

Water Quality Management in Kobe

For supply safe and high quality drinking water



Kobe City Waterworks Bureau

Introduction

Kobe City owns three reservoirs and two small rivers as water sources. One of them, Nunobiki Reservoir supplies water for more than one hundred years. They account for one-fourth of the Kobe's water supply. And the rest are taken from Lake Biwa-Yodo River system treated by Hanshin Water Supply Authority. Some amount of water is also supplied from Hyogo Prefectural Water Supply Authority.

Recently, the request for safety of the drinking water is more and more increasing among the citizens. However, Kobe City suffers from some troubles, such as offensive odor and filter clogging caused by algae which grow in the reservoirs. And there are risks of contamination of trace amount of chemical compounds in drinking water.

To overcome these problems, and respond to the citizens' high expectations, vigorous examinations are conducted in the Water Quality Examination Laboratory. We control the water quality through the whole monitoring from the source to the tap, and make efforts to provide better quality of water for citizens.

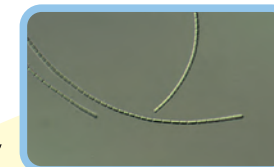
For Keeping Water Sources Clean

To ensure a high quality of drinking water, it is necessary to conserve water source quality. To that end, Kobe City has worked with the national government and other organizations to conserve the water quality of Lake Biwa and the Yodo River, the largest water sources; develop wastewater treatment systems in river basins; and tighten regulations on plant effluent. To conserve the water quality of city-owned water sources, Kobe City established the Hatsuka and Hazu River Basin Water Quality Conservation association, in collaboration with Sanda City and Takarazuka City located upstream of the Sengari Reservoir, and is extensively promoting environmental clean-up campaigns. To improve water quality, the City has also purchased tracts of land surrounding reservoirs for water quality conservation, and has installed equipment for bottom water circulation in reservoirs.



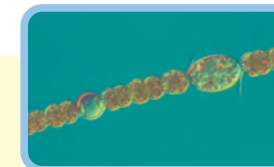
▼Phormidium tenue (Blue green algae)

This is an algae that causes the occurrence of musty odor in water. It grows from spring to early summer, producing the substance 2-methylisobaneol, or 2-MIB, which is a source of musty odor.



▼Anabaena macrospora (Blue green algae)

This is an algae that causes the occurrence of musty odor in water. It grows in summer, producing the substance geosmin, which is a source of musty odor.



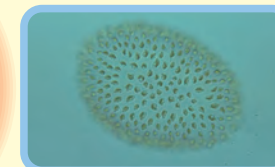
▼Microcystis (Blue green algae)

This algae is the main cause of water bloom in summer and autumn.



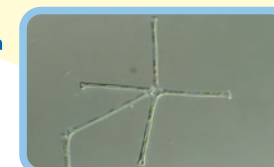
▼Uroglena americana (Golden algae)

This is an algae that causes the occurrence of fishy odor in water. It grows in spring, creating the phenomenon known as fresh-water red tide.



▼Asterionella Formosa (Diatoms)

Growing from winter into spring, this form of algae causes filter clogging.



▼Synedra acus (Diatoms)

Growing in spring, this form of algae causes filter clogging.



Microorganisms which cause troubles in water treatment

Daily Operation of the Water Supply System in Kobe

Kobe City inaugurated its modern water supply system in 1900, the seventh water system in Japan.

First, the City constructed a reservoir in the upper reaches of the rivers leading to Nunobiki Falls, to serve what is currently called Chuo Ward and a portion of Hyogo Ward. Later, in response to population increase and city area expansion, the City constructed reservoirs in Karasuhara and Sengari, to serve a wider area. Furthermore, in 1942, the City ensured new water sources, Lake Biwa and the Yodo River, through the Hanshin Water Authority. Kobe City has continued to provide its citizens with safe and high-quality water for about 100 years. The City's water supply facilities suffered severe damage from the Hanshin-Awaji Earthquake in January 1995.

This made water authorities realize anew the importance of water supply as a "lifeline."

Based on the lessons learned from this experience, Kobe City will continue to do its utmost to ensure its citizens a safe and continuous water supply.

Reservoirs

Kobe, surrounded by the sea and mountains, has no large rivers or lakes either within or nearby. Accordingly, three reservoirs were constructed to store rainwater and river water.



Karasuhara Reservoir (Hyogo Ward)



Sengari Reservoir (Kita Ward)



Nunobiki Reservoir (Chuo Ward)

Purification plants

A large volume of water is sent daily from the reservoirs to purification plants in the Kobe area. At the Okuhirano and Sengari Purification Plants, the rapid filtration method is used to process raw water into drinking water in about three hours.



Okuhirano Purification Plant (Hyogo Ward)
Capacity: 60,000 m³/day



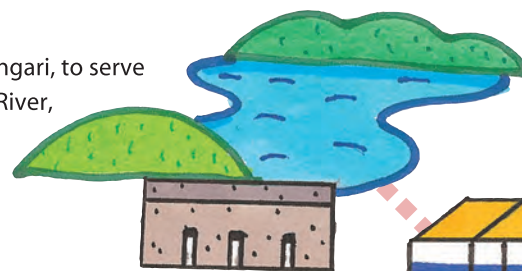
Sengari Purification Plant (Kita Ward)
Capacity: 108,000 m³/day



Uegahara Purification Plant (Nishinomiya City)
capacity: (Rapid filtration) 70,000 m³/day

Hyogo Prefecture Water Supply Project

Dondo Dam
Aono Dam



Purification plant



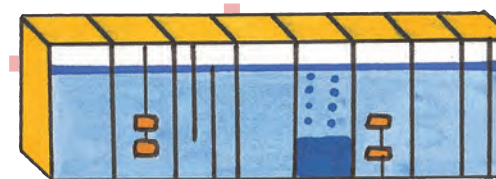
Hanshin Water Authority

Lake Biwa, Yodo River



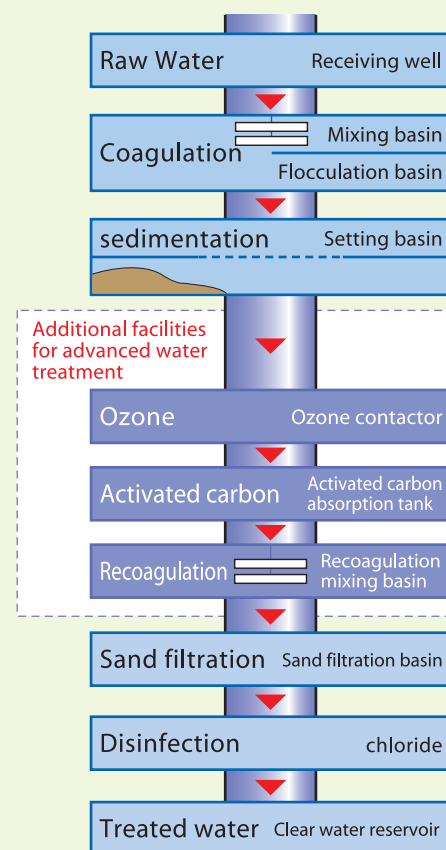
Purification plant

(advanced treatment facility)



Purchase

Water Treatment System



Advanced water treatment by the Hanshin Water Supply Authority enables nearly 100% removal of musty odor, and the reduction of trihalomethane and other organic substances to 1/3 of the pretreatment level.

Flow of water

Water supply Facilities in Kobe

(as of April 2011)

3 reservoirs

(Sengari, Nunobiki, Karasuhara)

Small rivers (the Sumiyoshi River), water springing from the Shin-Kobe Tunnel

● Effective volume: 13,528,705 m³

6 purification plants

(Uegahara, Okuhirano, Sengari, Motoyama, Sumiyoshi, Rokkosan)

● Filtration capacity: 246,500 m³/day

50 pump stations (246 pumps)

124 distribution reservoirs (253 tanks)

● Telemeter/telecontrol facilities

1 central control center, 8 relay stations, 50 cable (NTT) stations

Water distribution pipes

● Total length of conveyance, transmission and distribution pipes: 5,052,960 m

General households

- Rate of service pervation: 99.9%
- Population served: 1,532,764 persons
- Daily supply capacity: 894,381 m³

Monitoring from the source to taps

1 The inflow rivers

The water quality of the inflow rivers influences to that of the reservoir. To preserve the water quality of the reservoir, successive monitoring everywhere around the river is carried out.



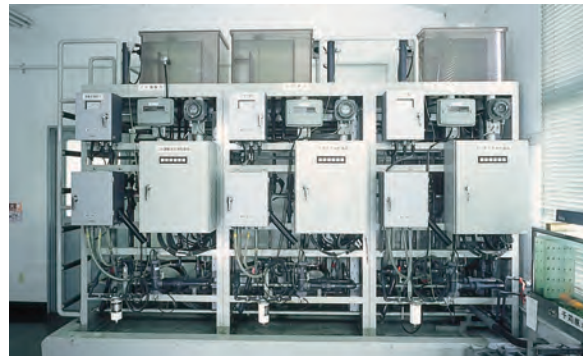
2 The reservoir

Water quality in the reservoir changes seasonally and spatially. Based on the successive monitoring results, the appropriate depth for water intake is determined.



3 The purification plant

From the tap water through the finished water, careful examinations on the water quality are conducted to check the water is purified properly in each process. And appropriate dose of coagulant and disinfectant is investigated.



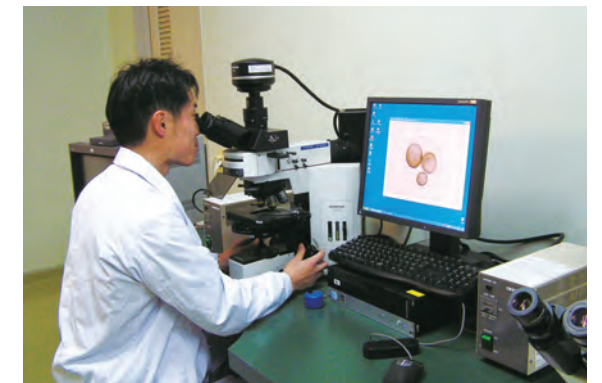
4 The taps

Besides the regular examinations on the water in the distribution reservoirs and taps, automatic monitoring on the seven items including turbidity and residual chlorine are carried out.



Water Quality Examination Laboratory

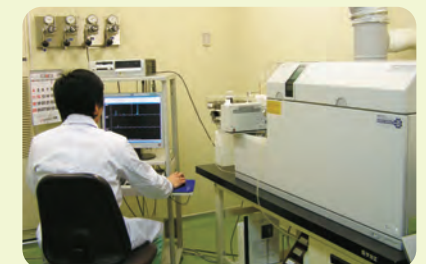
Supply safe and high-quality water to citizens, precise water examinations are carried out at various points from source to the tap. Water examinations (physicochemical, bacteriological, and biological examination) are conducted at about 21 points at the water resources, 21 points in purification plants, and 5 connection points of Hanshin Water Authority and Hyogo Prefecture Water Supply Project, 15 distribution reservoirs, and 30 service taps on a regular monthly basis. The number of items to be analyzed sometimes exceeds 200, including those required by regulations. Small trace compounds are measured by skilled engineers using highly advanced facilities.



Highly advanced facilities and equipments for water quality examination



■ **Gas chromatography mass spectrometer**
This equipment identifies and measures various kinds of trace organic compounds such as disinfectant by-products and pesticides.



■ **Inductively Coupled Plasma (ICP) mass spectrometer**
This equipment identifies and measures extremely small traces of heavy metals in water.



■ **Liquid chromatography mass spectrometer**
This equipment identifies and measures various kinds of trace organic compounds which are easily degraded at high temperature.



■ **Electron microscope**
Electron microscope can magnify images of microorganisms up to 500,000 times their natural size, giving views unavailable by optical microscopes.

FOR CLEAN, SAFE WATER

– Introduction of THE ADVANCED TREATMENT –

Water from Lake Biwa and the Yodo River is monitored in over 100 categories to ensure its safety. However, in the past 20 years, the water has begun to have a musty and fishy odor, and traces of organic chlorine compounds have become a problem.

The advanced treatment which uses ozonation and granular activated carbon can be used to eliminate organic compounds and odor.

Recently, many cities around the Yodo River adopted the advanced water treatment. Kobe City is also supplied the advanced treated water from the Hanshin Water Supply Authority.

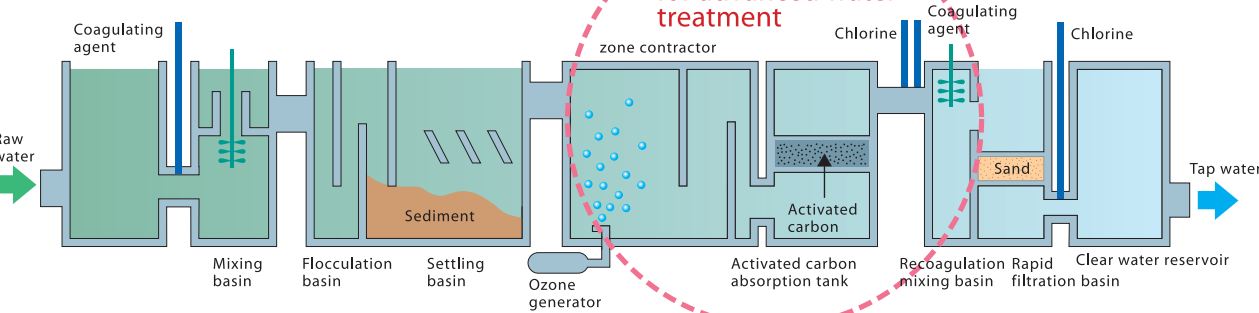


Lake Biwa
The water resource of the Kinki region, so called “water vessel”, providing water for 13 million people.

Advanced water treatment produces safer and higher-quality water.

For approximately 75% of its water supply, the City receives water from the Hanshin Water Authority, which supplies water from Lake Biwa and the Yodo River. Since April 2001, all the water sent from the Authority has been subjected to advanced water treatment, which combines ozone and activated carbon treatment processes with the conventional system. The advanced system removes musty odor almost completely and reduces trihalomethane to one third of the conventional levels, enabling us to supply higher-quality water to citizens. At our Sengari Purification Plant, we also add the granular activated carbon treatment process to the regular water treatment system when musty odor is generated, to produce higher-quality tap water.

■ Advanced Water Treatment System



- Adds an agent that causes dirt and fine impurities to settle down, and stirs.
- The dirt and fine impurities stick together to form a large clump (floc) and settle.
- Ozone dissolves organic substances, and activated carbon absorbs substances that generate musty odor and trihalomethane.
- After filtration, water is disinfected, as the final step in producing tap water.

More Safety and Higher Quality Water

Items on Water Quality Standard Regulation

179 Items

on the tap water quality [April 2011~]

50 drinking water quality standard items

30 items which may affect human health
20 items on daily-use water, such as turbidity, color, odor, and those for facility management

PLUS

27 complementary items

items that the Ministry of Health and Welfare encourages water supplier to monitor for the management of water quality
(102 agricultural chemicals are included)

Acquisition of ISO 9001 and ISO/IEC 17025 certification

To enhance trust and reliability of tap water for customers, the water quality examination laboratory acquired the certification of ISO 9001, a global standard for the quality management system in February 2005, and for ISO/IEC 17025, a global standard for the competence of specific examination and calibration in February 2009. To fulfill your high expectations regarding the tap water, Kobe City waterworks continues to promote water quality management.

ISO 9001



Scope of Supply
Water Quality Examination for Drinking Water

ISO/IEC 17025



ISO/IEC 17025:2005 accredited testing laboratory
The accreditation scope is specified to water quality examination for drinking water measured by ICP-MS

Drinking water quality standard items ;

50 items and water quality data (2010 fiscal year average)

	Water quality item	Tap water in Kobe City*	Standard value	Remarks
1	Standard plate count bacteria	0	The number of colonies formed in a 1 ml sample must be 100 or less.	Index of pathogenic organisms
2	Total coliforms	ND	Must not be detected	
3	Cadmium or cadmium compounds	<0.0003	0.003 mg/L or less	Inorganic chemicals and heavy metals
4	Mercury or mercury compounds	<0.00005	0.0005 mg/L or less	
5	Selenium or selenium compounds	<0.001	0.01 mg/L or less	
6	Lead or lead compounds	<0.001	0.01 mg/L or less	
7	Arsenic or arsenic compounds	<0.001	0.01 mg/L or less	
8	Hexavalent chromium compounds	<0.005	0.05 mg/L or less	Organic chemicals
9	Cyanide ions or cyanogen chloride	<0.001	0.01 mg/L or less	
10	Nitrate nitrogen or nitrite nitrogen	1.28	10 mg/L or less	
11	Fluoride or fluoride compounds	0.09	0.8 mg/L or less	
12	Boron or boron compounds	<0.1	1.0 mg/L or less	
13	Carbon tetrachloride	<0.0002	0.002 mg/L or less	Disinfection by-products
14	1,4-Dioxane	<0.005	0.05 mg/L or less	
15	Cis-1,2-dichloroethylene or trans-1,2-dichloroethylene	<0.004	0.04 mg/L or less	
16	Dichloromethane	<0.002	0.02 mg/L or less	
17	Tetrachloroethylene	<0.001	0.01 mg/L or less	
18	Trichloroethylene	<0.003	0.01 mg/L or less	Color
19	Benzene	<0.001	0.01 mg/L or less	
20	Chloric acid	<0.06	0.6 mg/L or less	
21	Chloroacetic acid	<0.002	0.02 mg/L or less	
22	Chloroform	0.006	0.06 mg/L or less	
23	Dichloroacetic acid	<0.004	0.04 mg/L or less	Taste
24	Dibromochloromethane	0.007	0.1 mg/L or less	
25	Bromic acid	0.002	0.01 mg/L or less	
26	Total trihalomethane	0.021	0.1 mg/L or less	
27	Trichloroacetic acid	<0.02	0.2 mg/L or less	
28	Bromodichloromethane	0.008	0.03 mg/L or less	Foaming
29	Bromoform	0.001	0.09 mg/L or less	
30	Formaldehyde	<0.008	0.08 mg/L or less	
31	Zinc or zinc compounds	<0.01	1.0 mg/L or less	
32	Aluminum or aluminum compounds	0.03	0.2 mg/L or less	
33	Iron or iron compounds	<0.03	0.3 mg/L or less	Odor
34	Copper or copper compounds	<0.01	1.0 mg/L or less	
35	Sodium or sodium compounds	17.8	200 mg/L or less	
36	Manganese or manganese compounds	<0.005	0.05 mg/L or less	
37	Chloride ions	15.6	200 mg/L or less	
38	Calcium, magnesium, etc. (hardness)	45.3	300 mg/L or less	Taste
39	Evaporated residue	107	500 mg/L or less	
40	Anionic surfactants	<0.02	0.2 mg/L or less	
41	Geosmin	<0.000001	0.00001 mg/L or less	
42	2-Methyl-isoborneol	<0.000001	0.00001 mg/L or less	
43	Non-ionic surfactants	<0.005	0.02 mg/L or less	Foaming
44	Phenols	<0.0005	0.005 mg/L or less	
45	Organic substances (amount of total organic carbon, TOC)	0.9	3 mg/L or less	
46	pH	7.6	From 5.8 to 8.6	
47	Taste	normal	Must not be abnormal	Fundamental properties
48	Smell	normal	Must not be abnormal	
49	Color	<1	5 or less	
50	Turbidity	<0.1	2 or less	

* Water treated by Hanshin water supply authority.

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