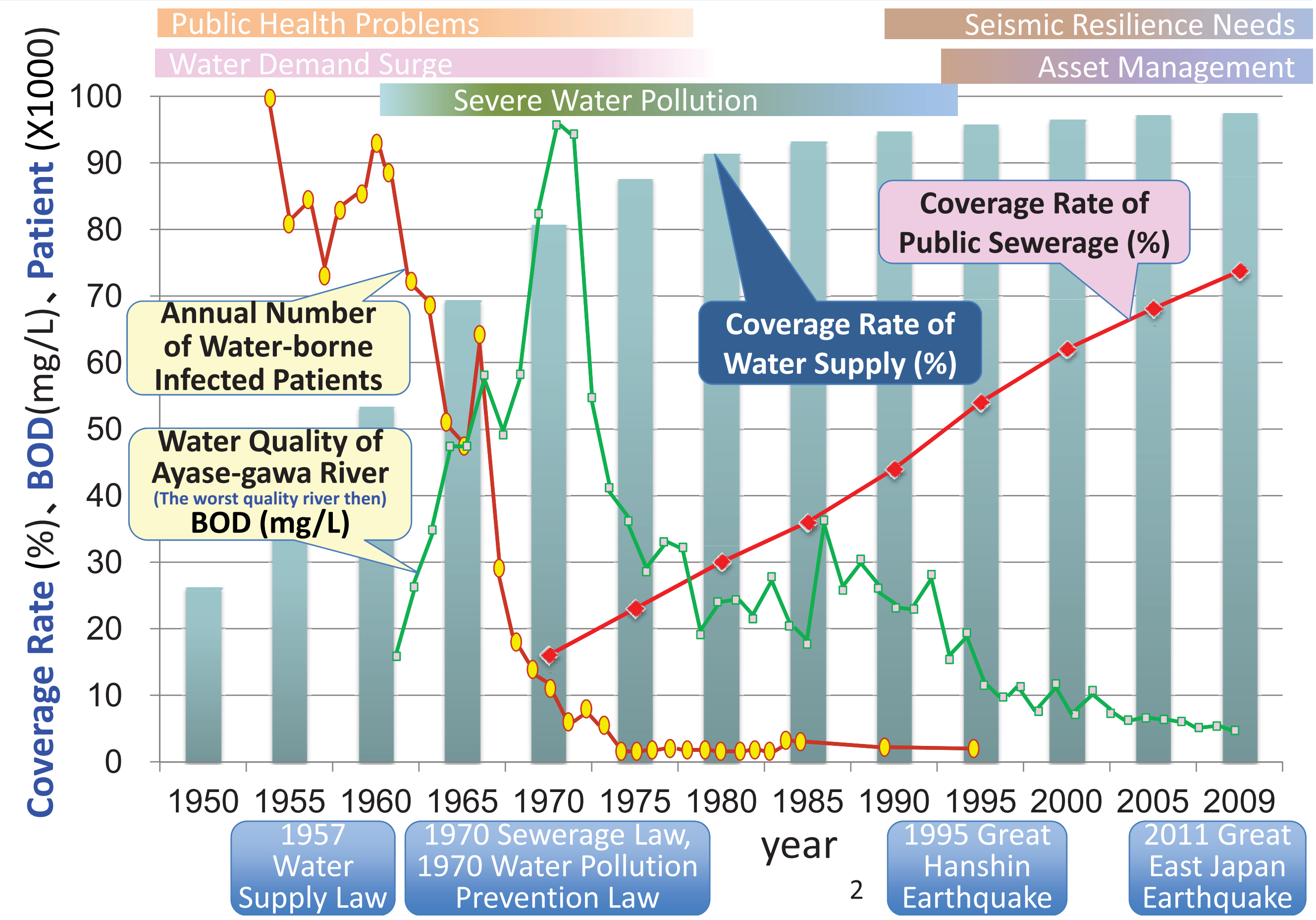
資料５

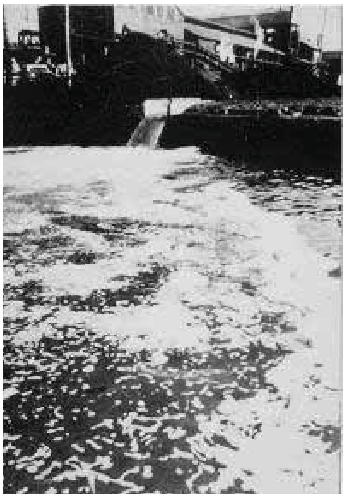
資料５　世界の水インフラ整備に資する日本の技術

History of Water Supply and Sewerage System in Japan in Post War Era



- **Water contamination in rivers and sea areas had rapidly escalated since around the 1960s, and the government was urged to take countermeasures.**
- **Against this background, a fundamental revision of the Sewerage Service Act, as well as the enactment of the Water Quality Pollution Control Act, was conducted in the so-called "Pollution Diet" in 1970.**

1960s



Serious water pollution in Kita-kyushu City (1960s)

Now

Water quality of Murasaki River in Kita-kyushu has remarkably improved

Reclaimed Wastewater with a Background of Severe Drought

- **Based on drought experiences, Japan has established wide ranges of wastewater reclamation applications.**

Fukuoka City

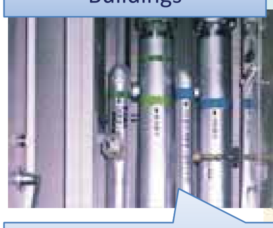
Drought in 1978

Water Truck in Operation

Dried up Minamihata Dam

Now

Double Pipe System in Buildings



Building of over a certain size are required of double pipe system

Treatment System
Activated Sludge ＋ Chemical Precipitation + Ozonation + Sand Filtration

Utilization of Reclaimed Water
1,165ha Service Area,
5,500m³/day supply

(waste water treatment plant)

Japan's Challenges for Recycling of Water, Resources, and Energy

<Challenges>

- Heavy rain
- Drought
- Lack of disposal sites for sludge
- Lack of energy source
- Global warming countermeasures
- Aging facilities
- Road cave-in accidents
- Need for expenditure leveling

<Solutions>

Water Cycle System
- Store rainwater and effectively use during clear weather
- Reuse of advanced treated water as a stable water resource
- Leakage prevention

Resource and Energy Recycling System
- Effective use of sludge without disposal
- Reuse of energy

Asset Management System
- Development of an efficient rehabilitation system
- Preventive maintenance
- Breakdown maintenance

Use of Reclaimed Wastewater in Tokyo

Conventional activated sludge process plus advanced wastewater treatment process

Reclaimed Wastewater about $78,000m^3$/day

Recreational Use

Ochiai Water Reclamation Center
SESERAGI NO SATO : about $16,000m^3$/year

Reuse in Office Buildings

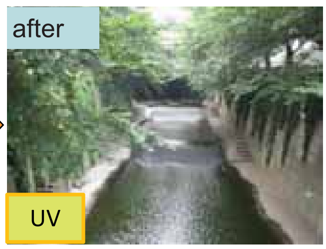
Water for toilet flushing in West-Shinjuku and Nakano Sakaue areas, etc. : about $9,300m^3$/day

Industrial Use

Cleaning water for train systems, YURIKAMOME : about $1,800m^3$/year

Environmental Use

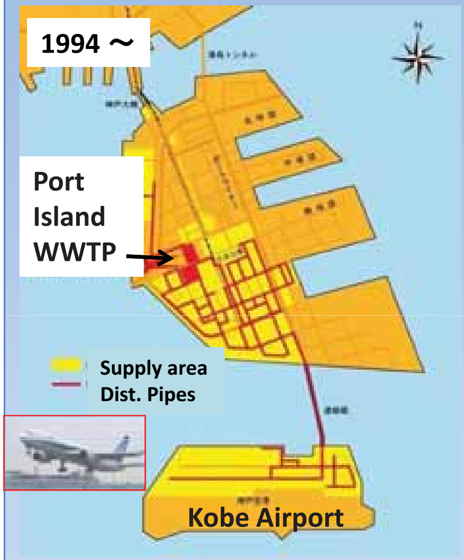
Water source for revival of Meguro River, etc. : about $68,000m^3$/day



Use of Reclaimed Wastewater in Artificial Islands

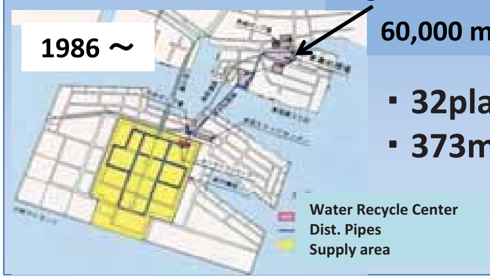
- In Kobe City, advanced treated water was introduced in order to secure stable water resources in the artificial islands.

Port Island and Kobe Airport (305 ha)



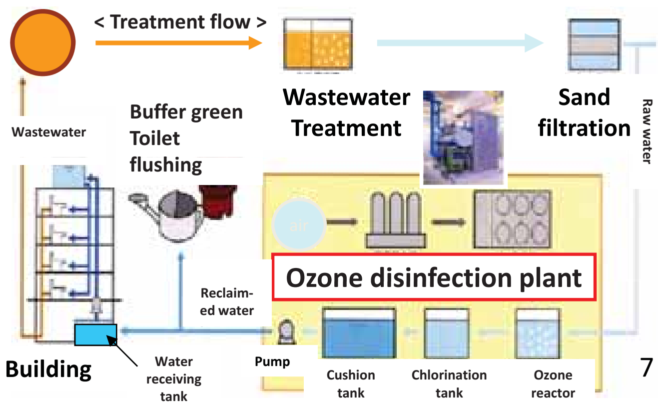
- 58places
- 600m^3/day

Rokko Island (166 ha)

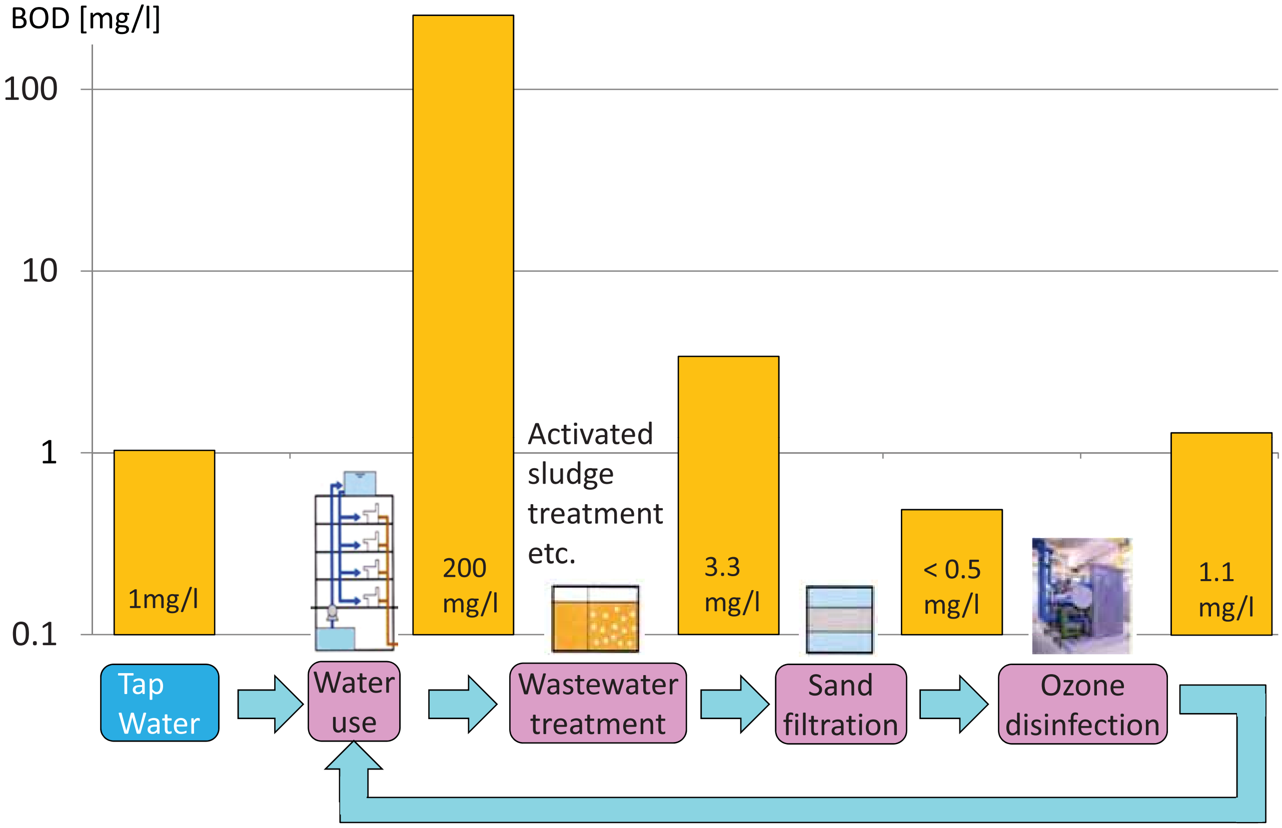


Higashinada WWTP
60,000 m3/day

- 32places
- 373m^3/day



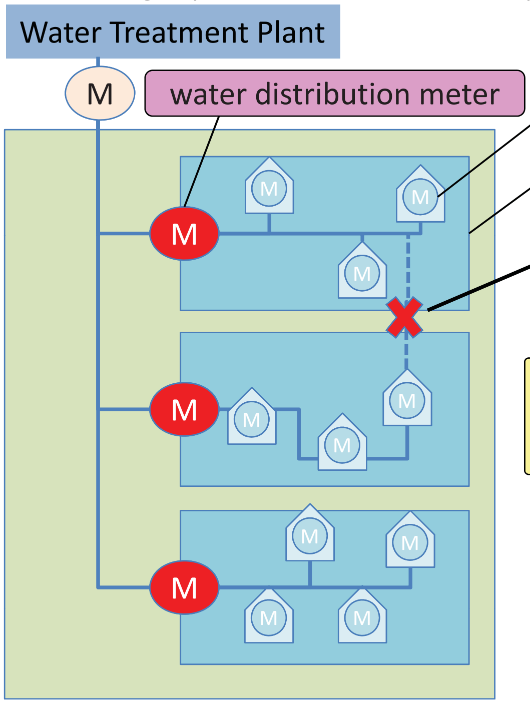
Transition of Biochemical Oxygen Demand (BOD) through the Water Cycle



- water qualities of treated water are obtained from experiments by Kobe city.
- water quality of tap water is typical value in Japan.

Leakage prevention by Block Distribution System

The Block Distribution System is installed in many major cities in Japan.
Hai Phong city of Viet Nam consults Kitakyushu city for the installment of the system.

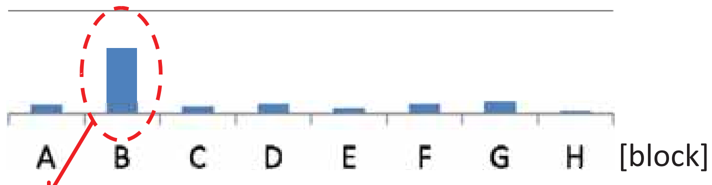


Enable water discharge measurable by abolishing link pipes between water distribution blocks, and by installing water distribution meter at the mouse of the water distribution block.

Non-Revenue Water Calculation

M - M M M = Non Revenue Water

Non-revenue water can be measured at every water distribution block.

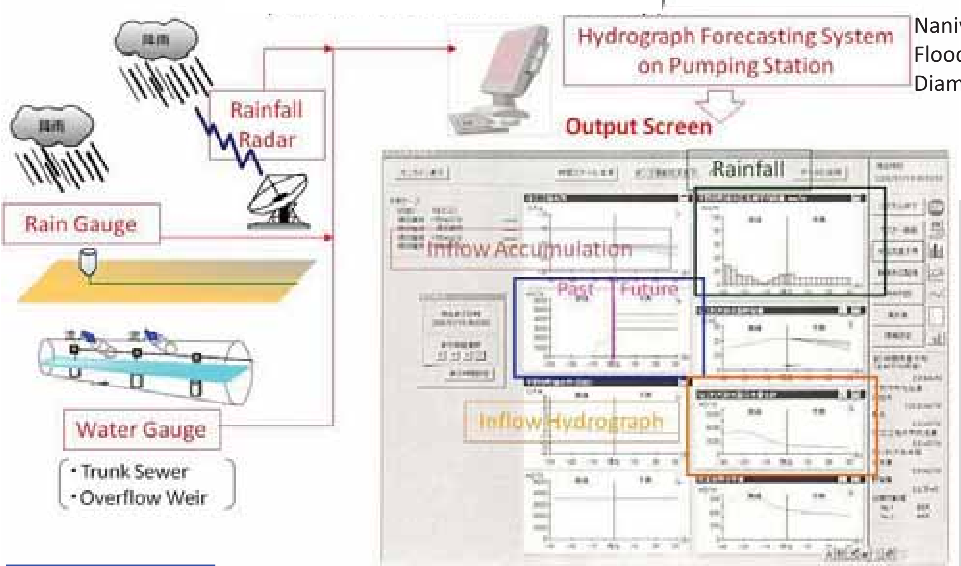


Leakage and water theft can be easily identified.
Effective investigations & countermeasures can be conducted.

Effective operation of drainage pump using sensor and software

Short time range inflow forecast can be made based on rainfall radar data and water level data

effective pump operation supported by the inflow forecast decreases prevents flood damage



Naniwa Grand Floodway
Diameter: 6.5m

The effect of structural measures, such as trunk sewer (Naniwa Grand Floodway), and non-structural measures, such forecast with rainfall radar

1979 (before constructed)

Number of flooded houses:
5,000
on 77mm/hr rain

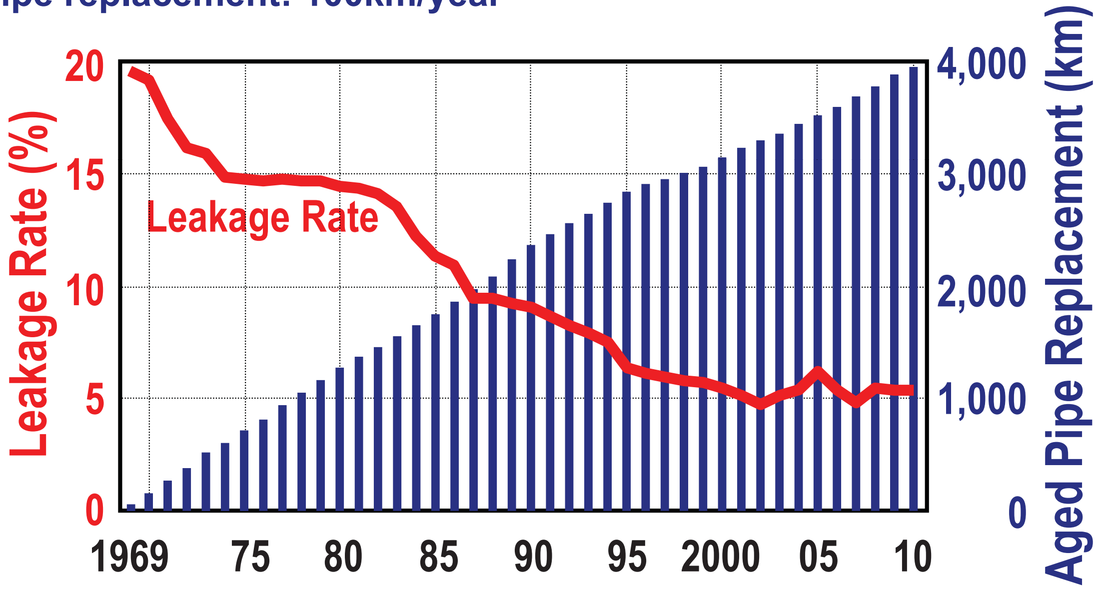
2011 (After constructed)

Number of flooded houses:
15
on 77mm/hr rain

Typical large diameter drainage pump takes about 5 minutes to start up. The prediction of the drainage water flow enables timely operation of pumps.

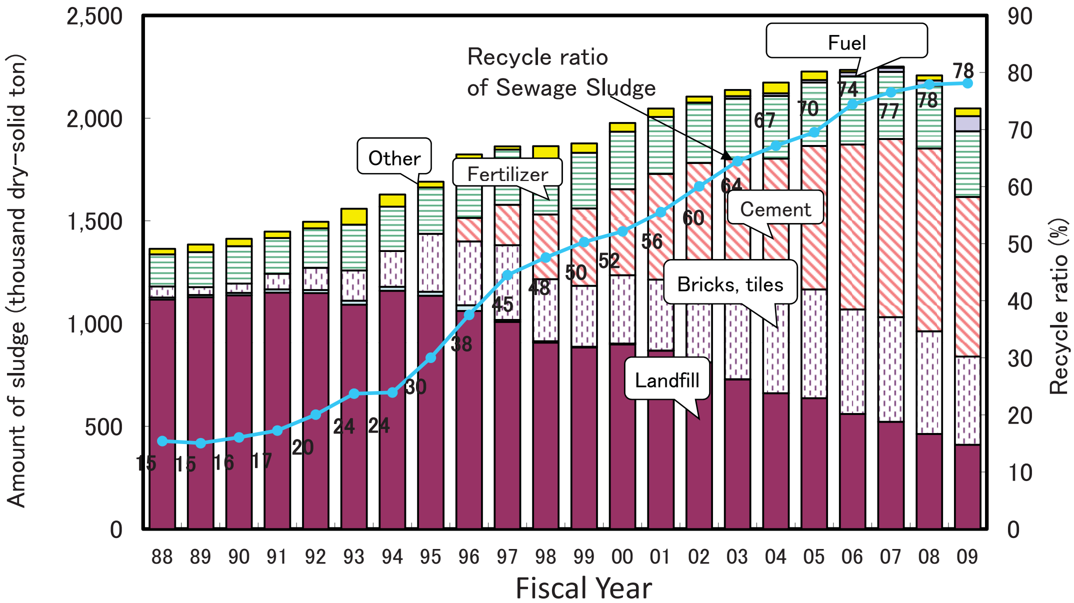
Leakage Prevention by controlled Aged Pipe Replacement

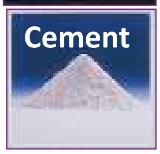
The example in Yokohama:
Planned pipe replacement: 100km/year

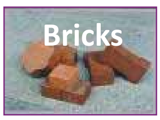


Leakage Rate 5.4% achieved.

Amount of sewage sludge production and recycle ratio



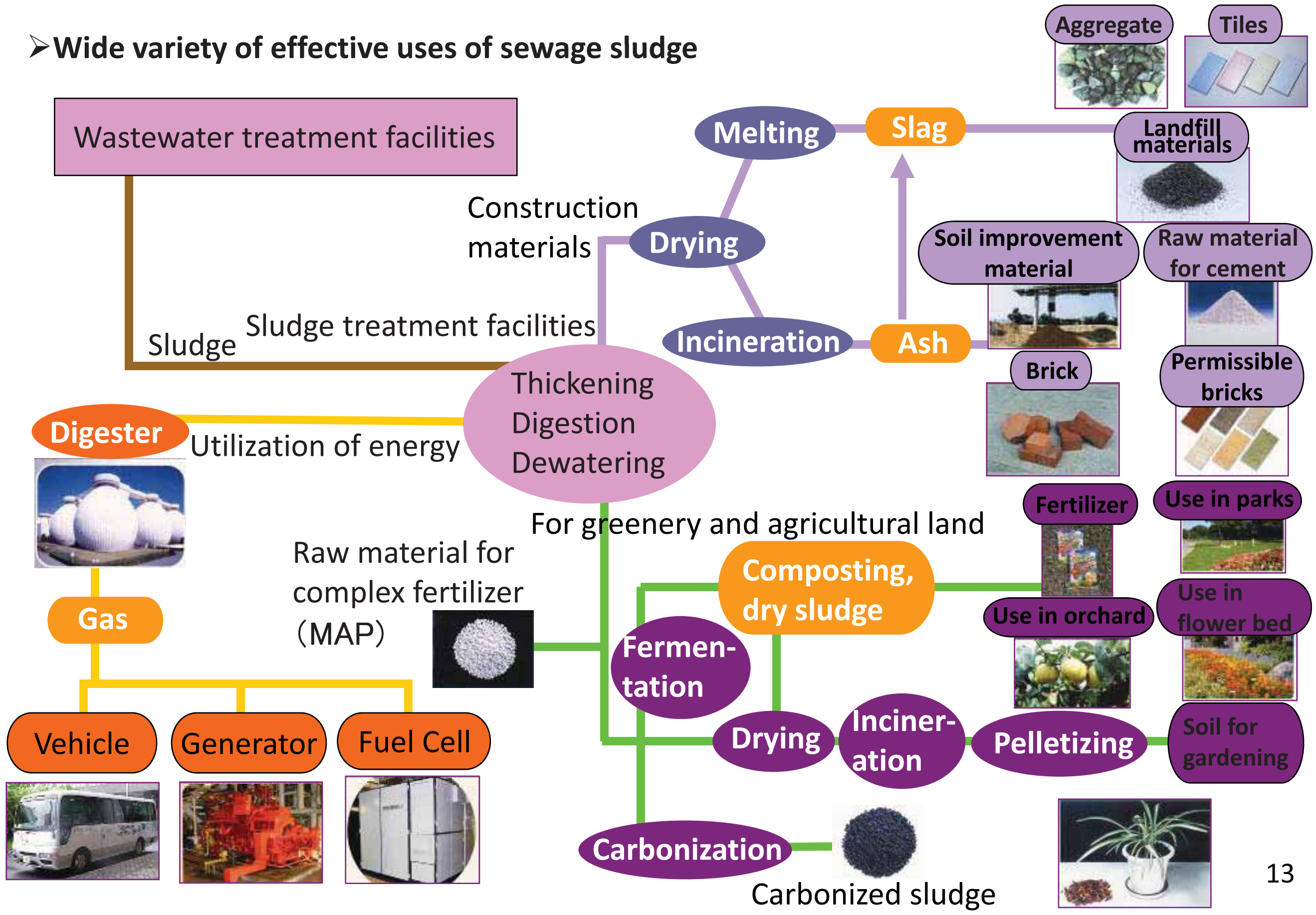




- **Recovery of Resource and Energy from sewage sludge, in order to ensure stable treatment and to reduce CO2 emission etc.**
- **Sludge recycle ratio around 80%**

Recycling of resource and energy from Sewerage

➢ **Wide variety of effective uses of sewage sludge**



Fertilizer from sewerage sludge

Example of Gifu Prefecture

➢ **Fertilizer produced from sewage sludge is used for the production of vegetables in Gifu, and the vegetables are famous for the excellent quality.**

Phosphorus Recycling system

Fertilizer made of recycled phosphorus

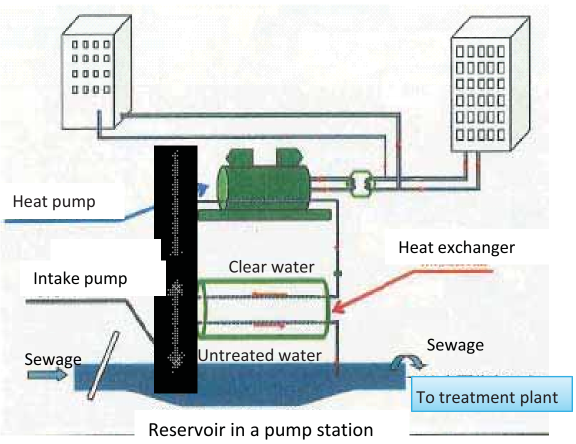
Sewage from 8,000 person/day
≒30〜40kg-dried solids of Phosphorus

Biogas generation from sewerage sludge

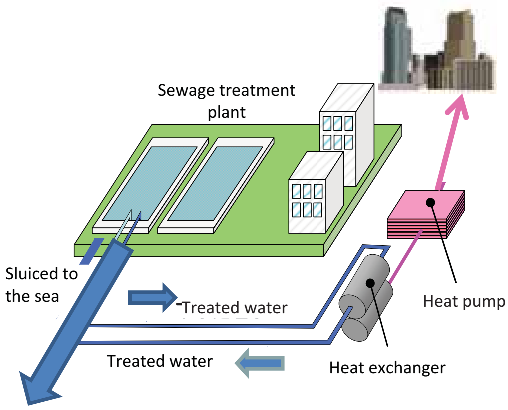
Sewage from 1,100,000 person/year
≒ 6,000,000 m^3 of methane gas

Utilization of sewage heat for local heating and cooling

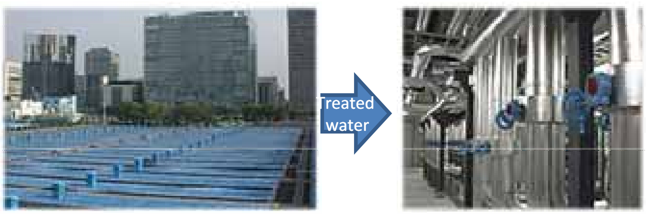
Utilization of untreated sewage (1994-)



Utilization of sewage treatment plant (2006-)



Sewage from 170,000 person/year
≒ 96,600GJ ≒ 2440kl crude oil equivalent



Shibaura water reclamation center, Tokyo

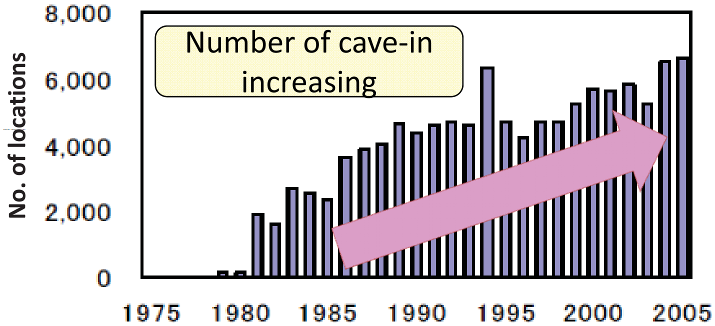
Sony Building
(Source: Homepage of Sony)

Troubles caused by aging sewerage stocks

Water leakage causes cave-in

Aged underground pipes causes water leakage because of deterioration. The water leakage causes cave-in.

Number of Cave-in on the Road due to Pipe Deterioration



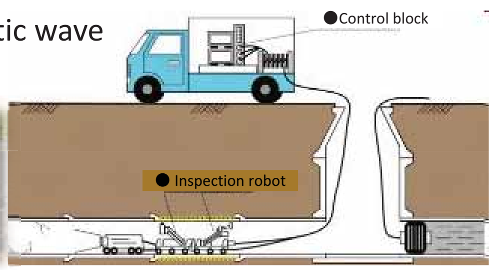
Technologies to support sewerage asset management policies

(1) Inspection and survey technologies

(Example) Sewer pipe diagnosis by the impact elastic wave inspection method and video camera

Fissure detection

Leakage detection



(2) Effective maintenance/operation and rehabilitation technologies

(Example) Rehabilitation of sewer pipes using the non-digging method

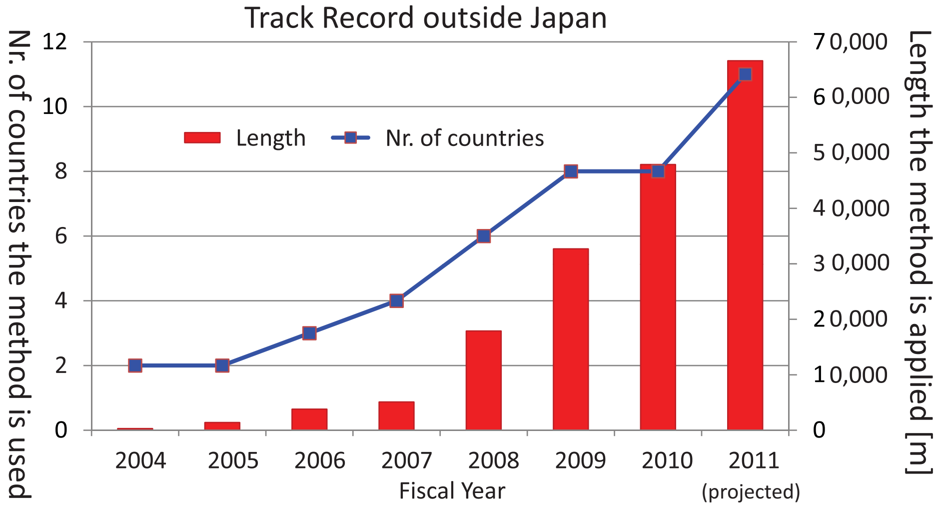
Leakage prevention

Sewage Pipe Renewal (SPR) Method for Aged Sewage Pipes

SPR method overseas application: More than 65,000m (projected by the end of March 2012)

Number of countries SPR method is used:
11 countries in Asia, North America and Europe, such as Korea, Singapore, China, Russia, Poland, Germany, US, Australia and Japan

Introduction in Bulgaria and other countries is projected.



Video

Trenchless pipe construction technology of Japan

- **Trenchless construction method such as Shield tunneling method and a Pipe jacking method was developed as a pipe construction technology in the crowded city area in Japan.**
- **Trenchless method is used for places where**

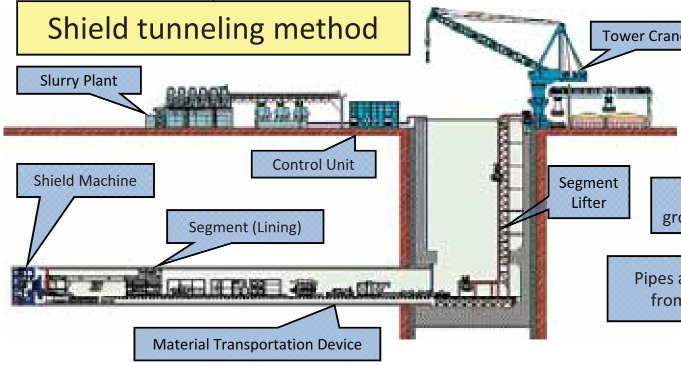
- Heavy traffic roads.
- Utility pipes buried underground are congested and difficult to dig from the surface of the ground.
- Roads and rivers crossing, which means impossible to dig from above ground.
- The level of the installation is deep and pipe jacking would be cost-effective.

Trenchless Methods

diameter > about 3000mm

Segment is assembled with digging ground with the machine

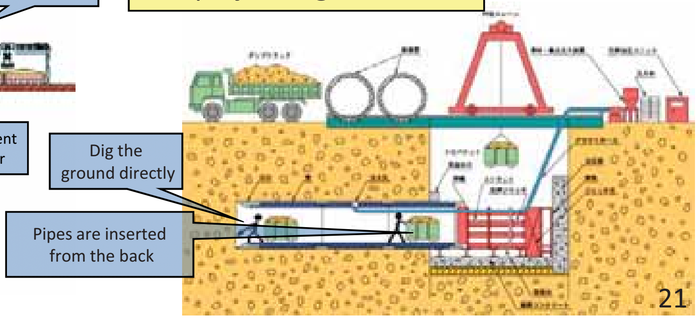
Shield tunneling method



diameter < about 3000mm

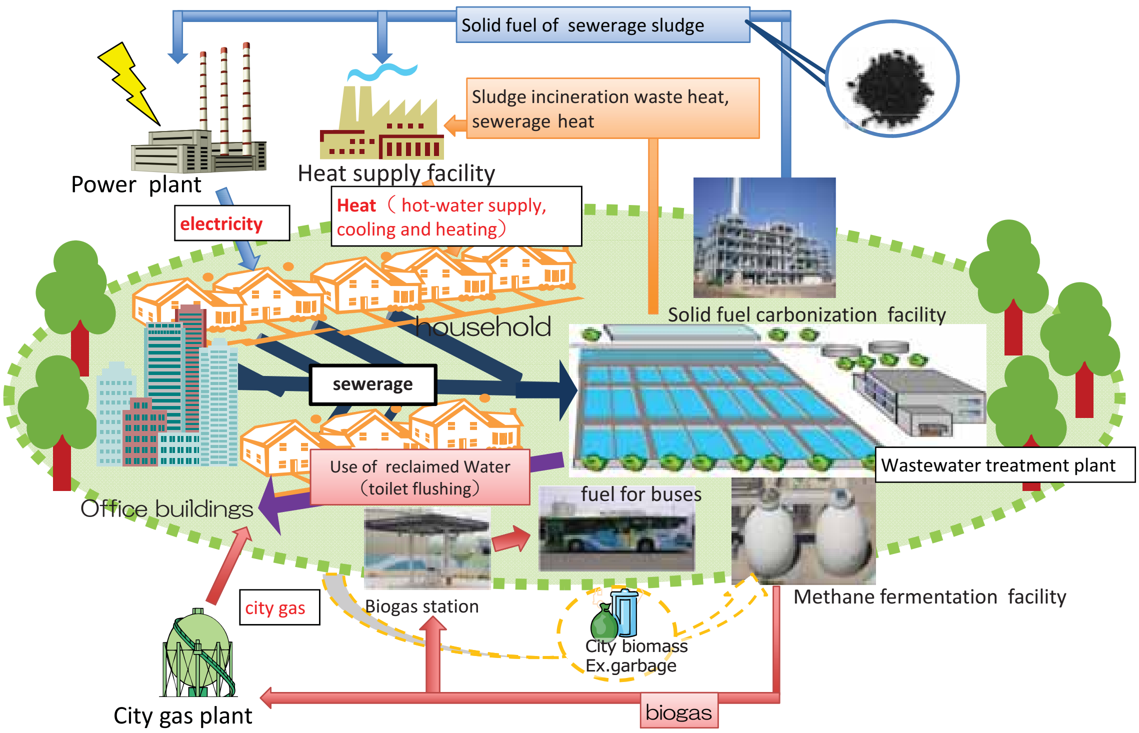
It is made to move machine forward with inserting pipe from the back

Pipe jacking method



Sustainable City based on the circulation of water, resources and energy

Japan has various technologies for Total Management of Sustainable Cities.
We are prepared to cope with total management consulting talks.



Thank you.

Source presentation materials are prepared by the following Council members:

Activities of NEDO

(New Energy and Industrial Technology Development Organization)

1. **Overview of NEDO**
2. **NEDO's Activity for Water Technologies**

Feb.16th 2012

http://www.nedo.go.jp

Overview of NEDO

Ministry of Economy, Trade and Industry (METI)

Council for Science and Technology Policy

Foundation: 1980
Budget: ¥151.2 billion (FY2011)
US$ 1.9 billion (1US$ ≒ ¥78)
Number of personnel: Approx.1,000

Coordination with policy making authorities

NEDO

Promotion of R&D projects

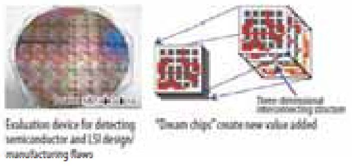
・Advanced R&D project management
・R&D activities with flexible and agile project management

Combined efforts of industry, government, and academia

Industry | Universities | Public research institutes

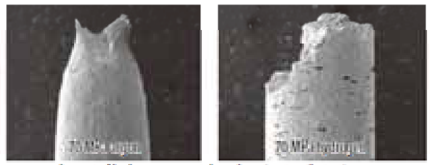
Overview of NEDO

Electronics & IT

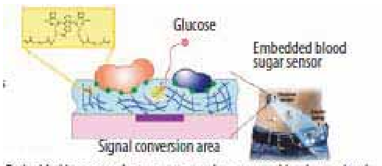

Evaluation device for detecting semiconductor and LSI design/manufacturing flaws
"Dream chips" create new value added

Aircraft & Space

Fuel cells & Hydrogen


Impact of hydrogen on metals undergoing tensile testing

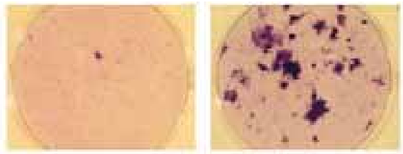
Machinery systems



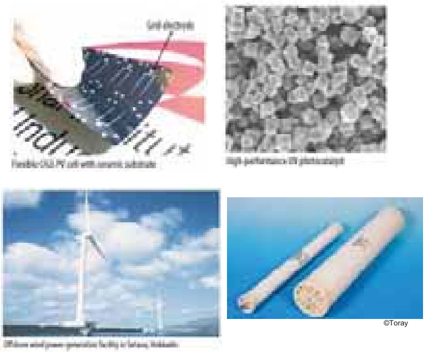
Embedded biosensor device continuously measures blood sugar level


Robot separating waste material at a construction site

Chemical sub. management

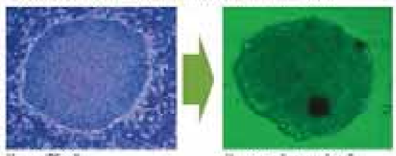

Cells for carcinogenicity evaluation cultured without chemical substances
By introducing carcinogenic substances to cells, cellular properties are altered and the cells grow in clusters.

Energy & Environment



Biotechnology & Medicine

Induction of cardiac muscle cell differentiation from human iPS cell


Human iPS cell
Human cardiac muscle cell

NEDO

NEDO's Activity for Water Technologies

Project on Water-saving Recycling Systems

(Period:2009～2013)

(Budget: about ¥7 billion≒US$ 0.1billion)

- Developing advanced water treatment technology and testing water resource management systems in Japan and overseas

Objectives

Contributing to the resolution of global water resource problems

1. Development for advanced technologies
2. Test-bedding for dissemination of newly developed systems

NEDO

Activity for Water Technologies

Project on Water-saving Recycling Systems

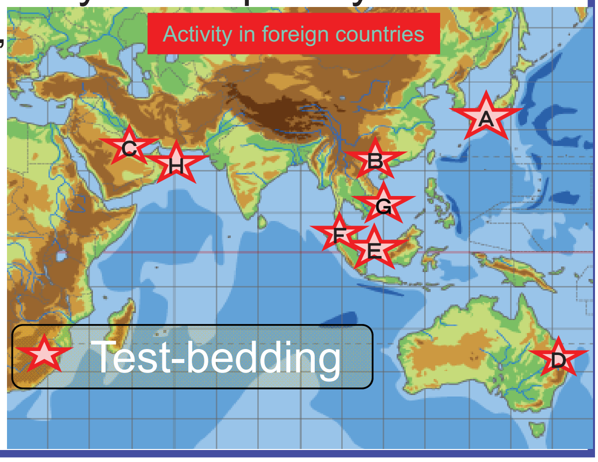
Theme

1. Development for advanced technologies
   RO, NF, MBR, Metal recovery, AOP, etc

AOP: Advanced oxidation process

2. Test-bedding for dissemination of newly developed systems
   7 countries (Australia, Japan, UAE, China, Vietnam, Singapore,Oman)

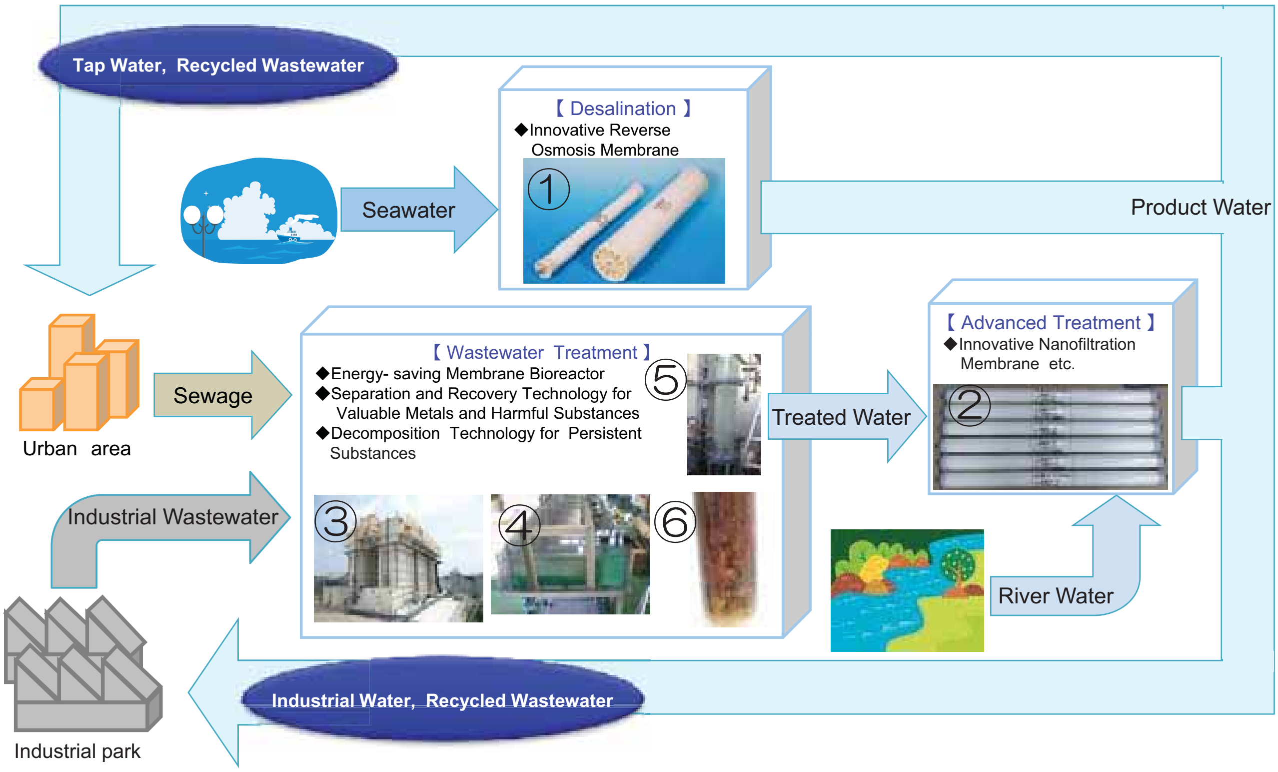
   8 projects (SWRO, MBR, Reuse, Rainwater harvesting etc.)



NEDO

Project on Water-saving Recycling Systems

1. Development for advanced technologies

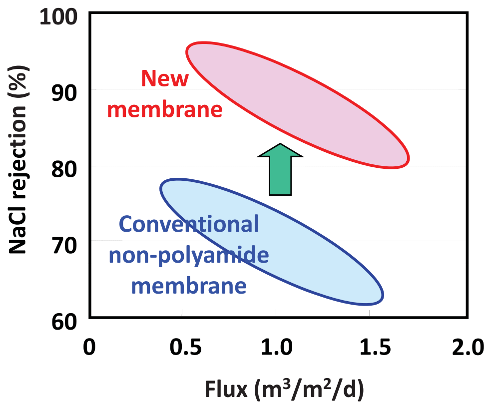


Project on Water-saving Recycling Systems
1. Development for advanced technologies

① Development of advanced material for RO membrane

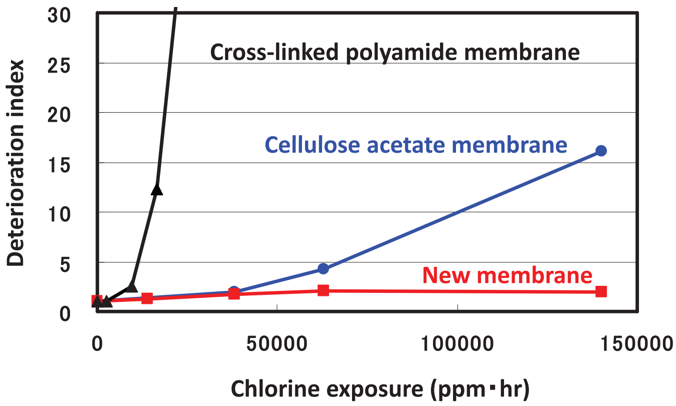
● A chlorine resistive high-performance membrane developed by fine molecular design of advanced material.

Performance of new RO membrane*)



*) Based on data presented by Toray

Comparison of chlorine durability)**



**) The data obtained in lab-scale experiment by Toray

Project on Water-saving Recycling Systems
1. Development for advanced technologies

② Development of ultra-low pressure NF membrane

● A newly developed high flux NF element achieved the interim target of a 20% energy-saving rate

2000 ppm-$MgSO_4$ rejection vs. pressure

Element no.	Purpose of measurement	Pressure MPa	Feed L/min	Solute	Rejection %
Existent item NTR729HF	$MgSO_4$ rejection performance	1.0	8	MgSO4	99.0
Development item KMD21-S2	$MgSO_4$ rejection performance/ pressure Dependence	0.8	8	MgSO4	99.9

Test conditions: 2000 ppm $MgSO_4$ at pH7, 25°C with the same normalized flux level

Appearance of innovative NF elements

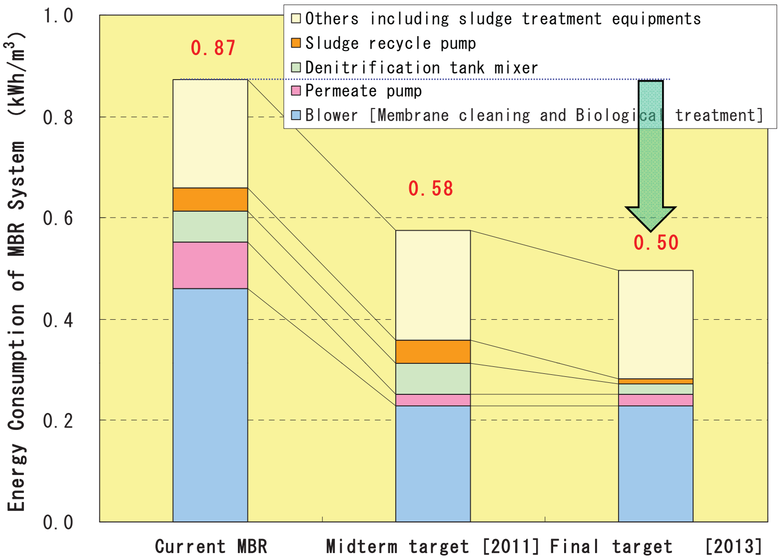
Two-inch diameter module test equipment

Project on Water-saving Recycling Systems
1. Development for advanced technologies

③ Energy-saving Membrane Bioreactor (MBR)

● **Reduce** MBR system **energy consumption by 40%** by developing

Prospect to reduce energy consumption of MBR system



New pilot plant at Fukusaki STP

100-150m3/d × 4lines

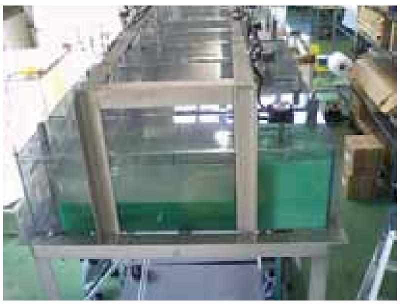
Project on Water-saving Recycling Systems
1. Development for advanced technologies

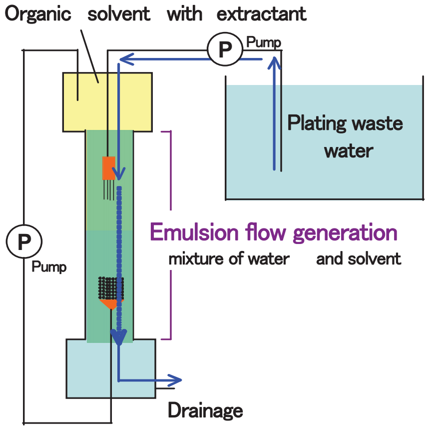
④ Technology to recover valuable metals

(Metal recovery technology by use of new extraction apparatus)
● High phase-separation performance, **3 to 15 times faster** processing speed, **Ni recovery cost reduced by 1/5**

Nickel recovery from plating waste solution

Conventional **mixer-settler** method ➡ Newly-developed emulsion-flow method



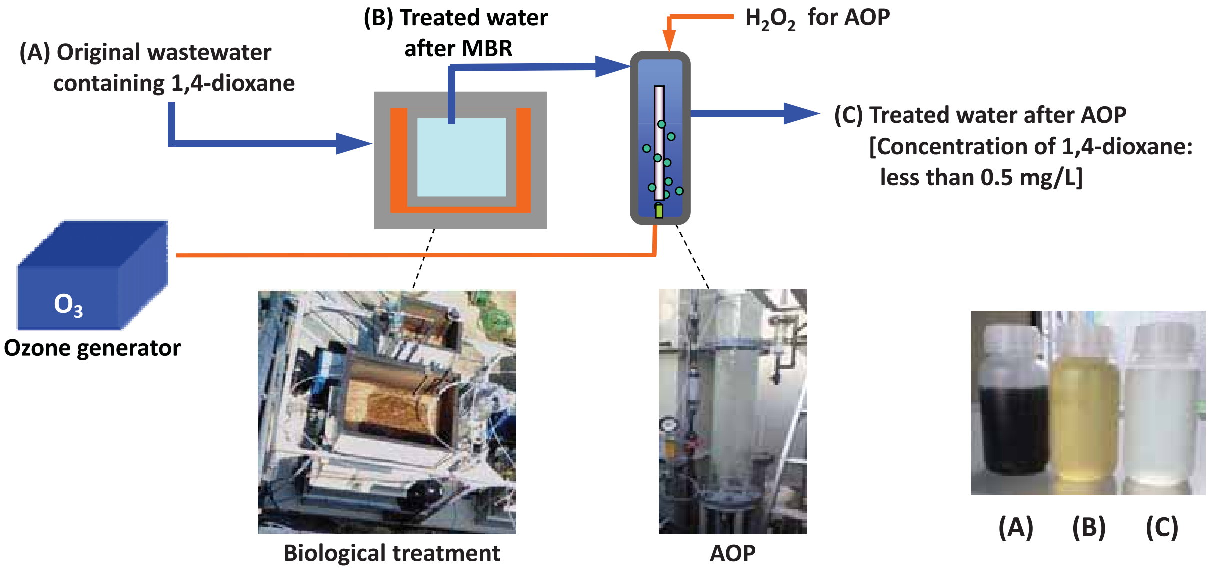


Project on Water-saving Recycling Systems
1. Development for advanced technologies

⑤ High-efficiency technology to decompose persistent substances

● Development of a new treatment system can **reduce energy use by 93%** compared to conventional ozone treatment alone.

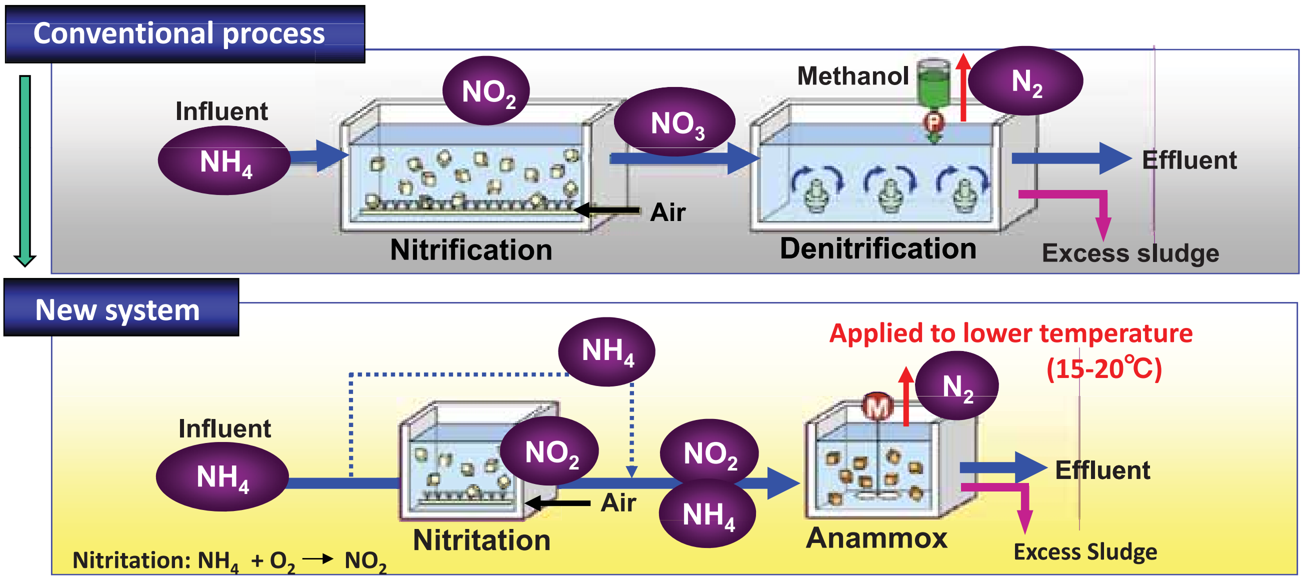
1,4-dioxanne removal system



Project on Water-saving Recycling Systems
1. Development for advanced technologies

⑥ Novel nitrogen removal system for energy-saving

●Energy for aeration **reduced to 50%** with an autotrophic denitrification process using novel anammox bacteria under low temperatures



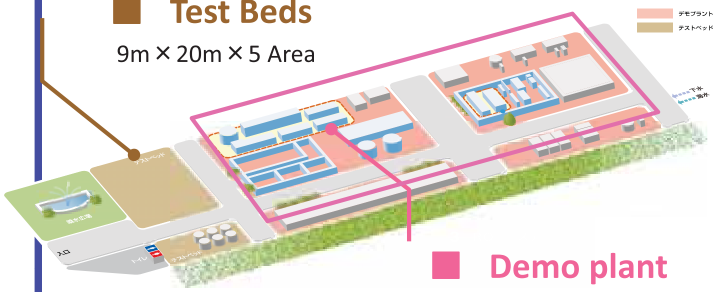
Project on Water-saving Recycling Systems

2. Test-bedding for dissemination of newly developed systems
Water Plaza Kitakyushu and Shunan, Japan

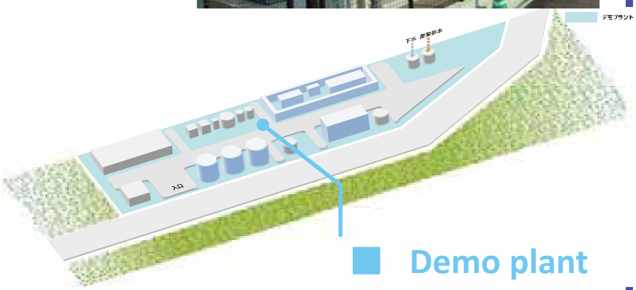
Water Plaza Kitakyushu

Water Plaza Shunan

■ Test Beds
9m × 20m × 5 Area



■ Demo plant



■ Demo plant

Integrated Seawater Desalination and Sewage Reuse System

Sewage | Seawater → For industrial use
Kyushu Electric Power Co., Inc.

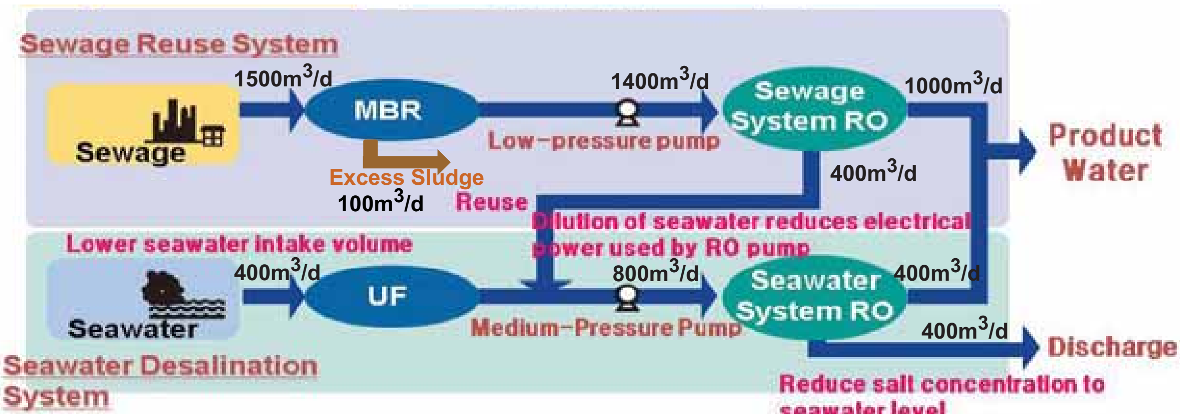
Integrated Sewage and Industrial Wastewater Reuse System

Sewage | Industrial Wastewater → For industrial use
Zeon Corporation

Project on Water-saving Recycling Systems

2. Test-bedding for dissemination of newly developed systems
Water Plaza Kitakyushu and Shunan, Japan

Water Plaza Kitakyushu



Energy Saving
- ○Dilution of seawater reduces electrical power used by RO pump

Low Cost
- ○Reduce UF equipment scale
- ○Decrease specification of seawater pump

Low Environmental Impact
- ○Reuse of sewage RO concentrate that was usually discarded
- ○Lower seawater intake volume
- ○Reduce salt concentration to seawater Level

Project on Water-saving Recycling Systems

2. Test-bedding for Dissemination of Newly Developed Systems

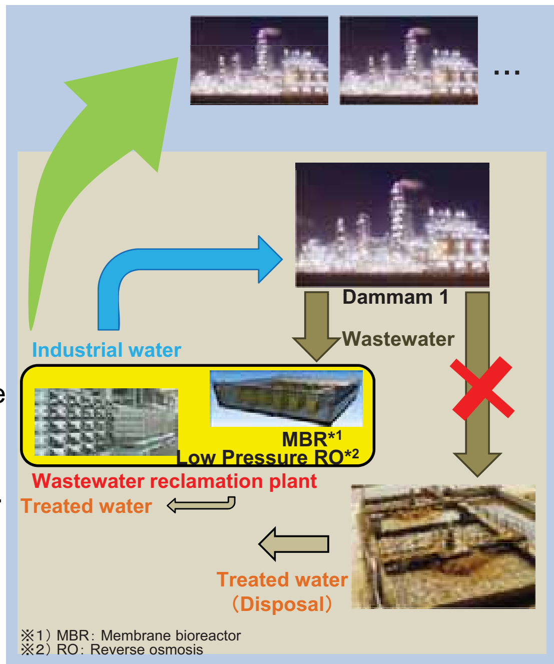
	Area	Project name	Outline
A	Japan	Integrated membrane system project utilizing seawater desalination and wastewater reclamation technologies	・Disseminate the Japanese technologies involved to the world through the incorporation and development of top-level technologies by means of public-private partnerships ・Energy-saving, low cost, low environmental impact
B	China	Lake water purification project in China involving ozone treatment technology	・Water quality improvement and water recycling with an energy conservation rate of 30% is to be established, making use of highly effective ozone
C	UAE	Water reuse business for developing regions in the Middle East	・Recycling sewage water through MBR-RO for use as production water ・Demonstrating the small-scale distributed water recycling and reuse systems business
D	Australia	Decentralized water resource supply system in Australia	・"Decentralized Water Resource Supply System", treating roof-rainwater for use as potable water and using storm water for non-potable water ・Complement the existing "Centralized Water Supply System" ・Contribute to the creation of a new water
E	Singapore (Tampiness)	Pilot test for fluoride wastewater treatment – using membrane technology	・The quantity of chemicals injected and the volume of waste sludge are reduced by the Ca-reuse system ・Equipment space is reduced and the treated water is reused by means of membrane separation technology
F	Singapore (Jurong)	Demonstrating research carried out on water treatment technology for high-COD concentration industrial effluent using a high-efficiency biological and separation membrane process	・Establish a high-efficiency biological and MBR + RO system to reclaim high quality water from industrial ・Achieve energy savings of 30% or more, compared with conventional technology
G	Viet num	Drinking water supply obtained from highly turbid surface water in Southeast Asia	・Build a small-scale distributed water supply system using a ceramic membrane filtration system ・Low energy requirement, simple maintenance by centralized monitoring, low unit cost
H	Oman	Demonstration of technology for reuse of oily effluent using MBR	・Demonstrate the reuse of oily effluent in order to develop O&M and a water sales business in cooperation with a local service company

NEDO-MODON Collaborative Demonstration Project

Energy Saving Wastewater Reclamation System with Membrane Technology

◆Outline of Technology

- Wastewater reclamation system with integrated membrane bioreactor (MBR) and reverse osmosis (RO) technologies.
- High quality industrial water (drinking water level) is produced from industrial and household wastewater.
- Energy saving with wastewater reuse by approximately 25% compared to using only a seawater desalination plant.
- Significant space saving facility compared to conventional wastewater treatment plant.



◆Project Objectives

- To disseminate the system to other industrial estates inside and outside of the KSA through a demonstration project.
- To contribute to resolution of an energy and water demand increase in the KSA by broad dissemination of the system.

JAPAN — Cooperation — KSA

NEDO — Entrustment — CHIYODA CORPORATION