Mercury Data in Japan

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[Introduction]

Environmental mercury level has increased dramatically with the industrial development in the world, Japan without exception. In Japan, mercury has been concerned as human health issue, since the recognition of the famous Minamata Disease in 1956. Yet it took nearly another 20 years, to find out that the direct cause of the disease was methyl-mercury, in 1977.

Once released into the environment, mercury could mobilize through various media such as ambient air, water, soil, sediment, and biota. Then, mercury would be biomagnified and accumulated into human body. It could be found in various forms, depending on the origins of emission. Methyl-mercury is known to be accumulated through diet, especially through fishes and other sea foods, and inorganic and elemental mercury is known to be accumulated mainly through inhalation and through skin. In Japan, numbers of intensive studies have been reported on the mercury emission and its impact on human health.

Thus, in order to improve our understanding of the fate and transport, health and environmental impact of mercury, data on mercury in Japan for the past 10 years were summarized.

[Sources and Releases of Mercury]

Nakagawa *et al.*[1] have estimated the quantity of mercury emitted into the environment from anthropogenic sources in Japan to be 60 tons/year (Table 1). The anthropogenic sources include coal-fired power production, combustion of waste, disposal of waste as landfill, and discharge of waste to water receptors. Among these sources, combustion of domestic waste and releases from facilities are said to account for approximately 30 to 40% of anthropogenic mercury emission. However, according to Nomura Kosan Co. Ltd, a manufacturer successfully recycling mercury from wastes, approximately 20 tons of mercury is recovered annually. Increase in such recycling facilities may contribute in decreasing anthropogenic emission into the environment.

The emission from volcanic gas and evaporation from sea water and soils are the known natural sources of mercury. Because there are neither mercury mines nor refinery facilities in Japan at present, mercury is not released or produced as a result of mercury mining. Thus, mercury is expected to be imported into Japan in forms of elemental mercury, reagents, or

products. However, the actual quantity of mercury imported as products has not been confirmed at this point.

Table 1 Mercury releases in Japan

Classification	Sources		Emission (t/y)	References
Anthropogenic sources	Coal-fired power plants	Atmosphere	0.638	Ito, *et al* [2]
		Public water area	0.00283	
	Combustion of domestic wastes		17	Tanigawa, *et al* [3]
	Specified facilities	Release	4.3587	Ministry of the Environment (PRTR: 2002 fis.yr.) [4]
		Transport	0 1210	
	Non-specified facilities	Release	8.2499	
Natural sources	Volcanic gas		1 4	Nakagawa, *et al* [1]

[Usage of Mercury]

Mercury is known to be used in various products, such as batteries, fluorescent lights, pesticides, caustic soda manufacturing processes, dental amalgams, preservatives in vaccines, and in bactericides and disinfectant. In Japan, the total quantity of mercury used in batteries was 169.24 tons in 1987, but the quantity decreased to 1.81 tons by 2003[5]. The numbers of manufactured fluorescent light is increasing with the increasing demands for backlights used for television and personal computer monitors. Chemical compounds such as phenyl mercuric acetate, metoxyethyl mercuric chloride, phenyl mercuric iodide were used widely in paddy fields as seed dressing and soil disinfectant. However, all mercuric pesticides were banned in 1973. As for caustic soda manufacturing, back in 1970's, mercury processes were employed in most caustic soda manufacturing factories in Japan, but all were replaced by ion-exchange membrane method by June 1986. Dental amalgam, thimerosal used as preservatives in vaccines, and mercurochrome used as bactericides are other known usages of mercury.

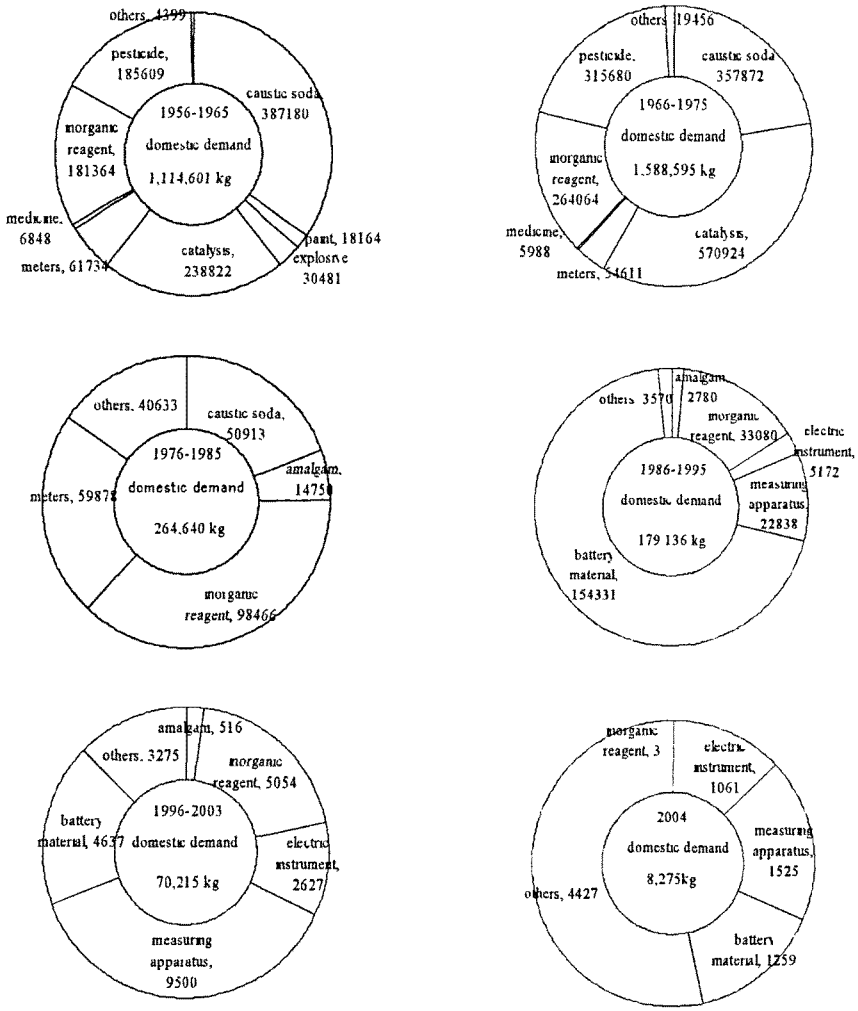

Figure 1 Breakdown of mercury demands[6,7]

[Mercury in Food and in Environmental Media]

Numbers of intensive studies have been done on mercury contained in food and in environmental media.

The provisional regulation value for total mercury in fish and shellfish was established in 1972: 0.4 ppm for total mercury and 0.3 ppm (reference value) for methyl-mercury. However, these values do not apply for tuna, river water fish, and deep sea fish. The monitoring result in year 2003 by the Ministry of Health, Labour and Welfare, Japan, is shown below. Numbers of samples exceeded the provisional regulation values. Also, according to the Tuna Monitoring results by Fisheries Agency, total mercury in tunas is generally higher than that of other fishes.

Table 2 Prefectural monitoring results of total mercury

	No of species	No. of samples	Minimum value (mg/kg)	Maximum value (mg/kg)	Average (mg/kg)
Fishes	223	1,987	0	6 1	0 108
Shellfishes	30	297	0	0 220	0.014
Aquatic animals	35	237	0	0 240	0 029

Note : the values for "fishes" include different types of species

(Ministry of Health, Labour and Welfare, 2001-2002)[8]

From 1997, the local administrations were obliged to monitor "mercury and mercury compounds" in the atmosphere, under the revised Atmosphere Pollution Control Law. The annual average values were within the guideline value. However, in 1999, two sites in Iwaki, Fukushima Prefecture, were detected as 50 ng/m^3.

Table.3 Monitoring results by local administrations

Fiscal year	No of sites	No. of samples	Average (ng/m^3)	Minimum (ng/m^3)	Maximum (ng/m^3)
1997	13	65	2.8	2	4
1998	179	1,697	2.8	0.27	10
1999	260	2,704	2.9	0.05	50
2000	283	3,003	2.6	0 14	15
2001	281	3,056	2.3	0.22	6
2002	244	2,928	2.1	0.32	5.4

(Monitoring Investigation of Hazardous Air Pollution Substances, Ministry of the Environment)[9]

The environmental quality standard for total mercury and alkyl mercury in public water and ground water are 0.0005 mg/L and ND (not detectable), respectively. Mercury (as total mercury and alkyl mercury) in water is considered pollutant toxic to human health and is regulated by Water Pollution Control Law. According to the results of Water Quality Monitoring of Public Waters from 1993 to 2002 by the Ministry of the Environment, only one site from 1996 survey exceeded the environmental quality of the total mercury. The Water Quality Monitoring of Ground Waters are also conducted and summarized by the Ministry of the Environment. There were sites exceeding the environmental quantity standard for total mercury, but none for alkyl mercury.

In regards to soil, though the environmental quality standard was established in 1996, monitoring surveys are not currently conducted for mercury. However, in 2004, under Soil Contamination Measures Law, which was established in 2002, three sites were assigned as "designated areas", where the mercury in soil exceeded the stipulated standards.

As for mercury in sediment of public water, the provisional removal standard is assigned based on the equation designated by the Ministry of the Environment in 1973. As a result of a series of surveys conducted from 1973 through 1980, sediments in 42 water areas were dredged based on the provisional removal standard.

[Conclusion]

Due to the historical background related to mercury pollution, environmental quality standards and effluent standards were established as early as 1970's, and environmental monitoring has been conducted for ambient air and public water. Also, lab facilities to conduct environmental analysis are installed in nearly all local administrations in Japan, today, and many public and private colleges and universities have intensively established departments specialized in environmental studies, especially over the past decade. In addition, Japanese manufacturers have been making efforts in decreasing the usage of mercury in manufacturing processes and in products. Therefore, as a whole, the usage of mercury is decreasing annually, and the environmental quality standards and other regulated values are being met for most of the environmental media.

[Suggestions for Future]

It is important to monitor pollutants in environmental media which may have impact on human health, but what is most important is to understand the behavior of such pollutants in the environment. In the monitoring program by EU, Clean Air for Europe (CAFE), the source of mercury release is determined by chemical characterization. However, the Japanese regulation sets quality standards only for two types of mercury compounds: either in total mercury or alkyl-mercury. When discussing chemical substances, it is necessary to take

into account not only those within Japan but also those migrating from other countries by air and water. Thus, like EU, monitoring station must be stationed in Asian nations to study the source of mercury release by chemical characterization.

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