Desalination plant with Unique Methods in FUKUOKA

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1.Introduction

Fukuoka is located in the southern part of Japan and northeastern of the Kyushu island. The nearest big city might be not Osaka but Pusan South Korea, and it can be said that Fukuoka is a door entrance of northeast Asia in Japan.

Fukuoka district area consists of 19 city and towns, and as the mother city of Fukuoka City. It has 2.5 million people, and the water demand amount is 700,000m3/day. Each city and town has the waterworks respectively, and the Fukuoka district waterworks agency is selling water wholesale to each waterworks.

2.Water Resource Development of Fukuoka district waterworks agency

Fukuoka district waterworks agency is established because for a single city or town it is difficult to develop water resource from the Chikugo river that is the remote place. Water from the Chikugo river that was the first development began supplying in 1983.

Fukuoka did the limitation water supply for 250 days or more in 1978 and 1994. Water from the Chikugo river has already been supplied at the second water shortage time of 1994, but what also an increase in the water demand by the development of the city, and ran short of water though the water saving type district area making was advanced. Usually water resource development with the dam took 20 years or more, and it was thought that period considerably was required to wait for the completion of the dam that had been advanced at that time. Therefore, the plan of the seawater desalination plant that can be developed in a short term will be promoted.

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3.Outline of desalination plant in Fukuoka

The name of plant is Uminonakamichi Nata seawater desalination center in where the name of a place was put.

The method of the desalination adopted in Fukuoka is a reverse osmosis membrane method(RO). This method is the fewest the cost, and the method that have been adopted worldwide in recent years.

It has been composed of five lines of each line 10,000m3/day, and 50,000m3/day is maximum capacity. But there is no extra line. Because the water demand changes according to the season, a necessary maintenance and the check, etc. assume doing in winter when water demand is a little, and have reduced the cost.

The plant is located in land where it faced the open sea and it is in the lot area 46,000m2, and the 2/3 is free leased land from the country. Therefore, the acquisition of land would end in a short time, and it led to shortening at the construction period. The plant is in one story, and 16,000m2 construction area though the office parts are 2 stories in the building.

The staff of the agency is 10 people, and 10 private operation members who work for operation, maintenance and management. This number of people is less than that of the filtration plant operated by FUKUOKA district waterworks agency, and it makes the cost reductions.

It started building in full scale in 2001, and have used from 2005. The total project cost including the convey pipe is 40.8 billion yen, and the subsidy such as countries is 58%.

4.Unique method

4-1. Natural sand filtration method

Clean seawater of four or less in the SDI value is necessary for the desalting of seawater. It was assumed that the sand filtration in the first stage was requested from the sea of nature though two sand filtration devices were set up in a usual desalination plant. We lay the collecting pipe which have tiny holes at the bottom of the sea underground, and the speed is 6m/day that is similar to slow sand filtration. The surface of sand of bottom of the sea is always washed in the action of the wave of nature and it is not stopped up.

Moreover, there is an advantage of not influencing the environment, the spectacle, and the fishery because there are no structures over the sea and in the sea in this method. Especially, this sea area is a Genkai national park district.

4-2. UF membrane preprocessing

The UF membrane was adopted for the first time in Japan instead of the sand filtration. Stably supplying clean seawater by this method becomes the advantage that easiness and the control of maintenance become easy. Moreover, the frequency of washing is decreased, and the reduction of the plant scale is attempted. It was proven that the UF membrane of the spiral type adopted in the desalination plant in Fukuoka, have not caused the problem especially for four years in operating, and can to become an effective preprocessing as for seawater filtration.

4-3. High collection RO membrane

As for the RO membrane that is the heart of the reverse osmosis plant, the collection rate of 40% is usually used in desalination plants with the Japanese sea water. The 60% collection membrane newly developed is adopted in the FUKUOKA desalination plant, and it leads to the reduction of the cost by making of facilities, compact decreasing in the amount of the seawater , and minimizing the plant site.

On the other hand, necessary pressure rises more than 8MPa because it makes it to the high collection rate, and more advanced management is needed. It is easy for the membrane of the hollow fiber type that wash it with some chlorines.

4-4. Low pressure RO membrane

Boron cannot be removed enough by high pressure RO membrane depending on the temperature of seawater. Therefore, low pressure RO membrane of the second step has been introduced for the boron removal. It produces as becoming boron in the desalination plant 1.5mg/l or less. And 1.0mg/l or less is the water quality standard, we assume it by mixing the product water and the purified river water in addition.

The RO membrane of the spiral type is adopted, and a part volume of high pressure RO product water is processed by this membrane.

4-5. Concentrated seawater discharge

Concentrated seawater that remains in desalination is discharged to the sea and mix with the seawater in a usual desalination facility. The sea water quality of HAKATA bay is a problem because of the half close bay that is the international trade port. Concentrated seawater is mixed with the sewage disposal water which makes the density of seawater, and it discharges it to the Hakata bay.

It means that a small river of the flowing quantity of about 100,000m3/day appeared newly. The water quality has not deteriorated though the result of a remarkable water quality improvement is not obtained for the water quality measurement until present.

4-6. Management of desalination facility

Fukuoka district waterworks agency was an owner of the desalination plant and selected the constructor by the technological proposal method from the private organization. In this case, the guaranteed term of 15 years after construction is installed, and the private company that constructs the plant is doing the operation and maintenance management. It is the first operation consignment in our agency, and the improvement of reliability is attempted by doing a certain operation and the control of maintenance by the person who constructed it. And a certain implementation of the guarantee agreement is requested.

5.Water quality

The seawater quality after preprocesses and it of the production water and the blend water are steady. Certain processing by the membrane excels in stability, and can obtain the water of a certain quality. Operation that makes the blend assumption can surely be executed about boron.

6.Expense analysis

Cost that requires it in the desalination plant of 2007 is 3.1 billion yen, the cost for each 1m3 is 213 yen, and it is more expensive than the clean water cost 120 yen of the dam water.

About the half of the cost is a cost of repayment, and the half is cost to the maintenance. The half for the maintenance fee is an electricity bill, and it costs 5kwh and 53 yen to make the 1m3 water. It is necessary to examine the decrease of the administrative and maintenance expense by the reduction in the amount to be written as depreciation by making of this electricity bill reduction and equipment long-lived and asset management etc.

7.Effective use of concentrated seawater

Concentrated seawater of the remainder that takes the fresh water has discharged 50,000m3/day to the sea. However, it is cleaned through the UF membrane, and the salinity concentration is twice, and thinks this concentrated

seawater to be a resource that hides various potential. Using at present as the effective use method is production of natural salts. Although the research and the examination have been advanced going side by side with the construction. Special new products in Fukuoka are produced by the private company with the salt manufacture device by the low temperature of decompression method made of concentrated seawater.

The concentrated seawater is expected to used for Thalassa Therapy, health enhancements, sea fish growing and the food manufacturing such as the miso, the soy sauce, the bean curd, and bread.

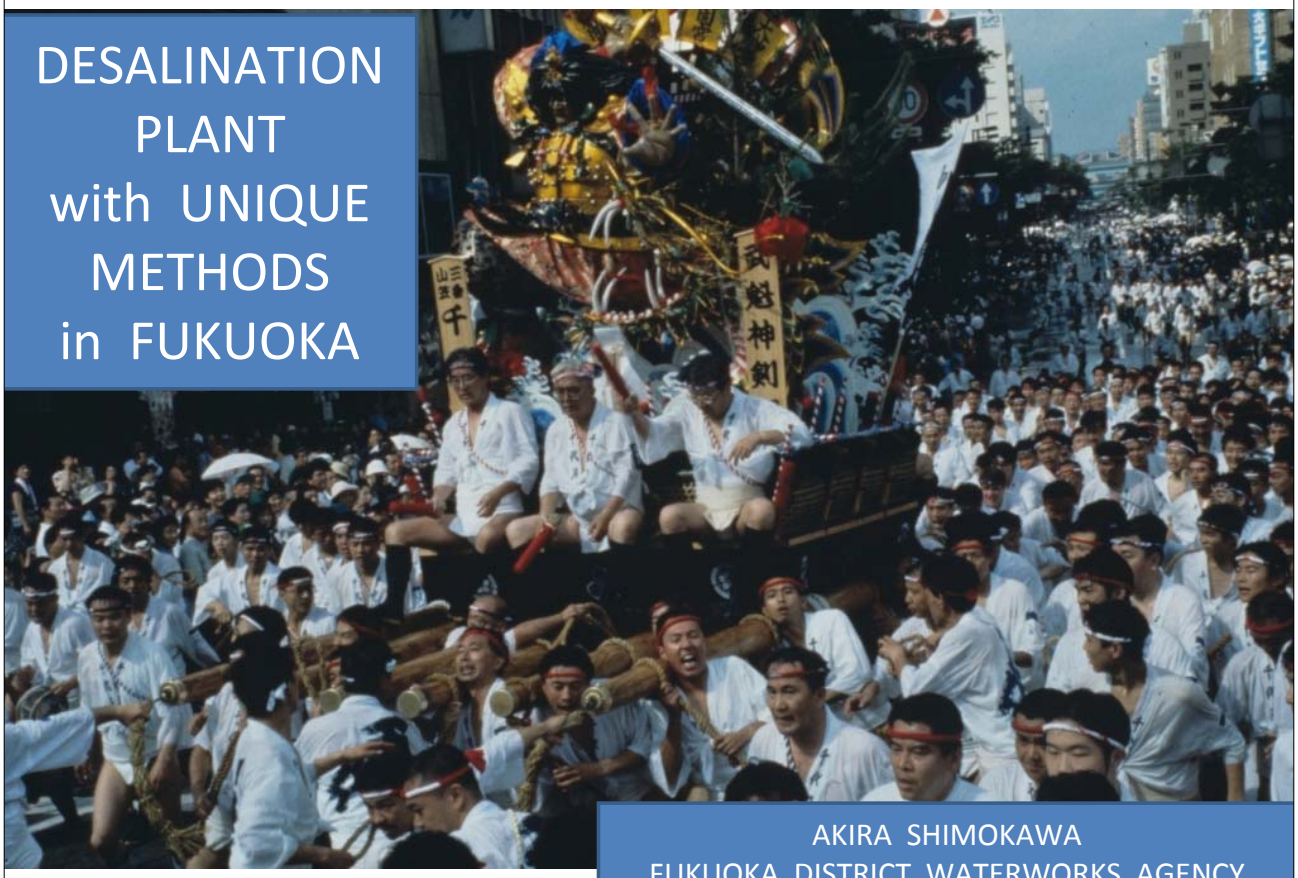
However, neither has arrived at the participation of the private company by a commercial base. Furthermore, the experiment on the osmotic pressure power generation is conducted, and the effectiveness is confirmed. There is a problem of an actual introduction, however, it continues and examines by some private companies.

8.Effective use of production water

Fresh water produced in the desalination plant is clean water that processes the membrane, and what packed into the PET bottle is being distributed free of charge to the people who visit the site for publicity about the desalination. Moreover, UF and RO membrane changed every five years based on longevity can be used enough for another usage.

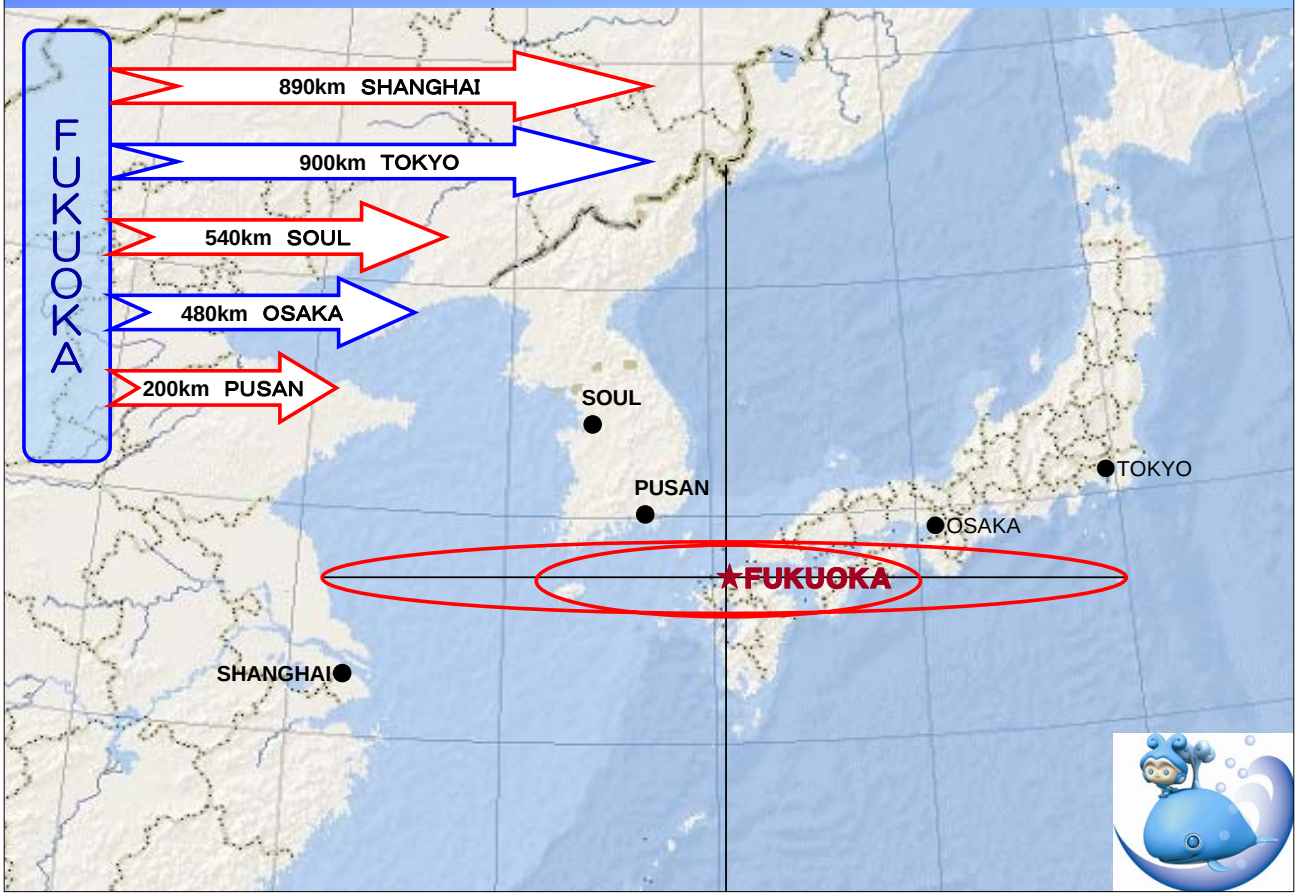
Therefore, the examination and the research on effective use of the fresh water and the membrane are advanced, and we want to tie to the total cost reduction of the desalination facility.

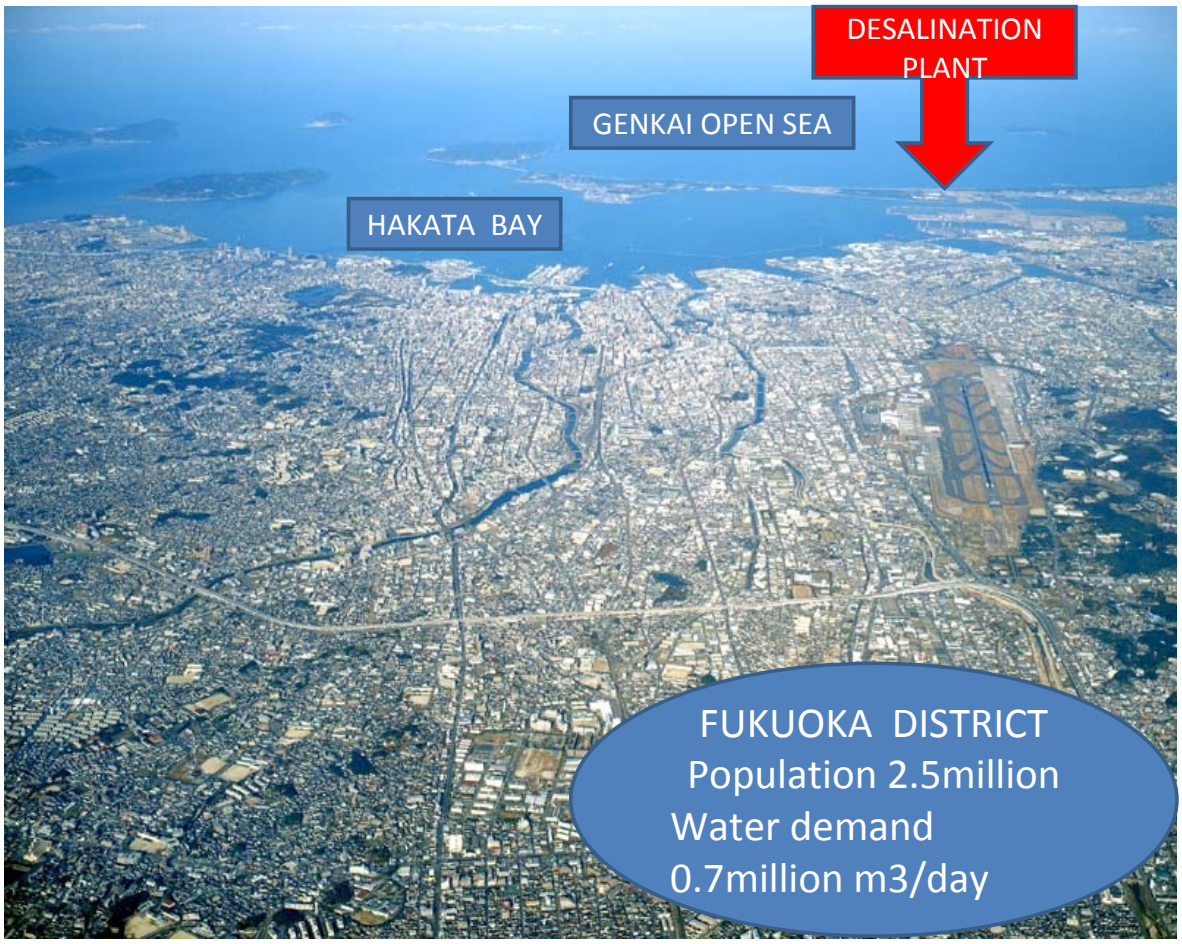
DESALINATION PLANT with UNIQUE METHODS in FUKUOKA



AKIRA SHIMOKAWA
FUKUOKA DISTRICT WATERWORKS AGENCY

FUKUOKA is the center of east ASIA





Drought experience

*2 times big drought experience
(1978year 287 days, 1994year 295days)

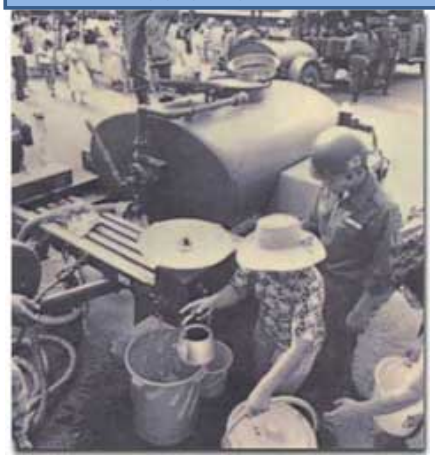
*Every 2year cut the intake amount from the main river

*prediction of water demand increase

*Save water rules

*Develop water resource
dams
reclamation water
desalination plant

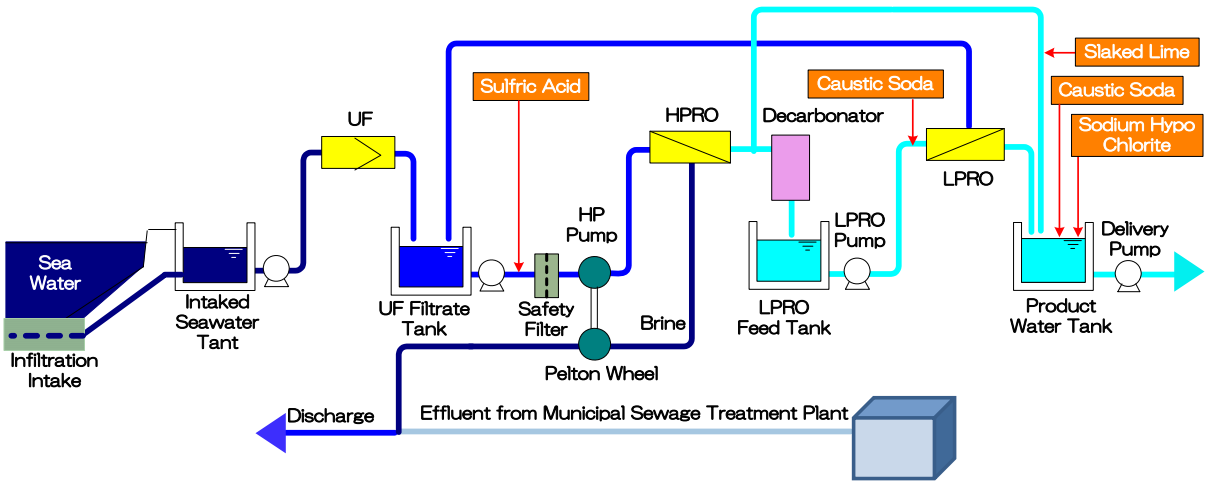
Water supply by tank in 1978



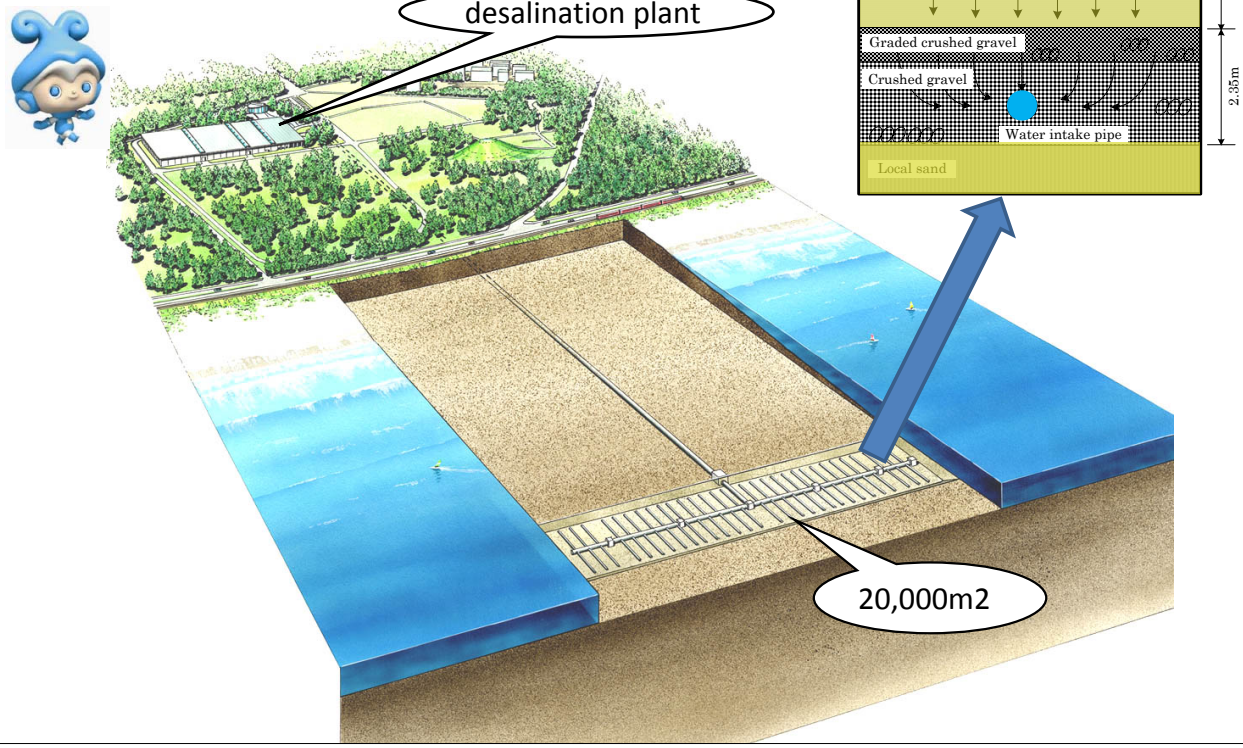
UMINONAKAMICHI NATA SEA WATER DESALINATION PLANT

PRODUCT CAPACITY 50,000m3/DAY (MAX)
INTAKE SEA WATER VOLUME 103,000m3/DAY
SITE AREA 46,000m2
BUIDING AREA 16,000m2
ELECTRIC DEMAND 12,000KW
NUMBER OF WORKING PERSONS 20

Schematic Flow Diagram



Unique method 1
Natural sand filter



Unique method 2
UF membrane Pretreatment

Conventional dual media filter

Perfect removal of turbidity

Consistent low SDI

Easy operation

Easy maintenance

Reducing cleaning frequency

UF membrane Pretreatment

SW type by NITTO DENKO

Unique method 3
High recovery RO module

High pressure hollow-fiber membrane by TOYOBO

60% recovery
(desalinated pure water)

Save plant area

Save amount of intake sea water

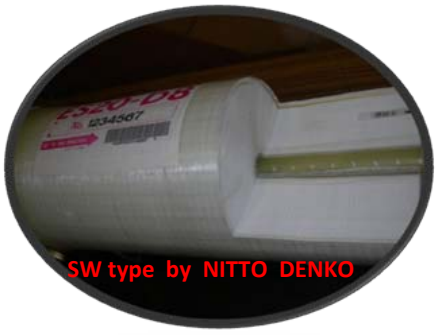
Decrease plant largeness

Decrease cost

Unique method 4
Secondly low pressure RO

Standard of water quality

Boron =<1.0mg/l



Pure water after first High pressure RO

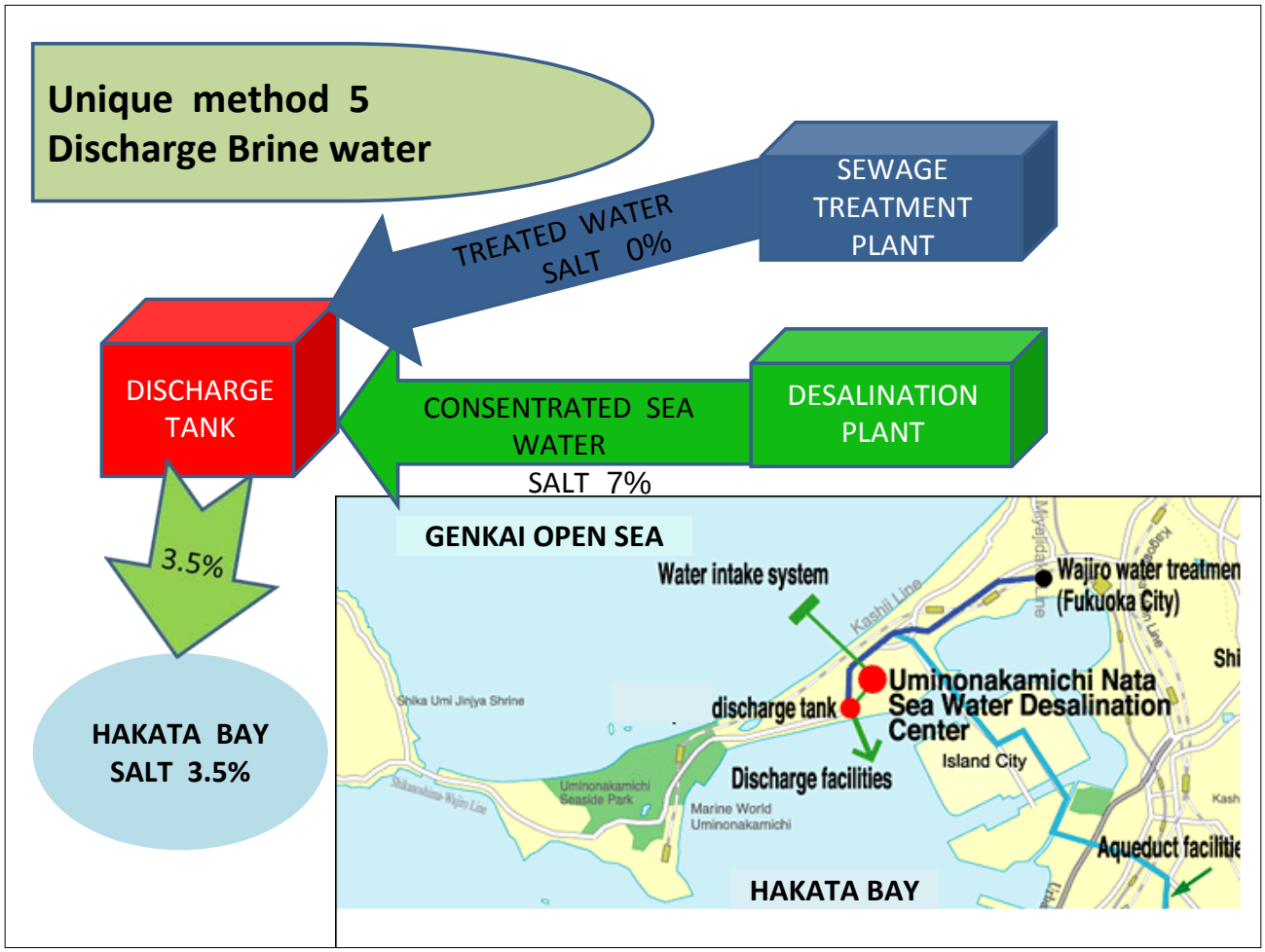
Boron 4mg/l

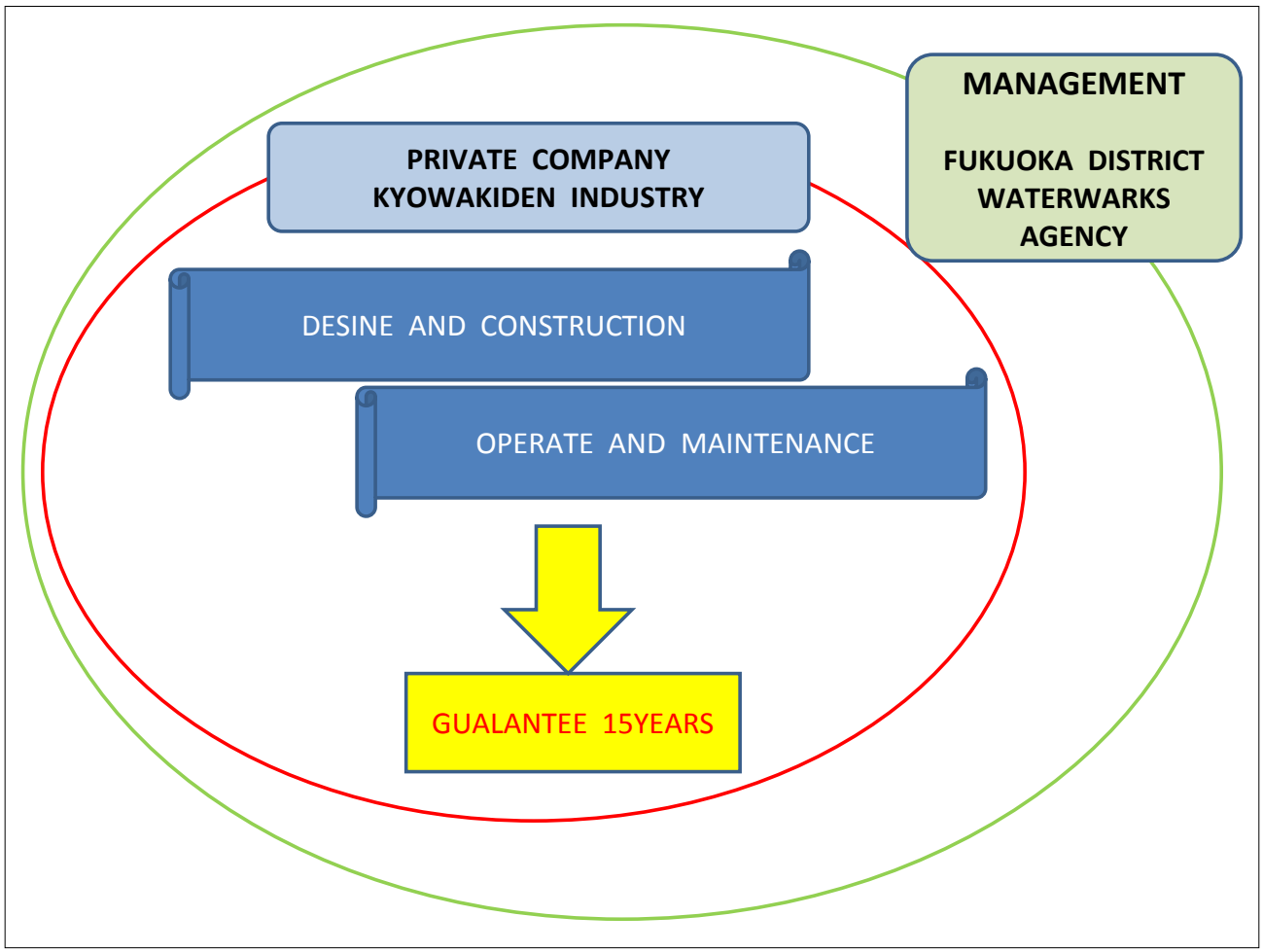
Secondly low pressure RO

Boron =<1.5mg/l

Mix with purified river water

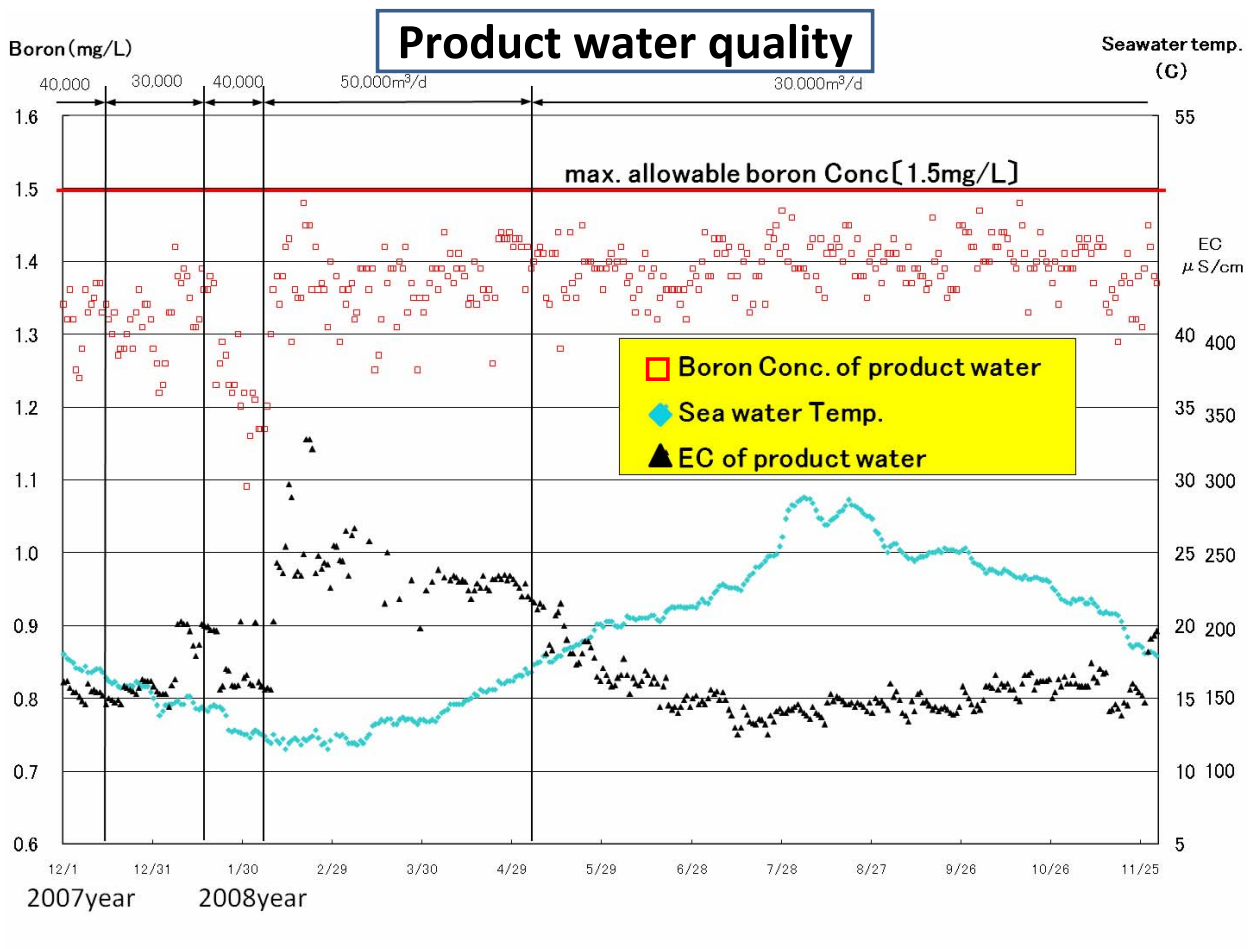
Boron =<1.0mg/l


Unique method 5
Discharge Brine water
SEWAGE TREATMENT PLANT
TREATED WATER
SALT 0%
DISCHARGE TANK
CONSENTRATED SEA WATER
SALT 7%
DESALINATION PLANT
3.5%
HAKATA BAY
SALT 3.5%
GENKAI OPEN SEA
Water intake system
Wajiro water treatmen
(Fukuoka City)
Uminonakamichi Nata
Sea Water Desalination
Center
discharge tank
Discharge facilities
Island City
Shika Umi Jinjya Shrine
Uminonakamichi
Seaside Park
Marine World
Uminonakamichi
Aqueduct facilitie
HAKATA BAY

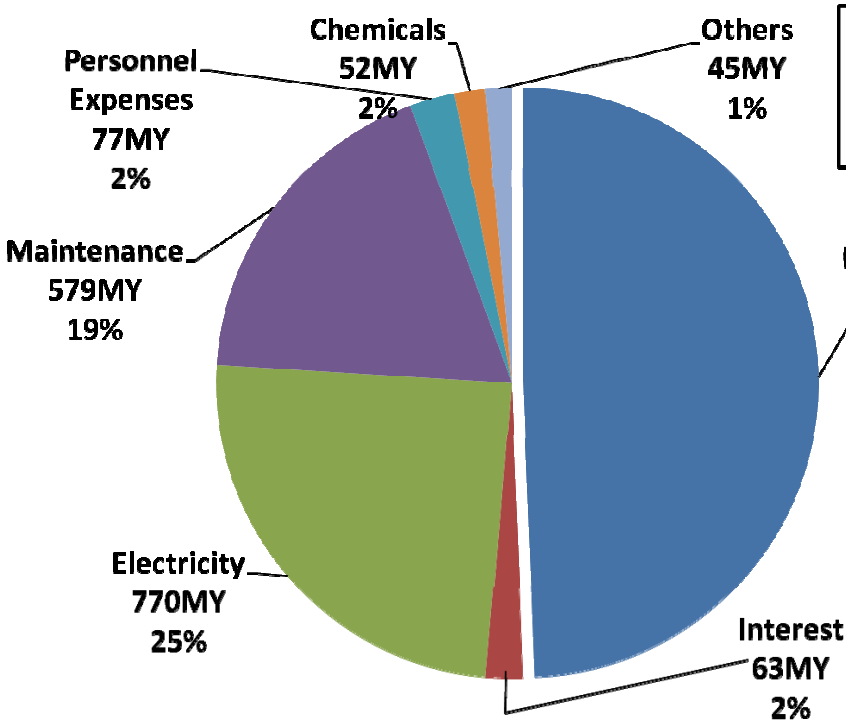

MANAGEMENT
FUKUOKA DISTRICT WATERWARKS AGENCY
PRIVATE COMPANY
KYOWAKIDEN INDUSTRY
DESINE AND CONSTRUCTION
OPERATE AND MAINTENANCE
GUALANTEE 15YEARS

WATER QUALITY in 2007FY

	filtrated sea water	desalted water	mixed water	standard
Total Dissolved Solids	40,200	108	138	=<500mg/l
Chloride Ion	20,300	42.1	32.0	=<200mg/l
Sodium and its compounds	10,800	26.1	23.7	=<200mg/l
Sulfate Ion		2.5		
Hardness	6,580	19.1	50.5	=<300mg/l
Electric conductivity	51,700	178	225	
Boron an its compounds	4.5	1.4	0.61	=<1.0mg/l



COST ANALYSIS



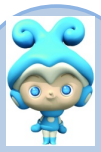
Total 3,133million yen
Unit cost 213yen/m3

(2007 fiscal year)

EFFECTIVE USE of CONCENTRATED SEA WATER

DESALINATION PLANT

EVAPORATION TANK



UNDER SURVEY

***use for food (tofu,miso,soy sauce,bread)**
***thalassa therapy**
***bring up fish**
***penetrate pressure power plant etc.**

NATUNAL SEA SALT

EFFECTIVE USE of pure water and others

Bottled pure water

Free distribution

Under survey

*reuse membrane

*selling bottled pure water