Material

Prevention Measures of Dioxins

—— Dioxins Pollution and Countermeasures ——

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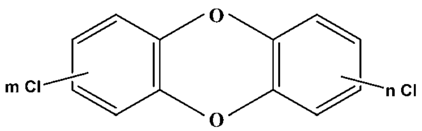
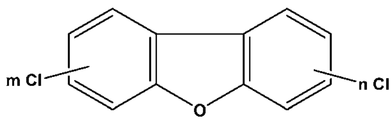
I. Dioxins and Pesticides

Dioxin is the generic term for 75 types of isomer known as PCDDs (polychlorinated dibenzo dioxins) and 135 types of isomer known as PCDFs (polychlorinated dibenzo furan). 2-3-7-8 TCDD (tetrachlorinated dibenzo dioxin) one of the PCDDs, is the most toxic of all dioxins. Dioxin measurements are expressed as the TEQ (Toxic Equivalents Quantity) by converting the amounts of detected isomers into the amount of 2-3-7-8 TCDD. Co-PCB (Coplanar Polychlorinated Biphenyls) are also similar to dioxins and consist of 12 types of isomer.



PCDDs
Polychlorinated Dibenzo Dioxins
75 isomers (4 to 5 chlorines)



PCDFs
PolyChlorinated Dibenzo Furans
175 isomers

Accident case 1: A gricultural chemical plant explosion at Seveso, Italy TCDD$_{s}$,which were spontaneously mixed into the manufacturing process of 2,4,5-T pesticide as impurities,were discharged into the environment

Accident case 2: Massive environmental pollution by dioxins was caused by the large-scale scattering of 2,4,5-T in defoliation operations by the American military during the Vietnam War.

1 to 6 chlorides

Production was suspended in 1972.

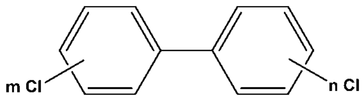
(Accident case 1)

Kanemi oil poisoning incident in Kitakyushu region from March 1968 to the first half of 1970:

Kanekrol 40 (PCB) mixed into rice sugar oil.

(Accident case 2)

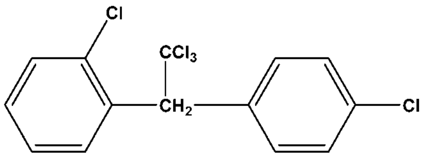
Multiple laborers at a condenser plant suffered from poisoning.



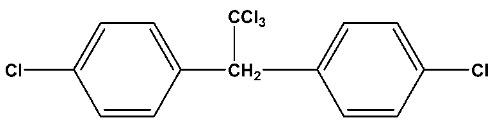
PCBs
Polychlorinated Biphenyls

From the 1960 to the first half of the 1970s, pesticides (organochlorines) were the predominant source of dioxins.Orgnochlorine pesticides such as DDT, BHC and hexachloro cycrohewane were used in large quantities around this time, and these included, dioxins typified by 2,3,7,8-TCDD thatwas spontaneously produced in the manufacturing stage. Around that time, however, little was understood about the environmental and health risks of these substances. Their extreme toxicity and impact on human health were brought into focus as a result of the defoliation tactics used in the Vietnam War that came to an end in 1973. The American military scattered large quantities of “orange”- a compound made from the organochlorine pesticide 2,4,5-T (2,4,5-trichloro phenoxy acetic acid) and 2,4-D (2,4-dichloro phenoxy acetic acid). This 2,4,5-T contained large amounts of dioxin impurities, thought to be the cause of various detrimental effects on human health which started appearing around this time. In Vietnam, numerous cases of liver cancer were recorded; many malformed babies with problems such as bigeminal bodies and anencephalia were born, and there was a spate of stillbirths and miscarriages. In America, too, numerous instances of abnormal births by the wives of returning soldiers became a major social issue.

In 1976, an explosion at an agricultural chemical plant manufacturing 2,4,5-T at Seveso in Italy scattered large amounts of dioxins over the surrounding area, leading to health problems among thousands of local citizens.

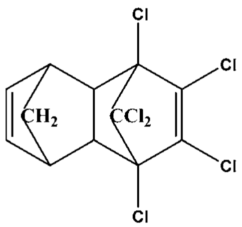


A. op'-DDT
MW 354.48

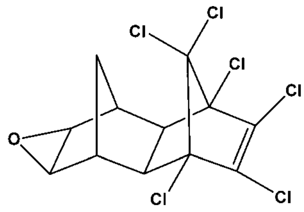


B. pp'-DDT
MW 354.48

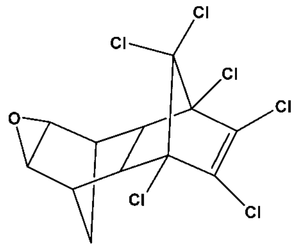
DDT : Dichloro Diphenyl Trichloroethane



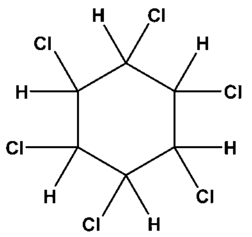
Aldrin



Endrin
2

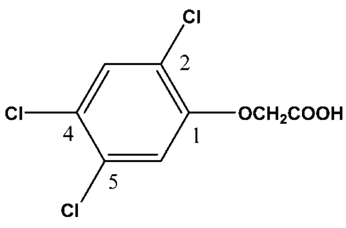


Dieldrin



HCH
Hexachloro Cyclohexane
MW 290.82

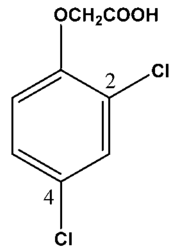
(Organochlorone Pesticide)



2,4,5-T (Weed Killer)
2,4,5-Trichloro Phenoxy Acetic Acid

Dioxins are produced as impurities in the manufacturing process. These include the particularly toxic 2,3,7,8-TCDD

Manufacture was discontinued 1974.



2,4-D
2,4-Dichloro Phenoxy Acetic Acid
MW 221.04

Measures to prohibit use are still not adopted.
Infiltration by dioxins is minor.

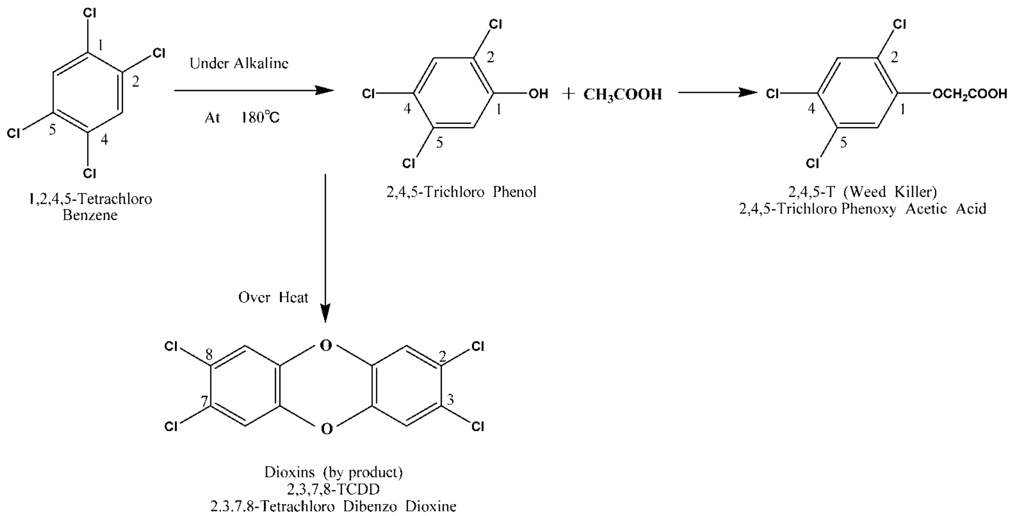
The large-scattering of organochlorine pesticides and accidents involving such substances led to the release of dioxins into the environment, and these dioxins remained and accumulated in the environment over time. Moreover, because dioxins are fat-soluble substances, they become consentrated in living fat at extremely high factors in each stage of the food chain. Having said that, advanced nations have banned the manufacture and use of problematic organochlorine pesticides, so additional environmental loads from these sources are being mitigated.

As another important source of dioxins, scientists in the Netherlands in 1977 discovered that high concentrations were generated from city waste incineration plants. When waste containing organochlorine compounds is incinerated at temperatures of 500°C or less, it was found that the dioxin forequarter quickly combines with the chlorine in order to generate dioxins. This discovery triggered a wave of legislative measures to encourage research and curb emissions throughout the world.

In Japan, a research team from Ehime University in 1983 sampled and measured incinerator fly ash and bottom ash from 12 city waste incineration plants throughout Japan, and their findings indicated high concentrations of dioxins at all 12 facilities.

II. Spontaneous formation of dioxins

(1) Formation through manufacturing herbicide



(2) By-products during PCBs production, & generation of PCDFs due to thermal reaction

*: By-products during PCBs production

When production is done with chlorine added to biphenyl at high temperatures, PCDFs is created through reactions in generated PCB. This reaction progresses further as temperature rises.

**: Generation during building fires

Old buildings still have transformers which use PCBs for electrical insulation. When fires break out in such buildings PCBs undergo thermal reactions, generating PCDFs. This becomes soot and dust which causes atmospheric pollution.

(3) Formation through disposal of waste

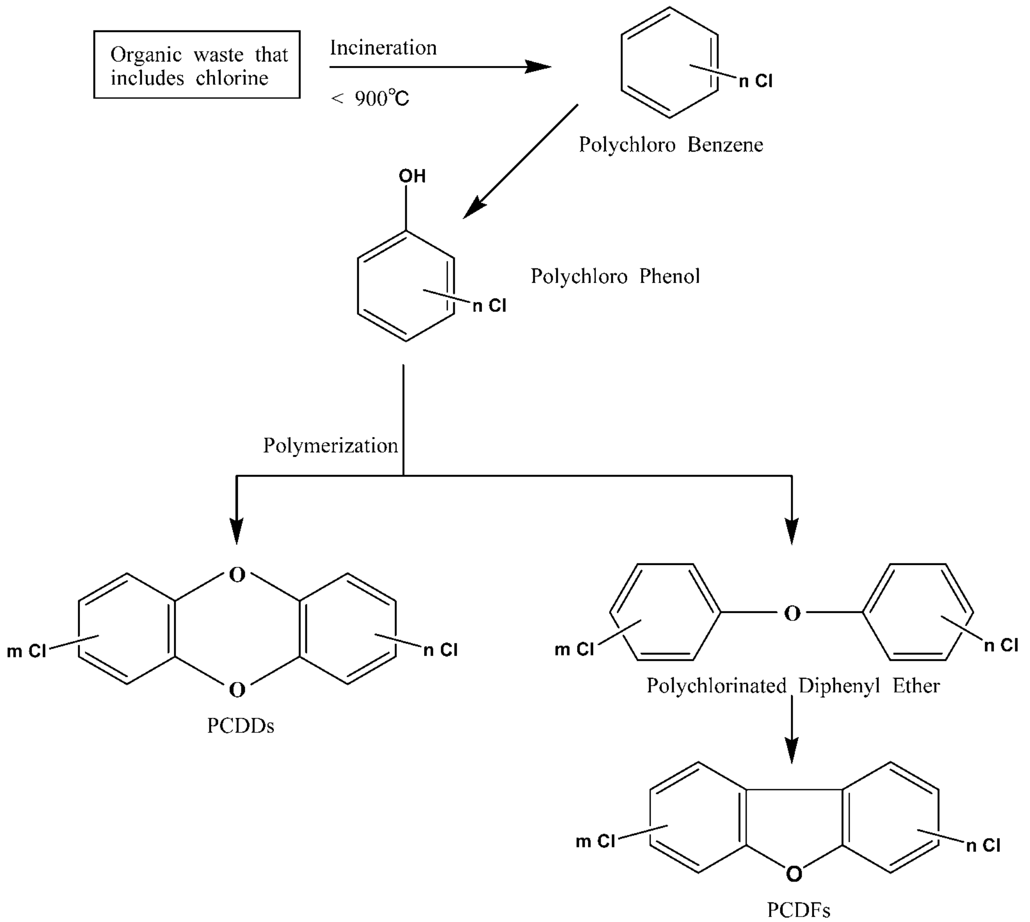
Development mechanism during the combustion of waste

*: General waste in Japan contains 1% chlorine. 30% of this is water-soluble chlorine, such as NaCl, which does not contribute to the formation of dioxins. The remaining 70% is combustible chlorine, which is included in polychlorinated vinyl, paper, pigments, and color inks. This combustible chlorine contributes to the formation of dioxins.

**: Generally, if waste is incinerated at temperatures of 900°C or higher, diozins are not formed, and those that were formed at lower temperatures are decomposed.
Problems arise when incomplete combustion occurs due to a lack of oxygen. It has been shown that polychloro benzene, aprecursor in the formation of dioxins, will form even at temperatures as high as 1100°C if there is a lack of oxygen.

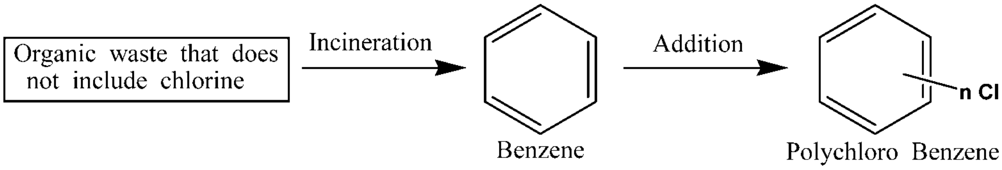
***: The production of high-density dioxins at urban waste incineration facilities was first shown by K.Olie in the Netherlands in 1977.
In Japan, high-density dioxins were detected in the incineration ash and fly ash from urban waste incineration facilities in 12 locations nationwide in 1983.

Formation from the incineration of organic waste that includes chlorine



Formation from the incineration of organic waste that does not include chlorine

In cases where benzene is produced during the incineration process, the presence of combustible chlorine results in its addition to benzene, producing the precursor polychloro benzene.



Incineration temperature (CO density), small incineration facilities (intermittent furnaces), and large facilities (continual furnaces)

In intermittent furnaces, the starting and stopping of furnaces causes the furnace temperature to drop. This results in an environment where incomplete combustion is likely to occur, resulting in an increase in the volume of dioxins formed.

III. Method for indicating dioxin density, and dioxin isomers

TEF Toxicity Equivalency Factor: 2,3,7,8-TCDD

This factor indicates the toxicity of isomers relative to the toxicity of 2,3,7,8-TCDD (the most toxic dioxin; assigned a value of 1).

TEQ Toxicity Equivalency Quantity: 2,3,7,8-TCDD

This is the total concentrations found by multiplying the (TEF) assigned to the measured concentration (C) for each isomer.

$$\sum_{i=1}^{29} (C)i \times (TEF)i$$

Units : (pg・TEQ / ℓ or m^3 or g)

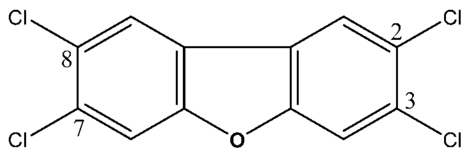
TDI Tolerable Daily Intake

This indicates the amount of dioxin intake per day that can occur throughout lifetime without abnormal effects to health.

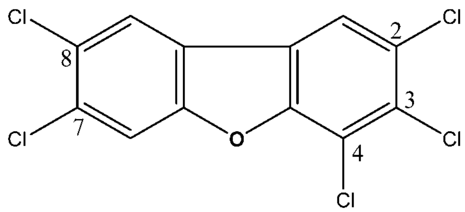
Units : (TEQ / kg・weight / day)

Chemical Structure for Tipical Dioxins with high Toxic Equivalence Factors

PCDFs (10 Isomers)

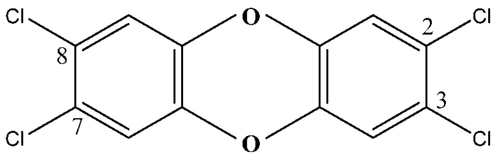


2,3,7,8-TeCDF
(TEF=0.1)

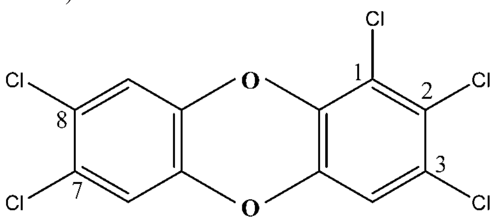


2,3,4,7,8-PeCDF
(TEF=0.5)

PCDDs (7 Isomers)

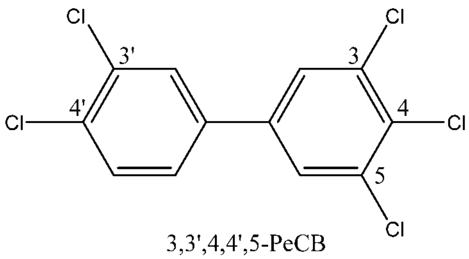


2,3,7,8-TeCDD
(TEF=1)



1,2,3,7,8-PeCDD
(TEF=1)

Co-PCBs (12 Isomers)



3,3',4,4',5-PeCB
(TEF=0.1)

$PCDD_s$

Number of Cl		Number of isomers
1 (Mono)	$MCDD_s$	2
2 (Di)	$DCDD_s$	10
3 (Tri)	$TCDD_s$	14
4 (Tetra)	$TeCDD_s$	22
5 (Penta)	$PeCDD_s$	14
6 (Hexa)	$HxCDD_s$	10
7 (Hepta)	$HpCDD_s$	2
8 (Octa)	OCDD	1
		Total 75

$PCDF_s$

Number of Cl		Number of isomers
1 (Mono)	$MCDF_s$	4
2 (Di)	$DCDF_s$	16
3 (Tri)	$TCDF_s$	28
4 (Tetra)	$TeCDF_s$	38
5 (Penta)	$PeCDF_s$	28
6 (Hexa)	$HxCDF_s$	16
7 (Hepta)	$HpCDF_s$	4
8 (Octa)	OCDF	1
		Total 135

PCB_s

Number of Cl		Number of isomers
1 (Mono)	MCB_s	3
2 (Di)	DCB_s	12
3 (Tri)	TCB_s	24
4 (Tetra)	$TeCB_s$	42
5 (Penta)	$PeCB_s$	46
6 (Hexa)	$HxCB_s$	42
7 (Hepta)	$HpCB_s$	24
8 (Octa)	OCB_s	12
9 (Nona)	NCB_s	3
10 (Deca)	DeCB	1
		Total 209

IV. Toxic equivalence factors for dioxins

1. Polychlorinated Dibenzofurans ($PCDF_s$) and Polychlorinated Dibenzo-p-Dioxins ($PCDD_s$)

$PCDF_s$		$PCDD_s$	
Isomer	Toxic equivalence factor	Isomer	Toxic equivalence factor
2,3,7,8-TeCDF	0.1	2,3,7,8-TeCDD	1
1,2,3,7,8-PeCDF 2,3,4,7,8-PeCDF	0.05 0.5	1,2,3,7,8-PeCDD	1
1,2,3,4,7,8-HxCDF 1,2,3,6,7,8-HxCDF 1,2,3,7,8,9-HxCDF 2,3,4,6,7,8-HxCDF	0.1 0.1 0.1 0.1	1,2,3,4,7,8-HxCDD 1,2,3,6,7,8-HxCDD 1,2,3,7,8,9-HxCDD	0.1 0.1 0.1
1,2,3,4,6,7,8-HpCDF 1,2,3,4,7,8,9-HpCDF	0.01 0.01	1,2,3,4,6,7,8-HpCDD	0.01
1,2,3,4,6,7,8,9-OCDF	0.0001	1,2,3,4,6,7,8,9-OCDD	0.0001
Others	0	Others	0

2. Coplanar polychlorinated biphenyl ($CO\text{-}PCB_s$)

Isomer	Toxic equivalence factor
3,4,4',5-TeCB 3,3',4,4'-TeCB 3,3',4,4',5-PeCB 3,3',4,4',5,5'-HxCB	0.0001 0.0001 0.1 0.01
2',3,4,4',5-PeCB 2,3',4,4',5-PeCB 2,3,3',4,4'-PeCB 2,3,4,4',5-PeCB 2,3'4,4',5,5'-HxCB 2,3,3',4,4',5-HxCB 2,3,3',4,4',5'-HxCB 2,3,3',4,4',5,5'-HpCB	0.0001 0.0001 0.0001 0.0005 0.00001 0.0005 0.0005 0.0001

Note: The toxic equivalence factors given in Tables 1 and 2 above are identical to those proposed by the World Health Organization (WHO) in 1997 and included in WHO-TEF's 1998 Environmental Health Perspective.

V. Dioxin Effects and Handling by the Government of Japan

On hearing this, the Ministry of Health and Welfare set up a conference of experts on dioxins from waste disposal, etc. and set to work on assessing the risks of dioxins.

From 1997 onwards, the government issued a series of documents concerning dioxin countermeasures and revised related legislation in an effort to reinforce countermeasures.

In August 1997, the Ministry of Health and Welfare announced partial revisions to cabinet orders and the ministerial orders based on the Waste Disposal Law, in order to curb dioxin emissions in line with waste incineration. In line with this, incineration facility operation and maintenance standards and the scope of permission pertaining to small-scale facilities underwent review and there was a complete tightening of regulations concerning standards for dioxin concentration in exhaust gases.

The Environment Agency in May 1996 revised enforcement regulations of the Air Pollution Control Law, and in doing so implemented the monitoring survey of harmful air pollutants. This periodic survey of 16 priority chemical substances including the 3 designated substances of benzene, trichloro ethylene and tetrachloro ethylene was simultaneously implemented at 15 government-operated monitoring points, prefectures and ordinance-designated cities throughout Japan from the second half of 1997.

Next, in response to a report from the Central Environment Council concerning measures to control dioxin emissions, the Environment Agency carried out further revision to the Air Pollution Control Law enforcement regulations. In this, as well as adding dioxins to the 3 designated substances in the above-mentioned monitoring survey, it established an average figure of 0.6 pg-TEQ/m^3/N as a guideline for air environmental concentration in the implementation of measures in the immediate future.

In recent years, dioxin contamination of surrounding soil by waste incineration facilities such as Tokyo Beautification Center in Osaka Prefecture has become a major problem on the nationwide scale. In view of this, the Environment Agency announced a 5-year plan of dioxin countermeasures from the viewpoints of preventing impacts to human health and the ecosystem in August 1997. Based on this, it proposed to implement source countermeasures and overall monitoring (air, water, soil, and bottom sediment) with a view to assessing environmental risk for 5 years from 1998.

Prior to this, in 1996 Japan adopted a TDI or tolerable daily intake, i.e. the amount that can be consumed every day throughout a lifetime without affecting health, with a view to focusing on the human health impact of dioxins.

Specifically speaking, the Ministry of Health and Welfare adopted a TDI of 10 pg-TEQ/kg bw/day in accordance with the WHO standard, while the Environment Agency set a figure of 5 pg-TEQ/kg bw/day as an assessment indicator of health risk. Incidentally, in the United States, where regulations are the most stringent, TDI is set at 0.01 pg-TEQ/kg bw/day, whereas Germany, which also as a strong interest in dioxins, has adopted a value of 1 pg-TEQ/kg bw/day.

In these circumstances, the WHO conference of experts on the health risks of dioxins revised its TDI standard was underpinned by the placing of greater emphasis on the behavior or dioxins as environmental hormone-like chemicals in minute quantities.

Currently, 90% of dioxins are said to originate from waste incineration facilities, while 70% of dioxin consumption into the human body is said to come through fish and shellfish. Thus, there are growing calls for standards pertaining to food including cow's milk, as well as the implementation of blood and breast milk inspections in order to investigate effects on the human body. Countries in Europe and America have already established standards for cow's milk, etc., and the Ministry of Health and Welfare has commenced work with a view to setting standards for foodstuffs in Japan too.

The Environment Agency has implemented water quality surveys concerning dioxins every year since fiscal 1990 at 12 rivers and water bodies throughout Japan; also, it commenced the emergency nationwide survey of dioxins in fiscal 1998 in order to conduct detailed investigations of water quality, air, soil, and bottom sediment, etc.

At the Ministry of Health and Welfare, a total of more than 76 billion yen was authorized under the first revised budget of fiscal 1998 as expenditure for waste disposal-related dioxin countermeasures, i.e. countermeasures at the source. This budget mainly targeted expenditure for construction of waste incineration facilities to counter dioxins, i.e. national treasury subsidies for converting old-type incinerators suspected of emitting dioxins into new high-temperature combustion models, as well as expenditure for the appropriate closure of illegal disposal sites, i.e. national treasury subsidies for countermeasures at waste final disposal sites.

It was in these circumstances that the Government of Japan enforced the Law Concerning Special Measures against Dioxins in January 2001. This law lays down standards acting as basic guidelines for measures (environmental standards for air, water quality, and soil, and emissions standards for waste gases and wastewater from waste incineration plants and other designated facilities), and prescribes regulations concerning waste disposal, fact-finding surveys of pollution conditions, and compilation of reduction plans, etc. Article 6 of the law prescribes a tolerable daily intake (TDI) of 4 pg-TEQ/TDI. Environmental standards established in Article 7 of the same law are as follows.

Environmental Standards

Harmful Air Pollutants (February 1997)	**Annual average**
Benzen	0.003 mg/m^3
Trichloro ethylene	0.20 mg/m^3
Tetrachloro ethylene	0.20 mg/m^3
Dichloro methane (added in 2001)	0.15 mg/m^3
Law Concerning Special Measures against Dioxins (January 2000)	
Atmospheric environment:	0.6 pg TEQ/m^3
Water environment:	1.0 pg TEQ/ ℓ
Soil:	1000 pg TEQ/g
TEQ: Toxic Equivalents Quantity	
Tolerable daily intake:	4 pg-TDI

VI. Recent Developments Concerning Dioxins in Japan

June 1996: Interim report by the Ministry of Health and Welfare's research group on dioxin risk assessment.

Tolerable daily intake (TDI) of 10 pg-TEQ/kg bw/day was proposed for the immediate future. On receiving this, the Ministry of Health and Walfare announced implementation of fact-finding surveys into dioxin emissions from all waste incineration facilities run by local governments throughout the country and contamination of foodstuffs in general. Incidentally, approximately 90% of dioxin emissions in Japan are said to come from waste incineration, while 60% of human intake is said to come from consumption of fish.

December 1996: The dioxin risk assessment investigative commission of the Environment Agency announced an interim report designating 5 pg-TEQ/kg bw/day as the guideline index for health risk assessment.

Incidentally, in an announcement made in February 1998, the Environment

Agency stated that Japanese have an average dioxin intake of between 0.5 to 3.5 pg.

[Reference]

1 milligram (1 mg)	:	1/1000 g
1 microgram (1 μg)	:	1/1,000,000 g
1 nanogram (1 ng)	:	1/1,000,000,000 g
1 picogram (1 pg)	:	1/1,000,000,000,000 g

TEQ (Toxic Equivalents Quantity) :
Symbol indicating dioxin isomers converted into 2,3,7,8-tetraclorinated dibenzo dioxins, which are the most toxic dioxin isomers of all.

TDI (Tolerable Daily Intake):
The amount that can be consumed over a lifetime without causing harm. Expressed as TEQ/kg bw/day.

January 1997: Announcement of the guidelines for prevention of dioxin generation in waste disposal by the Ministry of Health and Welfare.

June 1997: Announcement of the 4th report (concerning harmful air pollutant countermeasures) concerning dioxin emissions control measures by the Central Environment Council of the Ministry of Health and Welfare.

August 1997: Revision and promulgation of the Waste Disposal Law enforcement regulations (cabinet order) and Waste Disposal Law enforcement rules (ministerial order) based on the Waste Disposal Law, in order to reduce dioxins generated in waste incineration, by the Ministry of Health and Welfare. These revisions came into force from December 1, 1997. These revisions of cabinet orders and ministerial orders were intended to achieve the following from the viewpoint of dioxin reduction:

① Review of structural and maintenance standards for incineration facilities;

② Review of the scope of permission, in order to strengthen regulations for small-scale facilities (expansion in application of structural and maintenance standards, i.e. broadening of permitted facilities, by reducing the disposal capacity requirement from 5 tons/day to 200 kg/hour).

③ Clarification of disposal standards for prevention of open incineration.

Standards for Dioxin Concentrations in Exhaust Gases (TEQ)

Disposal capacity of incineration chamber	Standard for new chamber establishment	Standard for existing chambers
4 t/h minimum	0.1 ng/m^3	1 ng/m^3
2 to 4 t/h	1 ng/m^3	5 ng/m^3
Less than 2 t/h	5 ng/m^3	10 ng/m^3

August 1997: On receiving the 4th report (concerning harmful air pollutant countermeasures) concerning dioxin emissions control measures by the Central Environment Council, the Ministry of Health and Welfare promulgated a cabinet order and notifications partially revising enforcement orders of the Air Control Law.

(1) Main points of the cabinet order (implemented from December 1, 1997)

① Concerning harmful air pollutants thought to be a health risk through low-concentration, long-term exposure, dioxins were added to benzene, trichloro ethylene and tetrachloro ethylene, which were already designated as substances requiring immediate control with respect to emissions and fly-off.

② Waste incinerators, etc. were designated as facilities emitting designated substances pertaining to dioxins based on the Air Pollution Control Law.

The air environmental standard to act as the guideline for implementing measures was prescribed as an annual average of 0.8 pg-TEQ/m^3/N or less.

(2) Main points of the notification establishing the designated substance control standard

① The designated substance control standard was set at the same level as the standard for dioxins concentration in exhaust gases based on the revised Waste Disposal Law by the Ministry of Health and Welfare.

Newly installed facilities discharging designated substances: implemented from December 1, 1997

Existing facilities discharging designated substances: implemented from December 1, 1998

Announcement of the 5-year plan of dioxin countermeasures by the Environment Agency to be effective for 5 years starting from 1998.

(1) Promotion of countermesures for generation sources, etc.

① concerning waste incinerators and steel making electric furnaces, implement regulatory measures based on the Air Pollution Control Law.

② Concerning other sources of atmospheric discharge, industrial wastewater and wastewater from waste disposal sites, etc., implement fact-finding surveys of emissions and examination of emissions control methods over 3 years.

③ Offer low-interest loans and preferential tax measures for exhaust gas disposal equipment, etc. in order to prevent emissions of dioxins.

(2) General monitoring survey

Implement urgent surveys on contamination in air, water quqlity, soil, bottom sediment and people for 3 years. After that, implement general monitoring.

(3) Study and research

Conduct study and research to ascertain the behavior of dioxins in the environment. Also, implement epidemiological research into the relationship between the atmospheric environment and impact on health.

(4) Promotion of common understanding

Conduct risk communication in order to promote the formation of common understanding among officials concerned with this problem.

May 1998: WHO conference of experts on the health risk s of dioxins

Concerning the tolerable daily intake, it was decided to revise this from 10 pg-TEQ/kg bw/day to between 1 to 4 pg-TEQ/kg bw/day.

since the Ministry of Health and Welfare had determined emergency countermeasures at waste incinerators based on the WHO TDI of 10 pg-TEQ/kg bw/day, it was expected to revise this standard in line with the new value adopted by the WHO.

The former WHO TDI value of 10 pg-TEQ/kg bw/day was adopted in 1990 based on risk of acute toxicity, i.e. it was not the subject of assessment from the viewpoint of environmental hormones. This toughening of the TDI standard was implemented because greater emphasis came to be placed on the behavior of dioxins as environmental hormones, which trigger effects in much smaller quqntities. For this reason, voices in European countries had called for the TDI to be cut to just one-tenth. In Japan, even going by the current standard, babies drinking breast milk intake any number of times the TDI. If the standard were to be reduced to one-tenth, it would mean that the average adult consumes more than the allowable intake (according to the Asahi Shimbun morning edition of May 30, 1998).

January 2000: Enforcement of the Law Concerning Special Measures against Dioxins

(other)

(1) Dioxins situation in the environmental atmosphere of Kobe City

Environmental concentrations in the atmosphere in Kobe City are 0.00 to 0.72 pg-TEQ/m^3/N

This was between 0.00 to0.94 pg-TEQ/m^3/N in areas around incineration facilities burning waste products in the aftermath of the Great Hanshin Earthquake disaster.

This value is not large compared compared to concentrations surveyed in the environmental atmosphere of Japan by the Environment Agency.

(2) Incineration of obsolete power lines

Recent reseach in Europe and Japan has clearly shown that concentrations of dioxins are multiplied by hundreds of times when metals such as copper (polyvinyl covering in the case of obsolete power lines) are mixed in and act as catalysts during incineration.

Dioxin concentrations at fire scenes during the Great Hanshin Earthquake were measured as 22,800 pg-TEQ/g in residual ash from burned out electrical stores. This was 2,500 times higher than the concentrations found in surrounding soil and 50 times higher than those measured in residual ash from the burned out remains of houses.

(3) High-concentration dioxins from blood

In blood sampling of 60 people aged between 20 and 60 within a 2 km radius of a waste incineration plant in the town of Shin-Tone in Ibaraki

Prefecture, extremely high concentrations of dioxins were detected in 18 subjects.

Maximum value (women) 460 pg/TEQ/1g of fat in blood
(men) 200 pg/TEQ/1g of fat in blood
Minimum value 22 pg/TEQ/1g of fat in blood

	Newborn infants	Infants	Children	Adults
Total fats in blood	221 mg/100 ml	470 mg/100 ml	600 mg/100 ml	360 to 380 mg/100 ml

- The average value found in surveys in Japan and other countries has so far been 20 pg/TEQ/1g of fat in blood. Figures exceeding 100 pg/TEQ/1g of fat in blood have only ever been witnessed in the aftermath of accidents at chemical plants, and so on.
- A research group from Setsunan University found 250 pg-TEQ/1g of dioxins in soil downwind from an incineration plant in June 1997.

(Note) Carcinogenic effects, cancer-accelerating effects, endometriosis, and teratogenesis, etc. have so far been pointed to as potential health risks of dioxins, however, scientific clarification is lacking in many cases.

Because dioxins are fat soluble, blood, breast milk, and body fat are targeted for analysis when investigating human contamination. Since fat content in blood is far smaller than compared to content in breast milk and body fat, it is technically difficult to conduct analysis. Accordingly, data concerning blood concentrations are still rare in the world.

The Ministry of Health and Welfare and Environment Agency have started investigating methods to ascertain the actual state of contamination in human bodies.

(4) Survey of breast milk in Nose, Osaka

In the town of Nose, where the highest concentrations of dioxins in Japan (peak value of 8500 pg-TEQ/1g of soil) were measured from soil around a waste incineration plant, a survey of breast milk was started from the middle of April 2000. The survey involved sampling and analyzing 50 ml of breast milk on the 30th day after birth from women aged between 20 and 39. The targets were women who had lived within 5 km of the incineration plant for 5 years or more and who were scheduled to give birth to their first child up until September 2000.