1. History of legal systems and regulations regarding water supply

Following the Meiji Restoration (1868), which marked the beginning of the modernization of Japan, diseases like cholera began to enter Japan from overseas countries via commercial ships and spread throughout the country, resulting in a large number of deaths. The area of most concern in health administration at that time was waterborne diseases including cholera, which from time to time reached epidemic proportions. To address this situation the then Ministry of the Interior sought to ensure the sanitation of drinking water in wells and issued the Public Notice of Drinking Water, an official notice consisting of 10 provisions in total.

Despite the introduction and implementation of such health regulations including those governing drinking water, these initiatives proved to be of little value and cholera epidemics continued to occur from time to time thereafter. Little by little recognition of the need for a modern water supply system became widespread.

In establishing a modern water supply system, the government was required to establish a basic policy for water supply management. Therefore, in 1890 the government promulgated the former Waterworks Law.

The main provisions of this law were four:

- The water supply system shall be established by local authorities.
- Permits to establish water supply systems shall be provided by the Minister of the Interior.
- Materials, etc. required for the water service installation shall be procured at the expense of the water supply users.
- Local authorities shall also establish a common water supply and fire hydrants.

Figure 1-1 shows the 10 cities in Japan which were the first to establish modern water supply systems. Yokohama, the very first among these, established a modern water supply system in 1887. After that, modern water supply systems were successively established in other major cities and trade centers.
The legal framework providing for Japan’s current water supply system was established in 1957, a little over 50 years ago. In that year the Waterworks Law was promulgated and enacted. Legislation providing for the construction of a multipurpose dam was also passed and the Ogochi Dam, one of metropolitan Tokyo’s major water sources, was completed. Last year (2007) marked the 50th anniversary since the establishment of the Waterworks Law.

In these ways, the establishment of a legal system for the supply of water and the penetration of water supply systems made a significant contribution to the improvement of health and hygienic conditions in Japan.

Figure 1-2 is a graph showing both trends in the number of persons with waterborne infections and the penetration rate of drinking water supply systems. Looking at this graph, we can see the correlation between the penetration of drinking water supply systems and a significant decline in the number of persons affected by waterborne diseases.
2. Water Supply and Related Water Quality Issues including Offensive Tastes and Odors

Figure 2-1 shows degradation of the drinking water supply and offensive tastes and bad odors caused by water quality accidents. There were 224 accidents and more than half of these were due to unknown causes.

Figure 2-2 shows the offending substances in water contamination accidents in 2005. There was a total of 204 accidents, and the majority of these were caused by oil.

Figure 2-3 shows changes in the incidence of water affected by offensive tastes and odors in the water supply. The broken line shows the population affected by offensive tastes and odors and the bar graph shows the number of water utilities affected. These graphs show that while the number of affected utilities is leveling, the affected population is declining.

Figure 2-4 shows the breakdown of the occurrence of offensive tastes and odors at water purification facilities by type in fiscal 2006. There were 44 incidents, and musty odors and soil odors accounted for 60% of these.

As the above figures demonstrate, water quality problems along with the incidence of offensive tastes and odors are serious issues which require attention in Japan’s drinking water supply systems.
The graph in Figure 2-5 here shows trends in the introduction of ozonation as a method of advanced treatment in drinking water supply systems. The population affected by offensive odors and tastes peaked in 1990 and has been decreasing in line with the introduction of advanced treatment.

In addition to dealing with water quality accidents and water affected by offensive odors and tastes, taking measures to eradicate pathogenic microbes such as cryptosporidium is also an important task in water purification.

In 1996 in particular, there was a mass infection incident of cryptosporidiosis which infected the majority of the population of a town in the outskirts of Tokyo, and this outbreak shocked all stakeholders of Japan’s water supply services.

This serious outbreak occurred at a time in Japan when the research and development of membrane filtration technology in water supply systems was being promoted by the Japan Water Research Center, and it proved to be a fortuitous opportunity for introducing membrane technology into water supply systems as a measure for eradicating cryptosporidiosis.

Figure 2-6 shows trends in the introduction of membrane filtration in water treatment plants. As you can clearly see, both the number of facilities and facility capacity are rising steadily.
Figure 2-2  Offending Substances in Water Quality Contamination Accidents

- Promotion of measures to prevent outflow from originating points
- Promotion of structural measures for roads
- Educational and familiarization activities
- Establishment of an emergency contact system when accidents occur
- Compensation claims

Offending Substances in Water Quality Contamination Accidents

Total of 204 accidents in fiscal 2005 including cases without suspension of water services

Figure 2-3  Changes in the Incidence of Offensive Tastes and Odors in Water Supply Systems Over Time

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>No. of affected water Utilities</th>
<th>Population affected by offensive tastes and odors (thousand people)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>13,432</td>
<td>6,400</td>
</tr>
<tr>
<td>1986</td>
<td>14,519</td>
<td>6,044</td>
</tr>
<tr>
<td>1988</td>
<td>13,875</td>
<td>5,900</td>
</tr>
<tr>
<td>1990</td>
<td>13,632</td>
<td>5,800</td>
</tr>
<tr>
<td>1992</td>
<td>14,129</td>
<td>6,000</td>
</tr>
<tr>
<td>1994</td>
<td>12,096</td>
<td>6,120</td>
</tr>
<tr>
<td>1996</td>
<td>6,370</td>
<td>5,800</td>
</tr>
<tr>
<td>1998</td>
<td>3,705</td>
<td>5,688</td>
</tr>
<tr>
<td>2000</td>
<td>2,657</td>
<td>5,563</td>
</tr>
<tr>
<td>2002</td>
<td>2,331</td>
<td>5,000</td>
</tr>
<tr>
<td>2004</td>
<td>2,856</td>
<td>5,000</td>
</tr>
<tr>
<td>2006</td>
<td>2,656</td>
<td>5,000</td>
</tr>
</tbody>
</table>
Figure 2-4  Breakdown of the Occurrence of Offensive Tastes and Odors in Water Purification by Type 
(Total of 44 incidents in fiscal 2006)

Figure 2-5  Trends in the Introduction of Advanced Treatment

Trends in Ozonation Facilities

- 6 -

To establish guidelines for business activities in drinking water supply and sewerage services with a view to ensuring excellent water supply services to users at optimal prices and bearing in mind the worldwide water shortage forecast for the future, the ISO/TC224 was established and deliberation on the establishment of an international standard regarding water supply and sewerage services began. In November 2007 at the 7th Plenary Meeting of ISO/TC224 held in Tokyo, establishment of an international standard was approved and the standard was issued the following month on December 1.

Prior to the issue of the international standard, guidelines for the management and assessment of a drinking water supply service including PIs were established as the “JWWA Q 100” in Japan.

The JWWA Q 100 focuses on reliability, stability, sustainability, the environment, and management as the major purposes and performance indicators and it set down 137 PIs.

Under the area of “reliability,” for example, the supply of safe and comfortable water for every user is stated as the aim, and Figures 3-1, 3-2, 3-3, and 3-4 are illustrations of examples of PIs for drinking water quality. Using these diagrams as a reference, water utility can compare its standard with other drinking water utilities and understand the changes taking place over a
number of years. Using this data and information, water utilities can establish future water quality improvement measures and set goals.

**Figure 3-1 PI-1104 Violation ratio of water quality standard**

(As of FY2004)

Violation ratio of water quality standard (%)

\[
\text{Violation ratio of water quality standard} = \left( \frac{\text{Number of water quality failures (times)}}{\text{Total number of tests (times)}} \right) \times 100
\]

Number of utilities: 40

**Figure 3-2 PI-1105 Achievement Ratio of Conformable Water based on Musty Odor**

(As of FY2004)

Achievement ratio of conformable water based on musty odor (%)

\[
\text{Achievement ratio of conformable water based on musty odor} = \left( 1 - \frac{\text{Maximum geosmin concentration}}{\text{Standard geosmin concentration}} \right) + \left( 1 - \frac{\text{Maximum 2-methylisoborneol concentration}}{\text{Standard 2-methylisoborneol concentration}} \right) / 2 \times 100
\]

Number of utilities: 39
Compliance for TTHM (%)

\[ \text{Compliance for TTHM} = \left( \frac{\text{Maximum TTHM concentration (mg/L)}}{\text{Standard TTHM concentration (mg/L)}} \right) \times 100 \]

Number of utilities: 39

Compliance for TOC (%)

\[ \text{Compliance for TOC} = \left( \frac{\text{Maximum TOC concentration (mg/L)}}{\text{Standard TOC concentration (mg/L)}} \right) \times 100 \]

Number of utilities: 29

A Waterworks Vision was first adopted and made public by the Ministry of Health, Labour and Welfare in June 2004.
The Waterworks Vision is based on the concept that all parties involved in supplying water should quantitatively analyze and evaluate the current and future prospects of the services. These parties should discuss the ideal water supply services based on the results of analyses and evaluations, and reach a consensus on the future of the water supply service.

The primary objective of the Waterworks Vision was to give direction to these participants so they could collaborate with each other to achieve common goals and share responsibilities.

This Waterworks Vision set safety, stability, sustainability, environment, and globalization as its five long-term policy objectives. These five objectives are also common to the main purposes and performance indicators of JWWA Q 100.

The first periodic review of the Waterworks Vision adopted in 2004 was to take place in the third year following its adoption.

Accordingly, a review of the Waterworks Vision took place from 2007 to 2008, and in July 2008 the revised Waterworks Vision, indicating priority areas for future measures, was adopted. Included in the revision were provisions for the management of water quality in water supply services.

5. Overview of e-Water II Project Results (FY2005-2007)

To date, the Japan Water Research Center has received research and development subsidies from the Ministry of Health, Labour and Welfare to promote research and development in water supply technology as well as pipeline technology (Figure 5-1).

One JWRC project of particular note was the “Research on Establishment of Advanced Purification Technology Aimed at Safe and Good Quality Water” initiative, also known by its shorter name the “e-Water II Project,” which the JWRC conducted from 2005 to 2007.

Five committees were established to oversee this project: the Water Quality Committee, Functional Evaluation Committee, Purification System Committee and Odor Evaluation
Committee. The Purification System Committee was given the role of coordinator of these committees.

Made up of scholars and specialists from drinking water utilities and companies, the committees collaborated with each other as they proceeded with their research. The results of this research by the JWRC are currently in the process of being collated and prepared for a presentation of the results.

Figure 5-2 shows the processes for achieving purified water quality level as TOC examples.

Figure 5-3 is a summary of the procedures for selecting a water purification system, and supporting data of these procedures are attached to the report.

It is hoped that drinking water utilities will use resources like these as a reference to determine the future prospects for the quality of source water of their respective utilities, and will select appropriate water purification systems on the basis of the water quality targets that they are to achieve.

![Figure 5-1 Research and Development Projects by the JWRC](image-url)
Figure 5-2 Processes for Achieving the Purified Water Quality Level
(Example: TOC)

<table>
<thead>
<tr>
<th>Raw water quality</th>
<th>Purified water quality</th>
<th>level 1 1.5mg/l or less</th>
<th>level 2 1.0mg/l or less</th>
</tr>
</thead>
<tbody>
<tr>
<td>low 2.5mg/l or less</td>
<td>Coagulation(94%) Powdered activated carbon(99%) Granular activated carbon, or ozone+GAC(100%)</td>
<td>Coagulation(77%) Powdered activated carbon(86%) Granular activated carbon, or ozone+GAC(84%)</td>
<td></td>
</tr>
<tr>
<td>medium 2.5mg/l to 3.5mg/l</td>
<td>Granular activated carbon, or ozone+GAC(100%)</td>
<td>Granular activated carbon, or ozone+GAC(71%)</td>
<td></td>
</tr>
<tr>
<td>High 3.5mg/l to 7.5mg/l</td>
<td>Granular activated carbon, or ozone+GAC(89%)</td>
<td>Granular activated carbon, or ozone+GAC(67%)</td>
<td></td>
</tr>
</tbody>
</table>

( ) indicates an achievement rate for the process group

Figure 5-3 Procedures for Selecting a Water Purification System

① Check the raw water quality level
  Turbidity/organic substances (TOC, THMFP, odor substance)

② Check the target purified water quality level
  Turbidity/organic substances (TOC, THMFP, odor substance)/others

③ Multiple presentations of turbidity removal process
  Multiple presentations of organic substance removal processes

④ Check and brush up the purification systems
  Study additional facilities

⑤ Present the best water purification system in light of water quality
  (Multiple systems acceptable)

⑥ Provide additional information about cost, space, LCA and others
6. Conclusion
Japan faces many challenges in providing for an adequate water supply system. Aging waterworks facilities, degradation of raw water quality, a decline in the number of qualified technical staff, the occurrence of natural disasters such as typhoons and earthquakes, and worsening financial conditions are among some of the problems that it must manage.

To respond to these various challenges, all stakeholders in the supply of drinking water must work in cooperation to promote research and development and to renew and upgrade facilities. As a stakeholder in the supply of Japan’s drinking water, the JWRC intends to continue its activities to promote ongoing improvement in this area.