9. Research Agenda in Drinking Water / Wastewater Control

Presenter

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JAPANESE RESEARCH AGENDA IN DRINKING WATER CONTROL

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ABSTRACT

Researches on drinking water supply is becoming more important than before in Japan, and the Ministry of Health, Labor and Welfare(MHLW) is going to review its R & D strategy in drinking water supply. A new movement of water supply administration, like decentralization, may accelerate the development of water supply technologies. At present, main subjects of on-going and future researches include a sound water cycle in watershed, safe water plan, measures against terrorism and accidental contamination, *Cryptosporidium* control, endocrine disrupting chemicals, hydrophilic hard-degradable chemicals, and domestic water supply equipment.

INTRODUCTION

Now the regime of drinking water supply in Japan is going to change drastically and rapidly through the deregulation of drinking water supply administration. MHLW already allowed private sector participation in drinking water supply in April 2002. Under such a situation, researches on the control of drinking water quality is becoming more important than before.

In this paper, current research topics related to drinking water quality control in Japan are discussed.

BACKGROUND AND GENERAL TREND

The drinking water supply in Japan is recently becoming more flexible and open to the public than before due to a new movement of deregulation in drinking water supply administration. Such a movement is expected to accelerate research and development of drinking water supply technologies with high reliability and good performance.

MHLW enforced the Water Supply Facility Standards in April 2000. The standards newly established are characterized not as specification standards but as performance standards because the technologies of drinking water supply in Japan have been well

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established and we do not need specification standards any more. Moreover, MHLW considers that it is very important to make drinking water supply systems freely develop their facilities taking their individual situations into account. So a water supply system can adopt any water supply technology under its own responsibility so long as the technology meets the facility standards.

MHLW also enforced the amended Water Works Law in April 2002. The amendment allows a drinking water supply system to commit its management and operation to a third party including the private sector. This is also along with the movement of deregulation in drinking water supply administration.

Regarding research and development, MHLW organized the Committee on R a& D in Drinking Water Supply for the purposes of reviewing on-going R & D projects and discussing future directions of R & D in the field of drinking water supply in April 2002. It has been agreed in the committee that discussions will not be confined to the present frame of the drinking water supply system. The discussions of this committee is expected to contribute to the improvement of R & D strategy in drinking water supply.

Another important issue related to researches in drinking water supply technologies is the initiation of a series of research projects on the establishment of a sound water cycle in watershed as written below. This research area, with the aspects of resource and energy saving, and environmental friendliness, is one of those which are considered indispensable for the sustainable development of Japan in the future.

At present, MHLW is going to revise the Drinking Water Quality Standards, where all the parameters listed not only in the standards but also in other guidelines will be reviewed. The meeting of the Committee on Drinking Water Quality Control started in August 2002, and it is planned to review regulations related to drinking water quality control together with them. Therefore, researches and surveys contributing to the revision are also being conducted.

ESTABLISHMENT OF A SOUND WATER CYCLE IN WATERSHED

The Council for Science and Technology Policy, which was organized in the Cabinet Office in 2001, launched a new national big five-years' research project in the areas of life science, information/communication technology, environment, and nano-technology/material in 2002. A research project in the area of environment includes a sub-project with an objective of establishing the sustainability of the environment and ensuring the coexistence of human beings with natural ecosystem, one of whose components is a research project on the establishment of a sound water cycle

in watershed. MHLW takes part in this research project together with the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Land, Infrastructure and Transport, the Ministry of Environment and other ministries. Table 1 shows a list of research subjects granted by MHLW.

Table 1 Research subjects on the establishment of a sound water cycle in watershed

No	Research subject	Main research institution
1	Development of a new water treatment and distribution system considering the establishment of a sound water cycle of a regional scale	Japan Water Research Center
2	A new household water supply system contributing to the saving and reuse of water and the reduction in environmental loads	Japan Water Plumbing Engineering Promotion Foundation
3	Measures against infectious micro-organisms considering the establishment of a sound water cycle	Setsunan University
4	Possibility of a new water management system for creating a healthy water environment	Environmental Science Center, the University of Tokyo
5	Evaluation and monitoring of the water quality of a lake used as a drinking water source with the method of DOM fractionation	National Institute for Environmental Studies
6	Conservation of raw water for drinking water supply using a GIS system	National Institute of Public Health

The Japan Water Research Center(JWRC) launched a three-years' research project on the Environmental, Ecological, Energy Saving and Economical Water Purification System("e-Water" Project) in 2002 under a subject listed in Table 1 following a precedent five-years' research project on the Advanced Aqua Clean Technology for the 21st Century("ACT21" Project). This new project includes the development of large-scale membrane filtration technologies, the development of a new total system for the optimization of drinking water treatment, and the improvement of monitoring technologies for source water quality.

Other research projects related to the establishment of a sound water cycle in watershed include the one on the development of a new water abstraction technology. The objective of this research is to develop a environmentally-friendly surface water abstraction technology with minimizing the intake of suspended matter. The research project will be initiated by the National Institute of Public Health(NIPH) in 2003.

SAFE WATER PLAN

Safety of drinking water is the ultimate goal of its management. Drinking water quality standards are the most important tools for attaining the goal. As already written, MHLW started to review the standards referring to the revision of the WHO Guidelines for Drinking-Water Quality(GDWQ). Research studies on many regulated/unregulated chemicals and microorganisms, whose result will give a scientific basis for the revision of the Japanese standards, are being conducted since several years ago.

The revision of the WHO/GDWQ includes the preparation of the 3rd edition guidelines and many other supporting documents. One of the important supporting documents is "Water Safety Plans," which elucidate a holistic approach to ensure drinking water safety with good practices for health risk reduction in the whole processes of drinking water supply from a source to a tap. Such an approach is considered important also in Japan, and it will be taken into account in the revision of the Drinking Water Quality Standards.

The Water Supply Facility Standards are our important tools for drinking water quality control as well as the Drinking Water Quality Standards. However, some additional standards on the operation and maintenance of drinking water supply seem necessary in order to ensure drinking water safety. Therefore, researches in this respect should also be undertaken.

OTHER IMPORTANT RESEARCH ISSUES

MEASURES AGAINST TERRORISM AND ACCIDENTAL CONTAMINATION

Interest in drinking water contamination caused by terrorism is growing in Japan, and researches on the measures against such contamination are becoming more important. Some water supply systems in Japan have already prepared their own manuals and strengthened measures against drinking water contamination by terrorism. In Japan, we depend mainly on surface water sources which are vulnerable to accidental contamination. Therefore, researches on the measures against accidental raw water contamination are also very important. MHLW issued the Manual for Preparing Risk Management Procedures to be Taken in an Emergency Related to Drinking Water Contamination in 1999, and it is utilized by drinking water supply systems.

Considering the potential risk of terrorism, the National Institute of Infectious Diseases(NIID) conducted a research on the development of a rapid and sensitive method for the detection of microbial contaminants in drinking water as a means of

anti-bio-terrorism in 2001. One of the main objective of this research was to develop a sampling device for microbial contaminants in water. The device is equipped with a membrane filtration unit and a refrigerator to store concentrated water samples.

CRYPTOSPORIDIUM CONTROL

The efficient removal and control of *Cryptosporidium* is an urgent issue in drinking water supply in Japan as in many other developed countries. Researches on *Cryptosporidium* have been conducted for the past several years in Japan, and the focus at present is its health-risk assessment and management. One of the topics being discussed in the course of reviewing the Drinking Water Quality Standards is the necessity and possibility of establishing a standard value on *Cryptosporidium*.

MHLW has issued the Provisional Guidelines against *Cryptosporidium* in Drinking Water Supply in 1996(revised in 1998 and 2001). The guidelines require a drinking water supply system to install a filteration facility and to maintain the turbidity of filtrate at not more than 0.1 unit where there is a potential risk of raw water contamination with *Cryptosporidium*. Japan did not experience an outbreak of cryptosporidiosis since the one in Ogose Town, Saitama Prefecture, in 1996 because drinking water supply systems pay adequate attention to the control of *Cryptosporidium* according to the guidelines.

UV irradiation seems a promising technology for the control of *Cryptosporidium* in drinking water treatment. Its effectiveness has already been established well, and Setsunan University has initiated a research on the development of its practical application in 2002 as listed in Table 1.

INFORMATION COLLECTION ON ENDOCRINE DISRUPTING CHEMICALS

Endocrine disrupting chemicals(EDCs) is one of the issues of great concern in the field of drinking water supply. Although the health risk potential of EDCs is still not known well, people are very anxious about the contamination of drinking water, as well as food, with them. The main subjects of current researches on EDCs in drinking water conducted by NIPH and Hokkaido University are occurrence in raw and drinking waters, removal and behavior in drinking water treatment and release from materials used for drinking water supply. The EDCs focused on are dioxins, diethylhexyl phthalate, dibutyl phthalate, bisphenol A and nonyl phenol. So far, much information on these chemicals has been accumulated(refer to another paper presented in this conference).

MEASURES FOR THE CONTROL OF HYDROPHILIC HARD-DEGRADABLE CHEMICALS

Raw and/or treated water contamination with hydrophlic hard-degradable chemicals, such as 1,4-dioxane, methyl-*t*-butylether(MTBE), acrylamide monomer and bromate, is of concern in drinking water supply because they cannot be easily removed by a conventional water treatment system, i.e. coagulation/sedimentation and sand filtration, or activated carbon treatment. Therefore, MHLW has initiated a research on their control collaborating with National Institute of Health Sciences(NIHS) and NIPH. The research includes the development of analytical methods, survey on uses for industrial and other purposes, survey on dietary uptake, the mechanism of toxic effects, occurrence in water environment, and removal and behavior in drinking water treatment.

It has been found so far that the contamination of raw water used for drinking water supply with 1,4-dioxane is generally not serious in Japan, but ground waters in some areas are heavily contaminated with it. Ground water abstraction in such areas has been stopped since then. Raw water contamination with MTBE seems not so serious, and its production is going to be reduced in Japan. MHLW approved the use of polyacrylamide for drinking water treatment in 2000. Although there is still no drinking water supply system using this chemical, the development of analytical method of acrylamide monomer at very low concentration and the investigation on its behavior in drinking water treatment processes, e.g. chlorination, are important issues. It is well known that bromate is formed in ozonation process if much bromide ion exists in raw water, but its formation can be reduced even in such a case through the optimum control of the process. There are about 50 drinking water treatment plants adopting ozonation in Japan at present, and the surveillance on bromate formation at these plants are needed. Moreover, as bromate is also used for other purposes, like hair treatment and food processing, raw water for drinking water supply already contains a certain amount of it depending on a local situation.

PROPER MANAGEMENT OF DOMESTIC WATER SUPPLY EQUIPMENT

The proper management of domestic water supply equipment, i.e. service pipes and fittings, is an area drawing much attention by drinking water supply researchers and engineers in recent years. MHLW enforced the Standards on the Structure and Materials of Domestic Water Supply Equipment in 1997, and, since then, any product can be used freely for domestic water supply equipment so long as it meets the standards. Products are certified by their manufacturers or by a third party according to the standards. Therefore, some products, which do not meet the standards, are also sold in the market and used. For example, an o-ring containing polychlorinated naphthalene(PCN), whose

use is prohibited in Japan, and a bath water-heater with an improper backflow prevention device were found prevalently used, and, then, they were recalled. This fact shows that the improvement of quality and functions of domestic water supply equipment is an important issue in drinking water quality control.

Among others, lead problem is of great concern in Japan. Release of lead from lead service pipes and service fittings made of brass is a significant problem in drinking water quality control. Therefore, JWRC issued the Technical Guidelines on the Replacement of Lead Service Pipes in 2000 considering the importance of lead problem. The Japan Water Works Association(JWWA) also issued a report of the Special Committee on the Measures against Lead Problem in Drinking Water Supply in 2001 which stresses the necessity of coping with this problem by water supply systems.

On the other hand, MHLW has already announced to enforce a new drinking water quality standard on lead of not more than 0.01 mg/l from April 2003. However, a survey of JWRC has revealed that the total length of lead service pipes in Japan was still about 27,500 km in 1999, which was about 14,000 km less than that in 1991. As in many other countries, domestic water supply equipment is the property of individuals but not that of a water supply system. Therefore, it is difficult to replace lead service pipes with other pipes, and there is a high research need of developing lead control technologies in drinking water supply. The measures other than replacement being taken into account at present are pH control of drinking water and the application of a household water treatment unit with ion-exchange resin having a potential of lead removal.

CONCLUSIONS

The proper management of drinking water quality is the task of individual drinking water supply systems, and MHLW is responsible for administration for its control. Problems related to drinking water quality is always becoming complicated more and more. On the other hand, the deregulation of drinking water supply is inevitable even in Japan. Moreover, it is required to improve the level of drinking water supply services.

Under such a situation, the development of drinking water supply technologies for the purpose of ensuring its safety is becoming more important than before, and much attention to resource and energy saving, and environmental friendliness is needed in current and future researches in Japan.