Government of Japan

Dioxins

2003

Preface

Dioxins are substances not manufactured industrially. They are formed unintentionally, most often during the course of incineration. This explains why these substances are ubiquitous in the environment, although in very small in quantities.

The level of exposure to dioxins in everyday life in Japan does not lead to health effects, however, citizens still have questions and express concerns. To address these concerns, Ministries and Agencies that are members of the Ministerial Council on Dioxin Policy collaborated to produce this informational brochure.

Due to a nation-wide efforts to tackle a dioxin issue, national dioxins emission in 2001 has been reduced by about 77% from 1997 level. Accordingly, environmental levels of dioxins almost meet environmental quality standards.

This brochure explains in plain terms the nature of dioxins and how they are generated, and introduces concisely the actions of the Government in establishing a Council of Ministries and Agencies on Dioxin Policy and working in a unified way to promote dioxin responses. We sincerely hope that this brochure will promote public understanding about dioxins.

Council of Ministries and Agencies on Dioxin Policy:
Member Ministries and Agencies, Government of Japan

Cabinet Office
National Police Agency
Ministry of Public Management, Home Affairs, Posts and Telecommunications
Ministry of Foreign Affairs
Ministry of Education, Culture, Sports, Science and Technology
Ministry of Health, Labour and Welfare
Ministry of Agriculture, Forestry and Fisheries
Ministry of Economy, Trade and Industry
Ministry of Land, Infrastructure and Transport
Ministry of the Environment

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1 What are dioxins?

1 The term "Dioxins" refers to PCDDs, PCDFs and co-planar PCBs.

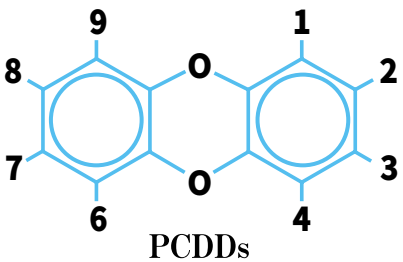
Polychlorinated Dibenzo-p-Dioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) are collectively called dioxins. Co-planar Polychlorinated Biphenyls (co-planar PCBs) possess toxicity similar to that of dioxins and are called dioxin-like compounds.

"Dioxins" are defined to include PCDDs, PCDFs and co-planar PCBs in the Law Concerning Special Measures against Dioxins (the Dioxins Law) promulgated on July 16, 1999.

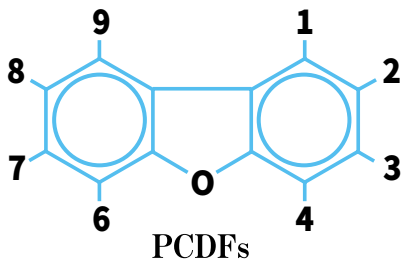
Accordingly, throughout this brochure, the term "Dioxins" will be used to refer to PCDDs, PCDFs and co-planar PCBs.

The general structure of a dioxin molecule is two rings of six carbon atoms (benzene rings, shown as ⬡ in Fig. 1) bound by oxygen atom(s) (shown as O in Fig. 1) with chlorine or hydrogen atoms attached (the numbered positions: 1-9 and 2′-6′ in Fig. 1). There are 75 kinds of PCDDs, 135 PCDFs and more than 10 co-planar PCBs, with the shape of the molecule depending on the numbers and locations of the chlorine atoms (Among dioxins, 29 congeners are thought to have some toxicities).

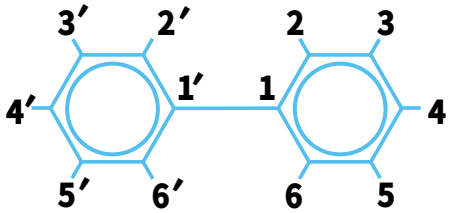
Figure 1 Chemical Structure of Dioxins



PCDDs



PCDFs



PCBs*

* PCB compounds, the two benzene rings of which are on the same plane, and thereby give the compound a flat structure, are designated as co-planar PCBs.
Nevertheless, some PCBs that do not have the planar structure, but possess dioxin-like toxicity, are practically classified as co-planar PCBs in current documents of the Government of Japan (See Table 1 on page 2 for details.).

2 Toxicity of dioxins overall is expressed as Toxic Equivalents (TEQs).

The degree of toxicity of dioxins varies from compound to compound. Among all dioxins, the tetrachlorinated dibenzo-p-dioxin with chlorine atoms attached in the 2, 3, 7 and 8 positions (2,3,7,8-TCDD) is known to possess the highest toxic potency.

In order to assess the toxicity of dioxins overall, a way is needed to consider their aggregate effects.

The method used here is to assign an individual Toxic Equivalency Factor (TEF) value to each dioxin compound. TEFs are estimates of the toxicity of dioxins relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1. In many studies and monitoring results, amounts or concentrations of dioxins are presented as Toxic Equivalents (TEQs), which are determined by summing the products that result from multiplying concentrations of individual dioxin compound by the corresponding TEF (See Table 1). Concentration, etc. of dioxins is presented as TEQ in this brochure.

Table 1 Toxic Equivalency Factors (TEFs)*

	Name of Compound	TEF value
PCDDs (Polychlorinated dibenzo-p-dioxins)	2,3,7,8-TCDD	1
	1,2,3,7,8-PeCDD	1
	1,2,3,4,7,8-HxCDD	0.1
	1,2,3,6,7,8-HxCDD	0.1
	1,2,3,7,8,9-HxCDD	0.1
	1,2,3,4,6,7,8-HpCDD	0.01
	OCDD	0.0001
PCDFs (Polychlorinated dibenzo-furans)	2,3,7,8-TCDF	0.1
	1,2,3,7,8-PeCDF	0.05
	2,3,4,7,8-PeCDF	0.5
	1,2,3,4,7,8-HxCDF	0.1
	1,2,3,6,7,8-HxCDF	0.1
	1,2,3,7,8,9-HxCDF	0.1
	2,3,4,6,7,8-HxCDF	0.1
	1,2,3,4,6,7,8-HpCDF	0.01
	1,2,3,4,7,8,9-HpCDF	0.01
	OCDF	0.0001
Co-planar PCBs	3,4,4',5-TCB	0.0001
	3,3',4,4'-TCB	0.0001
	3,3',4,4',5-PeCB	0.1
	3,3',4,4',5,5'-HxCB	0.01
	2,3,3',4,4'-PeCB	0.0001
	2,3,4,4',5-PeCB	0.0005
	2,3',4,4',5PeCB	0.0001
	2',3,4,4',5-PeCB	0.0001
	2,3,3',4,4',5-HxCB	0.0005
	2,3,3',4,4',5'-HxCB	0.0005
	2,3',4,4',5,5'-HxCB	0.00001
	2,3,3',4,4',5,5'-HpCB	0.0001

* Proposed at the WHO meeting in 1997 and published in an academic journal in 1998.

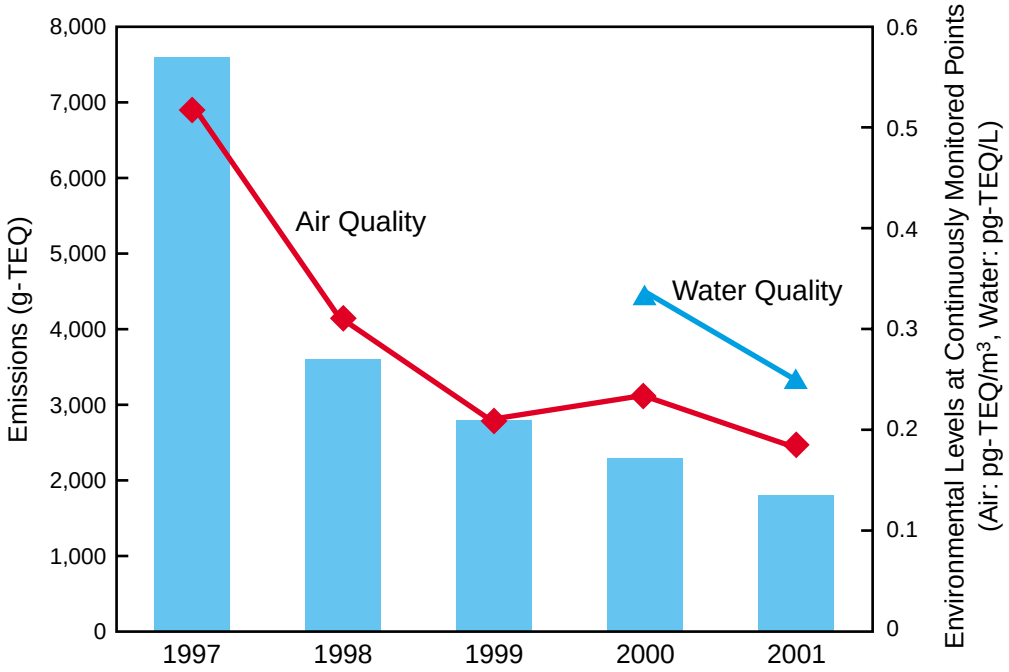
3 Dioxins have no color and very low water solubility.

Dioxins in general are colorless solids with properties of very low water solubility and low vapor pressure. On the other hand, dioxins characteristically exhibit a high degree of solubility in fats and oils. They are generally stable, not reacting easily to other chemical substances, acids and alkalis, but are thought to gradually decompose in the presence of solar ultraviolet light.

4 Dioxins are generated as unintended by-products in waste incineration and other various processes

Dioxin is not produced intentionally, other than for research purposes, such as to prepare standard material for analysis. Dioxins are by-products generated from processes when heat is applied to substances containing carbon, oxygen, hydrogen and chlorine.

Figure 2 National Dioxin Emissions and Environmental Levels in Air and Water



The main source of dioxins at present is waste incineration, with most being generated in combustion processes and released to the ambient air without being fully captured by waste-gas treatment equipment. Other sources exist, such as emissions from electric steel-making furnaces, cigarette smoke, and automobile exhaust. Some reports indicate that dioxins may have accumulated in sediment in the environment due to the past use of PCBs and some types of agricultural chemicals, which contained dioxins as impurities.

The behavior of dioxins in the environment is not fully known. Taking the atmospheric pathway, for example, dioxins in the air are associated with particulate matter and fall to the ground, contaminating soil and water. It is thought that over long periods of time these dioxins, together with those released into the environment via other pathways, ultimately accumulate in aquatic sediments and enter the food chain when ingested by plankton and fish, thereby starting to concentrate in organisms.

National dioxin emissions in Japan in 2001 are estimated between approximately 1,743 and 1,762 g-TEQ (See Table 2 for details).

Natural sources of dioxins are thought to exist. Forest fires and volcanic activities, for example, are said to produce dioxins.

In coming years, it will be important to get a better grasp of the state of dioxin emissions.

Table 2 National Dioxin Emissions Inventory

Sources	Emissions (g-TEQ/year)				
	1997	1998	1999	2000	2001
1. To the Air					
Municipal waste incinerators	5,000	1,550	1,350	1,019	812
Industrial waste incinerators	1,500	1,100	690	555	533
Small scale waste incinerators	368～619	368～619	307～509	353～370	185～202
Cremation	2.1～4.6	2.2～4.8	2.2～4.9	2.2～4.8	2.2～4.8
Industrial sources					
Electric steel-making furnaces	228.5	139.9	141.5	131.1	95.3
Sintering process for steel industry	135.0	113.8	101.3	69.8	65.0
Secondary production of zinc	47.4	25.4	21.8	26.5	9.2
Aluminum scrap melting process	30.7	28.8	23.0	22.2	19.6
Others	21.8	20.8	13.3	14.2	14.7
Cigarettes smoke	0.1～0.2	0.1～0.2	0.1～0.2	0.1～0.2	0.1～0.2
Automobile exhaust	1.59	1.59	1.59	1.59	1.59
2. To the Water					
Municipal waste incinerators	0.044	0.044	0.035	0.035	0.019
Industrial waste incinerators	5.27	5.27	5.29	2.47	1.47
Industrial sources	6.1	5.7	5.8	4.8	2.0
Sewage treatment plants	1.09	1.09	1.09	1.09	0.99
Joint industrial waste water treatment plants	0.126	0.126	0.126	0.126	0.107
Solid waste final disposal sites	0.093	0.093	0.093	0.056	0.027
Total	7,348～7,602	3,363～3,617	2,664～2,869	2,203～2,223	1,743～1,762
To the Water	12.8	12.3	12.4	8.6	4.6
Reduction from 1997 level (%)	–	52.4～54.2	62.3～63.7	70.0～70.8	76.3～76.8

2 What are the risks of dioxins to humans?

1 Exposure to dioxins in everyday life is not high enough to result in acute toxicity

It is said that dioxins are "more toxic than cyanide and the most toxic of the man-made chemicals." The toxicity referred to, however, is the acute toxicity that occurs from very high levels of exposure, such as ingesting at one time a dose of some hundred thousand times the regular daily intake.

Since dioxins are not produced intentionally and the amount present in the environment or in food is extremely small, the regular levels of daily intake are very unlikely to lead to acute toxicity, such as would happen in the case of accidental ingestion.

2 Although the dioxin 2, 3, 7, 8-TCDD has been recognized as carcinogenic based on accidental high-level exposures, the current level of contamination in the environment in Japan is below the cancer risks.

The International Agency for Research on Cancer (IARC) under the World Health Organization (WHO) identified 2,3,7,8-TCDD as the most toxic of all dioxin compounds, and as carcinogenic to humans based mostly on the studies involving accidental heavy exposure.

The carcinogenicity of dioxins is not caused by direct damage to genes, but rather is thought to be due to their promotional activities on the initiated cells by other possible carcinogens.

It should be noted that the present levels of dioxins in the general environment in Japan are lower than those known to cause cancer risks.

3 Relatively high doses of dioxins are known to result in congenital deformities such as cleft palate in experimental animals. However, the current contamination level in the general environment in Japan is not thought to result in the malformation of babies.

In experimental animals (rodents), high doses of dioxins during pregnancy are known to result in deformities in newborns such as cleft palate and hydronephrosis. Nevertheless, the current contamination level of dioxins in the general environment in Japan is considered below those that cause birth defects.

4 High-level exposures to dioxins are reported to affect reproductive, thyroid and immune functions in experiments in animals. However, evidence relating to humans is not adequately available

Dioxins are reported to cause malfunctions in thyroid glands, atrophy of gonads, reductions in the sperm production, and suppression of the immune system. Since effects on humans are not clear at present, further studies are needed of the impacts on human health.

5 Tolerable Daily Intake (TDI) is used as the indicator for evaluating safety of exposure to dioxins

The Tolerable Daily Intake (TDI) is the amount of intake per kg of body weight per day of a chemical substance suspected of having adverse health effects, when absorbed into the body over a long period of time. The TDI is judged not to give rise to manifestations of health effects if such an amount is taken every day for an entire lifetime. The TDI of dioxins in Japan was set at 4 pg in June 1999 based on the latest available scientific information.

Safety of the total amount of dioxins ingested by humans is assessed corresponding to this value.

Brominated Dioxins

The brominated dioxin molecule has the chemical structure with bromine atoms attached to the numbered positions (1-9, 2′-6′) in Fig. 1. According to the survey conducted by an international institution, brominated dioxins are generated when burning plastic containing bromine flame retardant. However, it calls for further research on such subject as its source.

Impacts of brominated dioxins on human health or the ecosystem have not been proved in details. Therefore, the Ministry of the Environment is promoting a research on brominated dioxins by gathering and assorting information on toxicity, revealed conditions or an analysis method while monitoring brominated dioxins in the waste gas and water.

Tolerable Daily Intake (TDI) of Dioxins

Environmental Health Committee of the Central Environment Council of the Environment Agency, and the Food Sanitation Investigation Council and Living Environment Council of the Ministry of Health and Welfare jointly discussed the TDI based on scientific grounds, and completed a report on the topic on June 21, 1999. The report was acknowledged at the meeting of Ministerial Council on Dioxin Policy on the 25th of the same month.

The main points of the report are summarized below:

The TDI of dioxins (PCDDs and PCDFs, including co-planar PCBs) is set at 4 pg-TEQ/kg/day (4 pg per day for each kg of body weight).

Since subtle effects have been observed in some animal tests at body burden levels below those of the evidence employed in estimation of the TDI value, it is important to promote further research.

TDI is a value calculated as an index of the effects on health when daily intake continues throughout life. A temporary slight excess of intake over the TDI does not necessarily mean damage to health.

The TDI is set based upon effects due to exposure during the fetal period that is the most sensitive period. Manifestation of effects such as carcinogenicity would occur as a result of higher exposure than the set TDI.

TDI value of 4 pg is determined by extrapolating results of animal tests for humans, multiplied by a factor of 0.1 for safety.

Units for Extremely Small Quantities

Units for measuring weight

kg	(kilogram)		
g	(gram)		
mg	(milligram)	$=10^{-3}$ g	(thousandth of a gram)
μg	(microgram)	$=10^{-6}$ g	(millionth of a gram)
ng	(nanogram)	$=10^{-9}$ g	(billionth of a gram)
pg	(picogram)	$=10^{-12}$ g	(trillionth of a gram)

If water were held in a container the size of Tokyo Dome baseball stadium, it would weigh about 10 12 g. Suppose, a lump of sugar (1 g) were dissolved in the water, the result would be 1 pg of sugar in each gram of water.

3 How large is the impact of dioxins on the environment?

1 Dioxin levels in the environment in Japan almost satisfy environmental quality standards

Based on the Dioxins Law, national and local governments are monitoring dioxin levels in air, water, sediment and soil in order to grasp the actual conditions of dioxins pollution throughout Japan. The fiscal 2001 monitoring results reveal that average dioxin concentrations are 0.13 pg-TEQ/m3 for the ambient air, 0.25 pg-TEQ/L for the public water, 8.5 pg-TEQ/g for the sediment and 6.2 pg-TEQ/g for the soil (See Table 3).

Dioxin levels in the environment in fiscal 2001 almost satisfy environmental quality standards. Meeting the standards in fiscal 2001 are 99.2% of all monitoring points for the ambient air, 97.9% for the public water, 100% for the groundwater and 99.97% for the soil.

Table 3 Dioxin Levels in the Environment

			FY1997	FY1998	FY1999	FY2000	FY2001
Air		Average	0.55	0.23	0.18	0.15	0.13
		Range	0.010～1.4	0.0～0.96	0.0065～1.1	0.0073～1.0	0.0090～1.7
		No. of Points	68	458	463	920	979
Public Water Bodies	Water	Average	—	0.50	0.24	0.31	0.25
		Range	—	0.065～13	0.054～14	0.012～48	0.0028～27
		No. of Points	—	204	568	2,116	2,213
	Sediment	Average	—	8.3	5.4	9.6	8.5
		Range	—	0.10～260	0.066～230	0.0011～1,400	0.012～540
		No. of Points	—	205	542	1,836	1,813
Groundwater		Average	—	0.17	0.096	0.092	0.074
		Range	—	0.046～5.5	0.062～0.55	0.00081～0.89	0.00020～0.92
		No. of Points	—	188	296	1,479	1,473
Soil		Average	—	6.5	—	6.9	6.2
		Range	—	0.0015～61	—	0～1,200	0～4,600
		No. of Points	—	286	—	3,031	3,735

(Note) Unit of Average and Range: Air pg-TEQ/m^3, Water pg-TEQ/L, Sediment pg-TEQ/g, Soil pg-TEQ/g

2 Impacts of dioxins on wildlife are not clear. Research and surveys on the state of dioxin contamination in wildlife are now underway

It is a difficult task to clarify the cause and effect relationship between dioxin contamination and disease or population decreases in wildlife, since wildlife is exposed to various chemicals besides dioxins, and is also affected by many different factors (such as habitat loss or impact of human activities).

Since there are studies that showed impacts of organochlorine compounds such as dioxins, PCBs, and DDT on the hatching of reptiles and birds, further studies are needed in Japan and overseas.

Surveys on the state of dioxin contamination in wildlife started in 1998 in Japan.

4 How much dioxins do we take in everyday life?

1 We take about 1.68 pg-TEQ of dioxins a day on average through food and respiration, etc., an amount that is below the safety index (TDI).

The average dietary intake of dioxins including co-planar PCBs in Japan amounts to 81 pg-TEQ a day which means 1.63 pg-TEQ for each kg of body weight based on an average body weight of 50 kg, according to a fiscal 2001 survey by the Ministry of Health, Labour and Welfare (Survey on Daily Intake).

In addition to the dietary intake, with an assumed intake of about 0.0039 pg-TEQ from the ambient air, and about 0.012 pg-TEQ from the soil via dirt on hands, etc., the total dioxin intake of a person in Japan amounts to 1.68 pg-TEQ/kg body weight/day on average (See Fig. 3). This level is below the Tolerable Daily Intake (TDI) and thereby regarded below the level to cause adverse effects on human health.

2 Since dioxins tend to accumulate in adipose tissue, dietary intake level is particularly large from seafood, meat, dairy products and eggs.

Because dioxins are lipid soluble and tend to accumulate in adipose tissue, seafood, meat, dairy products and eggs are most likely to contain them. In Japan the main source of dietary intake of dioxins is fish, while the main sources are meat and dairy products in Europe and the United States, reflecting differences in dietary habits. In any country, 70 to 90% of the dietary intake of dioxins is likely to come from the intake of seafood, meat, dairy products and eggs.

The intake of dioxins from vegetables is considered to be significantly less than that from seafood or meat.

3 Dioxins accumulate to the adipose tissue in particular. The half-life for elimination from the body is about seven years

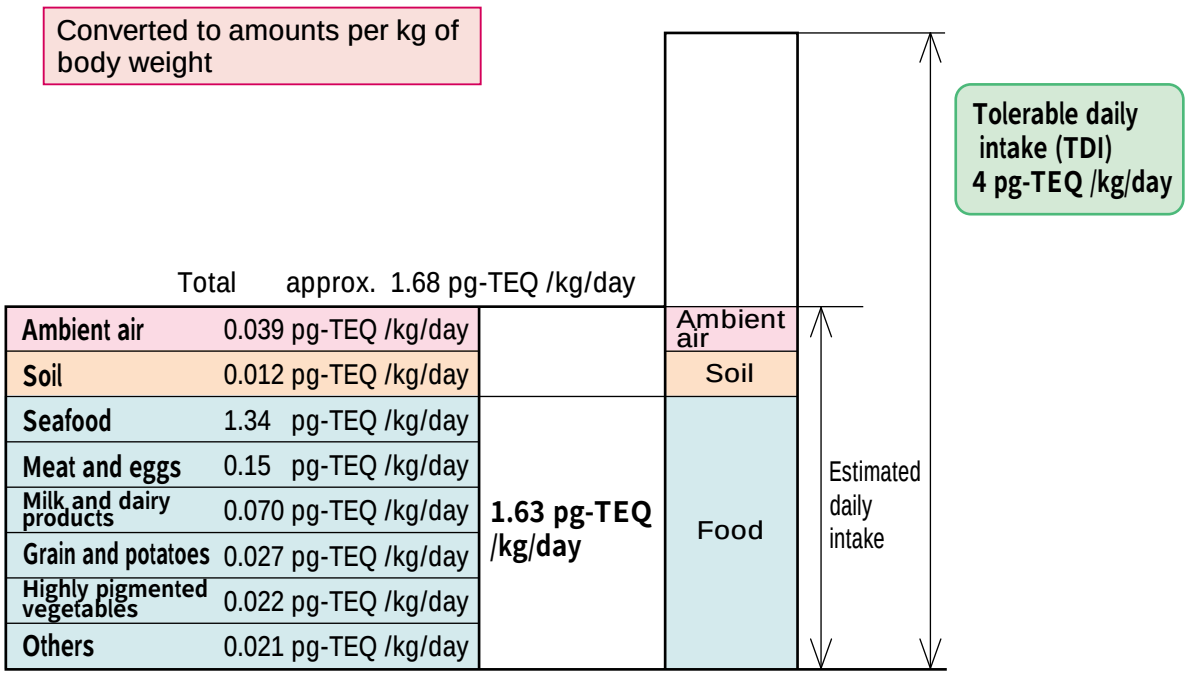
Once dioxins are absorbed in body, these compounds remain mostly in the adipose tissue. The rate of excretion after decomposition etc. of dioxins is very slow. It is reported to take about seven years for dioxin concentrations to be reduced one half in humans.

4 It is important to maintain a balanced diet over the long term not to exceed the TDI, an index for safety

Concentrations of dioxins vary by food items and by location and seasons of production even for the same type of food. For this reason, the intake through the regular diet is thought to be lower than the TDI when averaged over a long period of time and no problem is likely to emerge even if intake on a particular day exceeds the TDI of 4 pg-TEQ/kg body weight/day.

According to the results of a Ministry of Health, Labour and Welfare survey on the daily intake of dioxins, the dioxin intake of a person eating the average diet (as defined in a national nutritional survey) is estimated to be below the TDI of 4 pg-TEQ/kg body weight/day. Since nutrients from various foodstuffs are essential for health, it is important to follow a balanced diet with an abundant variety of food items.

Figure 3 Daily Intake of Dioxins in Japan

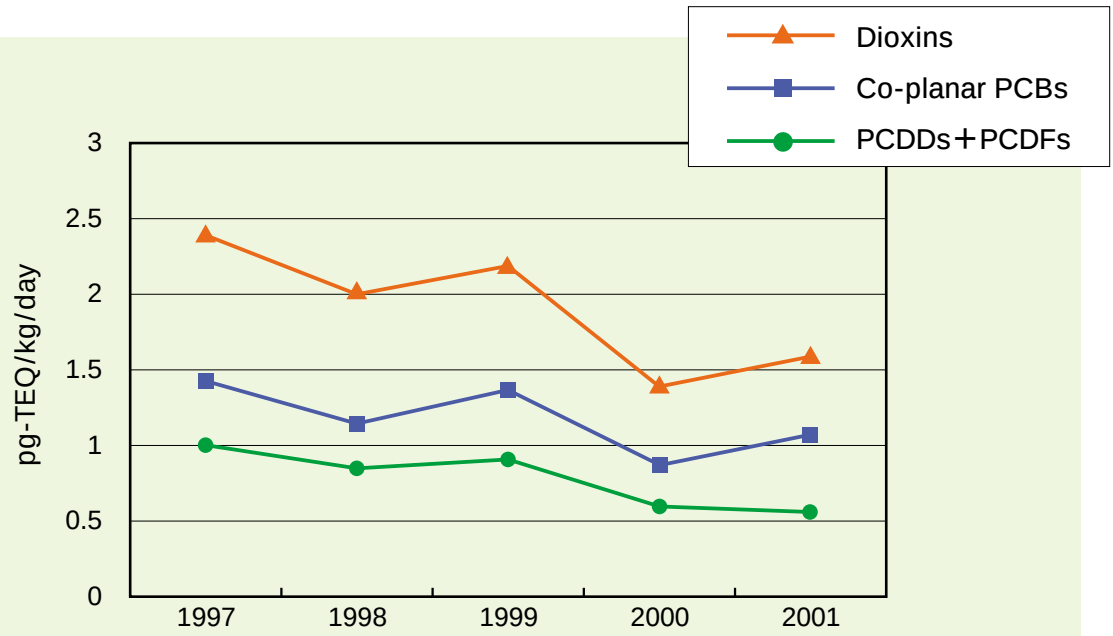


5 Intake of dioxins from food has decreased greatly since 20 years ago.

Specimens from past daily intake surveys in the Kansai region between 1977 and 1998, when analyzed for dioxins, indicated that daily intake of dioxins has dropped to almost one third for these 20 years (See Fig. 4).

Further decreases in the intake are expected as a result of measures to reduce dioxin emissions.

Figure 4 Chronological Change in Daily Intake of Dioxins from Food



Source: Ministry of Health, Labour and Welfare: Total Diet Study for Dioxins

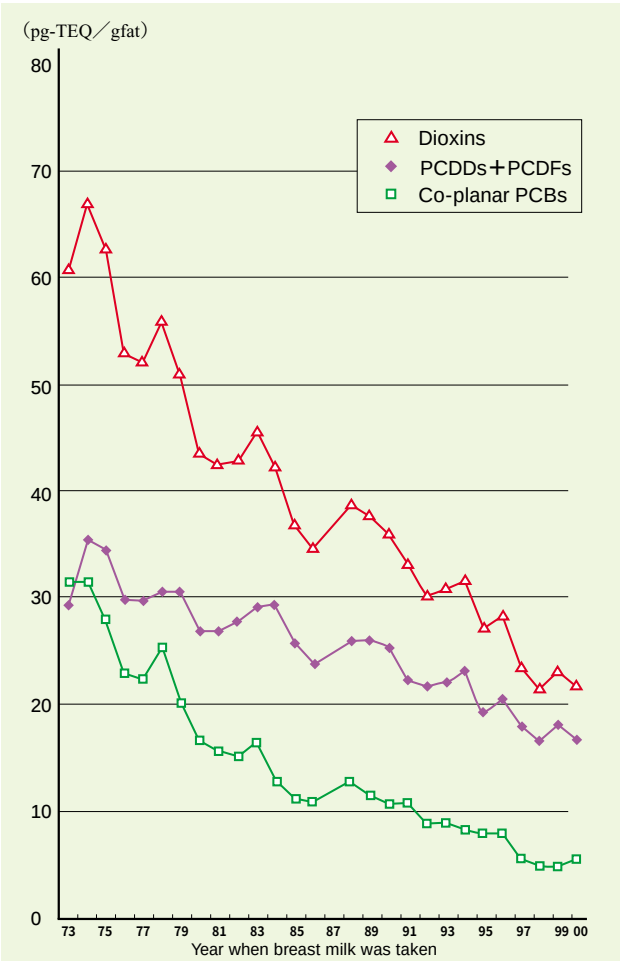
6 The concentration of dioxins in breast milk in Japan is almost the same as in other industrialized countries, and there are reports that describe the decline of dioxin concentrations to nearly half the level during the last 20 years. Breast-feeding should continue to be encouraged, considering the beneficial effects that it has on infants.

A concentration of 25.2 pg-TEQ/ 1 g of fat was found to be the average concentration of dioxins in mother's milk by a fiscal 1998 nationwide survey, which analyzed breast milk from 415 primipara mothers in 21 areas, 30 days after they gave birth. This concentration is considered similar to that of other countries. In addition, according to the survey of dioxins in breast milk conducted annually in six areas since fiscal 1998, the levels of dioxins show no change or slight decline depending on survey areas and years. No effects on resistance to infection, allergic reaction, thyroid functions or growth and development due to dioxins were observed in one-year old infants.

A study on dioxins in fat of breast milk preserved shows that dioxin concentrations have de-clined since 1973 to less than one-half level (See Fig. 5).

Further research is planed on the effects of dioxins ingested by infants via breast milk. Mean-while, breast-feeding should continue to be encour-aged, considering its beneficial effects on infant development. The WHO Consultation concluded similarly that there should be no change in the WHO policy of promoting breast-feeding.

Figure 5 Dioxin Concentrations in Breast Milk



Source: Health Labour and Welfare Scientific Study Project "Studies on Dioxins in Breast Milk"

5 What measures are being taken against dioxins?

1 Government ministries and agencies are working together to tackle dioxins issue through emission controls and improvement of waste incinerators.

It is assumed that about 90% of the dioxin emissions, of PCDDs and PCDFs in particular, are emitted from the incineration of household or industrial waste in Japan. Accordingly, measures such as emission gas controls on waste incinerators and other sources, and improvements of incineration facilities, have been imposed since December 1997 based on the Air Pollution Control Law and Waste Management and Public Cleansing Law.

In the meeting of the Ministerial Council on Dioxin Policy held on March 30, 1999, the Basic Guidelines of Japan for the Promotion of Measures against Dioxins were established (revised on September 28) and the Ministries and Agencies concerned are now diligently promoting various unified measures aiming for a significant reduction in dioxin emissions.

In particular, based on these Basic Guidelines, the total emission of dioxins is to be reduced by approximately 90% of the 1997 level by fiscal year 2002.

The Law Concerning Special Measures Against Dioxins (the Dioxins Law) was enacted in July 1999 and entered into force on January 15, 2000. This law stipulates basic standards for the measures concerning dioxins as well as necessary regulations or measures against polluted soil in order to prevent or remove environmental pollution caused by dioxins. Current measures against dioxins were implemented based on this law.

Outline of the Basic Guidelines of Japan for the Promotion of Measures against Dioxins

○ The total national release of dioxins is to be reduced to approximately 90% below 1997 level within four years.

○ Based on these Guidelines, in addition to smoothly executing the Law Concerning Special Measures against Dioxins which was enacted in July 1999, the Government will strongly promote the following measures in collaboration with local governments, business and citizens.

1. Reevaluating the Tolerable Daily Intake (TDI) and establishing standards
2. Promoting measures to reduce the release of dioxins
3. Improving inspection system relating to dioxins
4. Executing fact-finding studies into the impacts of dioxins on human health and environment
5. Promoting research and development
6. Promoting waste management and recycling
7. Providing the public with accurate information and promoting information disclosure
8. Contributing to the international community

Law Concerning Special Measures Against Dioxins (The Dioxins Law)

[Approved on Monday, July 12, 1999 and promulgated on Friday, July 16, 1999.]

Outline of the Law

1. Basic standards for formulating policies on dioxins
   1) Tolerable daily intake (TDI) (Article 6)
   2) Environmental standards for ambient air, water quality (including sediment) and soil (Article 7)
2. Regulations for emission gas and effluent relating to dioxins
   1) Specified facility (Article 2)
   2) Emission standards (Article 8)
   3) Total mass emission standards (Article 10)
   4) Notification of the establishment of specified facilities/Order for modification of plans (Articles 12-16)
3. Disposal of ash and dust relating to waste incinerators, etc.
   1) Standards for ash and dust (Article 24)
   2) Standards for maintenance and management of final landfill site of wa5) Restriction on emissions/Order for improvement (Articles 20-22) ste (Article 25)
4. Measures against soil contamination by dioxins (Articles 29-32)
   1) Designation of the areas for the measures against soil pollution by dioxins (Article 29)
   2) Plan formulation for the measures against soil pollution by dioxins (Article 32)
5. Government plan for the reduction of dioxin emissions (Article 33)
6. Obligations for monitoring and surveillance of the level of pollution caused by dioxins (Articles 26-28)
   1) Regular monitoring by the local governments (Article 26)
   2) Measuring the specified facilities by the persons who established it. (Article 28)
7. Date of enforcement (Supplementary provisions Article 1)
8. Review (Supplementary provisions Articles 2-3)
   - Promotion of research and study of bromine-based dioxins
   - Reviews based on scientific knowledge by taking into consideration the health risk and accumulation of dioxins in food
   - Reviews on the state of regulations for small-scale waste incinerators

Basic Standards for the Measures Concerning Dioxins

The Dioxins Law stipulates the tolerable daily intake (TDI) and environmental quality standards as basic standards for the measures.

Tolerable daily intake (TDI) 4 pg-TEQ/kg/day (4 pg per day for each kg of body weight).
Environmental quality standards

for the ambient air	annual average: not more than 0.6 pg-TEQ/m3
for the water	annual average: not more than 1 pg-TEQ/L
for the sediment	not more than 150 pg-TEQ/g
for the soil	not more than 1,000pg-TEQ/g (survey level: 250pg-TEQ/g)*

* If the soil monitored exceeds the survey level, an additional survey will be conducted.

Regulations for Emission Gas and Effluent Relating to Dioxins

The control standards for dioxins for the emission gas and effluent have been set in the Dioxins Law at the strictest values achievable at present.

1) Emission standards

(Unit: ng-TEQ/m^3 N)

Type of Specified Facilities	Scale of facilities (Capacity of incineration)	Standards for new facility	Standards for existing facility	
			January 2001~ November 2002	December 2002~
Waste incinerators (hearth area is more than 0.5 m2 or capacity of incineration is more than 50 kg/h)	More than 4t/h	0.1	80	1
	2t/h — 4t/h	1		5
	Below 2t/h	5		10
Electric steel-making furnaces		0.5	20	5
Sintering facilities for steel industry		0.1	2	1
Facilities for collecting zinc		1	40	10
Facilities for manufacturing aluminum base alloy		1	20	5

Note: Regarding newly constructed waste incinerators (capacity is more than 200kg/h) and electric steel-making furnaces to which the standards for controlling designated materials in the Air Pollutions Control Law have already applied, emission standards in the above chart for a new facility are applied.

2) Effluent standards

(Unit: pg-TEQ/L)

Type of Specified Facilities	Standard
・ Bleaching facilities using chlorine or chlorine compounds used for manufacturing sulfate pulps (kraft pulps) or sulfite pulps. ・ Cleansing facilities for acetylen used for manufacturing acetylene by carbide method ・ Cleansing facilities for waste gas used for manufacturing potassium sulfate ・ Cleansing facilities for waste gas used for manufacturing alumina fiber ・ Cleansing facilities for dichloroethane used for manufacturing vinyl chloride monomer* ・ Sulfuric acid concentration facilities, cyclohexane separation facilities, and waste gas cleansing facilities used for manufacturing caprolactam (limited to using nitrosyl chloride) ・ Water washing facilities and waste gas cleansing facilities used for manufacturing chlorobenzene or dichlorobenzene ・ Nitro-derivative and its reductant separation facilities, nitro-derivative and its reductant cleansing facilities, dioxazineviolet cleansing facilities, and hot-air drying facilities used for manufacturing dioxazineviolet ・ Cleansing facilities for waste gas and wet dust collecting facilities relating to roasting furnaces, melting furnaces or dry kilns used for manufacturing aluminum or aluminum—base alloy ・ Refining facilities, waste gas cleansing facilities, and wet dust collecting facilities used for collecting of zinc (limited to zinc collection from dust that is generated from electric steel-making furnaces and collected by dust-collector) ・ Cleansing facilities, wet dust collecting facilities, and ash storing facilities which are related to waste incinerators (hearth area is more than 0.5m2 or capacity of incineration is more than 50kg/h) and discharge sewage or waste solution* ・ Resolving facilities for waste PCB or PCB-processed products ・ Cleansing facilities for PCB contaminated matter or PCB-processed products ・ Facilities for disposing water discharged from plants or business places with facilities mentioned above ・ Terminal treatment facilities for sewerage relating to facilities mentioned above	10

Note 1: The standard relating to water discharged from terminal waste disposal facilities is 10pg-TEQ/L based on instructions stipulating standards for maintenance and management based on the Wastes Disposal and Public Cleaning Law.

Note 2: The provisional standards used to be applied for three years until January 14, 2003 for facilities with asterisk (20 pg-TEQ/L or 50 pg-TEQ/L).

The Government's Dioxins Reduction Plan

The Government formulated "the plan for reducing the release of dioxins generated by business activities in Japan" based on the Dioxins Law in September 2000. This plan sets the target amount of reducing dioxin release at the end of fiscal 2002 (843~891g-TEQ/year) and the target amount of reducing dioxin release of each business sector, and also stipulates measures to achieve those targets. This means that the policy objective to reduce dioxin emissions by approximately 90% included in the Basic Guidelines of Japan for the Promotion of Measures against Dioxins has been positioned in the legally-based plan.

1. Reduction targets relating to the estimated amount of dioxin emissions categorized by type of business activity in Japan
2. Points relating to essential measures for businesses to take in order to achieve reduction targets
3. Points relating to essential measures to be taken by the national and local governments to promote the recycling and reuse of resources, and to reduce waste which could cause dioxin emissions
4. Other necessary points relating to the reduction of dioxins resulting from business activities in Japan

Establishment of Sediment Quality Standard for Dioxins

1. Dioxins sediment quality standard

The Ministry of the Environment, based on the Dioxins Law, stipulated the sediment quality standard for dioxins on July 22, 2002. This standard is set for the target value to carry out remedial measures. When the sediment exceeding the standard is found, the contaminated area will be identified through the survey around there, and then remedial measures such as dredging will be conducted.

2. Standard value

(a) The following two methods were employed to decide the standard value.

- Using a formula on the relationship between sediment and pore water, the standard value is calculated as dioxin contents in the sediment where the dioxins concentration of its pore water is equal to that of the environmental quality standard for water (the equilibrium partitioning method).
- Through an experiment of shaking water and sediments containing high level of dioxins, the standard value is derived from the dioxins level in the sediment where dioxins concentration in the water in the shaking device is equal to that of the environmental quality standard for water on dioxins.

(b) Taking into the results from these two methods, the standard value was decided as 150 pg-TEQ/g.

3. Application

The dioxins sediment quality standard is applied to all of public water bodies while its compliance with the standard is judged site by site.

4. Remedial measures

Assessing each contaminated site, an environmentally sound remedial measure will be employed such as dredging, on-site solidification with concrete and covering with sand.

2 Ministries and Agencies concerned are cooperating to promote studies for further elucidation of human exposure levels, research on assessment of health effects, technological developments for proper waste management, cleaning of contaminated soil, detoxification and decomposition of contaminants and improvement of the inspection system

The Government formulated the comprehensive plan for research and surveys, and technological developments based on the "Basic Guidelines of Japan for the Promotion of Measures against Dioxins" in March 2000. Based on this, at present, the Government is conducting research and surveys on the environmental fate of dioxins (behavior of dioxins from the environmental release to human intake), human exposure assessment (grasping the amount of dioxins taken by human via various routes), and assessment of health effects and impacts on living organisms. At the same time, the Government is working on technological developments relating to proper waste incineration, cleaning of contaminated soil, detoxification and decomposition of dioxins, precision management, and simple methods for measurement and analysis.

In addition, guidelines for which analysis authorities themselves will follow have been arranged in order to actualize eligible precision management and promote improvement of the inspection system. Guidelines which commissioned institutions and facilities will follow have been arranged so as to ensure reliability when analysis authorities commission external institutions and overseas facilities.

These research and development activities are promoted by the Ministries and Agencies concerned in a coordinated manner and their results will be fully utilized in measures for the reduction of dioxin emissions.

Measures for Workers Relating to Waste Incinerators

So as to prevent health effects imposed upon the workers at waste incineration sites and the workers who pull down waste incineration, various measures, such as education on safety and hygiene, selection of supervisors, use of proper protective equipment and measurement of dioxin concentration, have been taken. Efforts to familiarize and enforce those measures have been made.

Yusho and PCBs/Dioxins

Yusho occurred in 1968 mostly in Kyushu. At that time, PCBs were considered to have caused Yusho. However, following research works revealed that contaminated rice oil contained not only PCBs but also several chemicals including PCDFs and PCDDs.

Present scientific knowledge shows that PCBs has 209 congeners, PCDFs 135, and PCDDs 75. But there was no clear understanding of dioxins around 1975 although TCDD was researched as a dioxin. Thus almost nothing was found out about toxicity and nature of PCDF and PCDD.

In 1988, NATO set TEFs for some of PCDDs and PCDFs, and then total toxic amount calculated by TEFs was called TEQ. This means that some kinds of PCDDs and PCDFs were internationally understood as dioxins.

Some kinds of PCDDs and PCDFs were officially recognized as dioxins in 1996 in Japan too. So were some PCBs in 1999.

Once PCB and dioxins are taken into a Yusho patient, they are gradually discharged from the body through bowel, skin, breast milk and sputum, and their concentration in the body decreases. As dioxins in the body were trace, it has been difficult to measure them accurately. However the research group has recently made it possible to analyze dioxins in a small amount of blood sample. It still remains mostly unclear how PCBs and dioxins affect human health.

The Ministry of Health, Labor and Welfare has examined Yusho patients since Yusho incident occurred. Based on the scientific data and knowledge gained from these examinations, the ministry now reassesses the Yusho examination guideline, and plans to increase items for the examination.

Stockholm Convention on Persistent Organic Pollutants (POPs Convention)

Among chemicals toxic to humans, some remain intact in the environment for long periods, and accumulate in the fatty tissue of living organisms. They are called Persistent Organic Pollutants (POPs). POPs circulate globally and can cause damage to the environment in many countries. Therefore every government in the world needs to cooperate in tackling POPs issue.

As the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) was adopted in May 2001, global action against POPs began. Japan acceded to this convention in August 2002. POPs Convention requires each Party to reduce as much as possible or eliminate if possible the unintentionally produced dioxins.

6 What can we do to limit dioxin release in everyday life?

1 The most important matter is that each of us becomes concerned with dioxin issues, tries to reduce waste by using products as long as possible and by avoiding the use of disposable goods, and takes part in reuse, segregated disposal and recycling

Since dioxins are generated in combustion processes, reducing the amount of waste is an effective way to lessen dioxin release.

Accordingly, six related laws for waste/recycling such as the Basic Law for Establishing the Recycling-based Society Enacted were established in June 2000. These laws set to avoid generating waste, to reuse waste as resources, and to dispose of wastes that are impossible to reuse as resources in proper ways without causing dioxin release. From now on, it is most important for each of us to become concerned with dioxin issues, try to reduce waste by using products as long as possible and by avoiding disposable goods, and taking part in reuse, segregated disposal and recycling.

It has been reported that the incineration of waste containing chlorine, such as polyvinyl chloride, may result in higher concentrations of dioxins in some cases if the incineration is not properly controlled. However, if appropriate measures and controls are taken, the influence of polyvinyl chloride and other chlorine compounds in waste becomes a relatively smaller factor, and on the other hand, the combustion and waste-gas treatment conditions become more important factors affecting the concentrations of dioxins. Accordingly, dioxin concentrations in emissions can be limited by adopting the proper measures and controls.

2 Burning waste outside is prohibited in principle. Small-scale incinerators, to which emission controls do not apply, is also regulated. Your cooperation is strongly requested

Since April 2001, by revision of the Waste Management and Public Cleansing Law, there is a prohibition and penalty against burning waste outside with some inevitable exceptions such as events of customs and burning for agricultural work.

Small-scale incinerators, to which emission standards are not applied, need to be able to burn at 800 degrees and higher and the structure must include a thermometer and devices for supporting combustion.

At present, the Ministry of Education, Science, Sports and Culture has instructed to halt the use of incinerators at schools unless their safeties are ensured.

In view of reducing the total amounts of dioxins, the incineration of household waste using simple incinerators for home use is not appropriate. It is desirable that the waste be treated at municipal incineration facilities that meet legal standards. For the disposal of household waste, your cooperation is highly requested in efforts to dispose of waste according to the rules of the municipality such as segregated disposal.

Structural Standards for Waste Incinerators (Article 1-7, Order of the Ministry of the Environment under the Waste Management and Public Cleansing Law)

1. Municipal solid waste shall be incinerated inside equipment from which the outer air shall be shut out except the air intake and the tip of the chimney and with maintaining the surface temperature of combustion gas generated in the combustion chamber at 800 degrees centigrade or more.
2. The amount of air shall be taken for incineration.
3. Waste shall be put into the combustion chamber by a set amount with maintaining the outer air of being shut out from there (except those taking gasified incineration method or others which are recognized that there is no other way due to its structure).
4. A facility shall be equipped with a device to measure the temperature of the combustion gas in the combustion chamber.
5. A facility shall be equipped with an auxiliary combustion device necessary to keep the temperature of the combustion gas.

Please address your opinions and inquiries to:

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