Water Reuse in Japan

March, 2018

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Precipitation and Water Resource in the World

- Average annual precipitation is nearly 1,700mm
  - about double the world average of 800mm
- A large population in a small area
  → precipitation per capita is about 1/3 the world average

![Bar chart showing annual precipitation and water resources per capita for various countries.](chart.png)
Droughts frequencies in Japan

- Low precipitation in recent years
- Fukuoka City: Large-scale drought in 1978
- SHIKOKU REGION: Chronic water shortage

Number of drought years in the past 30 years:
- 0 years
- 1 year
- 2 - 3 years
- 4 - 7 years
- 8 -

Water Reuse History in Japan

- **Severe drought** in west Japan 1978
- Large reuse start 1980
- 1st GL Toilet flushing, Spraying, Landscape use 1981
- 2nd GL + Recreational use 1990
- Cryptosporidium outbreak 1996
- Drinking Water Std. -> **E. Coli** 2003
- 3rd GL E. Coli, Turbidity <2 2005

Reuse amount **215 M m³ / y** 2014
Reclaimed Wastewater Use in Japan

- Recycle ratio **1.5%** (FY2014)
- Total reclaimed wastewater **14.7 billion m³/year**

**Reuse amount**: 215 million m³/year

- Snow melting: 20%
- Irrigation: 6%
- Industrial water system: 1%
- Directly supply industrial use: 10%
- Toilet flushing: 3%
- Landscapes: 30%
- Recreational use (sersenagi): 28%
- River flow augmentation: 20%
- Cleaning: 10%
- Industrial water system: 1%

**Recreational use**: 30%

**Irrigation**: 28%

**Industrial water system**: 10%

**Toilet flushing**: 3%

**Landscapes**: 30%

**Snow melting**: 20%

**River flow augmentation**: 20%

**Cleaning**: 10%
Reclaimed Wastewater Use in Tokyo

River flow augmentation

before

after

MEGURO River, etc. 68,000m³/day

Toilet flushing

Biological filtration + Ozone + MF

West-Shinjuku, Nakano Sakaue areas, etc. 9,300m³/day

Cleaning

YURIKAMOME train,
1,800m³/year

Recreational Use

FY2010 Total
78,000 m³/day

Ochiai Water Reclamation Center
SESERAGI NO SATO, 16,000m³/year
Based on drought experiences, Japan has established wide ranges of wastewater reclamation applications.

Drought in 1978

Water Truck in Operation

Dried up Minamihata Dam

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

Fukuoka City

Fukuoka City

Canal City Fukuoka (Commercial Facility)

Service Area

WWTP
In Yokohama City, advanced treated water is used for toilet flushing in a football stadium and event sites.

**Use of reclaimed wastewater for toilet flushing**

- No Coliforms
- ph 5.8~8.6
- No odors
- Turbidity lower than a certain value

* Quality test is done regularly for confirmation of safety.
Reclaimed Wastewater Use in Aqua/Agriculture (Saga City)

Reclaimed Wastewater Use and BISTRO Sewerage

Saga City operates and controls water quality of reclaimed wastewater by seasons to balance the benefit for water environment and the demand of seaweed cultivation in the Ariake sea.

By using reclaimed wastewater which contains rich nutrients, agricultural products such as paddy rice, spinach, mandarin oranges and strawberries are well raised in Saga. Fertilizers made from biosolids are also used to enhance local resources circulation, between foods and sewage systems, as “BISTRO Sewerage”.

<table>
<thead>
<tr>
<th>Seaweed farming activities</th>
<th>Period</th>
<th>Operation of WWTP</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming period</td>
<td>Oct – Mar</td>
<td>Nitrification restrained operation</td>
<td>Supply of nutrients (nitrogen)</td>
</tr>
<tr>
<td>Non-operation period</td>
<td>April - Sep</td>
<td>Nitrification enhanced operation</td>
<td>Removable of nitrogen and phosphorus</td>
</tr>
</tbody>
</table>

- **Paddy rice cultivated by reclaimed water**
- **Strawberry**
- **Soft-shelled turtle raised in treated water**
Demonstration Research Project of Innovative Water Reuse Technology in Itoman City, Okinawa Pref. (B-DASH Project) - (FY2015-2016)

**Title:** Advanced Wastewater Reclamation System Using Ultrafiltration Membrane and Ultraviolet Disinfection.

**Aim of the Project:**
Develop and demonstrate a safe and reliable wastewater reclamation system
Enhance local economy such as agriculture in water scarce area

**Demonstration Field:**
Itoman WTP

**Safety**
- E. Coli: ND
- Virus LRV: >5
- Turbidity: <0.2NTU

**Cost & GHG Reduction vs Conventional System**
- LCC: ~13%
- GHG: ~24%
- OPEX: ~27%

**Reclaimed Water Production**
- 1,000 m³/day

**Flow from Spring Water**
3,000 - 10,000 m³/day

**Use**
- Agriculture Use 5,000 m³/day
- Industrial Use 2,000 m³/day
- Use for Golf Course 2,000 m³/day
- Use for artificial stream 300 m³/day
- Use for Golf Course 300 m³/day

**Treatment System**
- Simple operation by full automation
- Free from by-product or persistence
- Inactivation of Viruses

- **Storage tank**
- **Ultra Violet**

Joint research body of Nishihara Environment CO., LTD, Tokyo Engineering Consultants CO., LTD, Kyoto Univ. and Itoman City supported by National Institute for Land and Infrastructure Management (NILIM) in B-DASH Project (Breakthrough by Dynamic Approach in Sewage High technology)
ISO/TC282 Water reuse

TC282: Established in 2013, 1st meeting in Tokyo in Jan. 2014
Secretariat (twinned): Japan and China, Chair: Israel

WG1 Health risk
- ISO/FDIS 20426
  Guidelines for health risk assessment and management for non-potable water reuse

WG2 Performance evaluation
- ISO/DIS 20468-1, CD 20468-2, NP 20468-3, -4, -5, -6
  Guidelines for performance evaluation of treatment technologies for water reuse systems –
  Part 1 - General
  Part 2 - Methods to evaluate environmental performance of treatment systems on the basis of greenhouse gas emissions
  Part 3 - Ozone treatment technology
  Part 4 - UV disinfection
  Part 5 - Membrane filtration
  Part 6 - Ion exchange technology

SC3 Risk and performance evaluation of water reuse systems
(Secretariat and Chair: Japan)

SC1 Treated wastewater reuse for irrigation

SC2 Water reuse in urban areas

SC4 Industrial water reuse

Secretariat (twinned): Japan and China, Chair: Israel

8th SC3 meeting in Seoul in May 2018
“Cool city” by reclaimed water