Overview on Drinking Water Quality Management in Japan

Mayuko HATTORI*
Division of Water Supply, Health Service Bureau,
Ministry of Health, Labour and Welfare

1. Introduction

In Japan, the Drinking Water Quality Standards (DWQSs) have been set as Ministry’s order so that water supply systems are always able to supply potable water from taps. In 2003, responding to situational changes surrounding water quality management, as well as taking the third edition of the WHO’s Guidelines for Drinking Water Quality into account, the Ministry of Health, Labour, and Welfare (MHLW) laid down a new set of the DWQSs, which went into effect on April 2004.

Considering some cases that took place in 2006, the government is now preparing for new revision of the DWQSs: there were several water quality incidents at small facilities, which involved some people infected by drinking water, a high level of unregulated substance was detected in Kanto Area (near Tokyo), Japan.

2. Revision of the DWQSs

2.1 Fundamental principles

In addition to the Drinking Water Quality Standards (50 items), which are based on the Water Works Law, the Complementary Items for Water Quality Management (27 items) have been set by the Director General of Health Bureau of the MHLW since 2003, whereas the Items for Further Study (40 items) have been suggested by the Minister’s Health Science Council to put under observation in order to cope with various emerging and future issues on water quality management.

・ Drinking Water Quality Standards

Tap water quality must meet the DWQSs based on the Water Works Law. Thirty

* 1-2-2 Kasumigaseki, Chiyoda, Tokyo 100-8916 Japan,
e-mail:hattori-mayuko@mhlw.go.jp
items are set from the viewpoint of human health, and twenty items are set from other reasons including user needs on water quality and control level at purification plants. The Water Works Law requires the water suppliers to monitor the tap water quality regularly to make sure that the water meets the standards. The DWQSs basically include items that are detected or can possibly be detected in purified water at levels of 10% of the health-based value or higher.

- Complementary Items
  The Complementary Items for Water Quality Management are items that the MHLW requests water suppliers to monitor. Fifteen items (including the total of 101 agricultural chemicals) are set from the viewpoint of human health and twelve items are set from other reasons including user needs on water quality and control level at purification plants.

- Items for Further Study
  The Items for Further Study are items of which health-based value are provisional, or items of which detect level and frequency in purified water are not clear. Further studies are needed to collect more information and knowledge on these items.

2.2 The state of the water quality in Japan

The present DWQSs and Complementary items went into effect on April 2004. Since then, water suppliers have monitored these items and the results show that water suppliers have to pay attention to the items which follow.

- DWQSs
  Lead is sometimes detected in purified water at higher level than the standard value. This is caused by lead water pipes which still have been used in private buildings or houses.
  
  Nitrate and Nitrite are detected in purified water at level of higher than the standard value in a few points. Many private drinking water wells are at risk and would need precaution against contamination.
  
  Bromate is sometimes detected in purified water at higher level than the standard value. The major causes for the formation are impurities included in Sodium hypochlorite. In addition, formation in the ozone treatment system is also to be noted.

- Complementary Items
  Chlorate is detected in purified water at 10% level of the health-based value in many points. And it is detected at higher level than the health-based value in a few places. It has been reported that chlorate may be formed in oxidation of Sodium hypochlorite, being used as disinfectants, more rapidly at warmer temperatures.
2.3 Addition of chlorate to the DWQSs

Considering frequent detections of high level of chlorate, the MHLW took an action to the Health Science Council, held on Aug 4, 2006, to add chlorate to the DWQSs. It was agreed by the Council to forward to the Food Safety Commission, which was established in July 2003 to undertake risk assessment under the Food Safety Basic Law to respond to the growth of national concern about food. The Commission is independent from management organizations such as the MHLW. The Commission conducts risk assessment on food in a scientific, independent, and fair manner. Hence, the MHLW have been requested to inquire the Commission to conduct risk assessment when the MHLW wishes to make any changes on the DWQSs. According to this rule, the MHLW submitted the draft for deliberation to the Commission on Aug 31, 2006 in order to conduct risk assessment to add chlorate to the DWQSs. After receiving the Commission’s report, the draft will be disclosed by the MHLW for public comments for one month. After checking public comments, the MHLW will finalize the standard. The proposed standard value is 0.6mg/L, which is decided from the viewpoint of human health, as it causes damage to the oxidation of blood cells.

3. Recent water quality incidents

3.1 The state of the occurrence of water quality incidents

Water suppliers in Japan always make efforts to supply potable water under the proper water quality management. However, a few water quality incidents take place every year. In 2006, more than ten incidents which lead to cutting off the water supply happened. When the MHLW receives the report of the incidents, it takes measures to prevent recurrence of the accident. For example, when an incident happened as a result of inappropriate coagulation management, The MHLW would issue a letter to all water suppliers in Japan in order to remind of the importance of appropriate use of coagulation chemicals. When it happened because of contamination of water source, the letter would focus on observation of water source.

3.2 Infectious diseases caused by drinking water

A few infectious diseases caused by drinking water happened in 2006. In Fukushima Pref., a small-scale water supply service supplied water without chlorination and 71 persons who drunk the water showed the symptoms of diarrhea, stomachache, or fever. The facility was not inspected appropriately. As a result, the deposition of sodium hypochlorite clogged the chlorine injecting nozzle. To make matters worse,
measures taken against the accidents was delayed because they disregarded the accident when they recognized that chlorine was not detected in the water. The inspection of untreated water of the facility and feces of the patients proved that the bacteria which caused the symptoms were *Campylobacter*.

The table shows the infectious diseases caused by drinking water in Japan. Many of them occurred because of the inappropriate management or defects of disinfection, therefore, taking proper management is essential in small-scale water services. Now the information of virus is so limited that further studies are necessary to gain more information and knowledge.

### Table: Infectious diseases caused by drinking water in Japan

<table>
<thead>
<tr>
<th>WHEN</th>
<th>WHERE</th>
<th>ORIGIN</th>
<th>PATHOGEN</th>
<th>FACILITIES</th>
<th>EATER</th>
<th>PATIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>July</td>
<td>Nagano spring</td>
<td><em>enterohaemorrhagic E. coli</em> O157</td>
<td>home</td>
<td>unknown</td>
<td>30</td>
</tr>
<tr>
<td>2000</td>
<td>Feb.</td>
<td>Kyoto well</td>
<td><em>enteropathogenic E. coli</em> O126</td>
<td>restaurant</td>
<td>unknown</td>
<td>50</td>
</tr>
<tr>
<td>2001</td>
<td>June</td>
<td>Nagano spring</td>
<td><em>enterotoxigenic E.coli</em> O169</td>
<td>accomodations</td>
<td>310</td>
<td>181</td>
</tr>
<tr>
<td>2002</td>
<td>Oct.</td>
<td>Akita spring, swamp</td>
<td><em>Campylobacter jejuni</em></td>
<td>home</td>
<td>unknown</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Mar.</td>
<td>Niigata well</td>
<td>Noroviruses, <em>Clostridium perfringens</em>, <em>Staphylococcus aureus</em>, <em>Campylobacter</em>, <em>E. coli</em></td>
<td>restaurant</td>
<td>227</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>Ishikawa well</td>
<td><em>Norovirus</em></td>
<td>restaurant</td>
<td>522</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>Chiba small water supply system (water cooler)</td>
<td><em>Rotavirus group A</em></td>
<td>school</td>
<td>86</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>Oita well</td>
<td><em>enterohaemorrhagic E. coli</em> (verotoxin producing)</td>
<td>home</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Sep.</td>
<td>Ehime private water supply system (water cooler)</td>
<td><em>Campylobacter jejuni, Campylobacter coli</em></td>
<td>school</td>
<td>525</td>
<td>69</td>
</tr>
<tr>
<td>2004</td>
<td>Mar.</td>
<td>Hiroshima well</td>
<td><em>Genus Escherichia</em></td>
<td>home</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Aug.</td>
<td>Ishikawa small water supply system</td>
<td><em>Campylobacter jejuni, Campylobacter coli</em></td>
<td>accomodations</td>
<td>78</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>Mar.</td>
<td>Akita small water supply system</td>
<td><em>Norovirus</em></td>
<td>home</td>
<td>unknown</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>Yamanashi small water supply system</td>
<td><em>Campylobacter jejuni, Campylobacter coli</em></td>
<td>home</td>
<td>unknown</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>Oita small water supply system</td>
<td><em>Plesiomonas shigelloides</em></td>
<td>accomodations</td>
<td>280</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>July</td>
<td>Oita well</td>
<td><em>enterotoxigenic E.coli</em> O168</td>
<td>campsite</td>
<td>348</td>
<td>273</td>
</tr>
<tr>
<td></td>
<td>Aug.</td>
<td>Nagano spring</td>
<td><em>enteroaggregative E.coli</em> O55</td>
<td>accomodations</td>
<td>81</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Aug.</td>
<td>Kochi well</td>
<td>unknown</td>
<td>home</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>2006</td>
<td>Aug.</td>
<td>Fukushima spring</td>
<td><em>Campylobacter jejuni</em></td>
<td>home</td>
<td>unknown</td>
<td>71</td>
</tr>
<tr>
<td></td>
<td>Sep.</td>
<td>Miyagi well</td>
<td><em>Clostridium botulinum</em> type A</td>
<td>home</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>
4. Measures to unregulated substances

Although the Water Works Law does not require regular monitoring on unregulated substances, unless listed in the DWQSs, observation of water source should be done wider perspective. With this in mind, the MHLW has been investigating unregulated substances in collaboration with research institutes and water laboratories of large water suppliers. It is also necessary to take measures immediately when unregulated substances are detected in tap water, as they might be caused by disorder of treatment facilities or some other important reasons. In other case, agricultural chemicals should also be monitored even if they were prohibited from marketing: it was the case in groundwater in 2006, and the water supplier had to stop taking water from the groundwater and strengthened the watching for water source.

In 2006, perchlorate, one of the unregulated substances, was detected by researchers' investigation in Tone River, which flew down through Kanto Plains. Although no body paid any attention to perchlorate by that time, the MHLW took measures and requested researchers to keep investigation on perchlorate and advocated investigating its level in wide-ranging area.

5. Conclusion

Water suppliers in Japan always supply potable water, which we can drink directly from taps without any cares or any special treatment. But recent researches reported that the number of people who drink tap water directly is decreasing. This may have been caused by a discontent on the tastes of tap water or popularity of bottled mineral water due to its convenience. Under this situation, in order to improve the popularity of tap water and improve the reliability of consumers on safety and reliability of drinking water, the MHLW will continue further efforts in cooperation with all water suppliers to take measures for appropriate water quality management, such as preventive measure against water quality incidents, encouragement to introduce advanced water-treatment facilities, and valuable information exchange on water quality management.
Overview on Drinking Water Quality Management in Japan

Mayuko HATTORI
Water Supply Division
Health Service Bureau
Ministry of Health, Labour and Welfare

1. Introduction

2. Revision of the DWQSs
   (Drinking Water Quality Standards)

3. Recent water quality incidents

4. Measures to unregulated substances
1. Introduction

State of Water Quality in Japan

- Source water quality has been improved
- The overall situation is good

① Current state depends on continuous efforts
② Further safety expected
③ Rising Concern about tasty water
2. Revision of the DWQSs

Drinking Water Quality Standards

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2002</td>
<td>MHLW inquired the Health Science Council about revision of the DWQSs</td>
</tr>
<tr>
<td>April 2003</td>
<td>The Council submitted a report</td>
</tr>
<tr>
<td>May 2003</td>
<td>MHLW laid down a new set of the DWQSs</td>
</tr>
<tr>
<td>April 2004</td>
<td>New DWQSs went into effect</td>
</tr>
</tbody>
</table>
2. Revision of the DWQSs

2.1 Fundamental principles

Drinking Water Quality Standards
(Based on The Water Works Law)
- The Water Works Law requires the water suppliers to monitor
- Detected in purified water at 10% of the health based value or higher

Complementary Items for Water Quality Management
(Set by the Director General of Health Bureau of MHLW)
- MHLW requests to monitor
- Risk assessments are provisional or detected at few points
2. Revision of the DWQSs

2.1 Fundamental principles

- Risk assessments are provisional
- Detected level and frequency in purified water is unclear
- Further study to collect more information and knowledge is needed

2.2 The state of the water quality in Japan

Results of water-quality monitoring

<table>
<thead>
<tr>
<th>Drinking Water Quality Standards</th>
<th></th>
</tr>
</thead>
</table>
| Lead                             | ・Higher than standard ---- 6 / 2,886 (points)  
|                                  | ・Causes: lead water pipes |
| Nitrate and Nitrite              | ・Higher than standard ---- 1 / 4,158 (points)  
|                                  | ・Private drinking water wells need precaution |
| Bromate                          | ・Higher than standard ---- 18 / 5,695 (points)  
|                                  | ・Causes: impurities in Sodium hypochlorite  
|                                  | also formed in Ozone treatment system |

Complementary Items

| Chlorate                         | ・Higher than health-based value ---- 6 / 248(points)  
|                                  | ・Causes: oxidation of Sodium hypochlorite |
2. Revision of the DWQSs

2.2 The state of the water quality in Japan

Causes of excess Chlorate

- Oxidation of Sodium hypochlorite, being used as disinfectants
- More rapidly at warmer temperatures
- Temperatures and purchase frequency are to be noted

Complementary Items

<table>
<thead>
<tr>
<th>Chlorate</th>
<th>Higher than health-based value ---- 6 / 248(points)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Causes: oxidation of Sodium hypochlorite</td>
</tr>
</tbody>
</table>

2.2 The state of the water quality in Japan

Causes of excess Chlorate

![Graph showing the concentration of chlorine injection in mg/L over time for different temperatures: 20°C, 25°C, and 30°C.](image)
## 2. Revision of the DWQSs

### 2.3 Addition of chlorate to the DWQSs

#### [Background]

Result of water quality monitoring in FY2004 shows

- Chlorate is detected in purified water at 10% level of the health-based value in many points
- Chlorate is detected at higher level than the health-based value in a few places

#### [Action]

Aug 4, 2006  MHLW took action to the Health Science Council to add chlorate to DWQSs

It was agreed by the Council to forward to the Food Safety Commission

Aug 31, 2006  MHLW submitted the draft for deliberation to the Commission
2. Revision of the DWQSs
2.3 Addition of chlorate to the DWQSs

After receiving the Commission’s reports, the draft will be disclosed by the MHLW for public comments.

MHLW will finalize the standard.

Chlorate causes damage to the oxidation of blood cells.

Proposed standard value is 0.6mg/L.
3. Recent water quality incidents

3.1 The state of the occurrence

In 2006, more than ten incidents leading to cutting off the water supply.
3. Recent water quality incidents

3.2 Infectious diseases caused by drinking water

A few infectious diseases happened in 2006

One Case at small-scale water supply service
- Aug 17-25, 2006
- Supplied water without chlorination
- 71 persons showed the symptoms of diarrhea, stomachache, or fever
- This facility was not inspected appropriately
- The bacteria is *Campylobacter*

MHLW issued a letter to all water suppliers to remind of the importance of appropriate management on chlorination

### Infectious diseases in Japan (2004-2006)

<table>
<thead>
<tr>
<th>WHEN</th>
<th>WHERE</th>
<th>ORIGIN</th>
<th>PATHOGEN</th>
<th>FACILITIES</th>
<th>EATER</th>
<th>PATIENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>Mar.</td>
<td>Hiroshima</td>
<td>well</td>
<td>Genus Escherichia</td>
<td>home</td>
<td>17</td>
</tr>
<tr>
<td>Aug.</td>
<td>Ishikawa</td>
<td>small water supply system</td>
<td><em>Campylobacter jejuni, Campylobacter coli</em></td>
<td>accommodations</td>
<td>78</td>
<td>52</td>
</tr>
<tr>
<td>Mar.</td>
<td>Aki</td>
<td>small water supply system</td>
<td><em>Nasovirus</em></td>
<td>home</td>
<td>unknown</td>
<td>29</td>
</tr>
<tr>
<td>June</td>
<td>Yamanashi</td>
<td>small water supply system</td>
<td><em>Campylobacter jejuni, Campylobacter coli</em></td>
<td>home</td>
<td>unknown</td>
<td>76</td>
</tr>
<tr>
<td>July</td>
<td>Oita</td>
<td>small water supply system</td>
<td><em>Plesiomonas shigelloides</em></td>
<td>accommodations</td>
<td>280</td>
<td>190</td>
</tr>
<tr>
<td>July</td>
<td>Oita</td>
<td>well</td>
<td>enterotoxigenic E.coli O168</td>
<td>campsite</td>
<td>348</td>
<td>273</td>
</tr>
<tr>
<td>Aug.</td>
<td>Nagano</td>
<td>spring</td>
<td>enterotoxigenic E.coli O55</td>
<td>accommodations</td>
<td>81</td>
<td>43</td>
</tr>
<tr>
<td>Aug.</td>
<td>Kochi</td>
<td>well</td>
<td>unknown</td>
<td>home</td>
<td>28</td>
<td>16</td>
</tr>
<tr>
<td>Aug.</td>
<td>Fukushima</td>
<td>spring</td>
<td><em>Campylobacter jejuni</em></td>
<td>home</td>
<td>unknown</td>
<td>71</td>
</tr>
<tr>
<td>Sep.</td>
<td>Miyagi</td>
<td>well?</td>
<td>Clostridium botulinum</td>
<td>home</td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
3. Recent water quality incidents
3.2 Infectious diseases caused by drinking water

Measures to incidents

- Many of incidents happened by inappropriate or poor management
- Appropriate management in small-scale water service

- Information of Virus in drinking water is limited
- Further study and knowledge

4. Measures to unregulated substances
4. Measures to unregulated substances

- Investigate into unregulated substances
- Research unknown substances
- Gather information on toxicity and knowledge

Detection of Perchlorate

Relationship between the water intake for drinking water supply and perchlorate in the tap waters.

(Department of Water Supply Engineering, National Institute of Public Health)
Conclusion

Image of Tap Water in City

Reason for discontent

① Bad taste (61.8%)
② Concern about safety (42.7%)
③ Smell of chlorine (28.7%)
④ Tepid (26.1%)

Questionnaire Survey
(2006, Tokyo, 453 persons)
In order to improve the popularity of tap water and improve the reliability of consumers on safety and reliability of drinking water,

the MHLW will continue further efforts in cooperation with all water suppliers to take measures for appropriate water quality management.

Thank you