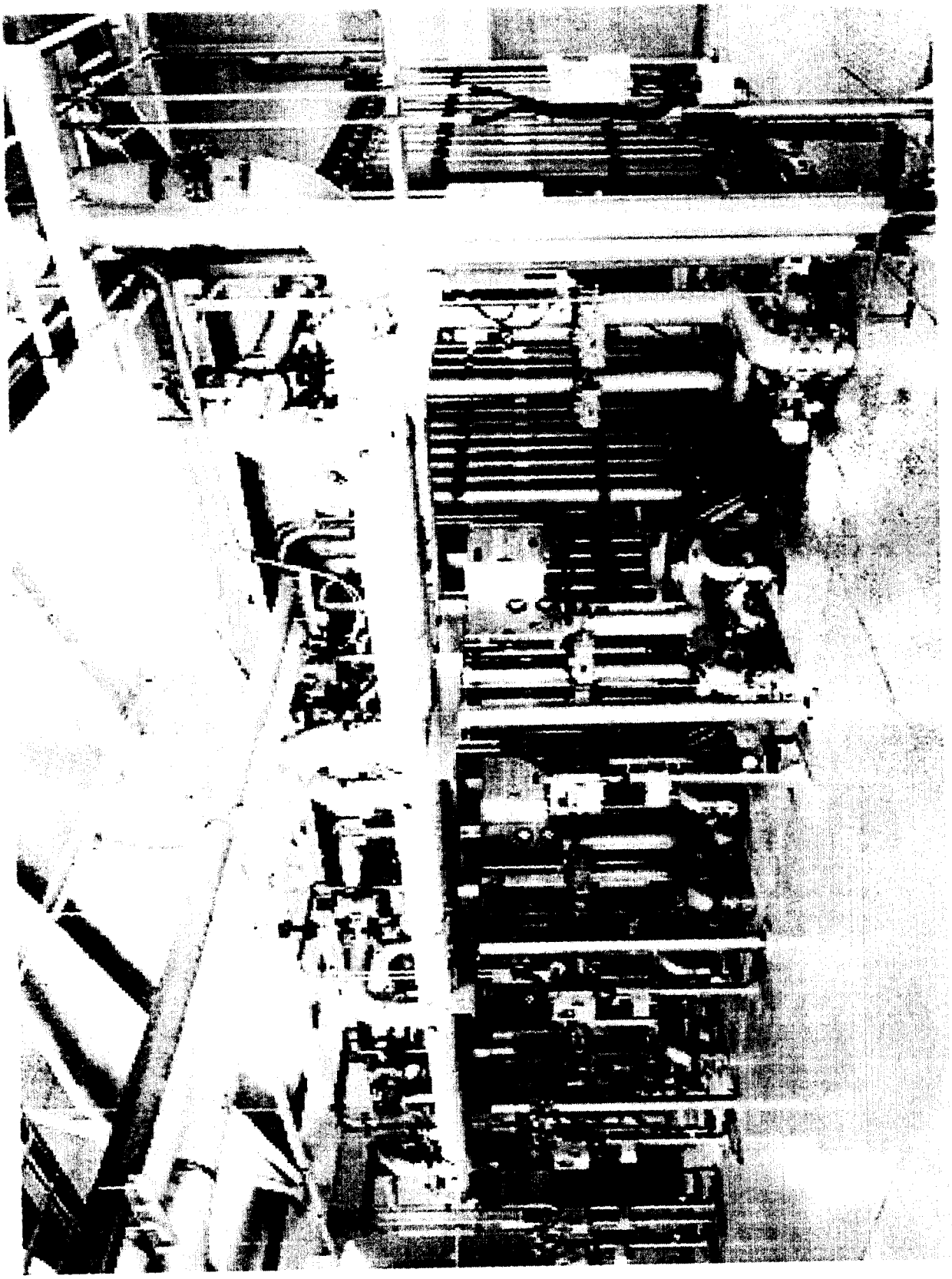
1. Maximum permeate flow: 4,000 m^3／day
2. Over 99% recovery rate guaranteed
3. C.Oocyst and other infectious bacteria are completely removed from drinking water.



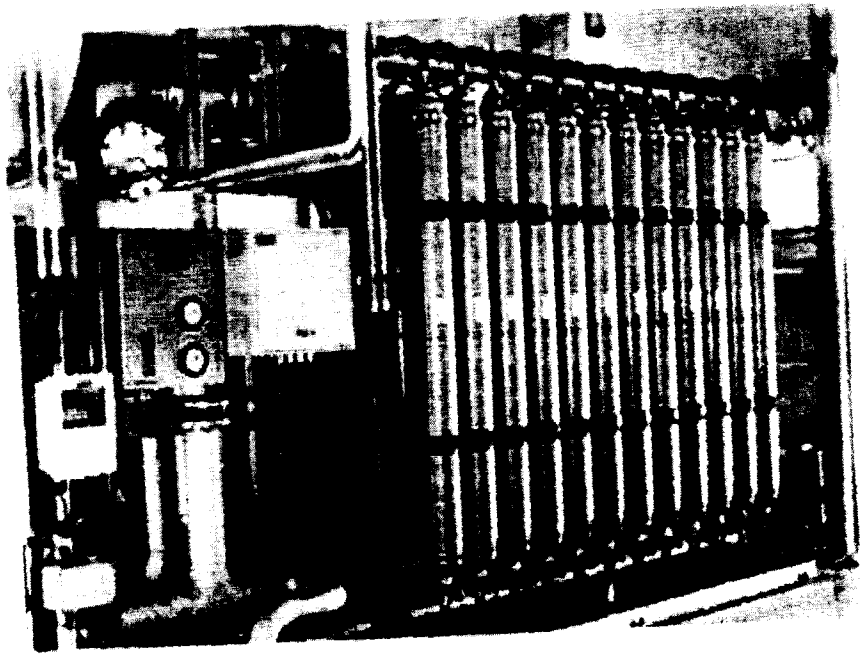
Block Flow of Ogose D.W.P



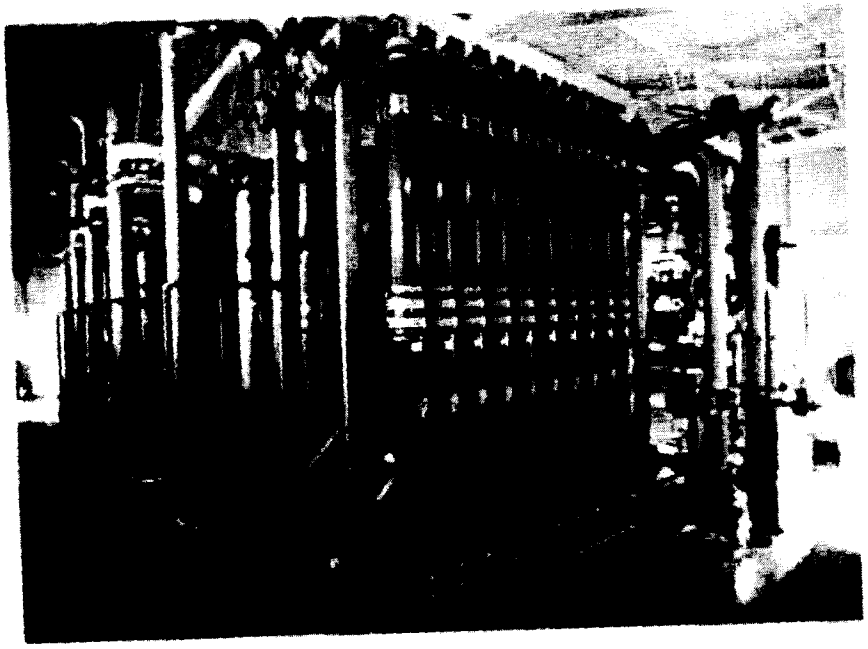
Block flow of membrane unit



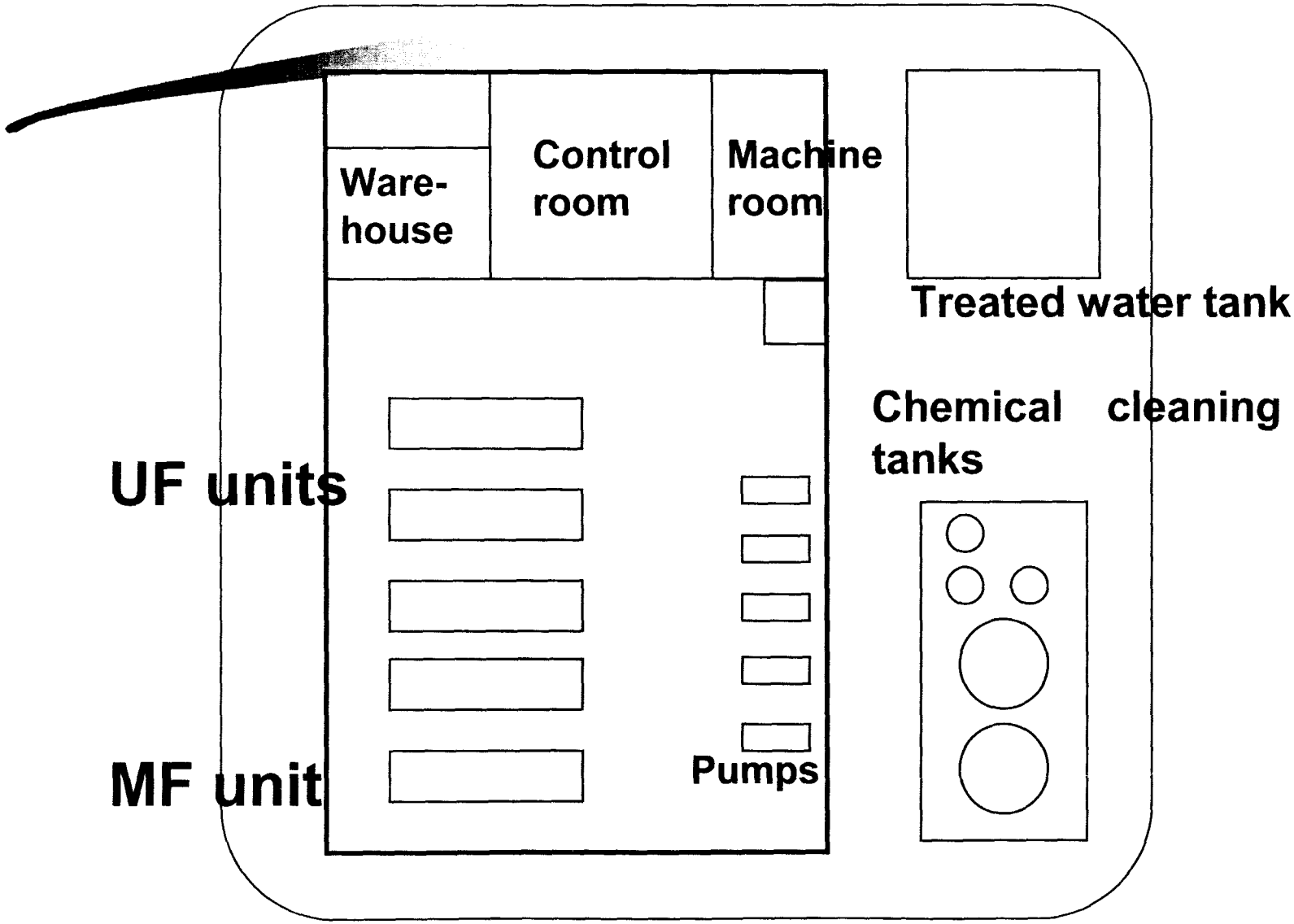
Main UF unit and Piping



UF Unit

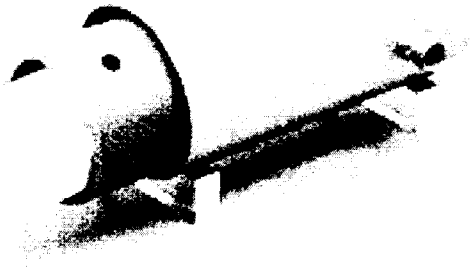


MF Unit



System Layout

UF and MF membrane

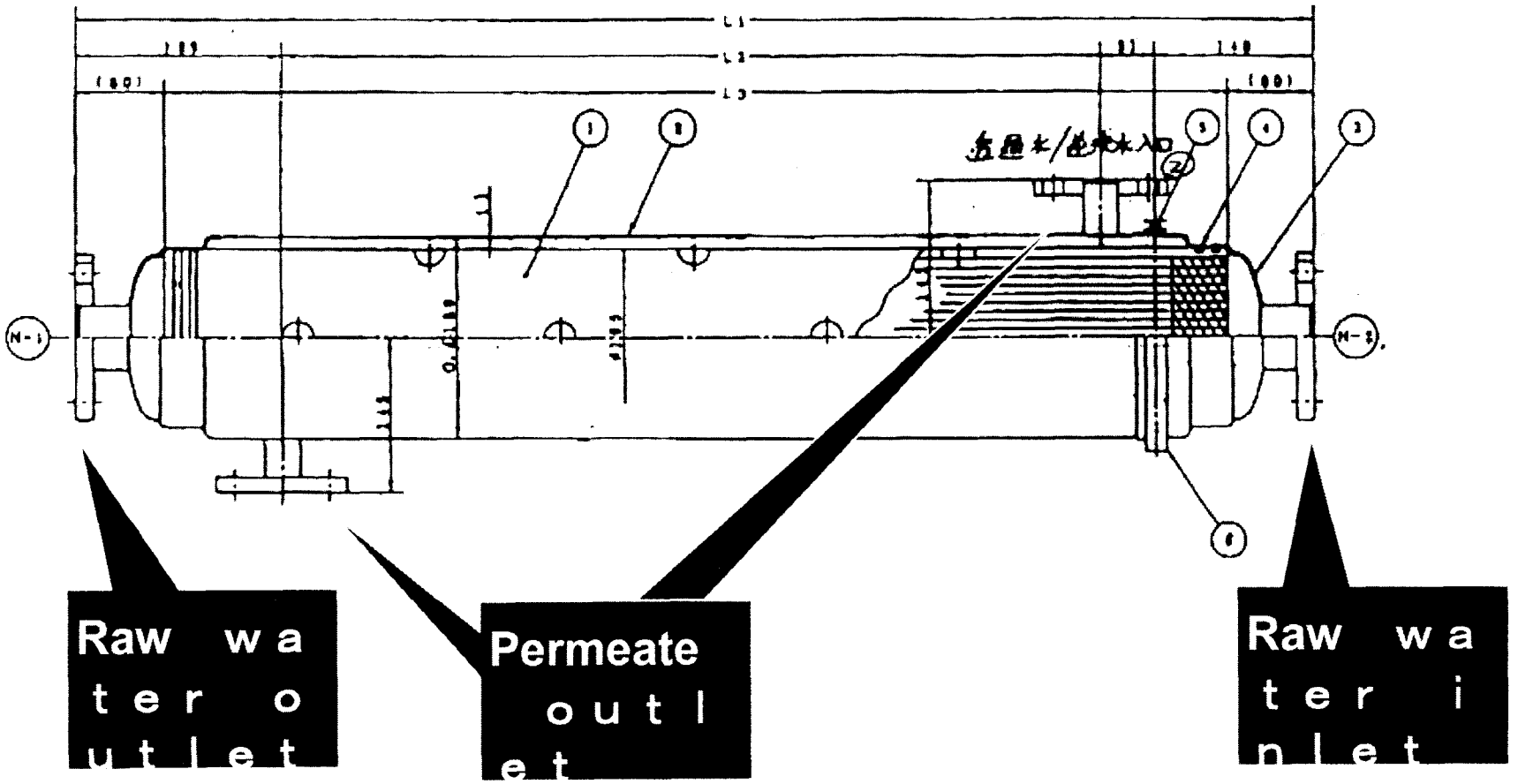


UF Unit

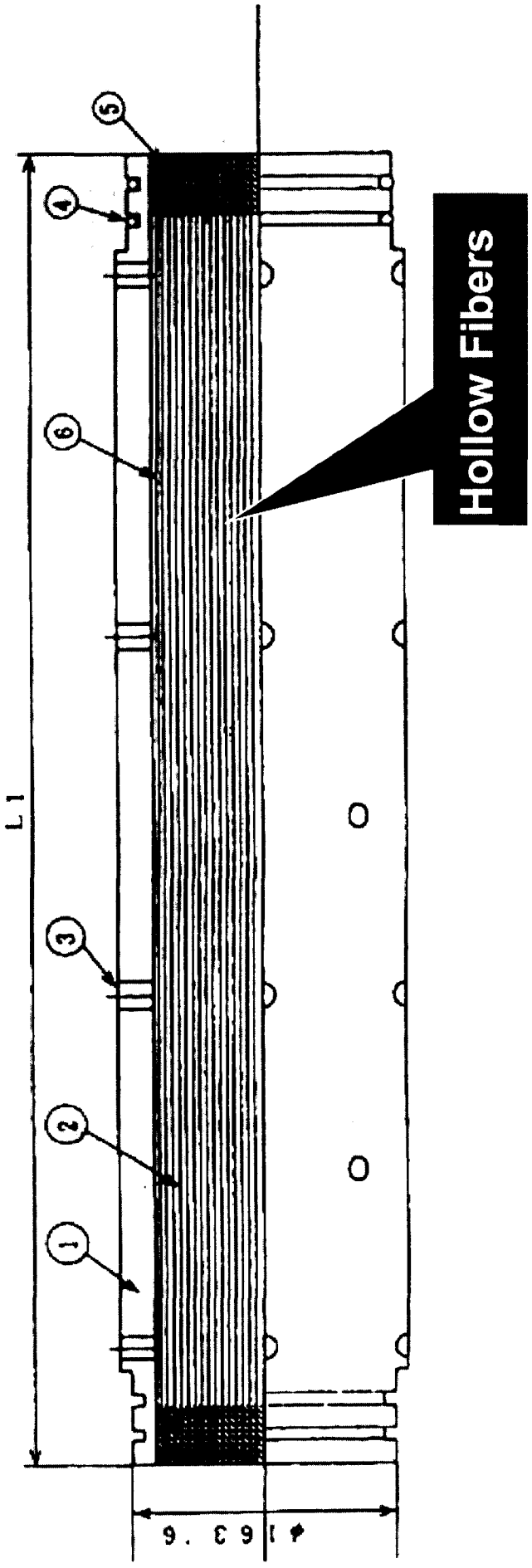
- MWCO 13,000dalton
- 23 m^3/module × 100 modules
- O.D. 2mm、I.D. 1.2mm、L 1.8m
- Inside-out flow, Polysulfone

MF Unit

- Average pore size 0.1 μ m
- 15 m^3/module × 20 modules
- O.D. 2mm、I.D. 0.8mm、L 1.0m
- Outside-in flow, Polysulfone



Module Pressure Vessel



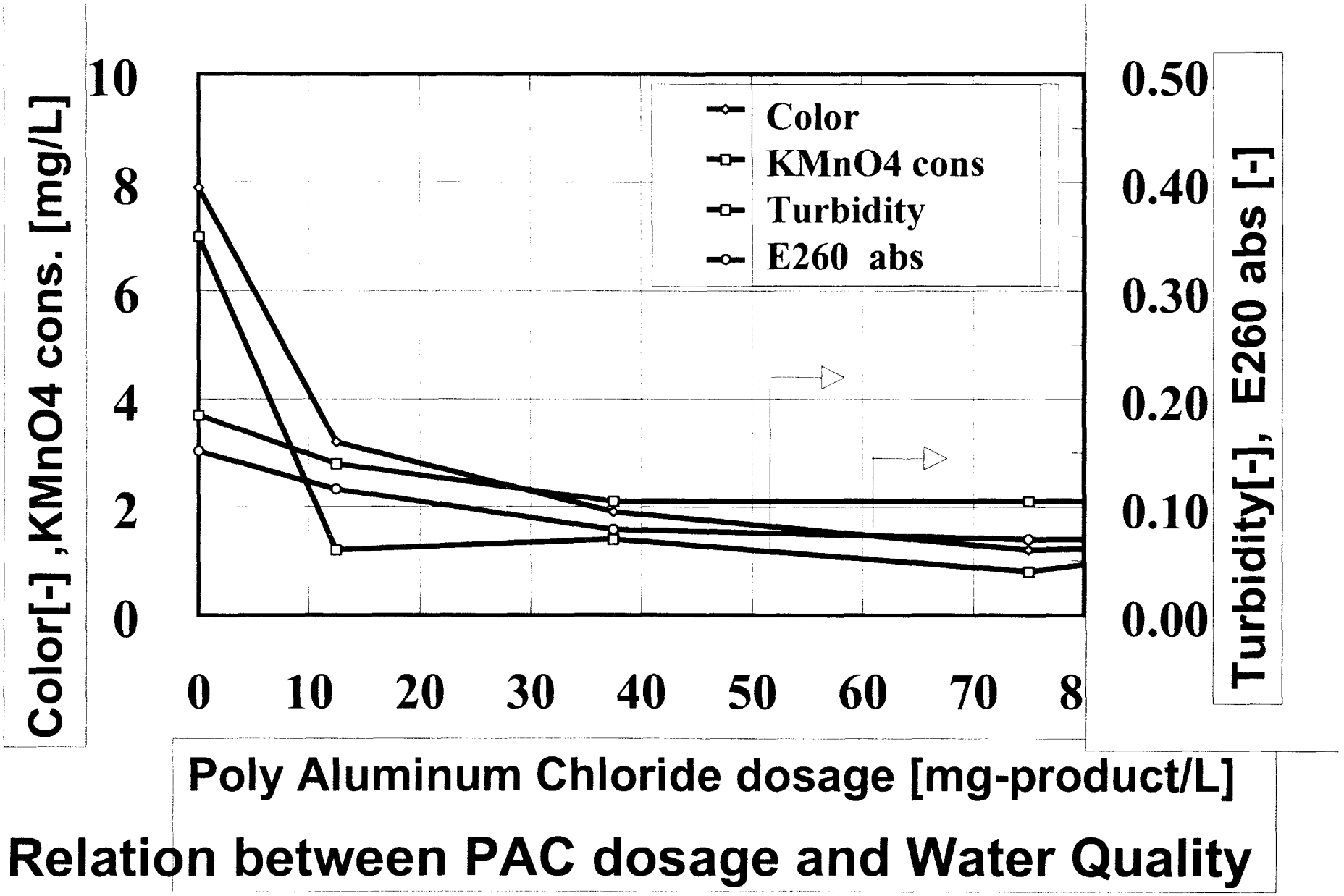
Element Cartridge

Advantages of Kurita's Membrane System

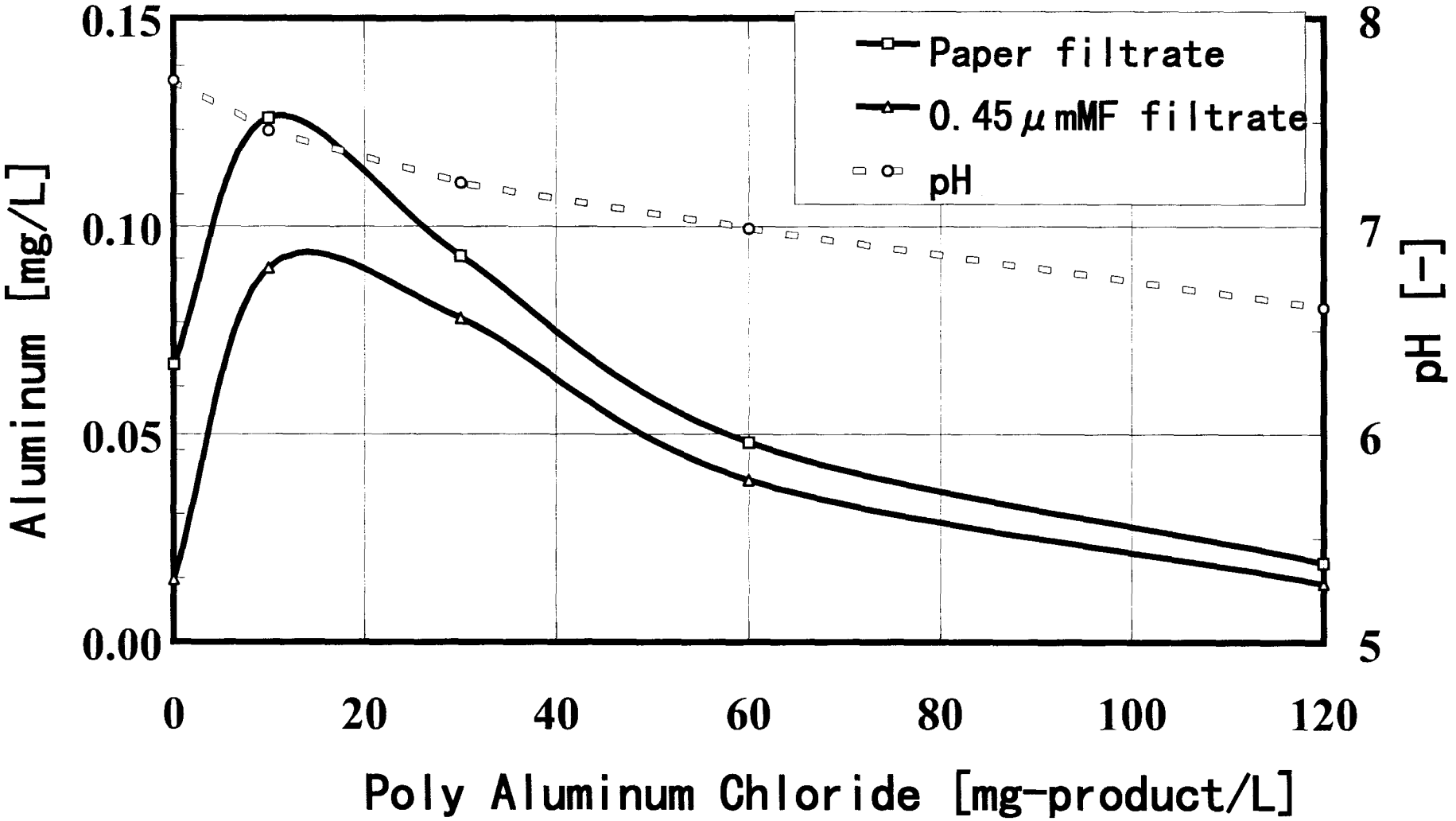
1. High permeability, strength and chemical stability with Polysulfone Membrane.
2. High recovery rate with Recovery MF.
3. Effective Twin Port Back Wash (TPBW) and Air Scrubbing (AS).
4. Low Cost Chemical Cleaning on site.
5. Computer aided automatic operation.

Pretreatment Settings

For stabilizing membrane filtration, it's important to remove fouling substances such as turbidity, organic compounds and colloidal aluminum with pretreatment (coagulation and sand-filtration).



Relation between PAC dosage and Water Quality



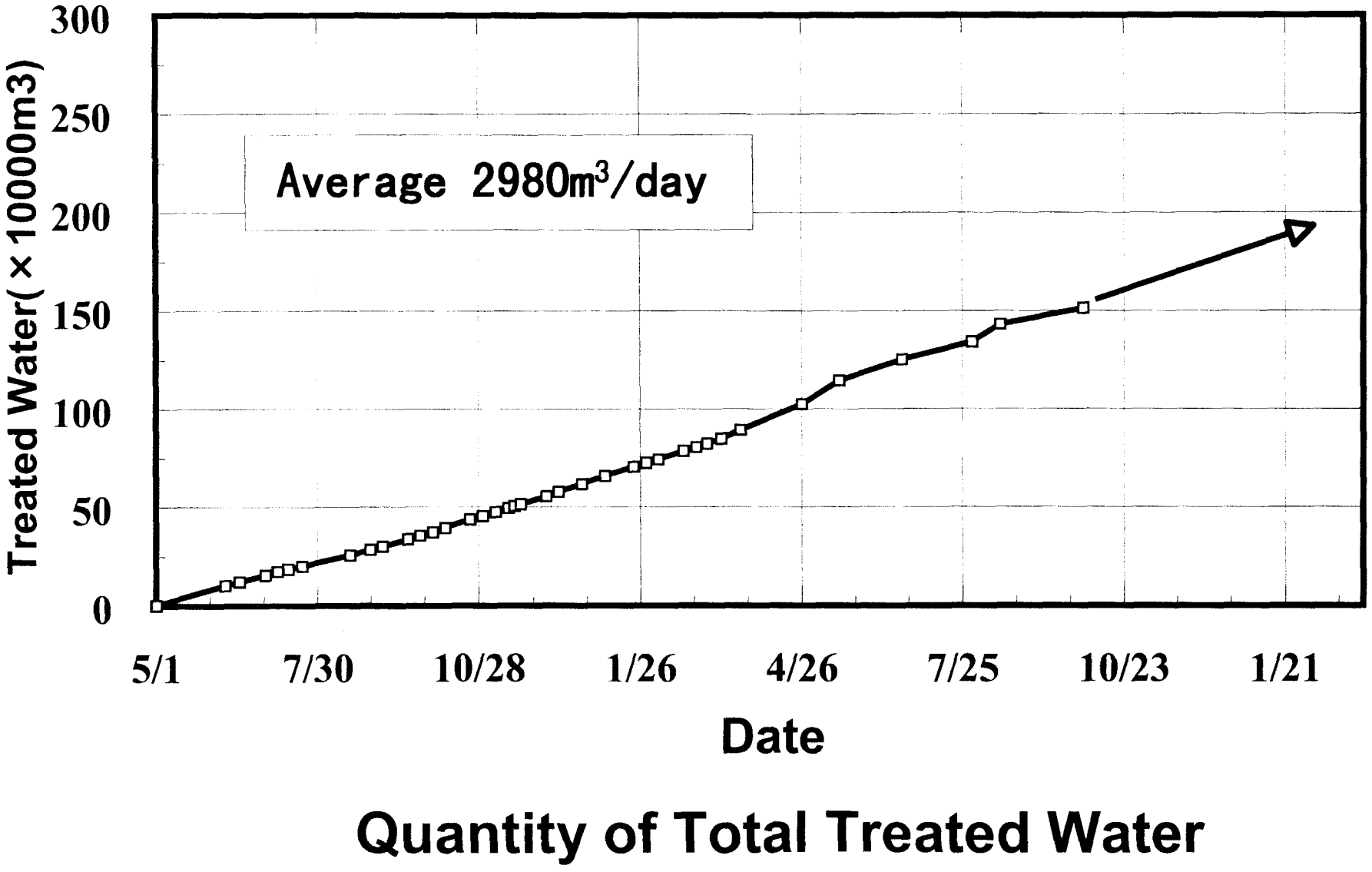
Relation between PAC dosage and residual Aluminum

Water quality after Pretreatment

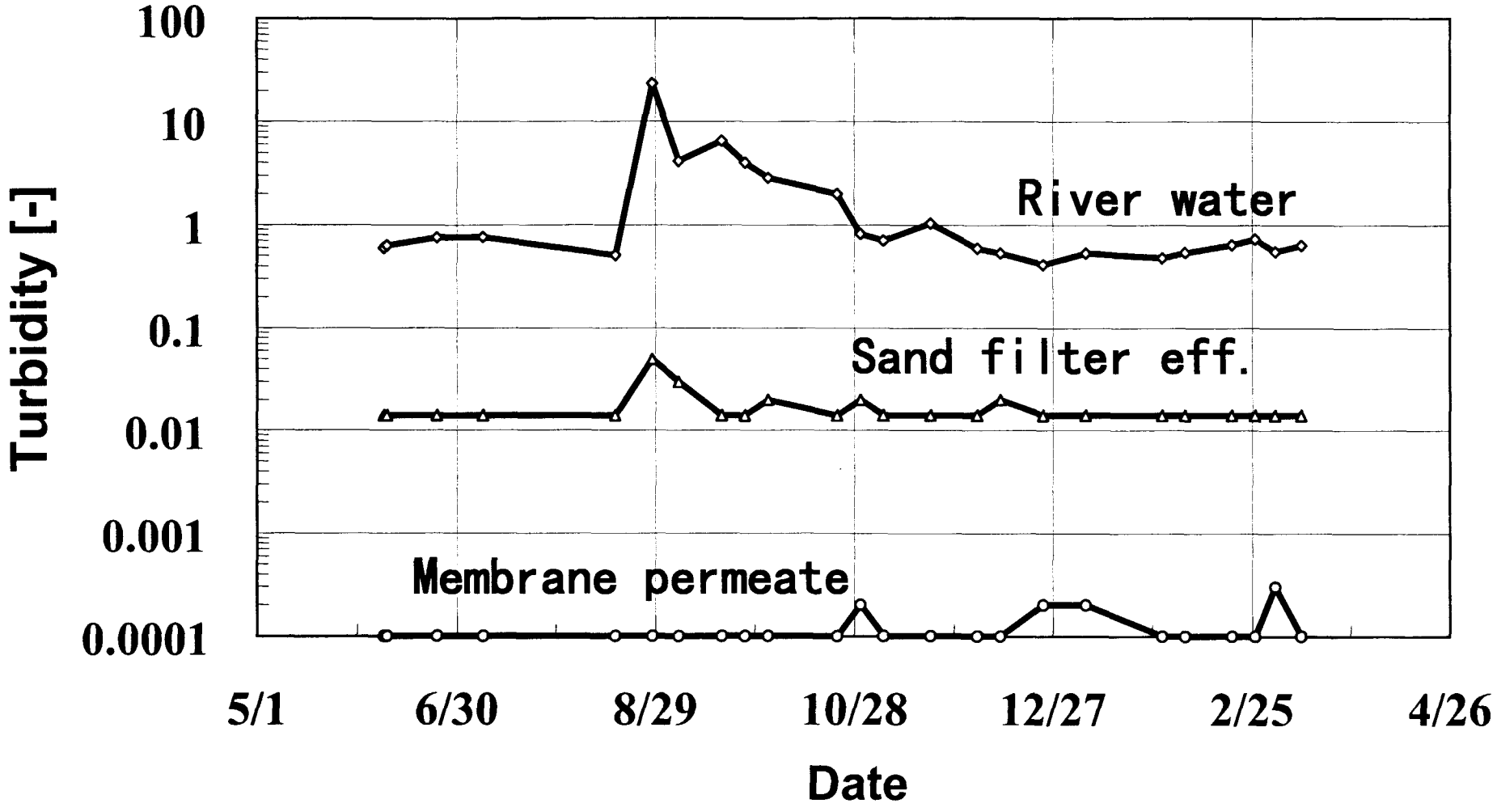
	unit	Min.	Max.	Average
pH	[-]	7.2	7.7	7.4
Turbidity	[-]	0.00	0.05	0.01
Color	[-]	0.00	0.30	0.10
KMnO4 consumption	[mg/L]	1.0	1.4	1.1
UV260nm absorbance	[-]	0.008	0.033	0.017
Total Organic Carbon	[mg/L]	0.1	0.6	0.4
Aluminum	[mg/L]	0.05	0.12	0.08

Actual Result of Operation

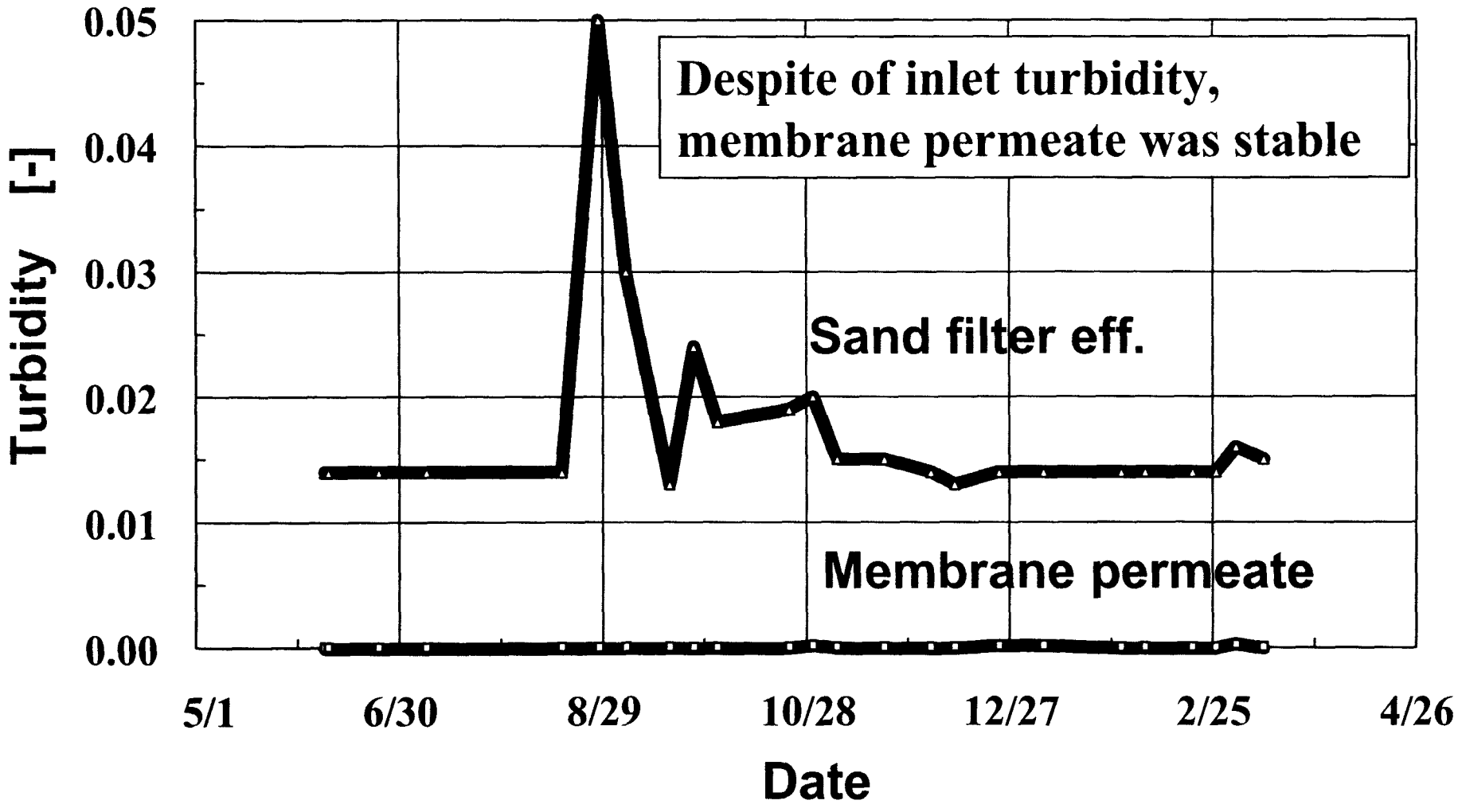
		Result	Design
2 UF permeate Flux	m/day	1.8 (ave. 1.35)	1.8
3 MF permeate Flux	m/day	0.8	0.8
4 Recovery Rate	%	99.9	99
5 BackWash cycle	min	100	20
6 Chemical Cleaning	Frequency /year	0	2



Quantity of Total Treated Water



Comparison of Turbidity

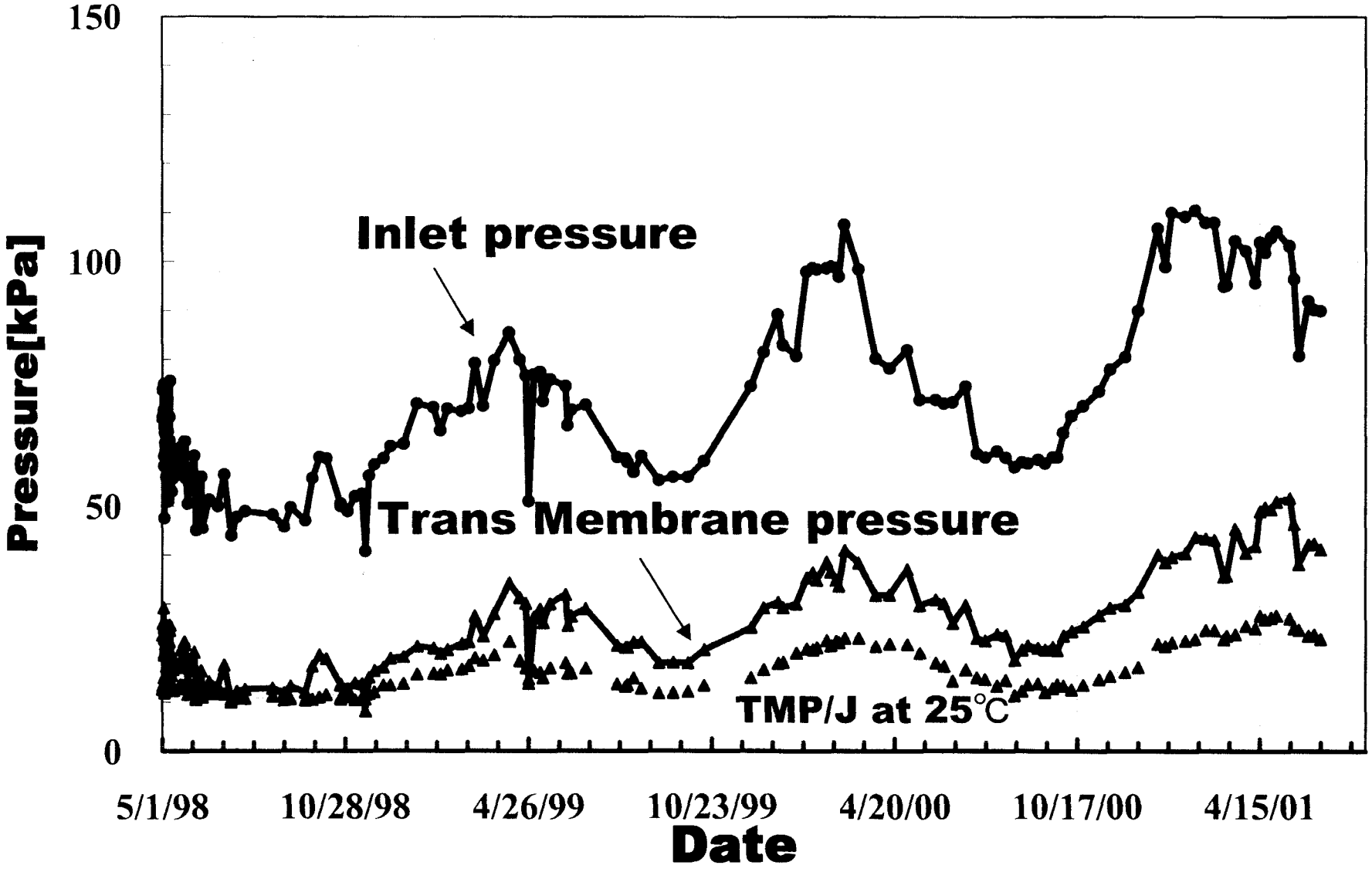


Influence of Inlet Turbidity

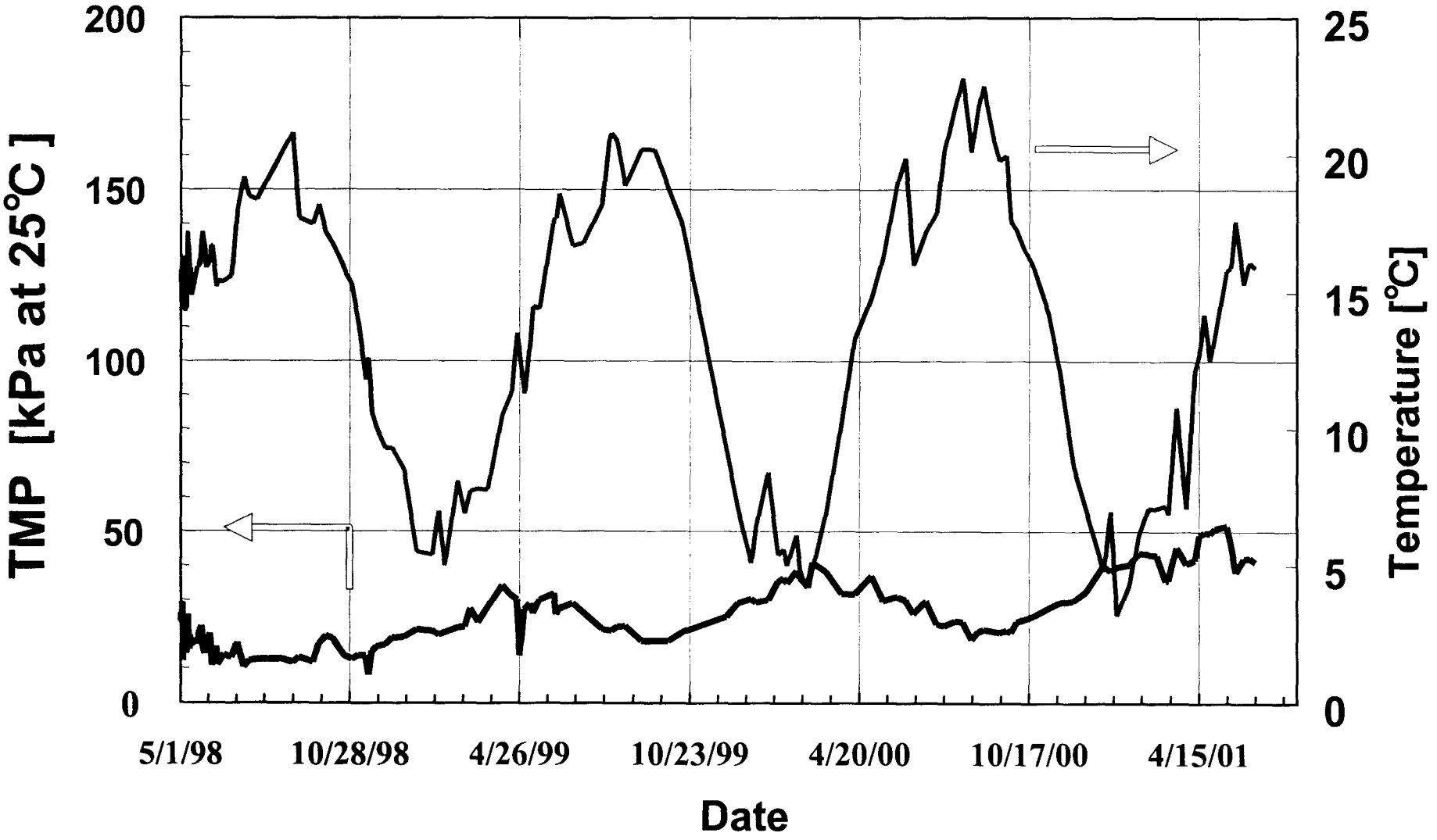
Water Quality

Average Water Quality of Each Unit

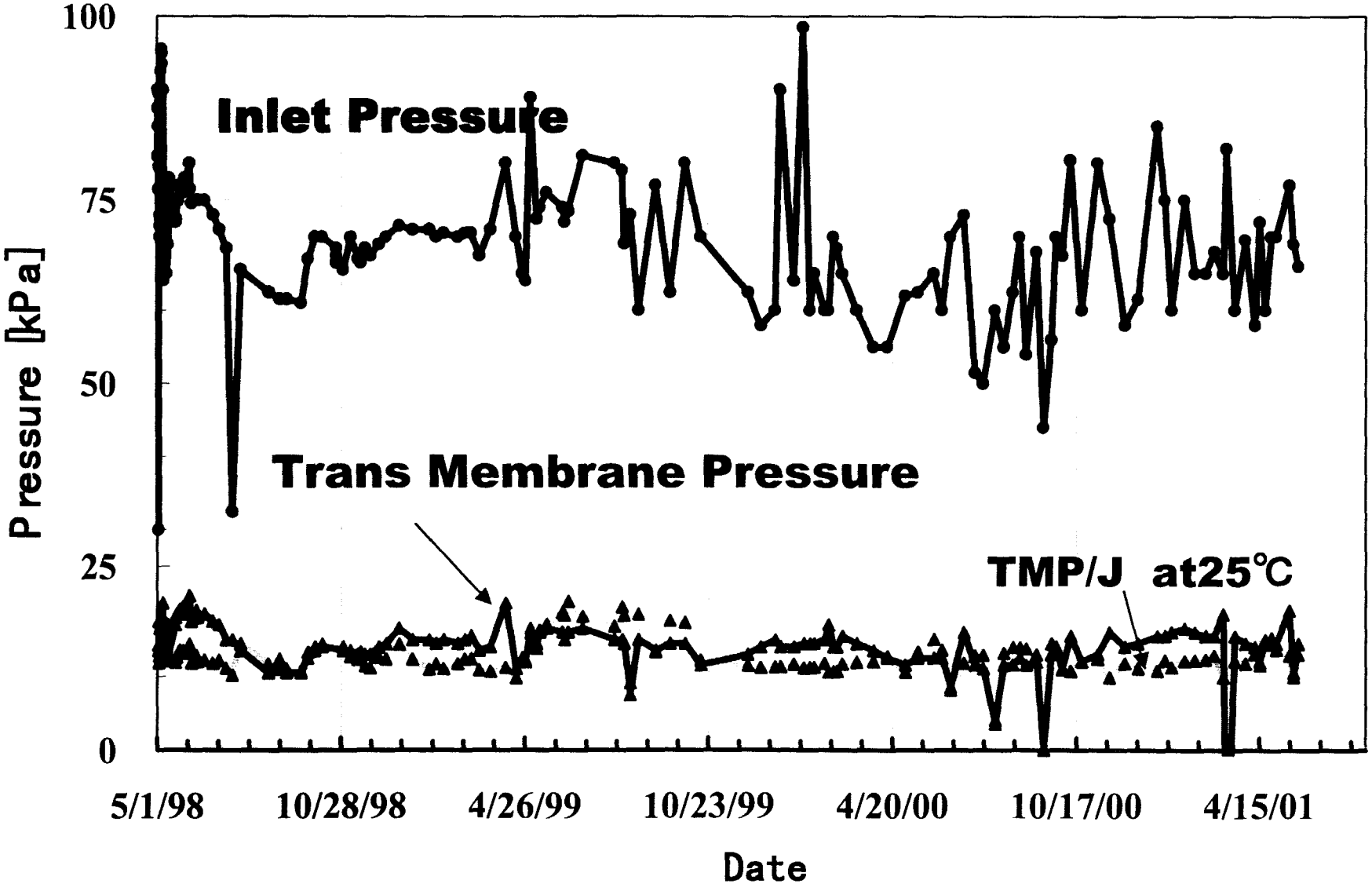
Analysis	Unit	River Water	Sandfilter eff.	Membrane Permeate
Turbidity	[-]	2.3~250	0.015	0.0001
Color	[-]	4	0.1	0.1
KMnO4 consump	mg/L	1.9	1.1	1.1
C.Oocyst	N /10L	N.D	N.D	N.D



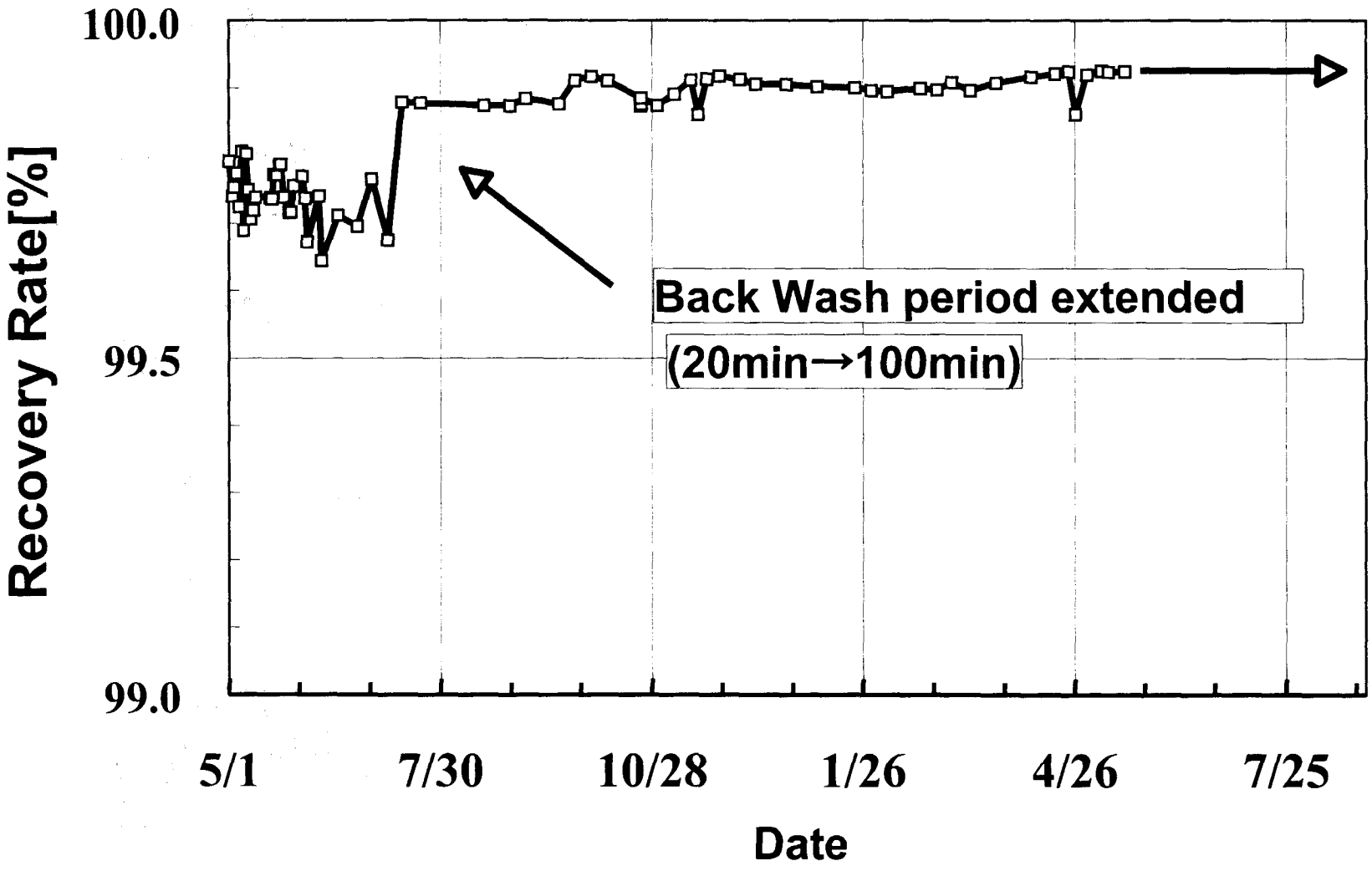
Tendency of UF Membrane Pressure



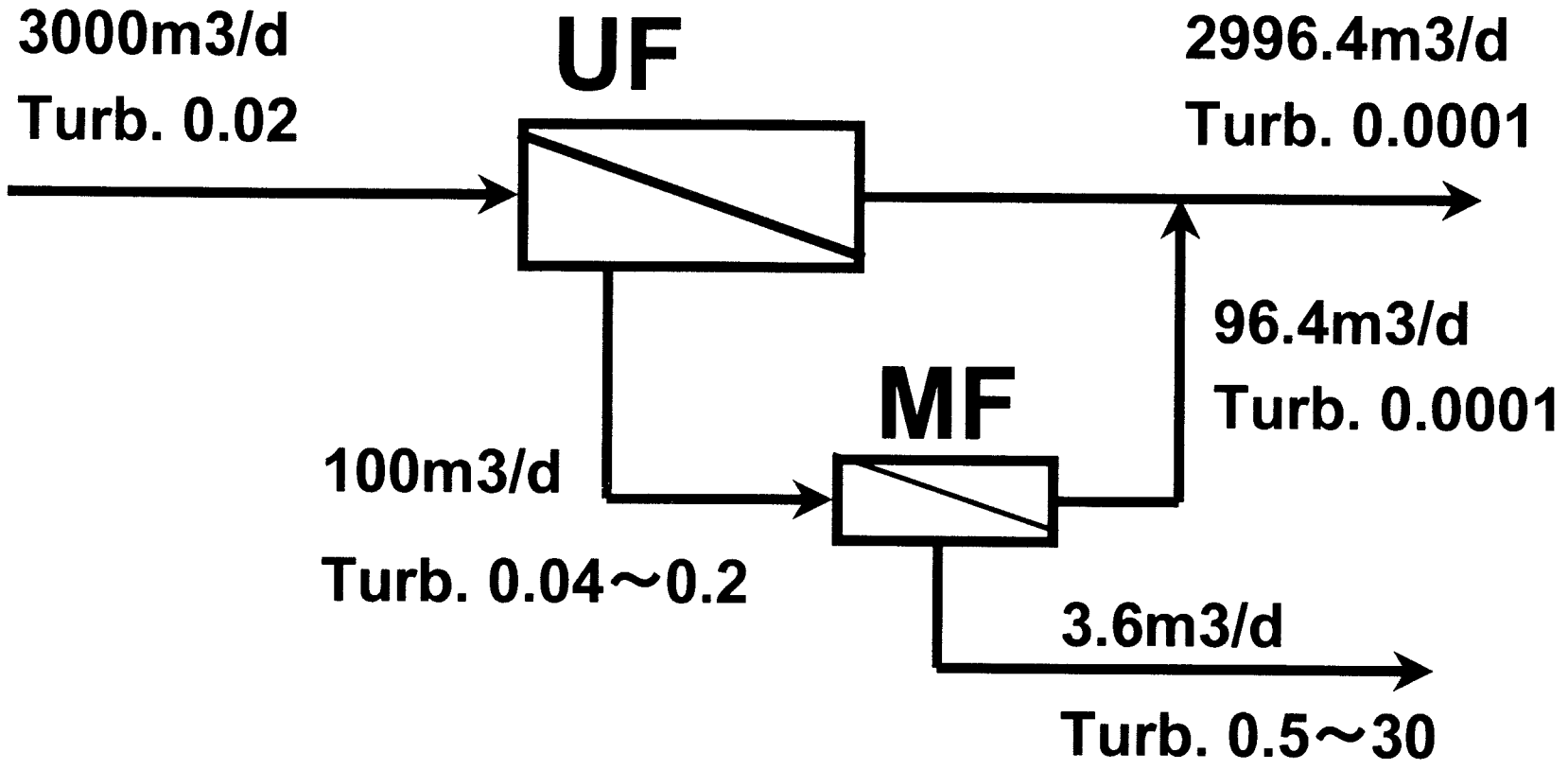
Relation between UF TMP and temperature



Tendency of MF Membrane pressure



Recovery Rate Performance



Mass balance of Membrane Filtration

Concentration Ratio of Back Wash Waste

Step	Recovery (%)	Conc. Ratio
UF Back Wash ①Air Scrubbing ②Back Wash with treated water	95.9	24.4
MF Back Wash 1 Back Wash with treated water	96.4	680
MF Back Wash 2 (weekly) ①Air Scrubbing ②Back Wash with treated water	96.4	680

Actual Concentration ratio of Back Wash Waste

	UF Back Wash	MF Back Wash 1	MF Back Wash 2
Turbidity	10.0	83.8	5395.0
KMnO 4 consumption	1.0	1.5	2.9
TOC	1.2	2.8	3.5
UV260nm absorbance	1.3	2.6	10.8
Total iron	1.1	2.1	58.5
Total manganese	1.0	1.0	16.0
Aluminum	1.1	1.5	60.8
Calculated conc. ratio	24.4	680	680

This value shows that Air Scrubbing is very effective.

Operation Results

1) Turbidity of treated water ave. 0.0001

2) UF flux max. 1.8 $m^3/m^2/day$

3) MF flux 0.8 $m^3/m^2/day$

4) Back Wash 100 min/cycle

5) Recovery rate 99.9% （membrane unit）

6) TMP increasing 10 kPa/year

Maintenance

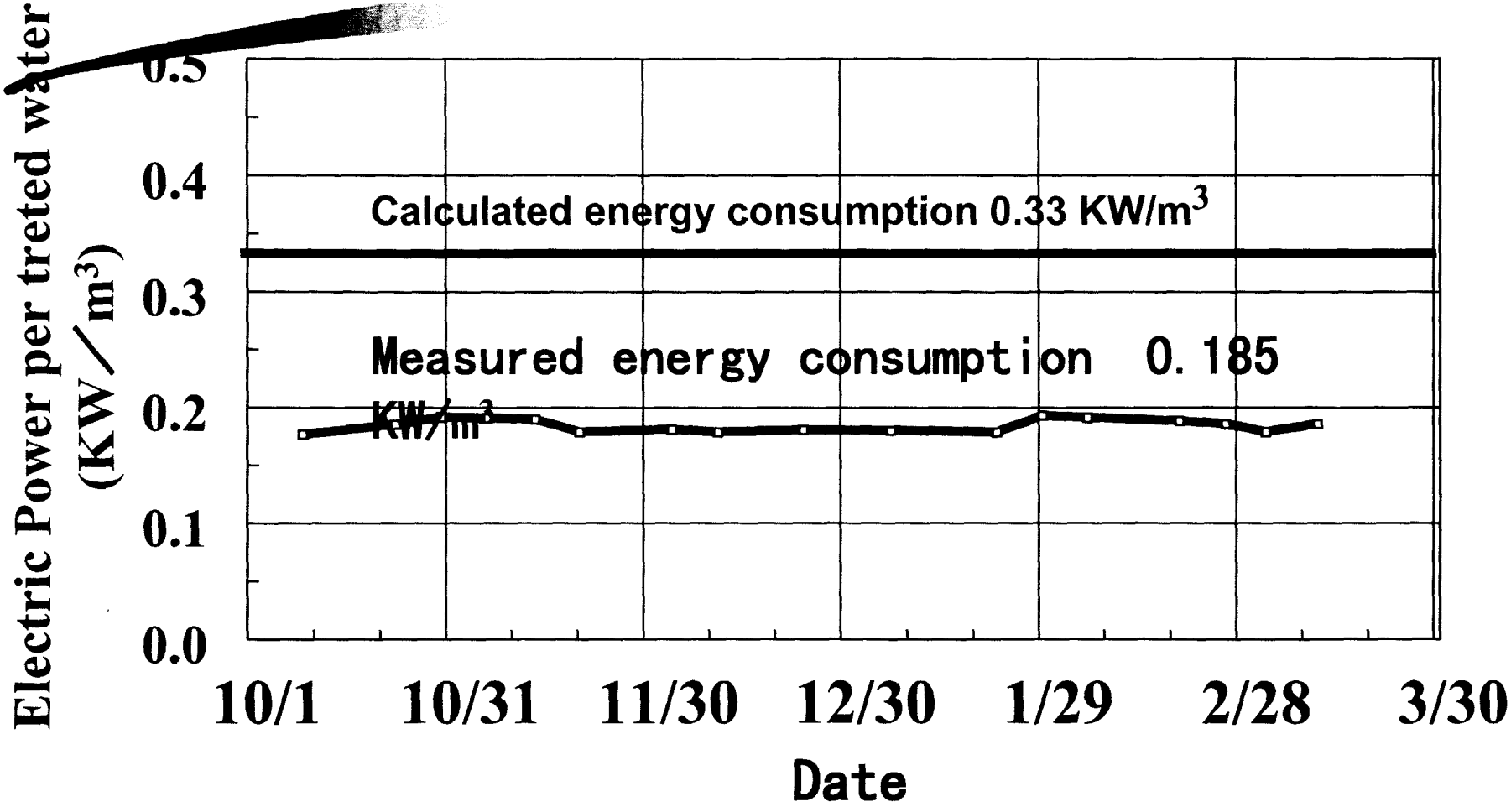
Effective Physical Cleaning (TPBW,AS) and Accurate System Control realize the following advantages:

① Low Energy Consumption.

② Long-lasting Membrane life due to low fouling and stress.

③ Long-lasting valve and machine life due to low rate operation.

④ Reduce the load of operator.



Energy consumption

Conclusion

1. Constant supply of high-quality water.
   (Treated water turbidity average 0.0001)
2. Effective Physical Cleaning (TPBW, AS) enables stable performance of membrane with recovery rate up to 99.9%.
3. Low energy consumption and virtually unmanned operation.