

CHAPTER 1

ENVIRONMENTAL SURVEY AND MONITORING OF 12 PERSISTENT ORGANIC POLLUTANTS (POPs) IN JAPAN

In 1974, Ministry of the Environment (i.e. MOE) of Japan introduced a “System of Investigation of Chemical Substances in the Environment”. Since then, a systematic environmental survey and monitoring on chemicals, including persistent organic pollutants (i.e. POPs), have been carried out.

This Chapter describes the survey and monitoring results on 12 POPs that are designated in the Stockholm Convention on the Persistent Organic Pollutants with their background information in Japan.

1.1 Surveyed the 12 POPs

MOE of Japan, introduced a "System of Investigation of Chemical Substances in the Environment" in 1974 (see Chapter 3). Under it, most of the 12 POPs in the environment were surveyed in the past and, once they were detected in the "General Inspection Survey of Chemical Substances on Environmental Safety", the environmental

monitoring such as i) wildlife monitoring on fish, shellfish and birds. ii) water and bottom sediment monitoring and the "Follow-up Survey of the Pollution by Unintentionally Formed Chemical Substances" have been made as a follow-up (see Table 1.1-1).

Table 1.1-1 POPs surveyed and/or monitored in the "Investigation of Chemical Substances in the Environment"

	Air	Water	Bottom Sediment	Wildlife
Drins (aldrin, dieldrin and endrin)		F.Y.1986-1998 (For dieldrin)	F.Y.1986-1998 (For dieldrin)	Since F.Y.1978 (For aldrin and endrin, F.Y.1978-1993)
Chlordanes (<i>trans</i> -chlordane, <i>cis</i> -chlordane)	F.Y.1986	F.Y.1982 Since F.Y.1986	F.Y.1982 Since F.Y.1986	F.Y.1982 (fish only) Since F.Y.1983
Heptachlor	F.Y.1986	F.Y.1982	F.Y.1982	F.Y.1982 (fish only)
Toxaphene and mirex		F.Y.1983	F.Y.1983	
<i>p,p'</i> -DDT		F.Y.1974 F.Y.1986-1998	F.Y.1974 Since F.Y.1986	F.Y.1974 (fish only) Since F.Y.1978
HCB	F.Y.1994, F.Y.1999	F.Y.1974, F.Y.1975, F.Y.1978 F.Y.1986-1998	F.Y.1974, F.Y.1975, F.Y.1978 Since F.Y.1986	F.Y.1974-1975 Since F.Y.1978
PCBs	F.Y.1997, F.Y.1999, F.Y.2000	F.Y.2000	F.Y.1996, F.Y.1997, F.Y.2000	Since F.Y.1978
PCDDs+PCDFs			F.Y.1989-1997	F.Y.1989-1997 (fish and shellfish)

Note:

The survey and monitoring on PCDDs and PCDFs were conducted from F.Y.1989 to F.Y.1997 in this survey, however they have been conducted in other surveys since F.Y.1998.

1.2 Summary of Survey and Monitoring Results on 12 POPs

Table 1.2-1 shows the summary of the survey and monitoring results on the 12 POPs.

Air

HCB, *trans*- and *cis*-chlordane and PCBs were detected in air. Only heptachlor was not detected.

Water

PCBs, dieldrin and HCB were detected in water, although dieldrin and HCB were scarcely detected. Heptachlor, *trans*- and *cis*-chlordane, *p,p'*-DDT, mirex and toxaphene were not detected in water.

Sediment

Dieldrin, *trans*- and *cis*-chlordane, *p,p'*-DDT, heptachlor, HCB, and PCDDs and PCDFs were detected in bottom sediment. Mirex and toxaphene were not detected.

Wildlife

Dieldrin, *trans*- and *cis*-chlordane, *p,p'*-DDT, heptachlor, HCB, PCBs, and PCDDs and PCDFs were detected in fish. Aldrin and endrin were scarcely detected.

Dieldrin, *trans*- and *cis*-chlordane, *p,p'*-DDT, PCBs, and PCDDs and PCDFs were detected in shellfish. Aldrin and HCB were not detected in shellfish.

Dieldrin, *trans*- and *cis*-chlordane, *p,p'*-DDT, HCB, PCBs and PCDDs and PCDFs were detected in birds. Aldrin was detected only in F.Y.1978 and endrin was not detected.

Table 1.2-1 Summary of survey and monitoring results on the 12 POPs

	medium	1974	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	
1 aldrin	A																												
	W																												
	S																												
	F					nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	D							
	SF					nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd						
	B					D	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd							
2 trans-chlordane	A													D															
	W									nd				nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
	S										D			D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
	F										D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	SF										D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	B										D	D	D	D	nd	nd	nd	nd	nd	nd	nd	nd			nd	nd	nd	nd	nd
3 cis-chlordane	A													D															
	W									nd				D	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
	S										D			D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
	F										D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	SF										D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	B										D	D	D	D	D	D	D	D	D	D	D	D	D			nd	nd	nd	nd
4 pp'-DDT	A																												
	W	nd												nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
	S	D												D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
	F	D				D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	SF					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	nd	nd	nd	D	nd	nd	nd	nd	D
	B					D	nd	D	D	D	D	D	D	D	D	D	D	nd	D	D	D	D	D			nd	D	D	D
5 dieldrin	A																												
	W													nd	nd	nd	D	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
	S													D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
	F					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	SF					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	B					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	nd			D	D	D
6 endrin	A																												
	W																												
	S																												
	F					nd	D	D	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd							
	SF					nd	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D						
	B					nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd							
7 heptachlor	A													nd															
	W									nd																			
	S									D																			
	F									D																			
	SF									D																			
	B									D																			
8 HCB	A																						D					D	
	W	nd	nd			D								nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	
	S	nd	D			D								nd	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
	F	D	D			D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	SF					nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	B					nd	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	nd			D	D	D

medium: A(Air), W(Surface Water), S(Bottom Sediment), F(Fish), SF(Shellfish), B(Birds)
symbol: D(measured and detected), nd(The substances were measured but not detected.)

8 mirex	medium	1974	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	
	A																												
	W										nd																		
	S										nd																		
	F																												
	SF																												
B																													

9 toxaphene	medium	1974	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	
	A																												
	W											nd																	
	S											nd																	
	F																												
	SF																												
B																													

10 PCBs	medium	1974	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	
	A																									D		D	D
	W																												D
	S																								D	D			D
	F					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
	SF					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D
B					D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	nd		D	D	D	D	

11 Dioxins (PCDDs+ PCDFs)	medium	1974	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	
	A																												
	W																												
	S																		D	D	D	D	D	D	D	D			
	F																		D	D	D	D	D	D	D	D			
	SF																		D	D	D	D	D	nd	D		D		
B																													

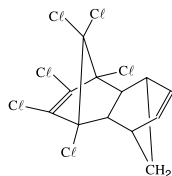
Dioxins (PCDDs+ PCDFs+ Co-PCBs)	medium	1974	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	
	A																										D	D	D
	W																										D	D	D
	S																										D	D	D
	F																										D	D	D
	SF																										D	D	D
	B																										D	D	D
	GW																										D	D	D
	Soil																										D	D	D
	Farm																										D	D	D
	Crops																										D	D	D
Wildlife																										D	D	D	

medium: A(Air), W(Surface Water), S(Bottom Sediment), F(Fish), SF(Shellfish), B(Birds), GW(Ground Water)

symbol: D(measured and detected), nd(The substances were measured but not detected.)

1.3 Individual POPs

1.3.1 Aldrin



(1) Characteristics

Aldrin is a yellow brown to dark brown solid at normal temperature with slight chemical smell. It is very little soluble in water, but soluble in a variety of solvents. It is stable to strong alkali, however it can be mixed with alkaline emulsifiers and diluents.

It stimulates the central nerve system and causes vomiting, hyperexcitability, convulsion, coma and at last respiratory paralysis to death. Chronically, it gives rise to loss of appetite, weight loss and degeneration of liver. In animal experiments, increase of cancer and manifestation of reproduction toxicity and teratogenicity in next generation are reported.

(2) Regulatory status and historical production and uses

1) Regulatory status

In Japan, aldrin was used as an agricultural pesticide to control pests in the soil, however, the registration under the Agricultural Chemicals Regulation Law was withdrawn in 1975, and since then, the use as agricultural pesticides has been prohibited. Aldrin was also designated in 1981 as "Class 1 Specified Chemical Substance" under the Law concerning the Examination and Regulation of Manufacture, etc., of Chemical Substances (hereinafter referred to as the "Chemical Substances Control Law"), whereby its production and use as industrial chemicals were in principle prohibited.

Laws	Status of aldrin
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1981.
The Agricultural Chemicals Regulation Law	Its registration was withdrawn in 1975.

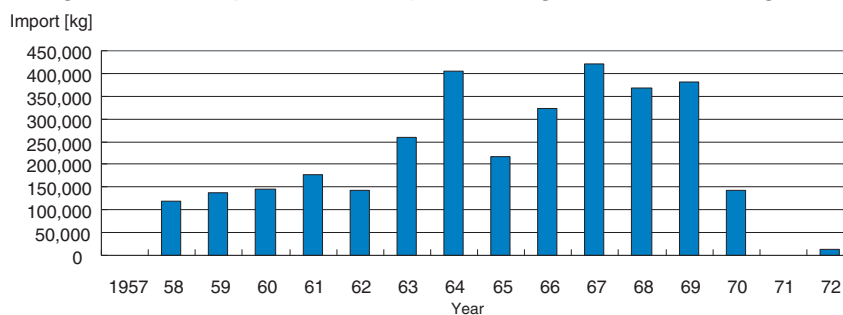
2) Historical production and use

The technical grade of active ingredient of aldrin was never manufactured in Japan, but imported from overseas. The volume of the imported aldrin during the period from 1958 through 1972 was summarized in Fig. 1.3.1-1. During this period, the accumulated volume of the imported technical grade of active ingredient of aldrin

amounted to 2,500 tons.

From the registration of agricultural chemicals as of 1970, it is known that 24 kinds of aldrin dust formulations and 4 kinds of emulsifiable concentrates and some mixtures with other ingredients used to be sold.

Fig. 1.3.1-1 Import of aldrin (technical grade of active ingredient)



Source: Japan Plant Protection Association, The Handbook on Agricultural Chemicals (1958-1973)

(3) Environmental status

Aldrin in wildlife had been monitored during the period from F.Y.1978 through F.Y.1993 except F.Y.1990 and F.Y.1992. Aldrin was not detected in fish, shellfish and birds with two exceptions of the fish data in F.Y.1993 (the detection range : 0.001 – 0.002 $\mu\text{g/g-wet}$, the detected frequency : 4 out of 70 samples) and the birds data in

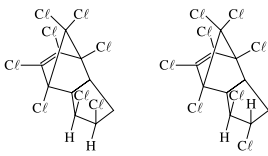
F.Y.1978 (the detected concentration : 0.002 $\mu\text{g/g-wet}$, the detected frequency : 1 out of 7 samples) as shown in Table 1.3.1-1.

Table 1.3.1-1 Detected frequency and detection range of aldrin

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	detection range
Fish	0/ 30	0/ 40	0/ 50	0/ 46	0/ 50	0/ 45	0/ 55	0/ 60	0/ 55	0/ 65	0/ 65	0/ 65		0/ 70		4/ 70	0.001 - 0.002 $\mu\text{g/g-wet}$ (in F.Y.1993)
Shellfish	0/ 10	0/ 15	0/ 15	0/ 20	0/ 20	0/ 20	0/ 20	0/ 20	0/ 20	0/ 20	0/ 20	0/ 21		0/ 30		0/ 30	
Birds	1/ 7	0/ 6	0/ 8	0/ 9	0/ 9	0/ 10	0/ 10	0/ 10	0/ 10	0/ 10	0/ 10	0/ 10		0/ 10		0/ 10	0.002 $\mu\text{g/g-wet}$ (in F.Y.1978)

Detection Limit: 0.001 $\mu\text{g/g-wet}$

1.3.2 Chlordane



(1) Characteristics

Chlordane has another nomenclature, “octachlor”, with the molecular formula of $C_{10}H_6Cl_8$. Pure chlordane is a colorless and odorless liquid. It is soluble in a number of organic solvents, but not in water. Like other insecticides, it is decomposable with alkalis.

There exist at least eight stereoisomers of chlordane theoretically. In commercial production for industrial use, it normally contains α and γ isomers by around 20% respectively, but it is practically a complex compound with other ingredients of heptachlor (approx. 10%), nonachlor (approx. 7%) etc.

Its toxicity to human and the environment is said to be at the same level as DDT.

(2) Regulatory status and historical production and uses

1) Regulatory status

Chlordane was once registered as an agricultural pesticide in 1950 under the Agricultural Chemicals Regulation Law, however the registration was withdrawn in 1968. It was also designated in 1986 as “Class 1 Specified Chemical Substance” under the Chemical Substances Control Law.

Laws	Status of chlordane
The Air Pollution Control Law	There is no emission control for it. Although it is cited on the "List of Substances Likely to be Harmful Air Pollutants" (234 substances) of the Environment Agency, it is not covered by "Priority Substances" (22 substances).
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1986.
The Agricultural Chemicals Regulation Law	Its registration was withdrawn in 1968.

2) Historical production and uses

(a) Pesticides

Chlordane was synthesized in 1945 for the first time in the United States and used as an insecticide in many countries of the world. In Japan it was used as an insecticide for agricultural use, termite control agent and insect control treatment for wood, and among them, the termite control and wood treatment were the major uses of chlordane.

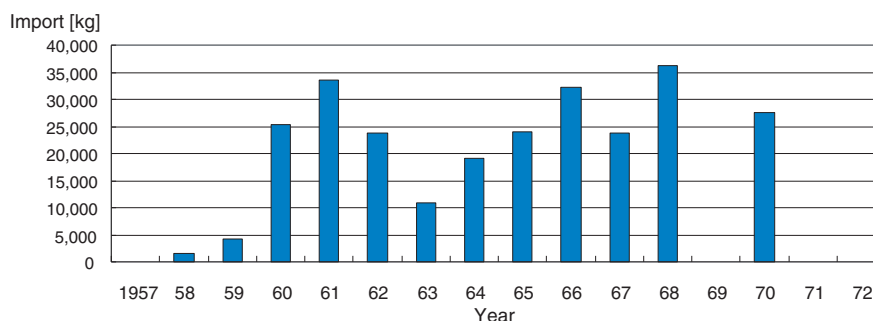
emulsifiable concentrates, dust formulations and mixtures with BHC etc. in 1970, but there were not so many kinds of products on the market.

The technical grade of active ingredient of chlordane was never manufactured in Japan. They were imported from overseas. Fig. 1.3.2-1 shows the volume of imported chlordane (technical grade of active ingredient) as raw material for agricultural pesticides. The accumulated volume of the imported chlordane during the period from 1958 through 1970 amounted to 262 tons.

a) Agricultural pesticides

Chlordane was commercialized in the form of

Fig. 1.3.2-1 Import of chlordane (technical grade of active ingredient) for use of agricultural pesticides



Source: Japan Plant Protection Association, The Handbook on Agricultural Chemicals (1958-1973)

b) Termite control agent

The history of use of chlordane for termite control is shown in Table 1.3.2-1.

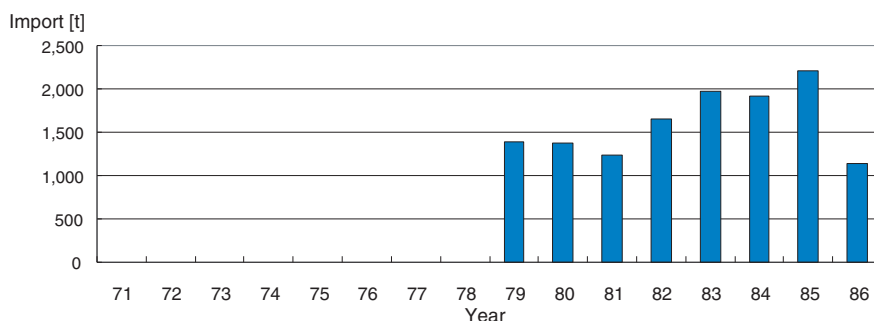
Table 1.3.2-1 History of use of chlordane for termite control

Year	History of Use
1955 - 1964	• It grew to have the market share of 90% in the area of termite control agent due to the prohibition of other chloride type competitive products.
1975 - 1984	• Attention was paid to the problems such as pollution of well water with termite control agent.
1978	• Formulations containing 6% or more chlordane technical materials were designated as Deleterious Substance.
1986	• It was designated as Class 1 Specified Chemical Substance under the Chemical Substances Control Law.

Even after the registration as an agricultural pesticide was withdrawn in 1968, the use of chlordane as a termite control agent increased, and the import showed a

remarked hike. As shown in Fig.1.3.2-2, 1000 – 2000 tons of chlordane was imported annually in the 1980s.

Fig. 1.3.2-2 Import of chlordane (technical grade of active ingredient) for use of termite control agent



Source: Ministry of Finance, Japan Trade Monthly (1980-1986).

Note : These figures contain heptachlor and aldrin as well as chlordane.

(4) Environmental status

In the environmental survey conducted in F.Y.1982, when 8 types of chlordane were targeted, 5 of them (*trans*-chlordane, *cis*-chlordane, *trans*-nonachlor, *cis*-nonachlor and oxychlordane) were detected with high frequencies. After that, the wildlife monitoring has been carried out on these 5 chlordanes. The monitoring of water and bottom sediment on them was conducted during the period from F.Y.1986 through F.Y.1998. The *trans*- and *cis*-chlordane in air were surveyed only in F.Y.1986.

Fig. 1.3.2-3 and 1.3.2-4 show the detected frequency and the detection range of *trans*- chlordane and *cis*-chlordane, respectively.

Air

In F.Y.1986, both *trans*- and *cis*-chlordane were detected with the detection ranges of 0.40 – 8.5 ng/m³ for

trans-chlordane and 0.43 – 5.0 ng/m³ for *cis*-chlordane. Their detected frequencies were 33/73, and 18/73, respectively.

Water and bottom sediment

trans-chlordane was never detected in water. Neither *cis*-chlordane was detected with the exception of the F.Y.1986 data, which showed 1/17 of the detected frequency and 0.01 µg/ℓ of the detected concentration.

They were detected in bottom sediment in each survey. Their detected frequencies decreased year by year. The detection ranges were 0.54 – 75 ng/g-dry for *trans*-chlordane and 0.2 – 51 ng/g-dry for *cis*-chlordane.

Wildlife

Both *trans*- and *cis*-chlordane were detected in fish and shellfish. These detected frequencies in fish were still high, although they were decreased year by year. The detection range of *trans*-chlordane was 0.001 – 0.069 µg/g-

wet and the one of *cis*-chlordane was 0.001 – 0.053 $\mu\text{g/g-wet}$. The detection range was 0.001 – 0.024 $\mu\text{g/g-wet}$ of *trans*-chlordane and 0.001 – 0.053 $\mu\text{g/g-wet}$ of *cis*-chlordane.

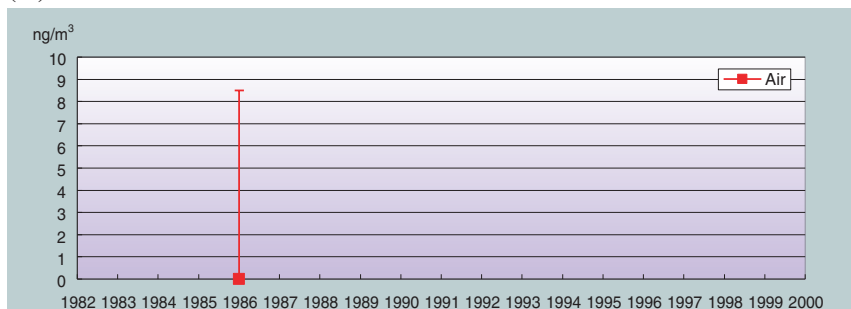
trans-chlordane was detected in birds between F.Y.1983 and F.Y.1986. However, it has never been detected since F.Y.1987. The detection range was 0.001 – 0.002 $\mu\text{g/g-}$

wet as a whole.

cis-chlordane was detected in birds between F.Y.1983 and F.Y.1994. However, it has never detected since F.Y.1997. The detection range was 0.002 – 0.021 $\mu\text{g/g-wet}$ as a whole.

Fig. 1.3.2-3 Detected frequency and detection range of *trans*-chlordane

(A) Air



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
A					33/ 73															

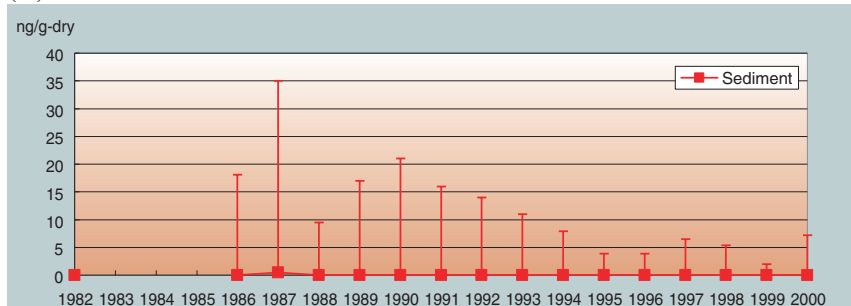
Detection Limit: 0.4 ng/m^3

(B) Surface Water

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
W	0/ 126				0/ 17	0/ 19	0/ 22	0/ 17	0/ 18	0/ 18	0/ 18	0/ 19	0/ 17	0/ 18	0/ 18	0/ 18	0/ 18		

Detection Limit(F.Y.1986-): 0.01 $\mu\text{g/l}$

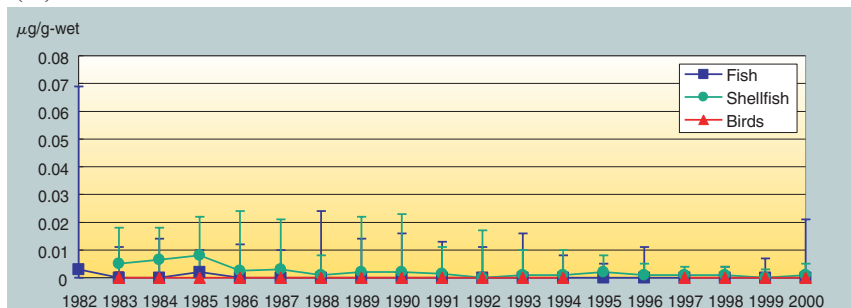
(C) Bottom Sediment



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
S	86/ 126				6/ 17	9/ 19	6/ 22	5/ 17	8/ 18	8/ 18	8/ 18	7/ 19	5/ 17	6/ 18	2/ 18	4/ 17	4/ 18	4/ 18	6/ 17

Detection Limit(F.Y.1986-): 1 ng/g-dry

(D) Wildlife



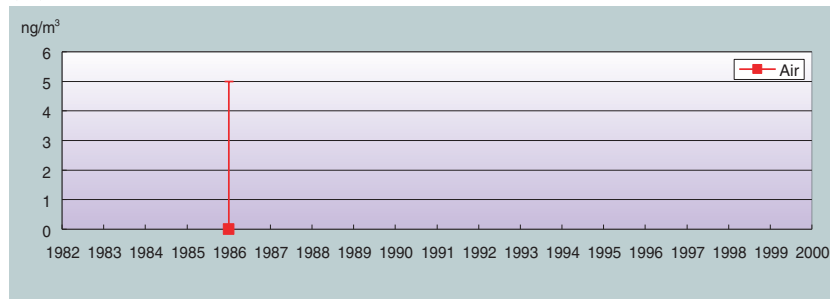
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F	90/ 123	24/ 50	26/ 60	33/ 60	23/ 55	32/ 65	25/ 65	26/ 65	22/ 70	17/ 70	23/ 70	23/ 70	17/ 70	14/ 70	20/ 70	11/ 70	15/ 70	14/ 70	14/ 69
SF		10/ 20	11/ 20	13/ 20	16/ 20	11/ 20	12/ 20	11/ 21	15/ 25	20/ 30	15/ 30	20/ 30	20/ 30	20/ 30	20/ 30	20/ 30	20/ 30	10/ 30	20/ 30
B		5/ 10	5/ 10	5/ 10	5/ 10	0/ 10	0/ 10	0/ 10	0/ 10	0/ 10	0/ 10	0/ 10	0/ 5			0/ 10	0/ 10	0/ 10	0/ 10

Detection Limit(F.Y.1983-): 0.001 $\mu\text{g/g-wet}$

Note :
 • Symbols (■, ●, ▲) show the median values of all measured values.
 • The vertical lines show the detection ranges.

Fig. 1.3.2-4 Detected frequency and detection range of *cis*-chlordane

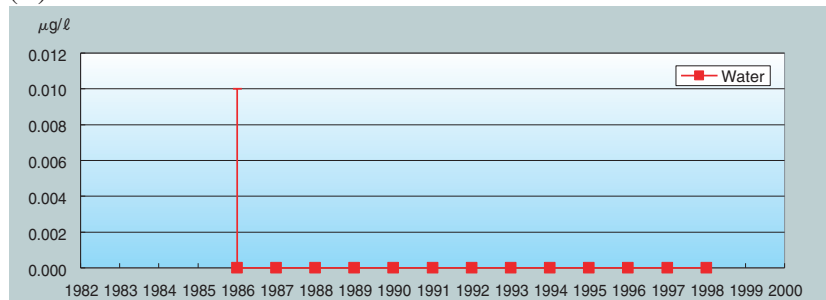
(A) Air



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
A					18/ 73															

Detection Limit: 0.4 ng/m³

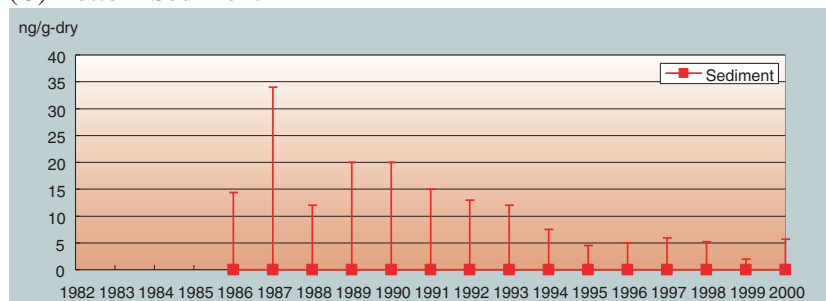
(B) Surface Water



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
W					1/ 17	0/ 19	0/ 22	0/ 17	0/ 18	0/ 18	0/ 18	0/ 19	0/ 17	0/ 18	0/ 18	0/ 18	0/ 18			

Detection Limit: 0.01 µg/ℓ

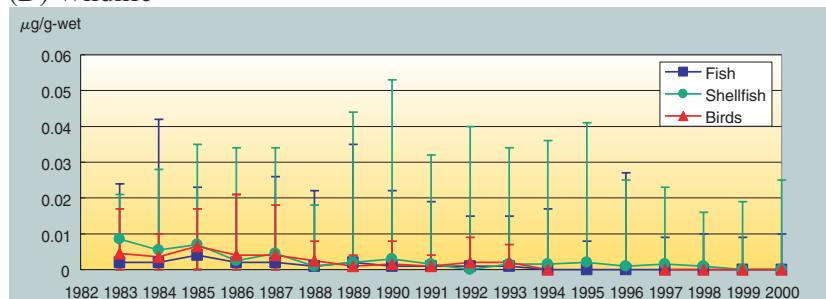
(C) Bottom Sediment



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
S					6/ 17	8/ 19	7/ 22	6/ 17	6/ 18	6/ 18	7/ 18	5/ 19	4/ 17	3/ 18	2/ 18	3/ 17	3/ 18	2/ 18	5/ 17

Detection Limit: 1 ng/g-dry

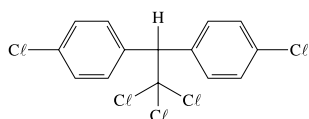
(D) Wildlife



	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F		31/ 50	41/ 60	35/ 60	34/ 55	44/ 65	37/ 65	45/ 65	42/ 70	43/ 70	37/ 70	37/ 70	33/ 70	33/ 70	24/ 70	27/ 70	25/ 70	20/ 70	26/ 69
SF		14/ 20	15/ 20	15/ 20	16/ 20	15/ 20	13/ 20	16/ 21	18/ 25	20/ 30	15/ 30	19/ 30	20/ 30	20/ 30	15/ 30	20/ 30	20/ 30	15/ 30	15/ 30
B		5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	5/ 10	0/ 5			0/ 70	0/ 10	0/ 10	0/ 10

Detection Limit: 0.001 µg/g-wet

1.3.3 DDT



(1) Characteristics

Pure DDT is a white and odorless needle crystal. It is very slightly soluble in water, but soluble in organic solvents such as benzene, acetone and ether. There are isomers of DDT, however *p, p'*-DDT is the only one that are covered under the Stockholm Convention. DDT is relatively stable to heat, and decomposes very little due to sunlight, so that the toxicity lasts long after application. It decomposes in the presence of alkali and iron or aluminum salts, resulting in loss of effect.

DDT is a neurological toxin. Its toxicity to humans and the

environment is not harsh. But it shows high insecticidal activity, and relatively high toxicity to fish.

(2) Regulatory status and historical production and uses

1) Regulatory status

DDT's registration under the Agricultural Chemicals Regulation Law was withdrawn in 1971, and since then, the commercial production and sale of DDT as an agricultural pesticide has been prohibited. DDT was also designated in 1981 as "Class 1 Specified Chemical Substance" under the Chemical Substances Control Law, whereby its production and use have in principle been banned.

Laws	Status of DDT
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1981.
The Agricultural Chemicals Regulation Law	Its registration was withdrawn in 1971.

2) Historical production and uses

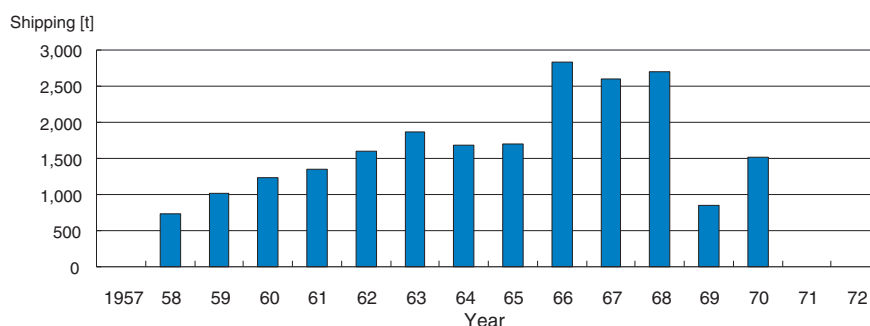
DDT was an organochlorine insecticide developed in 1938. In Japan, it was used for sanitary pest control in large quantities just after the World War II, and afterwards commercialized for agricultural use. The manufacture of DDT in Japan started in 1945. The manufacture was continued until 1970, and the accumulated production of DDT amounted to as much as 45,000 tons.

(a) Agricultural pesticide

A variety of formulations containing DDT were manufactured in an overwhelmingly many kinds and number of products as compared with the other pesticides called "drin insecticides".

The domestic shipping of DDT (technical grade of active ingredient) for pesticide from 1958 through 1970 is shown in Fig.1.3.3-1. The accumulated domestic shipping of DDT (technical grade of active ingredient) from 1958 through 1970 amounted to 21,700 tons.

Fig. 1.3.3-1 Domestic shipping of DDT (technical grade of active ingredient)



Source: Japan Plant Protection Association, The Handbook on Agricultural Chemicals (1958-1973)

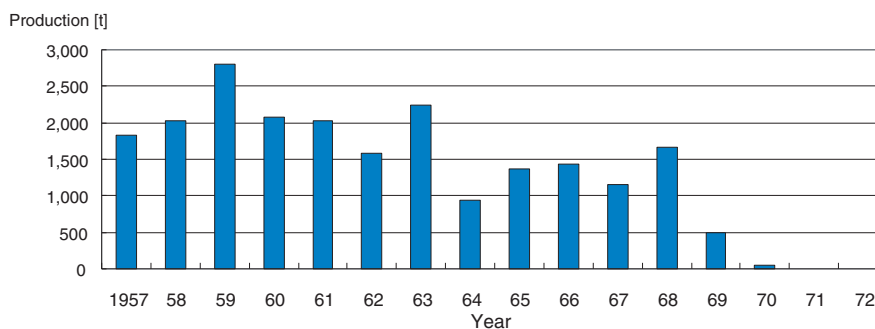
(b) Sanitary pest control

DDT and Lindane (γ -BHC) were exclusively used as an insecticide for epidemic prevention. The use of DDT as an insecticide for communicable disease control began just after the end of the World War II. In those days, aerial application of 10% dust formulations and blow of dust into cuffs and necks were conducted for the prevention of an epidemic louse-borne typhus, and 5% oil solution was also sprayed on the wall of houses. The single formulations and their

mixtures had prevailed on the market until the permission of manufacture of Dieldrin was issued in December 1955.

DDT was manufactured as a quasi-drug under the Pharmaceutical Affairs Law in the forms of dust formulation, liquid formulation and emulsifiable concentrate. The production level from 1957 through 1971 is shown in Fig.1.3.3-2. After the prohibition of the manufacture and import of DDT and other organochlorine insecticides in 1971, its production decreased in the 1970s.

Fig. 1.3.3-2 Production of insecticides containing DDT



Source: Ministry of Health and Welfare, The Annual Statistics of Pharmaceutical Industry (1958-1972)

(4) Environmental status

In F.Y.1974, the survey of water, bottom sediment and fish on *p,p'*-DDT was conducted in the "General Inspection Survey of Chemical Substances on Environmental Safety". The wildlife monitoring on *p,p'*-DDT has been carried out since F.Y.1978. The monitoring of water and bottom sediment on DDT has also been conducted since 1986. *p,p'*-DDT in air has not been surveyed yet. The detected frequency and the detection range of *p,p'*-DDT are shown in Fig. 1.3.3-3.

F.Y.1978) to 0/30 (in F.Y.1999). The detection range was 0.001 – 0.01 $\mu\text{g/g-wet}$ as a whole.

p,p'-DDT was detected in many samples of birds. The detected frequency decreased from 8/8 (in F.Y.1980) to 0/10 (in F.Y.1997). The detection range was 0.001 – 0.043 $\mu\text{g/g-wet}$.

Water and Bottom sediment

p,p'-DDT was never detected in water. On the other hand, in the bottom sediment, it was detected through the whole surveys. The detected frequency decreased from 4/17 (in F.Y.1986) - 2/12 (in F.Y.2000). The detection range was 1.0 - 20 ng/g-dry.

Wildlife

p,p'-DDT has been detected in many samples of fish, shellfish and birds.

The detected frequency for fish in F.Y.2000 was 16/69. The detection range was 0.001 – 0.095 $\mu\text{g/g-wet}$.

p,p'-DDT was detected in shellfish between F.Y.1978 and F.Y.1991. After F.Y.1992, it was scarcely detected. The detected frequency decreased from 10/10 (in

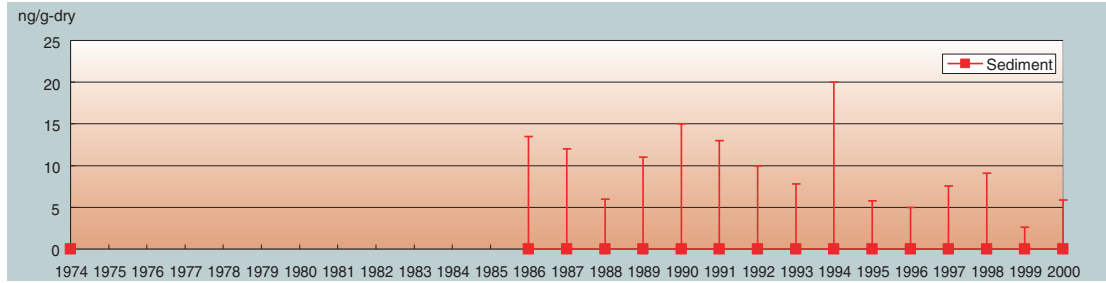
Fig. 1.3.3-3 Detected frequency and detection range of *p,p'*-DDT

(A) Surface Water

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
W	0/55												0/17	0/19	0/22	0/17	0/18	0/18	0/18	0/19	0/17	0/18	0/18	0/18	0/18		

Detection Limit: 0.01 $\mu\text{g}/\ell$

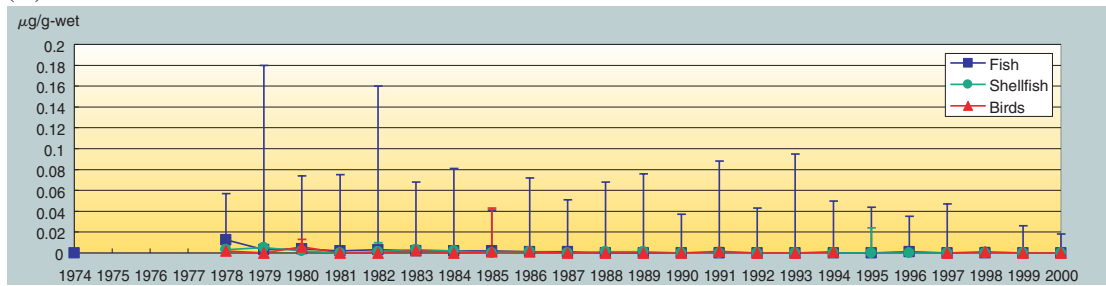
(B) Bottom Sediment



	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
S	20/50												4/17	3/19	3/22	3/17	5/18	4/17	6/18	8/19	5/16	3/18	6/17	4/17	5/18	2/18	4/17

Detection Limit: 1 ng/g-dry

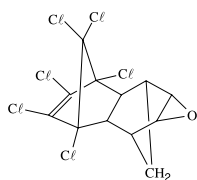
(C) Wildlife



	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F	7/49				25/30	34/40	37/50	26/46	40/50	35/50	45/60	40/60	34/55	38/65	30/65	32/65	28/70	29/70	24/70	27/70	17/70	33/70	38/70	26/70	35/70	15/70	16/69
SF					10/10	15/15	15/20	9/20	20/20	20/20	19/20	10/20	15/20	10/20	16/20	14/21	7/25	11/30	0/30	0/30	0/30	5/30	0/30	0/30	0/30	0/30	4/30
B					6/7	0/6	8/8	1/7	4/9	6/10	2/10	7/10	6/10	5/10	5/10	0/10	2/10	6/10	1/10	5/10	5/5			0/10	6/10	5/10	2/10

Detection Limit(F.Y.1983-): 0.001 $\mu\text{g}/\text{g-wet}$

1.3.4 Dieldrin



(1) Characteristics

Dieldrin, with the structure of further oxidized aldrin, is a yellowish brown to light brown substance in dry flakes at ordinary temperatures. It is slightly soluble in petroleum solvents, and easily soluble in aromatic solvents and hydrochloric solvents. As it is stable to alkali and its vapor pressure is low, dieldrin has a high potential of residual tendency in the environment.

Dieldrin is also stronger in residual effect and the toxicity towards fish is also stronger than aldrin.

(2) Regulatory status and production and uses in Japan

1) Regulatory status

The registration under the Agricultural Chemicals Regulation Law was withdrawn in 1975, and since then, the commercial production and sale of dieldrin as an agricultural pesticide has been prohibited. Dieldrin was designated in 1981 as "Class 1 Specified Chemical Substance" under the Chemical Substances Control Law, whereby its production and use were in principle prohibited.

Laws	Status of dieldrin
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1981.
The Agricultural Chemicals Regulation Law	Its registration was withdrawn in 1975.

2) Historical production and uses

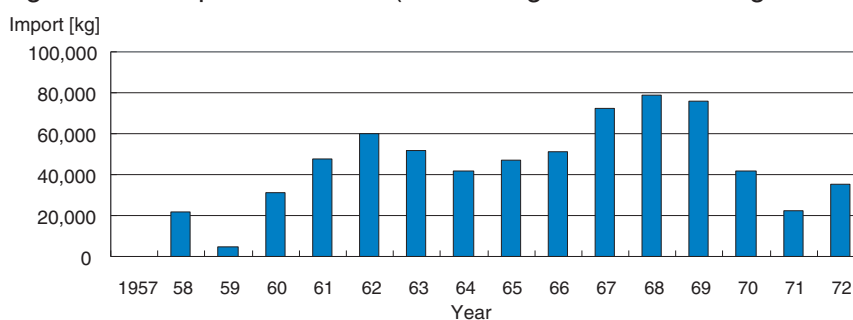
Dieldrin has a wide range of applications. It was used both for agricultural use and sanitary insects control in Japan.

(a) Agricultural pesticide

Dieldrin was used mainly in the form of dust formulations and emulsifiable concentrates, and there are found 8 kinds and 9 kinds of dieldrin respectively registered as of 1970.

The technical grade of active ingredient of dieldrin was never manufactured in Japan, but imported from the United Kingdom. The import of dieldrin (technical grade of active ingredient) during the period from 1958 through 1972 is shown in Fig. 1.3.4-1. During the period, the accumulated volume of imported dieldrin (technical grade of active ingredient) amounted to 683 tons.

Fig. 1.3.4-1 Import of dieldrin (technical grade of active ingredient)



Source: Japan Plant Protection Association, The Handbook on Agricultural Chemicals (1958-1973)

(b) Sanitary pest control

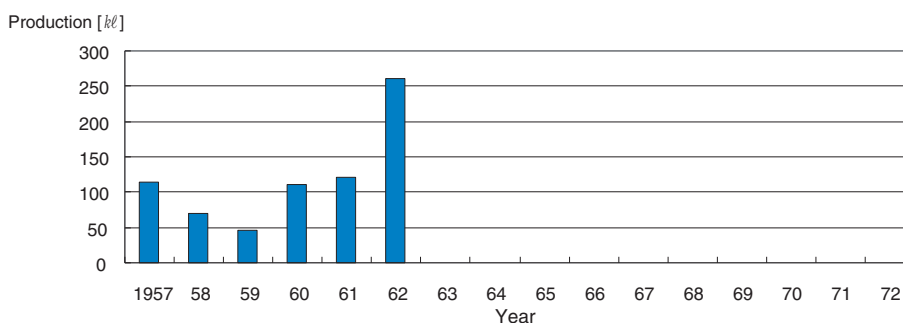
Dieldrin was used for sanitary pest control to exterminate cockroaches, mosquitoes (wrigglers and adult mosquitoes) flies, bedbugs and fleas. The ingredients of dieldrin formulations used for sanitary pest control were mainly as follows:

- Dieldrin emulsifiable concentrate (concentration of dieldrin: 18.5%) ;
- Dieldrin wettable powder (concentration of dieldrin: 50%) ; and
- Dieldrin dust formulation (concentration of dieldrin: 2.4%).

Dieldrin was also used for pest control treatment of wooden-frame buildings as well as pestproof finishing of woods and textiles.

The production of dieldrin-containing solution (liquid, dust formulation and emulsifiable concentrate) used for sanitary pest control as a quasi-drug is shown in Fig.1.3.4-2.

Fig. 1.3.4-2 Production of dieldrin for use of sanitary pest control



Source: Ministry of Health and Welfare, The Annual Statistics of Pharmaceutical Industry (1958-1963)

(4) Environmental status

The wildlife monitoring has been carried out since F.Y.1978 except F.Y.1997 and F.Y.1999. The monitoring of water and bottom sediment was conducted from F.Y.1986 to F.Y.1998. The air monitoring has not been conducted yet. Fig. 1.3.4-3 shows the detected frequency and the detection range of dieldren.

The detected frequency for birds also decreased from 6/6 in F.Y.1979 to 2/10 in F.Y.2000. The detection range was 0.001 – 0.124 $\mu\text{g/g-wet}$. It became lower year by year.

As for dieldrin, both the detected frequency and the detection level are considered to be lowering in these days.

Water and Bottom sediment

Dieldrin was not detected in water with an exception of the 1989 data, which showed that the detected frequency was 1/3 and the concentration was 0.011 $\mu\text{g/l}$. On the other hand, dieldren was detected in bottom sediment. The detected frequency was very low such as 1/17 or 1/12 and the detection range was 1.0 – 9.2 ng/g-dry as a whole.

Wildlife

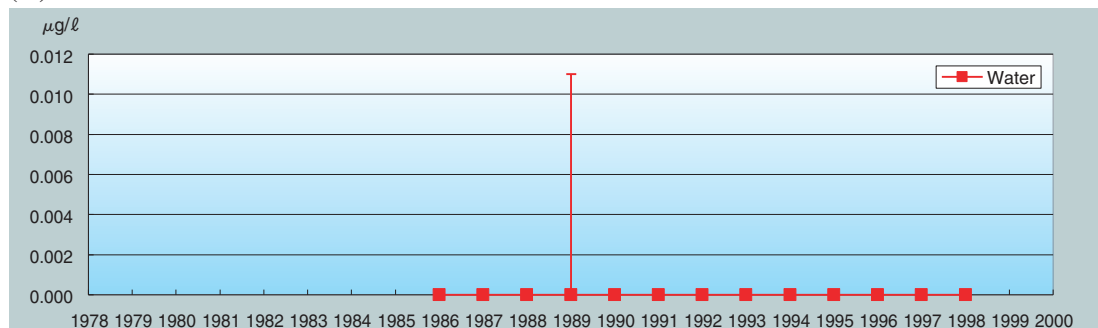
Dieldrin was detected in fish, shellfish and birds, within an exception of birds data in F.Y.1994.

The detected frequency for fish decreased from 22/30 in F.Y.1978 to 10/70 in F.Y.2000. The detection range was 0.001 – 0.046 $\mu\text{g/g-wet}$.

The detected frequency for shellfish also decreased from 5/10 in F.Y.1978 to 5/30 in F.Y.2000. The detection range was 0.001 – 0.685 $\mu\text{g/g-wet}$.

Fig. 1.3.4-3 Detected frequency and detection range of dieldrin

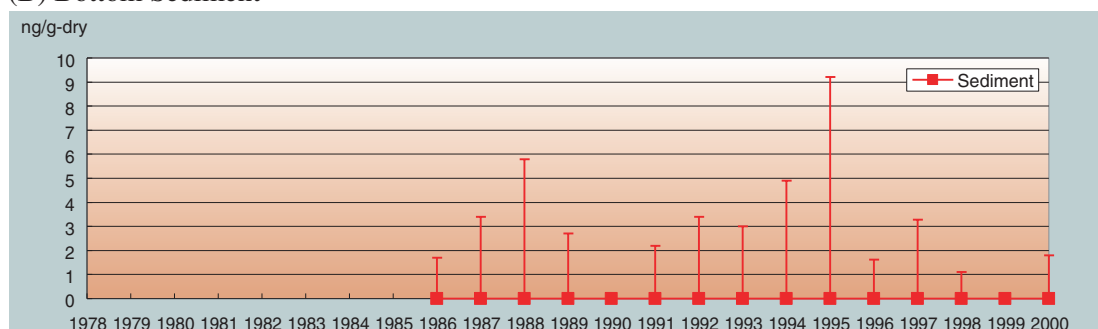
(A) Surface Water



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
W									0/17	0/19	0/22	1/17	0/18	0/18	0/18	0/19	0/17	0/18	0/18	0/18	0/18		

Detection Limit: 0.01 µg/l

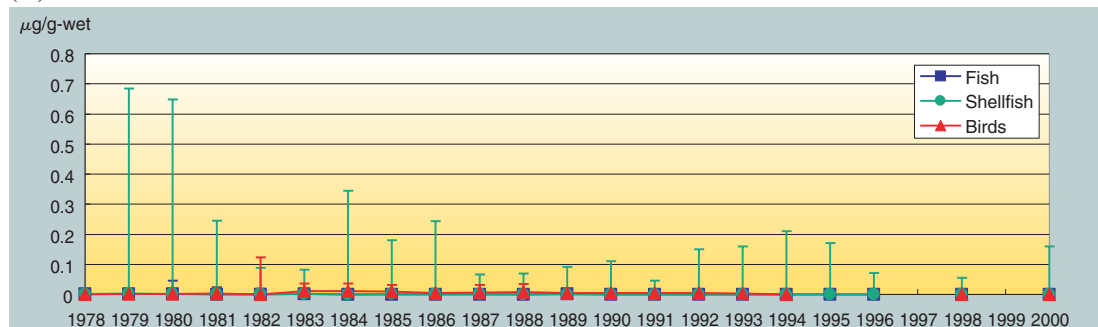
(B) Bottom Sediment



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
S									1/17	1/19	2/22	1/17	0/18	2/18	4/18	3/19	1/17	2/18	2/18	1/17	1/18	1/18	1/17

Detection Limit: 1 ng/g-dry

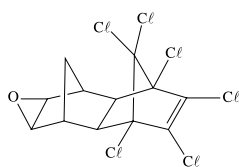
(C) Wildlife



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F	22/30	30/40	30/50	12/46	20/50	27/50	30/60	27/60	20/55	23/65	19/65	35/65	23/70	26/70	16/70	25/70	12/70	10/70	9/70		6/70		10/70
SF	5/10	10/15	9/15	10/20	10/20	10/20	10/20	11/20	10/20	12/20	8/20	10/21	12/25	15/30	10/30	10/30	10/30	5/30	10/30		8/30		5/30
B	1/7	6/6	5/8	7/7	4/9	10/10	5/10	5/10	8/10	5/10	6/10	7/10	5/10	9/10	7/10	7/10	0/5				5/10		2/10

Detection Limit(F.Y.1983-): 0.001 µg/g-wet

1.3.5 Endrin



(1) Characteristics

Endrin is an isomer of dieldrin. Like dieldrin, it has a long residual effect at the same level as DDT. It is stable to acids and alkalis, and miscible with many other chemicals as is the case with dieldrin. It is sparingly soluble in water but is soluble in organic solvents.

Endrin is said to be the harshest in toxicity to humans and the environment among the drin insecticides.

(2) Regulatory status and historical production and uses

1) Regulatory status

The registration under the Agricultural Chemicals Regulation Law was withdrawn in 1976, and since then, the commercial production and sale of endrin as an agricultural pesticide has been prohibited. It was also designated in 1981 as "Class 1 Specified Chemical Substance" under the Chemical Substances Control Law, whereby its production and use had in principle been prohibited.

Laws	Status of endrin
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1981.
The Agricultural Chemicals Regulation Law	Its registration was withdrawn in 1976.

2) Historical production and uses

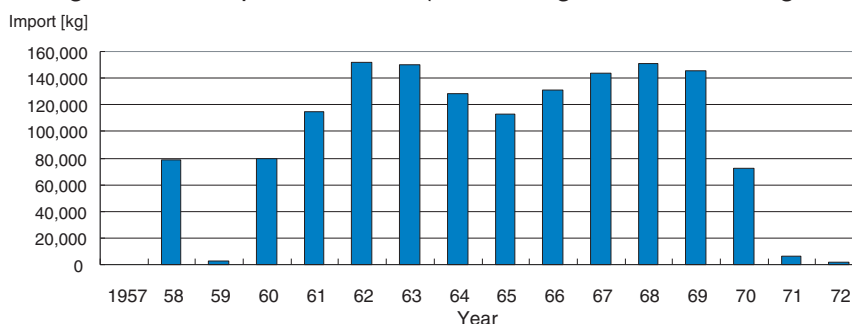
Endrin was used for pest control for fruit trees and vegetables as a pesticide. Because of its strong fish-toxicity, it was prohibited from use at paddy fields.

Endrin has never been produced in Japan. It was exclusively imported as technical grade of active ingredient from overseas. The import of endrin as technical grade of active ingredient is shown in Fig.1.3.5-1. During the period

from 1958 through 1972, the accumulated volume of imported endrin as technical grade of active ingredient amounted to about 1,500 tons, with the annual import of more than 150 tons at its peak in the 1960s.

According to the registration of agricultural chemicals, it is known that as of 1970 there existed 20 kinds of emulsifiable concentrates, dust formulations and mixed formulations with DDT.

Fig. 1.3.5-1 Import of endrin (technical grade of active ingredient)



Source: Japan Plant Protection Association, The Handbook on Agricultural Chemicals (1958-1973)

(4) Environmental status

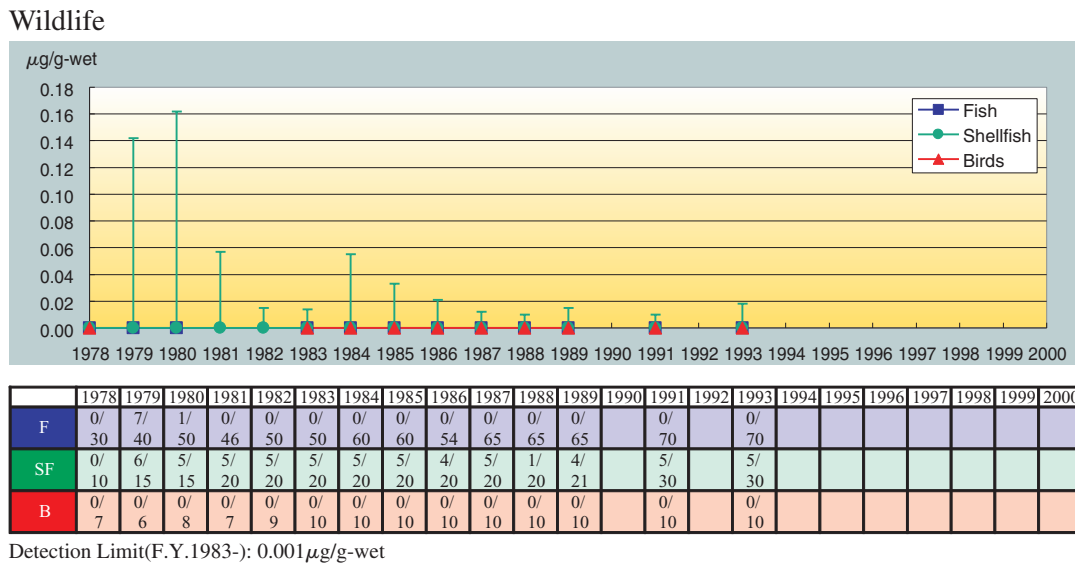
Endrin in wildlife was monitored from F.Y.1978 through F.Y.1993 except F.Y.1990 and F.Y.1992.

As shown in Fig. 1.3.5-2, endrin was mainly detected in shellfish. Concerning fish, endrin was detected only in F.Y.1979 and F.Y.1980. The F.Y.1979 data shows that the detected frequency was 7/40 with the detection range of 0.001 – 0.002 $\mu\text{g/g-wet}$. The F.Y.1980 data show that the detected frequency was 1/50 with the concentration of 0.004 $\mu\text{g/g-wet}$.

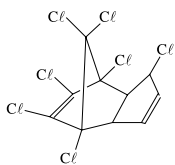
Concerning shellfish, endrin was detected every

fiscal year except F.Y.1978. For example, the detected frequency in F.Y.2000 was 5/30. The detection range decreased year by year. It was 0.001 – 0.162 $\mu\text{g/g-wet}$ as a whole.

Fig. 1.3.5-2 Detected frequency and detection range of endrin



1.3.6 Heptachlor



(1) Characteristics

Heptachlor is stable and resistant to heat. It is very slightly soluble in water, but soluble in organic solvents. The technical grade of active ingredient of heptachlor for industrial use is a white crystal with 72% purity. The remaining 28% comprises mainly chlordane.

It is said that heptachlor has slightly higher toxicity to humans and the environment than DDT.

(2) Regulatory status and historical production and uses

1) Regulatory status

The registration under the Agricultural Chemicals Regulation Law was withdrawn in 1975, and since then, the commercial production and sale of heptachlor as an agricultural pesticide has been prohibited. "Chlordanes" including heptachlor together with chlordane was designated in 1986 as "Class 1 Specified Chemical Substance" under the Chemical Substances Control Law, whereby the production and use of heptachlor had in principle been prohibited.

Laws	Status of heptachlor
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1986.
The Agricultural Chemicals Regulation Law	Its registration was withdrawn in 1975.

2) Historical production and uses

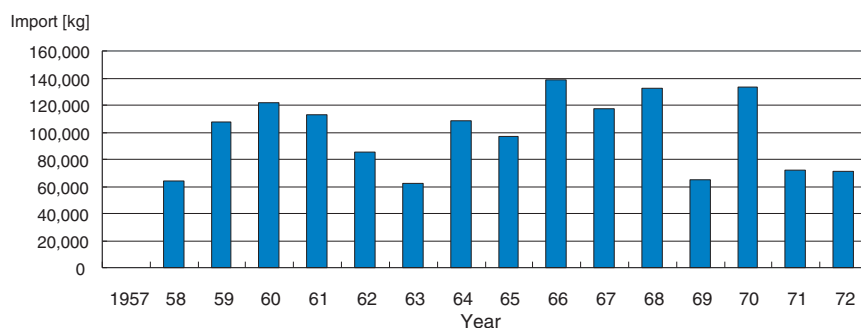
Heptachlor was effective for pests in the soil. In Japan, it was used as an agricultural insecticide for pest control in the fields in great quantities. It was also used as a termite control agent.

(a) Pesticides

The technical grade of active ingredient of heptachlor has never been manufactured commercially in Japan. It was imported from overseas. The import of

heptachlor (technical grade of active ingredient) during the period from 1958 through 1972 is shown in Fig.1.3.6-1. The accumulated volume of imported heptachlor (technical grade of active ingredient) during the period amounted to 1,500 tons. However, it has not been imported since 1973 with the last import of 71.3 tons in 1972.

Fig. 1.3.6-1 Import of heptachlor (technical grade of active ingredient)



Source: Japan Plant Protection Association, The Handbook on Agricultural Chemicals edited by (1958-1973)

As of 1970, as agricultural pesticides, 11 kinds of dust formulations, 7 kinds of emulsifiable concentrates, 5 kinds of granular formulations and mixed formulations with DDT were registered.

(b) Termite control agent

Heptachlor was used as a termite control agent along with chlordane. As described in the section on “Chlordane” (See Fig.1.3.2-2), chlordane for industrial use contained around 10% of heptachlor.

(4) Environmental status

The environmental survey was conducted on the monitoring of water, bottom sediment and fish in F.Y.1982.

Heptachlor in air was monitored in F.Y.1986. The detected frequency and the detection range are shown in Table. 1.3.6-1.

Heptachlor was detected in bottom sediment and fish. The detection range for bottom sediment was 0.2 – 3.7 ng/g-dry and the detection range for fish was 0.001 – 0.010 μg/g-wet. The detected frequencies for bottom sediment and fish were 14 out of 87 samples and 9 out of 110 samples, respectively.

Table 1.3.6-1 Detected frequency and detection range of heptachlor
A/B*

medium	1982	1983	1984	1985	1986
air					0/ 73
surface water					
sediment					
fish	0/ 125				
shellfish	14/ 87				
bird	9/ 110				

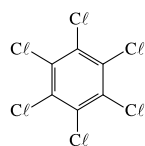
* Note: A;Number of detected sample B;Number of total sample

Detection range

medium	unit	detection range
sediment	ng/g-dry	0.3~1.2 (in F.Y.1982)
fish	μg/g-wet	0.001~0.01 (in F.Y.1982)

Detection Limit: Air(1 ng/m³), Surface Water(5 ng/ℓ), Bottom Sediment(0.2 ng/g-dry), Fish(1 ng/g-wet)

1.3.7 Hexachlorobenzene (HCB)



(1) Characteristics

HCB is an organochlorine compound with relative high vapor pressure compared with dioxins. It is insoluble in water, but fat-soluble, and has high bioaccumulation. It is white crystal powder or needle crystal at normal temperature and pressure, and has weak odor.

Its commercial products for industrial use have the purity of about 98%, and contain pentachlorobenzene and 1,2,4,5-tetrachlorobenzene etc. as impurities. It is chemically stable, but gradually decomposes by ultraviolet light. In its animal experiments, carcinogenicity, tumorigenicity and teratogenicity are reported, and it is also susceptible to carcinogenicity to humans. It shows medium toxicity by oral intake.

(2) Regulatory status, historical production and the emission

1) Regulatory status

In Japan, HCB has never been registered as an agricultural pesticide under the Agricultural Chemicals Regulation Law. It was designated in 1979 as "Class 1 Specified Chemical Substance" under the Chemical Substances Control Law, whereby its production and use have in principle been prohibited.

Laws	Status of HCB
The Air Pollution Control Law	Although it is cited on the "List of Substances Likely to be Harmful Air Pollutants" of Ministry of the Environment (234 substances), it is not classified in "Priority Substances" (22 substances).
The Water Pollution Control Law	Its effluent is not regulated.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1979.
The Agricultural Chemicals Regulation Law	There is no registration.

1) Historical production and uses

It is thought that more than 90% of its domestic use was a raw material for synthesizing pentachlorophenol (PCP) that was used as wood preservative, weed-killer, and fungicide. It is estimated that its annual demand was 4,000 tons at its peak.

2) Emission

Besides i) the emissions of HCB derived from the products containing HCB as impurities, there are two types of unintentional emissions; ii) one from heating process where organism and chlorine are used and iii) the other is from other processes.

(i) Emission derived from products

- HCB as a product
- Impurity in the pesticide

(ii) Unintentional emission from heating processes using organism and chlorine

- Incinerators of municipal wastes, hazardous wastes, hospital wastes or sewage sludge (including complex incinerators)
- Cement calcinating furnaces where hazardous wastes are burned
- Pulp manufacturing where chlorine or chemicals producing chlorine is used for bleaching.
- Heating process in metallurgical industry (secondary refining of copper, aluminum, zinc, and steel sintering furnace)

(iii) Unintentional emission from other processes

- Incineration at other places than wastes incinerators
- Heating processes of other sources than metallurgical industry
- Source of combustion at households
- Facilities where fossil fuels are burned, and industrial boilers.
- Facilities where biomass fuels such as wood, are burned.
- Manufacture of other chemical substances (particularly, chlorophenol and chloranil)
- Crematorium
- Automobiles (particularly, those burning lead additive gasoline)
- Animal demolition wastes treatment
- Dyeing with chloranile and finish by alkaline extraction of textile and leather
- Crushing facilities of used cars
- Roasting of copper cables
- Waste oil treatment facilities

(5) Environmental status

Fig. 1.3.7-1 shows the detected frequency and the detection range of HCB.

Air

HCB was detected both in F.Y.1994 and F.Y.1999. The detected frequency was 8/24 in F.Y.1994 and 39/39 in F.Y.1999. The detection range was 1.1 – 3.5 ng/m³ in F.Y.1994 and 0.013 – 1.1 ng/m³ in F.Y.1999.

Water and Bottom sediment

HCB was not detected in water with an exception of the F.Y.1978 data, which showed that the detected frequency was 6/78 and the detection range was 0.0016 – 0.0045 μg/ℓ .

In the bottom sediment monitoring, it was detected except F.Y.1974 and F.Y.1986. The detected frequency decreased from 63/76 in F.Y.1976 to 1/17 in F.Y.2000. The detection range was 0.12 – 153 ng/g-dry, and it decreased year by year.

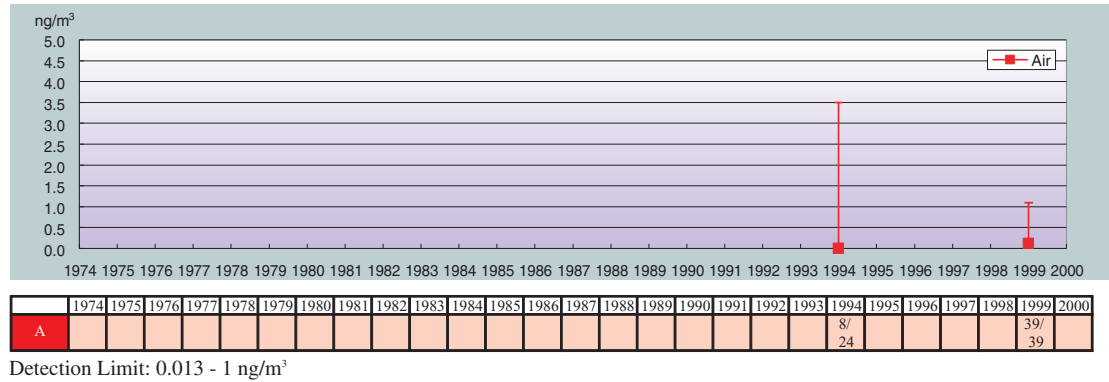
Wildlife

HCB was detected in fish and birds but not detected in shellfish. The detected frequency for fish varies from 104/105 in F.Y.1978 to 7/69 in F.Y. 2000. The detection range was 0.001 – 0.0126 μg/g-wet .

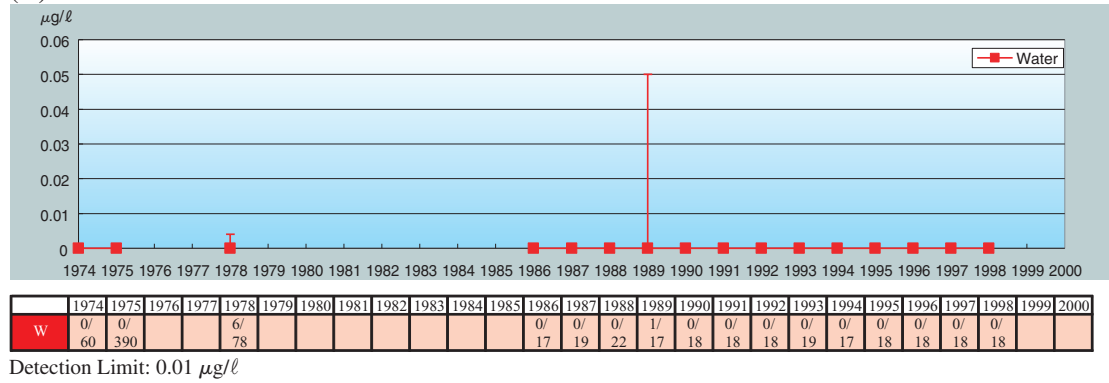
The detected frequency for birds was 5/10 in F.Y.2000 with the detection range of 0.001 – 0.059 μg/g-wet. The level of detected concentrations for HCB has become low.

Fig. 1.3.7-1 Detected frequency and detection range of HCB

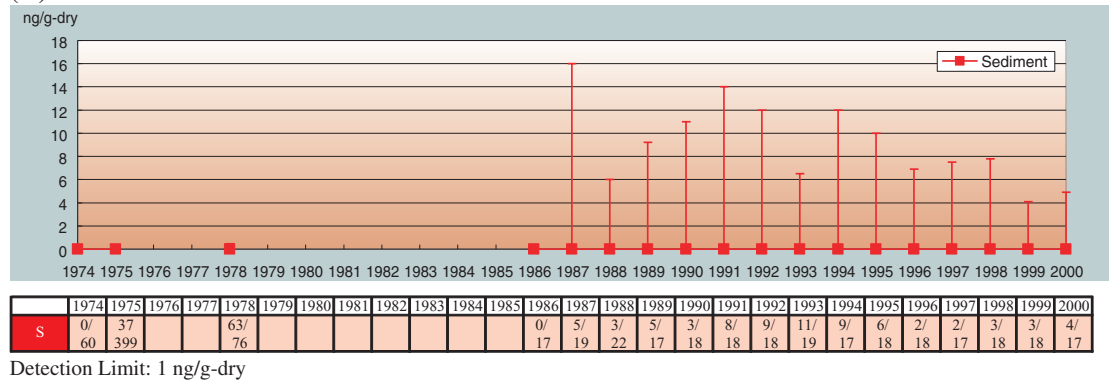
(A) Air



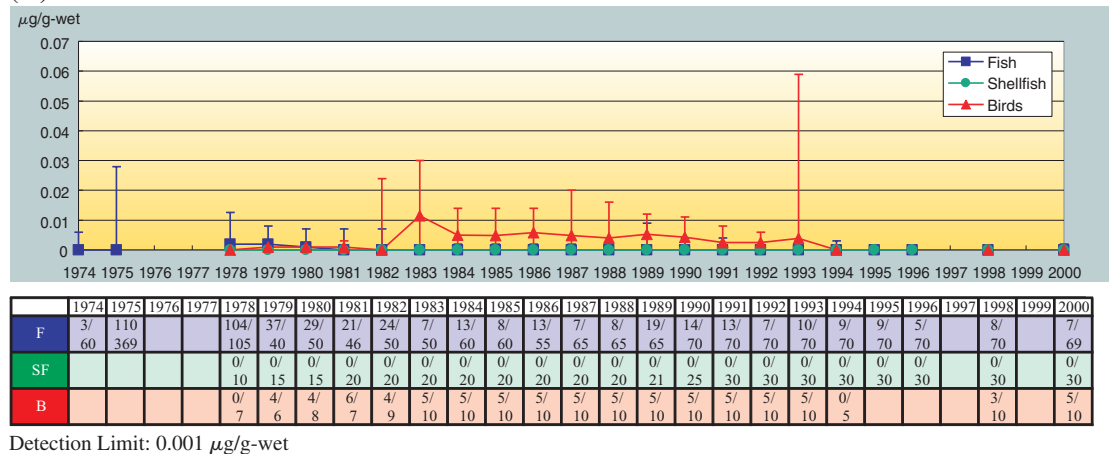
(B) Surface Water



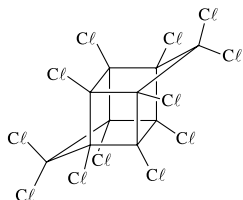
(C) Bottom Sediment



(D) Wildlife



1.3.8 Mirex



(1) Characteristics

Mirex is stable and resistant to heat, therefore, it was used as a flame retardant and insecticide in the United States. It shows toxicity by oral intake, and medium toxicity by aspiration and skin contact.

(2) Regulatory status and historical production and uses

1) Regulatory status

There is no regulation on production and uses of mirex.

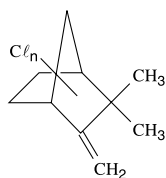
2) Historical production and uses

Mirex was used as a flame retardant and an insecticide in the United States. It has, however, not been produced or used in Japan.

(3) Environmental status

Mirex in water and bottom sediment was surveyed in F.Y.1983. Mirex was not detected in water (27 samples from 9 areas) and bottom sediment (27 samples from 9 areas).

1.3.9 Toxaphene



(1) Characteristics

Toxaphene is a compound obtained through chlorination of terpene or terpene mixtures, that are, soluble in organic solvents. It has rather slow-acting properties as a pesticide.

Toxaphene is absorbed from both digestive canal and skin, demonstrating toxicity to humans and the environment.

(2) Regulatory status and historical production and uses

1) Regulatory status

There is currently no regulation on production and uses of toxaphene.

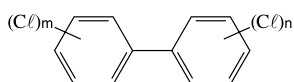
2) Historical production and use

Toxaphene was used mainly for pest control in raw cotton cultivation in the United States. It has not been produced or used in Japan.

(3) Environmental status

Toxaphene in water and bottom sediment was surveyed for the detection of toxaphene in F.Y.1983, but toxaphene was not detected in water (33 samples from 11 areas) or bottom sediment (33 samples from 11 areas).

1.3.10 Polychlorinated biphenyls (PCBs)



(1) Characteristics

PCBs are insoluble in water, but soluble in organic solvents interchangeably. Since PCBs have a high insulating property, a good stability, heat resistance, tackiness and expandability, they were used as insulating oil for transformers and condensers, heating medium for industrial processes, and pressure sensitive paper, etc.

PCBs assume various appearances ranging from oily liquid to white crystalline solid. They have low biodegradability, high bioaccumulation and chronic toxicity to the environment.

There are 209 different isomers of PCBs dependent on the number and bonding links of chlorine. Out of them,

there are 14 kinds of PCBs with coplanar structures called "coplanar PCBs". As the 12 kinds of PCBs out of the 14 kinds of coplanar PCBs have the same level of toxicity as PCDDs and PCDFs, those coplanar PCBs with PCDDs and PCDFs added are grouped and defined as "dioxins" under the Low Concerning Special Measures against Dioxins.

(2) Regulatory status and historical production and uses

1) Regulatory status

PCBs were designated in 1981 as "Class 1 Specified Chemical Substance" under the Chemical Substances Control Law, whereby its production and use were in principle prohibited.

Laws	Status of PCBs
The Air quality standard	Tentative air quality standard: 0.5 $\mu\text{g}/\text{m}^3$ Tentative emission standard for exhaust combustion gas: 0.25 mg/m^3 (average 0.15 mg/m^3) In case of liquid PCBs incineration: 0.15/ m^3 (average 0.1 mg/m^3)
The Water Pollution Control Law	The water quality standard: Not to be detected. (Detection limit: 0.0005 mg/ℓ) The effluent standard: 0.003 mg/ℓ
The Waste Disposal and Public Cleaning Law	PCBs or PCBs-containing substance was designated as Special Management Waste. (1992) Disposed PCBs wastes were designated as Special Management Waste. (1997) Technical criteria for the disposal of electric devices using PCBs as Special Management General Wastes or waste PCBs and PCBs-contaminating substances as Special Management Industrial Wastes, and for the collection/transport and final disposal of disposed PCBs are provided for. Effluent standard for the water quality discharged from final disposal sites: 0.003 mg/ℓ
The Law for the Promotion of Environmentally Sound Destruction of PCB Waste (Promulgated in June 2001 and enforced in July 2001)	It was obligated to locate PCBs disposal facility within 5 years of, and to complete the disposal of PCBs wastes within 15 years of, the enforcement of the said law.
The Chemical Substances Control Law	It was designated as "Class 1 Specified Chemical Substance" in 1974.

2) Historical production and uses

PCBs were used as insulating oil for electric devices such as transformers and condensers, heating medium for heat exchangers, and ink for pressure sensitive copying paper, plastic materials, paints and other applications.

In Japan, the impact of PCBs started around 1950 by the electric industry, followed by domestic production in 1954. As shown in Table 1.3.10-1, it had been produced in Japan with the volume of 58,787 tons up to 1972 when an administrative guidance that requested suspension of

production was issued. There is an estimate that about 54000 tons had been used domestically, and that among them, 37,156 tons were used as insulating oil for transformers, condensers and other electric devices, 8,585 tons for heating medium, 5,350 tons for pressure sensitive papers and 2,910 tons for other open type uses such as plastic materials and paints.

(Source: Masakatsu Hiraoka, Environmental Management, Vol.38, No.3, pp201, 2002)

Table 1.3.10-2 shows the survey results on the storage situation of PCBs containing wastes in F.Y.1998.

Table 1.3.10-1 Production, import, export and consumption of PCBs in Japan (Unit:ton)

PCBs								
	production	import	export	domestic consumption				
				insulating oil	thermal medium	carbonless duplicating paper	others	total
1953	-	20	-	-	-	-	-	-
1954	200	30	-	200	-	-	-	200
1955	450	30	-	430	20	-	-	450
1956	500	30	-	430	50	-	20	500
1957	870	-	-	760	80	-	30	870
1958	880	-	-	740	100	-	40	880
1959	1,260	-	-	1,060	120	-	80	1,260
1960	1,640	-	-	1,320	170	-	150	1,640
1961	2,220	-	-	1,860	180	-	180	2,220
1962	2,190	3	100	1,640	240	10	200	2,090
1963	1,810	37	100	1,270	240	30	170	1,710
1964	2,670	8	40	1,920	400	100	210	2,630
1965	3,000	-	160	1,980	450	170	240	2,840
1966	4,410	117	580	2,600	660	300	270	3,830
1967	4,480	164	720	2,370	730	390	270	3,760
1968	5,130	223	540	2,830	720	780	260	4,590
1969	7,730	145	590	4,220	1,290	1,300	330	7,140
1970	11,110	181	1,000	5,950	1,890	1,920	360	10,120
1971	6,780	170	730	4,560	1,160	350	100	6,170
1972	1,457	-	758	1,016	85	-	-	1,101
total	58,787	1,158	5,318	37,156	8,585	5,350	2,910	54,001

Table 1.3.10-2 Storage situation of PCB wastes in Japan

	Stored (as of 1998)		Being Used (as of 1998)	
	Number of sites	Quantity	Number of sites	Quantity
High-voltage transformer and condenser	39,367	219,327	22,035	60,477 (Numbers)
Waste of carbonless duplicating paper	456	644 (tons)		
PCB waste	382	126,000* (tons)		
Low-voltage transformer and condenser	670	390,000* (Numbers)		
Stabilizer	2,084	2,400,000* (Numbers)		
Pole transformer	49	1,380,000* (Numbers)		
Rag	670	390,000* (Numbers)		
Sludge etc.	2,084	2,400,000* (Numbers)		
	49	1,380,000* (Numbers)		

(Source : Data from Ministry of the Environment)

(Notice : Numbers marked * show approximate numbers)

(4) Environmental status

As for PCBs, the wildlife monitoring has been carried out since F.Y.1978, and also PCBs in air were surveyed in F.Y.1997, 1999 and 2000 and PCBs in bottom sediment were done in F.Y.1996, 1997 and 2000.

PCBs in water were done in F.Y.2000. Fig.1.3.10-1 shows the detected frequency and the detection range of total PCBs.

Air

The detected frequency was 63/63 in F.Y.1997, 48/48 in F.Y.1999 and 21/21 in F.Y.2000. The detection range was 0.044 – 2.3 ng/m³ as a whole.

Water and Bottom sediment

The detected frequency for water was 30/30 with the detection range of 0.095 – 8.4 ng/ℓ .

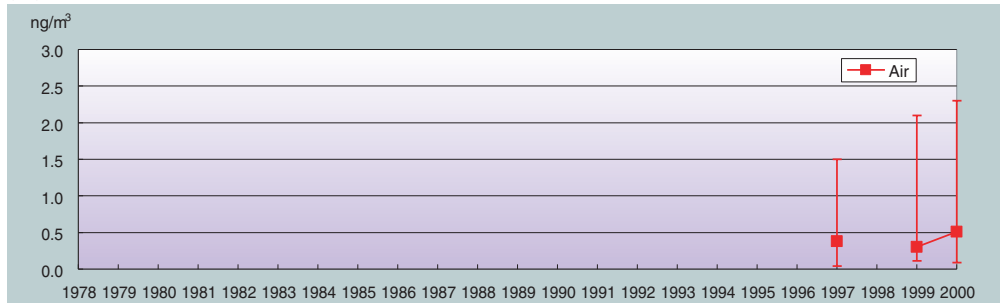
The detected frequency for sediment was 16/36 in F.Y.1996, 17/40 in F.Y.1997 and 38/38 in F.Y.2000. The detection range was 0.042 – 750 ng/g as a whole.

Wildlife

PCBs were detected in fish, shellfish and birds. The detection range was 0.01 – 2.1 μg/g-wet in fish, 0.01– 0.11 μg/g-wet in shellfish and 0.01 – 8.9 μg/g-wet in birds.

Fig. 1.3.10-1 Detected frequency and detection range of total PCBs

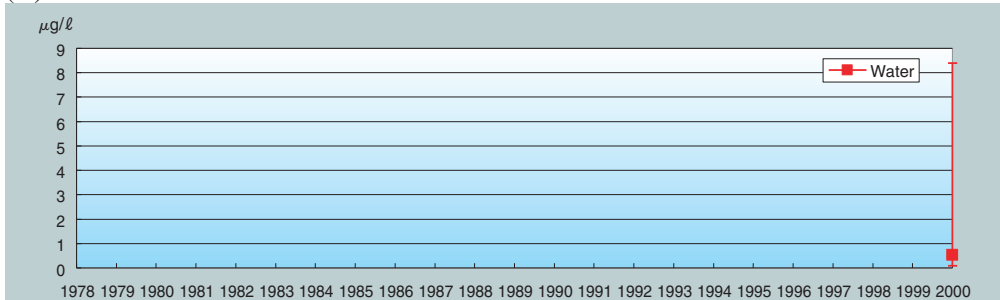
(A) Air



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
A																				63/ 63		48/ 48	21/ 21

Detection Limit: 0.0004 pg/m³ - 0.003 ng/m³

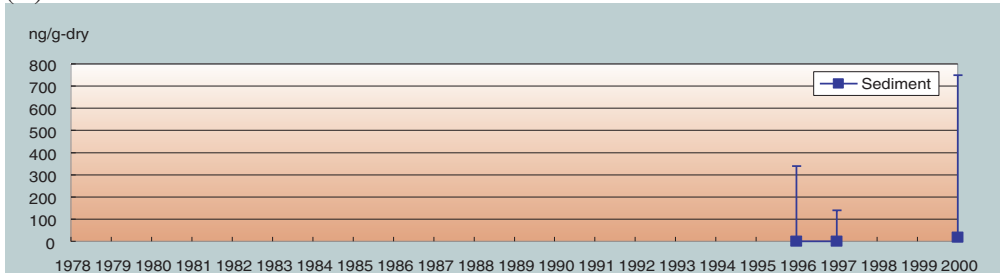
(B) Surface Water



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
W																							30/ 30

Detection Limit: 0.03 pg/ℓ

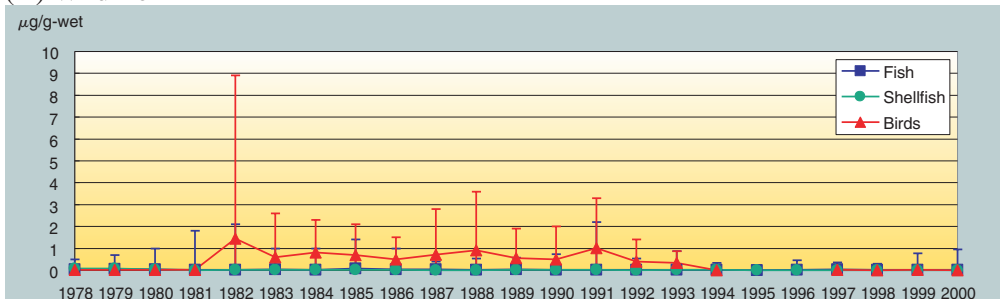
(C) Bottom Sediment



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
S																			16/ 36	17/ 40			38/ 38

Detection Limit: 0.06pg/g-dry - 10ng/g-dry

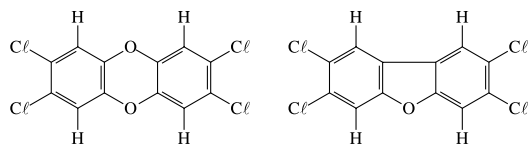
(D) Wildlife



	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F	25/ 30	35/ 40	33/ 30	24/ 45	27/ 50	28/ 50	35/ 60	35/ 60	39/ 55	52/ 65	47/ 65	41/ 65	46/ 70	41/ 70	37/ 70	39/ 70	39/ 70	34/ 70	65/ 105	71/ 108	39/ 70	40/ 70	73/ 107
SF	15/ 15	15/ 15	15/ 15	5/ 15	11/ 20	10/ 20	10/ 20	10/ 20	10/ 20	10/ 20	10/ 20	11/ 21	15/ 25	20/ 30	15/ 30	18/ 30	16/ 30	15/ 30	15/ 30	15/ 30	10/ 30	13/ 30	10/ 30
B	6/ 7	6/ 6	8/ 8	7/ 7	5/ 8	5/ 10	9/ 10	5/ 10	6/ 10	10/ 10	7/ 10	9/ 10	5/ 10	5/ 10	5/ 10	5/ 10	0/ 5			5/ 10	5/ 10	7/ 10	5/ 10

Detection Limit: Fish(0.02 pg/g-wet - 0.01 µg/g-wet), Shellfish(0.001 µg/g-wet), Birds(0.01 µg/g-wet)

1.3.11 PCDDs / PCDFs



(1) Characteristics

PCDDs (Polychlorinated dibenzo-p-dioxins) and PCDFs (Polychlorinated dibenzofurans) are not what are formed intentionally, but the substances formed subordinately and unintentionally in the process of combustion and others.

PCDDs and PCDFs are tricyclic aromatic compounds which are very similar in structure. Their

physical and chemical properties and toxicity are also similar each other. There are 75 isomers of PCDDs and 135 isomers of PCDFs. In appearances, PCDDs are colorless needle crystals and PCDFs are white crystal.

(2) Regulatory status

The Low Concerning Special Measures against Dioxins

Tolerance daily intake (TDI)	4pg-TEQ/kg · day
Environmental quality standard	Air: 0.6 pg-TEQ/m ³ or less Water quality: 1 pg-TEQ/ℓ or less Soil: 1,000 pg-TEQ/g or less(In case of 250 pg-TEQ/g or higher, necessary investigation has to be carried out.)
Standard for dioxin emission	The emission standard for dioxins is shown in Table 1.3.11-1 and the effluent standard for dioxins is shown in Table 1.3.11-2.

Table 1.3.11-1 Air emission standard for dioxins

(Unit : ng-TEQ/m³N)

Type of facility	Capacity of incinerator	Standard value for new facilities	Standard value for existing facilities	
			Jan.15,2001 ~ Nov.30,2002	Dec.1, 2002~
Incinerator	4t/h and above	0.1	80 (application from Dec.1,1998)	1
	2 ~ 4t/h	1		5
	50 kg/h ~ 2t/h	5		10
Electric furnace for iron manufacture		0.5	20	5
Sintering furnace for steel		0.1	2	1
Zinc recovery facility		1	40	10
Aluminum alloy manufacturing		1	20	5

Table 1.3.11-2 Effluent standard for dioxins

(Unit : pg-TEQ/ℓ)

Type of designated facilities *3	Standard value for new facilities	Standard value for existing facilities *1
<ul style="list-style-type: none"> • Bleaching facilities with chlorine or chlorine compound which is used for the manufacturing of sulfate pulp(kraft pulp)or sulfite pulp • Decomposition facilities of waste PCB or materials used for PCB treatment • Wet scrubbers of polluted substances by PCB or materials used for PCB treatment 	10	10
<ul style="list-style-type: none"> • Wet scrubbers or wet dust collector equipped with roasting furnaces, fusion furnaces or drying furnaces which is used for the manufacturing of aluminum or aluminum alloy • Wet scrubbers of 2-ethylene chloride which is used for the manufacturing of vinyl chloride monomer 		10 (20)*2
<ul style="list-style-type: none"> • Wet scrubbers for flue gas, wet dust collectors, or ash strage facilies which are discharging waste water or liquid, at municipal waste incinerators (The incineration capacity should be 50 kg/h and above.) • Wet scrubbers for flue gas, wet dust collectors, or ash strage facilies which are discharging waste water or liquid, at industrial waste incinerators (The incineration capacity should be 50 kg/h and above.) 		10 (50)*2
<ul style="list-style-type: none"> • Sewage treatment plants which are treating sewage from the above facilities • Waste water treatment facilities which are treating waste water from the above working sites 		10

(Note) *1 The application for existing facilities is from Jan. 15, 2001.

*2 This shows the temporary effluent standard which is applied for 3 years after the enforcement of this law.

*3 The effluent standard from the final disposal site is 10 pg-TEQ/ℓ, according to the order which lays down the management standards at the final disposal site.

(3) Emissions

PCDDs and PCDFs are unintentionally formed in the processes of waste combustion, synthesis of chemical substances, metal refining process, etc.

Table 1.3.11-3 gives an “Inventory of dioxins emission” compiled in Japan. According to the table, the estimated annual emission of dioxins in 2000 (this inventory includes coplanar PCBs) is 2,198 - 2,218 g-TEQ, most of which is occupied by emission into air. As shown in the table, the greatest source of its emission is waste incinerators, and in particular, general waste incinerators are the greatest contributor. As for its annual dioxins emission in 2000, the emission from general waste incinerators is 1,019g-TEQ, 46% of the total emission, which is followed by 555g-TEQ of industrial waste incinerators, accounting for as high as 25%. And next followers are electric furnaces for steel manufacturing (131.1 g-TEQ, 5.9%), steel sintering (69.8 g-TEQ, 3.2%), recovery of zinc (26.5 g-TEQ, 1.2%), manufacturing of aluminum alloy (12.8 g-TEQ, 0.58%).

As a result of survey of specified facilities under the “Low Concerning Special Measures against Dioxins” conducted in April 2000, 23,243 facilities to be covered by the air quality standard made notification throughout the country. Out of them, there are 22,453 waste incinerators (comprising 2,444 large incinerators with the capacity of 2t/h or more, 4,336 medium incinerators of 0.2 -2 ton/h, and 15,673 small incinerators of less than 0.2 t/h) and 790

industrial waste incinerators (632 aluminum alloy manufacturing facilities, 113 electric furnace for steel-making, and others).

In order to reduce dioxins emission at waste incinerators, advanced technologies have been developed and put into practice, such as improved combustion, high-efficiency dust collection, blowing activated carbon into a bag-filter, adsorption treatment, and waste gas treatment technology including catalytic treatment.

Table 1.3.11-3 Inventory of dioxins emission

(Unit : g-TEQ/year)

Source	Estimated Emissions			
	1997	1998	1999	2000
• Municipal waste incineration (Emissions into water)	5,000 (0.044)	1,550 (0.044)	1,350 (0.035)	1,019 (0.035)
• Industrial waste incineration (Emissions into water)	1,500 (5.27)	1,100 (5.27)	690 (5.29)	555 (2.47)
• Small size waste incineration	368~619	368~619	307~509	353~370
• Crematory	2.1~4.6	2.2~4.8	2.2~4.9	2.2~4.9
• Industrial sources				
• Electric furnace	228.5	139.9	141.5	131.1
• Paper mfg. KP collection boilers (Emissions into water)	0.041 (0.74)	0.038 (0.71)	0.039 (0.74)	0.041 (0.73)
• Vinyl chloride mfg. (Emissions into water)	0.20 (0.54)	0.20 (0.53)	0.20 (0.55)	0.19 (0.20)
• Cement mfg.	4.03	3.48	3.38	3.44
• Iron and steel sintering process	135.0	113.8	101.3	69.8
• Cast and forged iron mfg.	1.98	1.98	1.53	1.40
• Copper primary smelting	4.88	4.88	0.45	0.59
• Lead primary smelting	0.055	0.055	0.038	0.189
• Zinc primary smelting	0.33	0.33	0.13	0.12
• Copper recovery	0.053	0.053	0.048	0.038
• Lead recovery	1.23	1.23	0.44	0.54
• Zinc recovery	47.4	25.4	21.8	26.5
• Precious metal collection	0.031	0.031	0.046	0.055
• Elongated copper mfg.	3.16	3.16	1.16	1.28
• Aluminum alloy mfg.	21.3	19.4	13.6	12.8
• Electric wires/cables mfg.	1.25	1.25	1.21	1.30
• Aluminum cast/die cast	0.36	0.36	0.37	0.39
• Thermal power plants	1.63	1.55	1.64	1.71
• Others (Emissions into water)	7.30 (6.02)	7.14 (5.59)	7.12 (5.64)	7.18 (5.02)
• Cigarette smoke	0.1~0.2	0.1~0.2	0.1~0.2	0.1~0.2
• Automobile exhaust gas	1.61	1.61	1.61	1.61
• Final disposal site (Emissions into water)	(0.093)	(0.093)	(0.093)	(0.056)
Total (Emissions into water)	7343~7597 (12.7)	3358~3612 (12.2)	2659~2864 (12.3)	2198~2218 (8.5)

* mfg. : manufacturing

(Source : Data from the Ministry of the Environment)

(4) Environmental status

PCDDs and PCDFs in bottom sediment and wildlife (fish and shellfish) were monitored between F.Y.1989 and F.Y.1997. In this monitoring, the targeted substances are 13 kinds of PCDDs and 15 kinds of PCDFs. The detected frequency in each medium was still high. The range of detection in bottom sediment, fish and shellfish was 0.000006 – 50.68 ng/g (WHO-TEF), 0.00003 – 2.7956 ng/g (WHO-TEF) and 0.000006 – 0.085 ng/g (WHO-TEF), respectively.

On the other hand, after the Urgent Simultaneous Nationwide Survey of Dioxins was conducted in F.Y.1998,

other investigations for dioxins have been carried out. Fig. 1.3.11-1 shows survey results on the monitoring of bottom sediment and wildlife.

Table 1.3.11-4 shows the summary of the results of other surveys on dioxins carried out such as

- i) Urgent Simultaneous Nationwide Survey of Doixins
- ii) National Monitoring for Dioxin in F.Y.2000
- iii) Survey on the State of Dioxin Accumulation in Wildlife.

Table 1.3.11-5 shows TEFs of PCDDs, PCDFs and coplanar-PCBs.

Fig. 1.3.11-1 Detected frequency and detection range of dioxins (WHO-TEF)

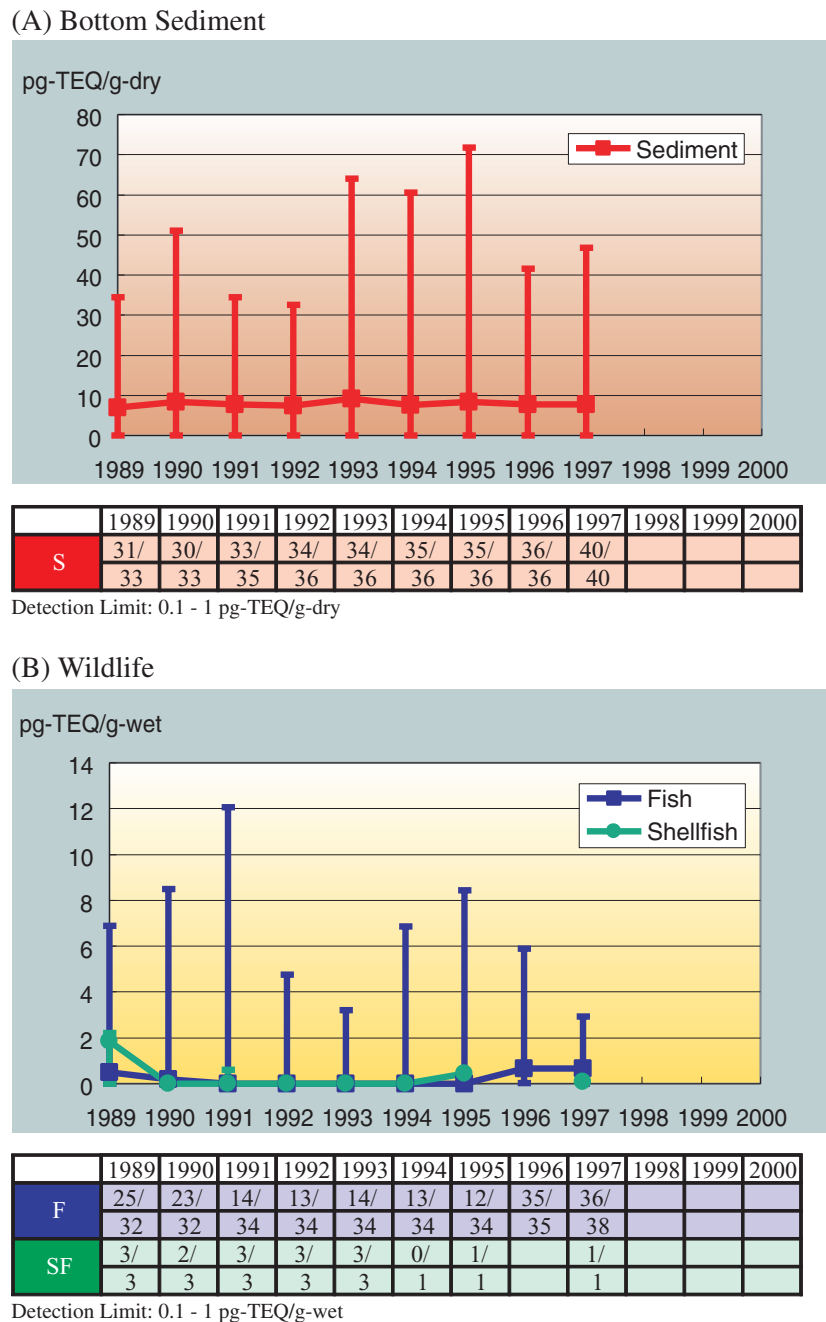


Table 1.3.11-4 Summary of the results of other surveys on dioxins

(1) Air

fiscal year	site category	number of sites	number of samples	sites		detection range			remarks
				exceed NAQS	mean (pg-TEQ/m ³)	(pg-TEQ/m ³)			
2000	in general	705	2,816	4	0.14	0.0073	-	0.76	PCDDs/DFs + CoPCBs, WHO-TEF(1998)
	vicinity of sources	189	648	6	0.15	0.0078	-	1.0	
	along roads	26	98	0	0.17	0.018	-	0.53	
	all sites	920	3,562	10	0.15	0.0073	-	1.0	
1999	in general	353	1,246		0.18	0.0065	-	0.7	
	vicinity of sources	96	276		0.18	0.0094	-	1.1	
	along roads	14	51		0.23	0.024	-	0.75	
	all sites	463	1,573		0.18	0.0065	-	1.1	
1998	vicinity of sources	64	256		0.25	0.015	-	0.70	Source: RUSNSD
	large city region	26	104		0.21	0.0050	-	0.53	
	small/medium city region	6	24		0.20	0.0017	-	0.66	
	background level	4	16		0.02	0.0018	-	0.071	
	all sites	100	400		0.23	0.0017	-	0.70	
1998	vicinity of sources	138	552		0.25	0.00030	-	1.8	PCDDs/DFs, WHO-TEF(1998); Source: RUSNSD
	large city region	118	472		0.22	0.00050	-	1.1	
	small/medium city region	118	472		0.18	0	-	0.86	
	background level	7	28		0.01	0	-	0.067	
	along roads	3	12		0.44	0.00093	-	0.72	
	a distance away	3	12		0.44	0.014	-	0.70	
	all sites	387	1,548		0.22	0	-	1.8	
1998	in general	381	1,360		0.23	0.0	-	0.96	PCDDs/DFs, I-TEF(1988)
	vicinity of sources	61	176		0.20	0.00027	-	0.65	
	along roads	16	54		0.19	0.0030	-	0.48	
	all sites	458	1,590		0.23	0.0	-	0.96	
1997	in general	63	181		0.55	0.010	-	1.4	
	vicinity of sources	2	8		0.58	0.40	-	0.75	
	along roads	3	8		0.47	0.14	-	0.80	
	all sites	68	197		0.55	0.010	-	1.4	
1996	in general	21	84		0.94	0.05	-	1.7	
1994	in general				0.40	0.01	-	1.3	
1992	in general				0.54	0.01	-	1.4	
1990	in general				0.64	0.01	-	2.7	

NAQS: National Air Quality Standard

RUSNSD: Results of the Urgent Simultaneous Nationwide Survey of Dioxins (Conducted in 1998, included in the CD-ROM)

(2) Water and Bottom Sediment

unit; Water: pg-TEQ/ℓ ; Sediment: pg-TEQ/g-dry

fiscal year	medium	number of sites	sites exceed		mean	detection range		remarks
			NWQS					
2000	Public Water	2,116	83	0.31	0.012	-	48	PCDDs/DFs + CoPCBs, WHO-TEF(1998)
	Ground Water	1,479	0	0.097	0.0008	-	0.89	
	Bottom Sediment	1,836	-	9.6	0.0011	-	1,400	
1999	Public Water	568		0.24	0.054	-	14	
	Ground Water	296		0.096	0.062	-	0.55	
	Bottom Sediment	542		5.4	0.066	-	230	
1998	Public Water	204		0.40	0.0014	-	13	Source: RUSNSD
	Ground Water	188		0.081	0	-	5.4	
	Bottom Sediment	205		7.7	0	-	260	
1998	Public Water	204		0.36	0	-	12	PCDDs/DFS, WHO-TEF(1998)
	Ground Water	243		0.086	0	-	5.3	
	Bottom Sediment	205		6.8	0	-	230	
1997	Public Water	12		0.37	0.005	-	3.9	PCDDs/DFs,
1996	Public Water	7		0	0	-	0.1	I-TEF(1988) River only
1995	Public Water	12		0.1	0	-	0.3	Coast and Ocean
1992	Public Water	14		0	0	-	0	Coast and Ocean
1991	Public Water	6		2	0	-	3	
1990	Public Water	8		0	0	-	1	Coast and Ocean

NWQS: National Water Quality Standard

RUSNSD: Results of the Urgent Simultaneous Nationwide Survey of Dioxins (Conducted in 1998, included in the CD-ROM)

(3) Soil

fiscal year	site category	number of sites	sites exceed		mean (pg-TEQ/g-dry)	detection range (pg-TEQ/g-dry)		remarks
			NSQS					
2000	in general	1,942	0	4.6	0	-	280	PCDDs/DFs + CoPCBs, WHO-TEF(1998)
	vicinity of sources	1,089	1	11	0	-	1,200	
	all sites	3,031	1	6.9	0	-	1,200	
1998	vicinity of sources	161		7.1	0.0015	-	49	
	large city region	59		6.1	0.063	-	35	
	small/medium city region	59		6.0	0.024	-	61	
	background level	7		1.8	0.26	-	6	
	all sites	286		6.5	0.0015	-	61	
1998	vicinity of sources	219		6.8	0.00067	-	110	PCDDs/DFs, WHO-TEF(1998)
	large city region	59		5.4	0.057	-	33	
	small/medium city region	59		5.6	0.022	-	61	
	background level	7		1.7	0.13	-	6	
	all sites	344		6.2	0.00067	-	110	

NSQS: National Soil Quality Standard

(4) Aquatic Organisms

fiscal year	site category	number of sites	mean (pg-TEQ/g-wet)	detection range (pg-TEQ/g-wet)	remarks
1999	all sites	543	1.4	0.032 - 33	PCDDs/DFs +
1998	all sites	368	2.1	0.0022 - 30	CoPCBs, WHO-TEF(1998)
	vicinity of sources	118	2.3	0.065 - 12	
	large city region	118	2.5	0.032 - 30	
	small/medium city region	118	1.7	0.0061 - 12	
	background level	14	0.73	0.0022 - 4.1	
1998	all sites	368	0.64	0 - 11	PCDDs/DFs, WHO-TEF(1998)
	vicinity of sources	118	0.82	0 - 8.4	
	large city region	118	0.6	0 - 11	
	small/medium city region	118	0.51	0 - 4.5	
	background level	14	0.43	0 - 3.4	

(5) Farm unit: pg-TEQ/g-dry; PCDDs/DFs + CoPCBs, WHO-TEF(1998)

fiscal year	farm type	number of samples	mean	detection range		
2000	all sites	188	26	0.028	-	200
1999	all sites	188	27	0.035	-	180
1998	all sites	52	28	0.066	-	130
	cabbage	8	21	1.5	-	65
	sweet potato	6	11	0.066	-	30
	paddy rice	20	52	15	-	130
	Japanese radish	7	8.3	2.7	-	17
	potato	5	19	0.16	-	39
	grass	6	8.6	0.56	-	27

(6) Crops unit: pg-TEQ/g-dry; PCDDs/DFs + CoPCBs, WHO-TEF(1998)

species	fiscal year	number of samples	mean	detection range		
all species	2000	374	---	0	-	0.47
	1999	188	0.046	0	-	0.60
	1998	52	0.026	0.000071	-	0.61
paddy rice	2000	134	0.00060	0	-	0.010
	1999	46	0.0016	0.000006	-	0.027
	1998	20	0.025	0.00019	-	0.13
wheat	2000	6	0.00040	0.00001	-	0.0014
	1999	2	0.00013	0.000037	-	0.00023
soybean	2000	8	0.0013	0	-	0.0072
	1999	14	0.0044	0	-	0.06
adzuki bean	2000	4	0.00017	0.000015	-	0.00032
sweet potato	2000	6	0.00030	0	-	0.00078
	1999	4	0.00013	0.000005	-	0.00047
	1998	6	0.0085	0.00025	-	0.047
Chinese yam	1999	2	0			
taro	2000	2	0.000005	0	-	0.00001
	1999	2	0.000006	0.000006	-	0.000006
ginger plant	2000	2	0.0044	0.0038	-	0.0049
Japanese radish	2000	8	0.00045	0	-	0.002
	1999	4	0			
	1998	7	0.00057	0.000071	-	0.0019
carrot	2000	4	0.0000038	0	-	0.00001
	1999	8	0.0012	0.000010	-	0.0041

(6) Crops (continued)

unit: pg-TEQ/g-dry; PCDDs/DFs + CoPCBs, WHO-TEF(1998)

species	fiscal year	number of samples	mean	detection range	
potato	2000	10	0.00023	0	- 0.00091
	1999	6	0.00013	0.000005	- 0.00042
	1998	5	0.0075	0.00033	- 0.021
cabbage	2000	18	0.000024	0	- 0.0004
	1999	10	0.0000056	0	- 0.00041
	1998	8	0.0046	0.00009	- 0.018
komatsuna	2000	4	0.043	0.025	- 0.064
crown daisy	2000	2	0.011	0.0097	- 0.012
leek	2000	10	0.000071	0	- 0.00071
Chinese cabbage	2000	4	0.0000035	0	- 0.000014
spinach	2000	10	0.12	0.091	- 0.20
	1999	22	0.15	0.0038	- 0.55
jew's mallow	2000	2	0.30	0.29	- 0.31
onion	1999	2	0		
lettuce	2000	6	0.00027	0	- 0.0011
	1999	2	0.000002	0	- 0.000005
sweet corn	1999	2	0		
field peas	1999	4	0.016	0	- 0.06
young soybeans	2000	4	0.0000015	0	- 0.000006
	1999	2	0.00002	0.000007	- 0.000034
okra	2000	4	0.000064	0	- 0.00024
pumpkin	2000	2	0.00075	0.0004	- 0.0011
cucumber	2000	12	0.0011	0	- 0.011
	1999	2	0.00026	0.00002	- 0.0005
strawberry	2000	6	0.0000018	0	- 0.000006
	1999	2	0		
tomato	2000	4	0.00005	0	- 0.0002
	1999	6	0.00011	0	- 0.0005
eggplant	2000	10	0.0000029	0	- 0.000011
	1999	8	0.0000075	0	- 0.000032
green pepper	2000	8	0.000001	0	- 0.000006
broccoli	2000	2	0.00023	0	- 0.00045
green tea	2000	14	0.14	0.021	- 0.47
	1999	4	0.26	0.12	- 0.57
green tea(product)	1999	10	0.37	0.072	- 0.60
ume	2000	2	0.00033	0.00033	- 0.00033
kaki	2000	16	0.0063	0	- 0.082
	1999	4	0.0037	0	- 0.0078
pear	2000	6	0.000028	0	- 0.00011
grape	2000	10	0.072	0.00071	- 0.35
	1999	6	0.02	0.00033	- 0.060
ponkan orange	2000	2	0	0	- 0
mandarin orange	2000	22	0.0000018	0	- 0.00002
	1999	6	0.000011	0	- 0.000032
peach	2000	6	0.0000042	0	- 0.00002
apple	2000	4	0.00085	0.00004	- 0.0021
	1999	4	0.00076	0.00012	- 0.0015
chestnut	1999	2	0.000025	0	- 0.00005
grass	1998	6	0.12	0.0044	- 0.61

(7) Wildlife

unit: pg-TEQ/g-dry; PCDDs/DFs + CoPCBs, WHO-TEF(1998,mammals)

species	part	fiscal year	number of samples	fat rate(%)	mean	detection range		
carp		1998	48	1.8	3.0	0.56	- 1	
frogs		1998	80	1.1	4.1	0.50	- 11	
domesticated pigeon	mustle, liver	1998	5	5.3	0.79	0.40	- 1.3	
	mustle,	1998	2	4.9	4.7	4.4	- 5.0	
	liver, kidney							
	mustle,	1998	8	7.8	4.2	1.1	- 10	
	liver,							
	kidney, fat							
kite	mustle	2000	20	5.2	21	1.7	- 100	
		1999	22	6.4	21	1.7	- 100	
		1998	8	6.0	100	11	- 470	
	liver	2000	20	4.7	49	3.6	- 400	
		fat	1999	16	78	49	3.6	- 400
		mustle, fat	1998	20	16	86	13	- 220
cormorant	mustle	2000	34	3.9	160	3.8	- 570	
		1999	50	4.2	160	3.8	- 570	
	fat	2000	6	64	2900	150	- 6500	
Birds of Prey(Blakiston's fish owl)	mustle, fat	1998	4	23	49	37	- 70	
Birds of Prey(Others)	liver	1998	5	10	120	10	- 380.	
Stejneger's beaked whale	mustle	2000	5	1.5	4.8	1.7	- 13	
		1999	14	2.9	4.5	0.68	- 16	
	fat	2000	5	86	150	83	- 360	
		1999	14	82	99	9.6	- 260	
Finless porpoise	mustle	2000	10	2.8	2.2	0.71	- 4.5	
		1999	13	5.4	6.6	0.48	- 62	
	fat	2000	10	78	79	17	- 140	
		1999	12	77	65	24	- 110	
Whales	fat	1998	22	77	88	1.3	- 200	
seals	fat	1998	13	86	17	8.6	- 27	
wood mouse (Apodemus speciosus)	whole body	2000	20	2.7	1.2	0.61	- 2.4	
		1999	37	3.0	0.68	<0.22	- 7.9	
		1998	37	4.7	39	0.52	- 120	
Nihonzaru	fat	1998	6	4.6	0	5.4	- 27	
	mustle	1998	4	25	7.1	0.48	- 22	
	fat, mustle	1998	10	38	4.4	0.33	- 18	
	fat, liver	1998	5	35	5.6	1.7	- 19	
	fat, liver,	1998	5	39	4.2	0.82	- 9.4	
	mustle							
bears	fat	1998	10	88	0.45	0.080	- 2.1	
	fat, liver	1998	6	77	0.45	0.18	- 1.1	
raccoon dog	mustle	1999	10	7.4	21	1.4	- 78	
		fat	2000	10	64	39	7.8	- 110
		1999	10	65	140	8.0	- 310	
		1998	1	82	28			
	liver	1998	4	10	23	9.7	- 42	
		fat, liver	1998	5	76	34	13	- 100
		fat, liver,	1998	1	66	9.7		
		mustle						
Sika deer	liver	1998	25	7.1	3.5	0.93	- 10	
	fat, liver	1998	5	23	4.5	1.4	- 6.1	
	kidney	1998	28	5.9	1.9	0.43	- 11	
	fat, kidney	1998	20	34	5.3	2.0	- 10	

Table 1.3.11-5 Toxic equivalency factors (TEFs) for PCDDs, PCDFs and coplanar-PCBs

Congener		I-TEF (1988)	WHO-TEF (1998)	WHO(1998 van der Berg et.al)			
				mammals	fish	birds	
PCDD	2,3,7,8-T ₄ CDD	1	1	1	1	1	
	1,2,3,7,8-P ₅ CDD	0.5	1	1	1	1	
	1,2,3,4,7,8-H ₆ CDD	0.1	0.1	0.1	0.5	0.05	
	1,2,3,6,7,8-H ₆ CDD	0.1	0.1	0.1	0.01	0.01	
	1,2,3,7,8,9-H ₆ CDD	0.1	0.1	0.1	0.01	0.1	
	1,2,3,4,6,7,8-H ₇ CDD	0.01	0.01	0.01	0.001	<0.001	
	1,2,3,4,6,7,8,9-OCDD	0.001	0.0001	0.0001	<0.0001	0.0001	
PCDF	2,3,7,8-T ₄ CDF	0.1	0.1	0.1	0.05	1	
	1,2,3,7,8-P ₅ CDF	0.05	0.05	0.05	0.05	0.1	
	2,3,4,7,8-P ₅ CDF	0.5	0.5	0.5	0.5	1	
	1,2,3,4,7,8-H ₆ CDF	0.1	0.1	0.1	0.1	0.1	
	1,2,3,6,7,8-H ₆ CDF	0.1	0.1	0.1	0.1	0.1	
	1,2,3,7,8,9-H ₆ CDF	0.1	0.1	0.1	0.1	0.1	
	2,3,4,6,7,8-H ₆ CDF	0.1	0.1	0.1	0.1	0.1	
	1,2,3,4,6,7,8-H ₇ CDF	0.01	0.01	0.01	0.01	0.01	
	1,2,3,4,7,8,9-H ₇ CDF	0.01	0.01	0.01	0.01	0.01	
	1,2,3,4,6,7,8,9-OCDF	0.001	0.0001	0.0001	<0.0001	0.0001	
Toxic equivalency factors (TEFs) for PCBs							
Congener		IUPAC	WHO/IPCS- TEF(1993)	WHO-TEF (1998)	WHO(1998 van der Berg et.al)		
					mammals	fish	birds
Non-ortho	3,4,4',5'-T ₄ CB	#81	-	0.0001	0.0001	0.0005	0.1
PCBs	3,3',4,4'-T ₄ CB	#77	0.0005	0.0001	0.0001	0.0001	0.05
	3,3',4,4',5'-P ₅ CB	#126	0.1	0.1	0.1	0.005	0.1
	3,3',4,4',5,5'-H ₆ CB	#169	0.01	0.01	0.01	0.00005	0.001
Mono-ortho	2',3,4,4',5'-P ₅ CB	#123	0.0001	0.0001	0.0001	<0.000005	0.00001
	2,3',4,4',5'-P ₅ CB	#118	0.0001	0.0001	0.0001	<0.000005	0.00001
	2,3,3',4,4'-P ₅ CB	#105	0.0001	0.0001	0.0001	<0.000005	0.0001
	2,3,4,4',5'-P ₅ CB	#114	0.0005	0.0005	0.0005	<0.000005	0.0001
	2,3',4,4',5,5'-H ₆ CB	#167	0.00001	0.00001	0.00001	<0.000005	0.00001
	2,3,3',4,4',5'-H ₆ CB	#156	0.0005	0.0005	0.0005	<0.000005	0.0001
	2,3,3',4,4',5'-H ₆ CB	#157	0.0005	0.0005	0.0005	<0.000005	0.0001
	2,3,3',4,4',5,5'-H ₇ CB	#189	0.0001	0.0001	0.0001	<0.000005	0.00001
Di-ortho	2,2',3,4,4',5,5'-H ₇ CB	#180	0.00001	-	-	-	-
	2,2',3,3',4,4',5'-H ₇ CB	#170	0.0001	-	-	-	-