Current water reuse practices and challenges in Japan

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Contents

• Background
• Applications and select cases
• Institutions for promotion
• Future directions
Background
Water resources

<table>
<thead>
<tr>
<th>Precipitation (mm/year)</th>
<th>Per capita precipitation volume (mm/person/year)</th>
<th>Per capita natural renewable water resources (mm/person/year)</th>
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<tbody>
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<td>Egypt</td>
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<td>Saudi Arabia</td>
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Per capita precipitation volume

Per capita natural renewable water resources
Precipitation (mm/year) and Per capita natural renewable water resources (mm/person/year)
Sewage works, as basis for water reuse

- Sewage work coverage: 73% (91 million capita), others by small centralized or decentralized systems
- Wastewater of 14 billion m$^3$/year treated in 2,129 WWTPs
- Mainly secondary, 311 WWTPs adopt advanced treatment
- Maximize potential of water/sludge
Applications and select cases
Applications

- Treated wastewater: 13.9 billion m³ per year
- Industrial use: 9.4%
- Agricultural use: 6.9%
- Toilet flushing: 3.5%
- Landscape irrigation: 29.1%
- Others: 0.4%
- Snow melting/flowing: 19.0%
- Recreational use: 3.0%
- Water reuse: 203 million m³ per year

(In fiscal 2007)
Social significance

Earthquake disaster mitigation
Toilet flushing use in case drinking water system is down

Global warming mitigation
Utilization of thermal energy of reclaimed water

Ambient water quality improvement
Reduction of withdrawal for drinking water and pollution loads discharge from WWTP

Global warming adaptation
Heat island mitigation by sprinkling road surface with reclaimed water

Global warming mitigation
Drought risk mitigation using reclaimed water with stable quality and quantity

Global warming adaptation
Reduction of GHG emission through efficient water use

Urban amenity
Improvement of landscape and enhancement of QOL

Industry

Sewerage

Water-Reuse

Drinking water system
Case 1: Fukuoka City

- Large scale dual system for toilet flushing

**Central WWTP**
Capacity: 7,200 m³/year
Service area: 1,013 ha
Advanced treatment: Chemical precipitation, Ozonation, Sand filtration, Chlorination, Fibre filtration

**Eastern WWTP**
Capacity: 1,600 m³/year
Service area: 291 ha
Advanced treatment: Chemical precipitation, Ozonation, Biological filtration, Chlorination

(Fukuoka City’s website)
Case 2: Tokyo

- Large scale dual system for toilet flushing

3 WWTPs provide reclaimed water to 7 areas.

9,000 m³/day (FY 2009) → 13,000 m³/day (FY 2013)
● River flow augmentation

Stream revitalization by reclaimed water of Ochiai WWTP
19,900 m³/day + 30,200 m³/day + 36,300 m³/day (at maximum)

● Train cleaning

● Road sprinkling
Case 3: Tadotsu Town

Regional WWTP

10,000 m$^3$/day of Reclaimed water

Pump up (3km)

Advanced Treatment Centre

Agricultural use 2,000 m$^3$/day

River flow augmentation 5,500 m$^3$/day

Recreational use 2,445 m$^3$/day

Recreational use 55 m$^3$/day

- In-line coagulation-filtration
- Activated carbon
- Chlorination

- In-line coagulation-filtration
- Ozonation
- Activated carbon
Case 4: Sapporo City

Use wastewater regulating tanks for snow melting in snow season
2 tanks with snow melting capacity of 10,000 m$^3$/day, 6,000 m$^3$/day

Use storage sewers (CSO abatement) for snow melting in snow season
2 sewers with snow melting capacity of 2,200 m$^3$/day, 4,000 m$^3$/day

Advanced treatment: Sand filtration

Snow flowing gutters along trunk roads
In 6 areas with gutters, 300,000 m$^3$ of snow is disposed per snow season.
Institutions for promotion
[1] National vision

Concept of “circulation”

Policy of water

“Animating” water
- Revive natural river flow
- Conserve water quality
- Improve water independence of urban areas

“Gentle” water
- Create water environment gentle to people
- Create rich water/green space in urban areas
- Create water-based communities

“Protective” water
- Improve sanitation
- Implement new flood controls
- Use rainwater, reclaimed water, springs, etc. for disaster preparedness
- Conserve/revive local ecosystems

Policy of resources

Policy of facility renovation

Water reuse contributes to …
## Water quality criteria

<table>
<thead>
<tr>
<th></th>
<th>Toilet flushing</th>
<th>Sprinkling in lawn/street, etc.</th>
<th>Landscape irrigation</th>
<th>Recreation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>E.Coli</strong></td>
<td>N.D./100ml</td>
<td>1,000CFU/100ml (provisional)</td>
<td>N.D./100ml</td>
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<tr>
<td><strong>Turbidity</strong></td>
<td>2 or less (maintenance target value)</td>
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<td>2 or less</td>
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<tr>
<td><strong>pH</strong></td>
<td></td>
<td>5.8-8.6</td>
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<tr>
<td><strong>Appearance</strong></td>
<td></td>
<td>Not unpleasant</td>
<td></td>
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<tr>
<td><strong>Colour</strong></td>
<td>(Set according to users preference)</td>
<td>40 or less (set stricter according to users preference)</td>
<td>10 or less (set according to users preference)</td>
<td></td>
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<tr>
<td><strong>Odour</strong></td>
<td>Not unpleasant (odour intensity set according to users preference)</td>
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<tr>
<td><strong>Residual chlorine</strong></td>
<td>0.1mg/l in free or 0.4mg/l in combined (maintenance target value)</td>
<td>N.A.</td>
<td>0.1mg/l in free or 0.4mg/l in combined (maintenance target value)</td>
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</table>
Important notes

Hygienic safety
- Requirements of water reclamation facilities
- Maintenance of residual chlorine in supply process
- Prevention of cross connection
- Prevention of accidental ingestion
- Emergency preparedness/response

Appearance/comfortableness
- Control of rusty water and colour/turbidity
- Control of water appearance in landscape irrigation/recreation facilities
- Control of midges in toilet flushing

Control of facility malfunction
- Control of corrosion/blockage in water reuse system
[3] Local ordinances on buildings/developments

- Big buildings/developments to use reclaimed water or rainwater for toilet flushing, etc.

**Tokyo Prefecture**
Target: buildings with total floor space of 10,000m² or more, and developments with area of 3,000m² or more
Reclaimed water or rainwater for non-potable water use (incl. toilet flushing)

**Fukuoka City**
Target: buildings with total floor space of 5,000m² (3,000m² in reclaimed water provided area) or more
Reclaimed water or rainwater for toilet flushing
[4] Subsidy for facility construction

- Specially subsidize sewerage projects taking new roles:

  - Water environment creation
  - Recycle promotion (sludge/energy)
  - IT/new technologies propagation

  - Water reuse for sound water cycle systems
  - Emergency provision of reclaimed water in drought
  - Snow melting/flowing by reclaimed water
  - Micro hydroelectric power generation by reclaimed water
[5] Satellite MBR demonstration project

- Satellite system (sewer mining) is recommended in “National Vision”, but practices are not common.
- MBR, space saving, is appropriate for satellite system.
- National project for Satellite MBR demonstration launched in fiscal 2009.
- Stability of reclaimed water quality, issues on maintenance, etc. surveyed in Nagoya City.
[6] Experiment on reclaimed water export

- Import iron ore through tankers from Austria. Export reclaimed water through the same tanker, replacing seawater in ballast.

- Chiba/Kawasaki Cities, Japan → Western Australia

- Experiment on water quality degradation from Japan to Australia this autumn

- Export starts in fiscal 2012 earliest. Application: industrial use (iron ore cleaning, etc.)
Future directions
I. Evaluation of water reuse in realizing sound water/material cycle systems and better cities

- Evaluate water reuse in realizing sound water/material cycle systems
- Evaluate water reuse in realizing better cities
- Promote water reuse for pollution loads reduction and global warming mitigation
II. Info sharing and advocacy of water reuse

- Share info with other sectors to foster water reuse
  - Actively disclose info on reclaimed water
  - Share info on water availability with water providers

- Advocate social significance of water reuse
  - E.g., global warming mitigation
III. Establishment of water quality standards and new technology evaluation methodology

- Establish water quality standards
  - For agricultural and industrial uses
  - Conduct study on hygienic safety

- Establish new technology evaluation methodology
  - E.g., membrane treatment technologies
IV. Water reuse promotion through collaboration with private sectors, etc.

- Provide groundwork for private sectors participation
  - E.g., reclaimed water distribution network by public sectors

- Reduce cost through collaboration with other works
  - E.g., laying sewers and reclaimed water distribution pipes together
V. Water reuse as energy

- Positively utilise thermal or potential energy of reclaimed water
  - E.g., reclaimed water distribution pipes or sewage system
Thank you for your attention.