

**Standard Guidelines
for the Environmental Monitoring of Chemicals**

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I Monitoring Chemical Substances

I.1 Introduction

For the past few decades, industrialized societies have been both developing new chemical substances and producing large quantities of existing chemicals every year. These chemicals serve many useful purposes and are to be found in all aspects of modern life. They have contributed significantly, and continue to contribute significantly, to the improvement of human health, welfare and lifestyle. However, many chemicals are released into the environment during production, transportation, utilization, or disposal, and once there produce harmful side effects, particularly on human health and ecosystems, through the persistence of significant residues in the environment, or by bioaccumulation (bioconcentration) in food chains. Environmental pollution issues, such as organic mercury and PCB pollution, groundwater pollution with trichloroethylene and tetrachloroethylene, marine pollution by organic tin compounds, and dioxin emissions from garbage incineration, are not just scientific problems, but have also become significant social issues.

The recent increase in the number and quantity of chemicals produced has seen a concomitant increase in the range of related environmental problems. Environmental pollution by harmful chemicals is of concern not just to Japan, but also to many countries worldwide. At UNCED (the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992) it was determined in "Agenda 21" that the management of harmful chemicals in the environment is an international theme, and the IFCS (the International Forum of Chemical Safety) was established as an inter-governmental forum in an effort to provide active international follow-up to the Conference's resolutions.

In December 1994, concern over chemicals threatening the maintenance or preservation of the environment saw the formulation of Japan's "Basic Environment Plan." This Plan, based on the "Basic Environment Law" (November 1993) set out as policy that a knowledge of the environmental risk posed by chemicals was one of the basic requirements for environmental preservation. The Plan aims to both quantitatively evaluate environmental risk, and at the same time eliminate the risk by several means e.g. in order to decrease environmental risk during the production, use, and disposal of chemicals, the Plan set out (i) regulations for the

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manner and methods of discharge of harmful chemicals, (ii) regulations for the management of chemical production and use appropriate to the degree of harmfulness (toxicity) of the chemical, (iii) regulations for the development and spread of substitute technology and products, and (iv) regulations for the appropriate treatment of recovered harmful chemicals.

In order to be able to control and manage appropriately the environmental risk posed by chemicals (decrease the risk), it is first important to determine and quantitatively evaluate the environmental risk. Such risk evaluation is based on a chemical “risk assessment” (an evaluation of the toxicity of the chemicals in question to humans or ecosystems) and an “exposure assessment” (an evaluation of the degree of chemical exposure experienced by humans or ecosystems based on determinations of the environmental concentrations of the chemicals).

After passing the Resolution accompanying the Law Concerning the Examination and Regulation of Manufacture etc. of Chemical Substances (the Chemical Substances Control Law) in 1973, the Japanese Parliament (the Diet) amended the law to make the national government perform a safety check of chemicals produced in Japan or imported, and in use at that time (of which over 20,000 were listed). This was followed by the Environmental Agency beginning a survey of residues of these chemicals in the general environment. Later the objectives of these investigations were expanded to include newly registered chemicals and unintentionally produced chemicals (by-products or contaminants). While the Chemical Substances Control Law, by controlling production (or import) and regulating the use of harmful chemicals to control their environmental toxicity and residues, is an important method for environmental risk management, investigations into the actual levels of environmental contamination by chemicals provides the type of important basic information required for exposure evaluation. Furthermore, such investigations provide, and are expected to provide, information required in the performance of other environmental risk management functions, such as discharge regulation. The Chemical Substances Control Law was enacted in October 1973 amid concern over environmental pollution by PCBs, and enforced from April 1974. According to the Chemical Substances Control Law new chemicals were to be investigated before production or import (pre-examination of new chemicals) if the chemicals were (i) chemically inert under natural conditions, (ii) if they were easily accumulated in the living tissue (high bio-accumulation potential), (iii) if they have posed a significant risk to human health when ingested / absorbed on a continuous basis (chronic toxicity), and (iv) to be registered as ‘first grade’ and the production, import, and use etc. regulated, specified chemicals having all these characteristics. By the end of December 1995, 5,879 new chemicals (4,404 produced locally, 1,475 imported) were reported, of which the safety of 4,679 chemicals (3,591 produced locally,

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1,088 imported) had been investigated.

Existing chemicals are investigated by three government organizations : chemical decomposition by microorganisms and bioaccumulation in fish and other marine products is investigated by the Ministry of International Trade and Industry (MITI), human toxicity is investigated by the Ministry of Health and Welfare, and general investigations into actual environmental residue levels and ecological effects are performed by the Environmental Agency. By December 1996, nine chemicals had been designated as Class 1 Specified Chemical Substances - PCBs, HCBs, PCNs, aldrin, dieldrin, endrin, DDT, chlordanes, and bis(tributyl tin)=oxide.

The Chemical Substances Control Law was revised in May 1986 (enforced from April 1987) after detection of trichloroethylene contamination of groundwater in Japan. This revision covered the production and import of Designated Chemical Substances which do not significantly bioaccumulate, are slightly degradable and have indeterminate chronic toxic effects. Where there are strong concerns over damage to human health caused by environmental contamination by such chemicals, the chemical manufacturers were required to investigate and report chemical toxicity data. If such chemicals showed significant toxicity, their production and import was regulated. To date 257 chemicals, such as chloroform, 1,2-dichloroethane, have designated as Designated Chemical Substances. Since April 1989, when tetrachloromethane, tetrachloroethylene, and trichloroethylene were designated Class 2 Specified Chemical Substances, there are now 23 such Class 2 Specified Chemical Substances.

In 1974, after enactment of the Chemical Substances Control Law, the Environmental Agency began the Survey for Chemical Substances (determining the real state of the environment), and other related projects. In order to systematically investigate the large number of chemicals, a temporary toxic substances list was prepared based on known human health effects. Chemicals on the list and which received priority for investigation were those which (i) are highly toxic and are regulated under the Law, (ii) which are known to be difficult to degrade (persistent chemicals), and (iii) which have structures similar to PCBs, or are industrial substitutes for such chemicals.

As the number and types of matrices under investigation have increased, new chemical analytical methods have had to be developed for most chemicals. As a result, since 1977 research has been classified into three areas, namely the development of chemical analytical methods, general environmental research, and specific highly detailed environmental research

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projects. Research bodies were organized with local government environmental research institutes to these research areas.

As such research was systematized, the first general investigation of chemical environmental safety was conducted from 1979 to 1988 (first 10 Year Plan) using as its starting point the above mentioned temporary toxic substances list. Since 1988, a second general investigation of chemicals environmental safety has been conducted (second 10 Year Plan). Hereafter follows a summary of chemical monitoring in Japan.

I.2 Monitoring - Concepts and Design

Environmental management involves three basic types of activities. First, measurement and observation to describe both the current state of the environment and any change. Second, evaluation and analysis of environmental data. Third, developing warning systems based on predetermined standards to alert society to change. "Monitoring" in this manual includes the first activity (scientifically planned measurement and observation systems) and also partly includes the second action (evaluation).

Many chemicals discharged into atmosphere, water, and onto farmland are spread all over the planet. These chemicals are now also found pristine terrestrial and ocean environments far from human habitation. Some of them are known to be highly toxic at high doses, but it is unknown if such chemicals have long term effects on people and other living things when the doses are small. In addition, once discharged these harmful chemicals exist in the environment without degradation, or with only minimal degradation for tens of years, and it is clear that some animals and plants have been affected by these harmful chemicals to the point of population decrease or increase in diseases.

Heavy metals (lead, mercury, cadmium), organochlorine compounds (DDT and its metabolites and degradation products, PCB), and petroleum products are often cited as 'slightly degradable' harmful chemicals. Pollution occurs in the every media - atmospheric, aqueous, soil, and in organisms. However, it is important that these products stay long in the biosphere such as soil and seawater. Almost every kinds of artificial pollutants end up in the ocean. Industrial wastes and pesticides are discharged directly into coastal waters, or are carried into the sea

through rivers. Huge amounts of harmful chemicals are often dumped onto bottom of the sea or into the ocean far from the coast. Pollutants carried through by the atmosphere are deposited by rain or absorbed directly onto the surface of the ocean.

The biosphere has therefore effectively become a toxic waste dump, and that inevitably has effects on the growth and propagation of animals and plants. Every kinds of pollutants affects on ecology structure by decreasing species diversity though there are level differences. Harmful chemicals endanger human health directly or accumulated through food chain. It is unknown if the distribution pattern of these chemicals is stable (quasi-equilibrium state) at moment, or if some of these chemicals will keep circulating in the biosphere following transport processes which are not well understood when chemical discharge from urban, industrial, and agricultural activity ceases.

Observing varied bioinfluences makes clear about effects which pollutants give biota. For example, change of biomass and the sphere of distribution, change of group structure of animals and plants, total exchange of ecosystem or change of productivity are given. Therefore, choosing and evaluating specified variety of living thing or items to describe high level change of creature system can make special or general effects giving biota clear.

It is necessary to consider constructing automatic adjusting system as monitoring for check chemical influences on animals and plants and humans circulating the environment where they are living. It is needed to make priority from several 10,000 chemicals used commercially. Also it is decided which environmental media (atmosphere, water soil, and living things) tends to include these chemicals depending on the physical, chemical character of these chemicals. It is important to select environmental media to meet the chemicals. Concentration of pollutants in the atmosphere changes depending on the climate condition. So it is needed to sample considering space and time wise. Therefore the total monitoring system has to be planned highly sensitively which includes these special sub-program needs.

I.3 Target Chemicals

In order to determine environmental chemical residues, it is first necessary to choose target chemicals from among the many thousands currently in commercial use. The Environment

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Agency in Japan has been developing chemical analytical methods for more than 700 chemicals and accumulating environmental pollution data for the past 20 years (details of the analytical methods are described in subsequent chapters. All such analytical methods and other information will be useful for other countries monitoring chemicals in their environment. A list of the chemicals is shown in **Table I-2**). The number of chemicals which have been found in water, sediments, in fish, and in the air between 1974 and 1995 is summarized in **Table I-1**.

Table I-1. Summary of number of chemicals detected in the environmental survey (1974 - 1995).

	Water	Sediment	Fish	Air	Total
No. of chemicals investigated	731	710	226	174	752
No. of chemicals detected	135	219	87	104	287
Detection rate (%)	18.5	30.8	38.5	59.8	38.2

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Table I-2. Summary of the results of environmental survey for chemical substances 1974 to 1994
(conducted by Environmental Agency)

○ : Detection / × : Undetection

W:Water S:Sediment F:Fishes O:Others(A:Air R:Rain Water P:Plankton)

Substance	CAS No.	Year	W	S	F	O
Acenaphthene	83-32-9	83	×	○		
		84	○	○	○	
Acenaphthylene	208-96-8	83	×	○		
		84	○	○	○	
Acephate	30560-19-1	93	×	×	×	
Acetaldehyde	75-07-0	77	×	○		
		87	×			AO
Acetonitrile	75-05-8	77	×	×		
		87	×	○		AO
		91				AO
		92	○	○		
Acrolein	107-02-8	78	×	×		
		87	×			A×
Acrylamide	79-06-1	75	×			
		91	○	○	×	
Acrylonitrile	107-13-1	77	×	×		
		87	×	○		AO
		91				AO
		92	×	○	×	
Adipic acid	124-04-9	85	×	○		
Adiponitrile	111-69-3	78	×	×		
Aldrin	309-00-2	74	×	×	×	
Alkyldimethylbenzyl-ammonium chloride (*1) (Benzalkonium chloride)	8001-54-5 68391-01-5	82	×	○		
		83	×	○	×	
Allylamine	107-11-9	81	×	×		
Allyl chloride	107-05-1	77	×			
1-Aminoanthraquinone	82-45-1	85	×	○		
2-Aminoanthraquinone	117-79-3	85	×	×		
3-Aminobenzenesulfonic acid		81	×	×		
o-Aminobiphenyl	90-41-5	77	×	×		
2-Amino-5-chloro-4-methylbenzenesulfonic acid	88-53-9	80	×	×		
1-Amino-2-methoxy-5-methylbenzene	120-71-8	85	×	×		
1-Amino-2-methylantraquinone	82-28-0	86	×	×		
1-Aminonaphthalene-4-sulfonic acid	84-86-6	85	×	×		
2-Aminonaphthalene-1-sulfonic acid	81-16-3	85	×	×		

Substance	CAS No.	Year	W	S	F	O
2-Aminonaphthalene-5-sulfonic acid	81-05-0	85	×	×		
2-Aminonaphthalene-6-sulfonic acid	93-005	85	×	×		
2-Aminonaphthalene-7-sulfonic acid	494-44-0	85	×	×		
2-Aminonaphthalene-8-sulfonic acid	86-60-2	85	×	×		
1-Amino-8-naphthol-3,6-disulfonic acid	90-20-0	80	×	×		
2-Amino-5-naphthol-7-sulfonic acid	87-02-5	80	×	×		
o-Aminophenol	95-55-6	86	×	×		
m-Aminophenol	591-27-5	86	○	×		
p-Aminophenol	123-30-8	86	×	×		
2-Aminopyridine	504-29-0	83	×	×		
3-Aminopyridine	462-08-8	83	×	×		
4-Aminopyridine	504-24-5	83	×	×		
3-Amino-1, 2, 4-triazole	61-82-5	84	×	×		
Aniline	62-53-3	76	○	○		
		90	○	○	○	AO
Anionic surfactants		74	○			
o-Anisidine	90-04-0	76	○	○		
		90	○	○	×	A×
m-Anisidine	536-90-3	76	○	○		
		90	○	×	○	A×
p-Anisidine	104-94-9	76	○	○		
		90	×	×	×	A×
Anthracene	120-12-7	76	×	○		
		77	×	○		
Anthraquinone	84-65-1	88	×	○		
		89	×	○		
Atrazine (2-Chloro-4-ethylamino-6-isopropyl-amino-sym-triazine)	1912-24-9	91	×	×		
Auramine	2465-27-2	86	×	×		
Azinphos-methyl	86-50-0	93				A×
Azobisisobutyronitrile	78-67-1	79	×	×		
C. I. Basic Green 4	569-64-2	85	×	×		
C. I. Basic Violet 10	81-88-9	86	×	×		
Benzaldehyde	100-52-7	84	×	○		

(*1) Total of compounds with alkyl chains having 12, 14 or 16 carbons

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Substance	CAS No.	Year	W	S	F	O
Bentazone [3-Isopropyl-1H-2, 1, 3-benzothiadiazin-4 (3H)-one-2, 2-dioxide]	25057-89-0	92	○	×	×	
Benthiocarb (S-4-Chlorobenzyl N, N-diethylthiocarbamate)	28249-77-6	92	×	○	×	A○
Benz [a] anthracene	56-55-3	89	×	○	○	A○
Benzene	71-43-2	77	×	×		
		85	○	○		
		86	○	○	○	
Benzene tricarboxylic acid tris (2-ethylhexyl) ester	3319-31-1	80	×	×		
Benzidine	92-87-5	77	×	×		
1, 4-Benzodinitrile	623-26-7	81	×	×		
Benzoepin (Hexachloro-hexahydrom ethano-benzodioxathepin oxide) (α, β) (Endosulfan)	959-98-8 33213-65-9	82	×	×		
		92				A×
Benzo [b] fluoranthene	205-82-3	89	×	○	○	A○
Benzo [j] fluoranthene	205-99-2					
Benzo [k] fluoranthene (*2)	207-08-9					
Benzoic acid	65-85-0	85	○	○		
		86	○	○	○	
Benzonitrile	100-47-0	77	×	×		
Benzo [ghi] perylene	191-24-2	89	○	○	○	A○
Benzophenone	119-61-9	81	×	×		
Benzo [a] pyrene	50-32-8	89	×	○	○	A○
Benzo [e] pyrene	192-97-2	89	×	○	×	A○
Benzothiazole	95-16-9	83	×	○		
Benzyl alcohol	100-51-6	85	×	○		
Benzyl butyl phthalate	85-68-7	85	×	○		
Benzyl chloride	100-44-7	76	×	×	×	
		77	×	○		
		89	×	×		A○
Biphenyl	92-52-4	76	×	×	×	
Biphenyl ether	101-84-8	76	×	×	×	
		84	×	×		
Bis (4-bromophenyl) ether	2050-47-7	84	×	×		
1, 1-Bis (t-butylperoxy)- 3, 3, 5-trimethyl-cyclohexane	6731-36-8	89	×	○	×	
Bis (2-chloroethyl) ether	111-44-4	77	×	×		
		84	×	×		
Bis (2-chloroisopropyl) ether	108-60-1	84	×	×		
1, 1-Bis (p-chlorophenyl)-2, 2, 2-trichloroethanol	115-32-2	78	×	×		

Substance	CAS No.	Year	W	S	F	O
4, 4'-Bis (dimethylamino) benzophenone	90-94-8	85	×	×		
4, 4'-Bis (dimethyl-aminophenyl) methane	101-61-1	86	×	×		
2, 2-Bis [4-(2-hydroxy)- 3, 5-dibromophenyl] propane	4162-45-2	86	○	×		
2, 2-Bis (4-hydroxy-phenyl) propane (Bisphenol A)	80-05-7	76	×	×	×	
		81	×	×		
Bis (2, 3, 3, 3-tetrachloropropyl) ether	127-90-2	84	×	×		
Bis (tribromophenoxy) ethane	37853-59-1	87	×	○	×	
BPMC (o-s-Buthylphenyl methylcarbamate)	3766-81-2	88	×	×		A○
o-Bromoaniline	615-36-1	84	×	×		
m-Bromoaniline	591-19-5	84	×	×		
p-Bromoaniline	106-40-1	84	×	×		
Bromobenzene	108-86-1	81	×	×		
1-Bromobutane	109-65-9	81	×	×		
Bromochloromethane	74-97-5	76	×	×	×	
o-Bromophenol	95-56-7	83	×	×		
m-Bromophenol	591-20-8	83	×	×		
p-Bromophenol	106-41-2	83	×	○		
4-Bromophenylphenyl ether	101-55-3	84	×	×		
1-Bromopropane	106-94-5	81	×	×		
β-Bromostyrene	103-64-0	85	×	×		
Butachlor	23184-66-9	94	×	×	×	
Butadiene	106-99-0	77	×	×		
1, 3-Butanediol	107-88-0	86	×	×		
1, 4-Butanediol	110-63-4	86	×	×		
n-Butanol	71-36-3	79	×	×		
s-Butanol	78-92-2	79	×	×		
t-Butanol	75-65-0	79	×	×		
1-n-Butoxy-2, 3-epoxy-propane	2426-08-6	84	×	×		
2-Butoxyethanol	111-76-2	76	×	×		
Butyl acrylate	141-32-2	80	×	×		
n-Butylamine	109-73-9	81	×	×		
p-t-Butylbenzoic acid	98-73-7	85	×	○		
		86	○	○	○	
2-t-Butyl-4-(2, 4-dichloro-5-isopropoxy-p henyl)- 1, 3, 4-oxadiazolin-5-one	19666-30-9	81	×	×		
n-Butyl formate	592-84-7	81	×	×		
i-Butyl formate	542-55-2	81	×	×		
t-Butylhydroxyanisole (BHA)	121-00-6	80	×	×		

(*2) The values are the total of the three compounds.

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Substance	CAS No.	Year	W	S	F	O
p-t-Butylhydroxyphenol	1948-33-0	80	×	×		
4, 4'-Butylidene bis (6-t-butyl-3-methyl phenol)	85-60-9	81	×	×		
Butyl methacrylate	97-88-1	79	×	×		
Butyl-naphthalene-sulfonic acid	25638-17-9	81	×	×		
p-t-Butylphenol	98-54-4	76	×	×		
ε-Caprolactam	105-60-2	77	×	○		
		91	×	×	○	A○
Captafol [cis-N-(1, 1, 2, 2-Tetrachloroethylthio)-4-cyclohexene-1, 2-carboximide]	2425-06-1	80	×	×		
Carbazole	86-74-8	76	×	×		
		94				A×
Carbofuran (2, 3-Dihydro-2, 2-dimethyl-benzofuran-7-yl methylcarbamate)	1563-66-2	92	×	×	×	
Carbon disulfide	75-15-0	77	×	×		
		92				A○
Carbon tetrachloride	56-23-5	74	×			R○
		75	○			R○
		79				A○
		80				A○
		83				A○
cis-Chlordane	57-74-9	82	×	○	○	
		86				A○
trans-Chlordane	57-74-9	82	×	○	○	
		86				A○
γ-Chlordene	3734-48-3	82	×	○	○	
		86				A○
Chlormethoxynil (2, 4-Dichlorophenyl-3'-methoxy-4'-nitrophenyl ether)	32861-85-1	82	○	×		
		91	×	×		A×
Chlorinated paraffines	63449-39-8	79	×	○		
		80	×	○	×	
Chloroacetaldehyde	107-20-0	80	×	×		
Chloroacetic acid	79-11-8	84	○	○		
Chloroacetone	78-95-5	86	×	×		
o-Chloroaniline	95-51-2	76	○	○	×	
		90	○	○	○	A×
m-Chloroaniline	108-42-9	76	○	○	×	
		90	○	○	×	A×
p-Chloroaniline	106-47-8	76	○	○	×	
		90	×	○	×	A×
1-Chloroanthraquinone	82-44-0	85	×	×		
2-Chloroanthraquinone	131-09-9	85	×	×		
o-Chlorobenzaldehyde	89-98-5	84	×	×		

Substance	CAS No.	Year	W	S	F	O
m-Chlorobenzaldehyde	587-04-2	84	×	×		
p-Chlorobenzaldehyde	104-88-1	84	×	×		
Chlorobenzene	108-90-7	76	×	×	×	
		83				A○
o-Chlorobenzoic acid	118-91-2	85	×	×		
Chlorocyclohexane	542-18-7	77	×	×		
Chlorodibromomethane	124-48-1	80				A○
		81	○	○		
		83				
1-Chloro-2, 4-dinitrobenzene	97-00-7	78	×	×		
2-Chloroethyl vinyl ether	110-75-8	84	×	×		
2-Chloro-6-methylaniline	87-63-8	81	×	×		
3-Chloro-4-methylaniline	95-74-9	81	×	×		
4-Chloro-2-methylaniline	95-69-2	81	×	×		
2-Chloro-5-methylphenol	615-74-7	84	×	×		
2-Chloro-6-methylphenol	87-64-9	84	×	×		
4-Chloro-2-methylphenol	1570-64-5	84	×	×		
4-Chloro-3-methylphenol	59-50-7	84	×	×		
1-Chloro-2-methyl-propa ne	513-37-1	80	×	×		
3-Chloro-2-methyl-propene	563-47-3	80	×	×		
1-Chloronaphthalene	90-13-1	77	×	×		
		86	×	×		
2-Chloronaphthalene	91-58-7	77	×	×		
		86	×	×		
4-Chloro-2-nitroaniline	89-63-4	78	×	×		
o-Chloronitrobenzene	88-73-3	75	×			
		91	×	×	×	A○
m-Chloronitrobenzene	121-73-3	75	×			
		94	×	×	×	A×
p-Chloronitrobenzene	100-00-5	78	×	×		
		91	×	×	×	A○
2-Chloro-5-nitrobenzene-sulfonic acid	96-73-1	79	×	×		
Chloronitrofen (2, 4, 6-Trichlorophenyl-4'-nitrophenyl ether)	1836-77-7	78	×	×		
		82	○	○		
		91	×	×		A×
4-Chloro-3-nitro-α, α, α-trifluorotoluene	121-17-5	81	×	×		
Chloropentabromo-cyclohexane	87-84-3	85	×	×		
o-Chlorophenol	95-57-8	78	×	×		
m-Chlorophenol	108-43-0	78	×	×		
p-Chlorophenol	106-48-9	78	×	×		
Chloropicrin	76-06-2	79	×	×		
		94	×			A×
Chloroprene	126-99-8	77	×			

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Substance	CAS No.	Year	W	S	F	O
1-Chloropropane	540-54-5	81	x	x		
2-Chloropropane	75-29-6	81	x	x		
2-Chloropyridine	109-09-1	80	x	x		
o-Chlorostyrene	2039-87-4	81	x	x		
m-Chlorostyrene	2039-85-2	81	x	x		
p-Chlorostyrene	1073-67-2	81	x	x		
Chlorothalonil (Tetrachloroisophthaloni- trile)	1897-45-6	77	x	x		
		91	x	x	x	Ax
o-Chlorotoluene	95-49-8	79	x	x		
		89	x	x		A○
p-Chlorotoluene	106-43-4	79	x	x		
		89	x	x		Ax
Chlorpyrifos [O, O-Diethyl-O-(3, 5, 6-trichloro-2-piridyl) phosphorothioate]	2921-88-2	83	x	x		
		88	x	○	x	Ax
		90	x	○		
o-Cresol	95-48-7	77	x	x		
m-Cresol	108-39-4	77	x	x		
p-Cresol	106-44-5	77	x	○		
Cresyldiphenyl phosphate	26444-49-5	81	x	x		
Crotonaldehyde	4170-30-3	87	x			Ax
CVMP [2-Chloro-1-(2, 4, 5-trichlorophenyl) vinyl dimethyl phosphate]	961-11-5	88	x	x	x	Ax
CVP [2-Chloro-1-(2, 4-dichlorophenyl) vinyl-diethyl phosphate]	470-90-6	88	x	○	x	Ax
		93 (*3)	x	x	x	
2-Cyanopyridine	100-70-9	84	x	x		
3-Cyanopyridine	100-54-9	84	x	x		
4-Cyanopyridine	100-48-1	84	x	x		
Cyclohexane	110-82-7	79	x	x		
Cyclohexanone	108-94-1	80	x	x		
Cyclohexylamine	108-91-8	82	○	○		
		83	○	○	○	
N-Cyclohexyl-2-benzo-thi- azolesulfenamide	95-33-0	77	x	x		
Cyclopentadiene	542-92-7	80	○	x		
Cyclopentane	287-92-3	80	○	○		
pp'-DDD (p, p'-Dichloro-diphenyldichl- oroethane)	72-54-8	74	x	○	○	
pp'-DDE (p, p'-Dichloro-diphenylethyl ene)	72-55-9	74	x	○	○	
op'-DDT (o, p'-Dichloro-diphenyltrich- loroethane)	789-02-6	74	x	x	○	
pp'-DDT (p, p'-Dichloro-diphenyltrich- loroethane)	50-29-3	74	x	○	○	
DDVP (2, 2-Dichloro-vinyldimethyl phosphate)	62-73-7	83	x	x		
		93				A○

Substance	CAS No.	Year	W	S	F	O
Decabromobiphenyl	13654-09-6	89	x	x	x	Ax
Decabromodiphenyl ether	1163-19-5	77	x	x		
		87	x	○	x	
		88	x	○	x	
cis-Decahydro-naphthale- ne	91-17-8	84	x	x		
trans-Decahydro-naphth- alene	191-17-8	84	x	○		
Decanol	112-30-1	79	x	x		
Diallylamine	124-02-7	81	x	x		
Diallyl phthalate	131-17-9	85	x	x		
1, 4-Diamino-anthraquinon- e	128-95-0	86	x	x		
4, 4'-Diamino-diphenylmeth- ane	101-77-9	85	x	x		
1, 6-Diaminohexane	124-09-4	87	x	x		
1, 2-Diaminopropane	78-90-0	87	x	x		
1, 3-Diaminopropane	109-76-2	87	x	x		
2, 3-Diaminotoluene	2687-25-4	78	x	x		
2, 4-Diaminotoluene	95-80-7	78	x	x		
		90				Ax
2, 6-Diaminotoluene	823-40-5	90				Ax
o-Dianisidine	119-90-4	77	x	x		
Diazinon (O, O-Diethyl-O-2-isopropyl- 4-methyl-6-pyrimidinyl phosphorothioate)	333-41-5	83	x	x		
		93				x
		93				Ax
Dibenz [a, h] anthracene	53-70-3	89	○	○	○	A○
Dibenzofuran	132-64-9	83	x	x		
2, 2'-Dibenzothiazyl disulfide	120-78-5	77	x	x		
Dibenzothiophene	132-65-0	83	x	○		
p,p'-Dibenzoyl quinone dioxime	120-52-5	80	x			
Dibenzyl ether	103-50-4	84	○	○		
Dibenzyltoluene	26898-17-9	77	x	x		
o-Dibromobenzene	583-53-9	81	x	x		
m-Dibromobenzene	108-36-1	81	x	x		
p-Dibromobenzene	106-37-6	81	x	x		
1, 2-Dibromo-3-chloropropa- ne	96-12-8	82	x	x		
		89	x	x		Ax
Dibromocresyl glycidyl ether	22421-59-6	77	x	x		
1, 2-Dibromoethane	106-93-4	76	x	x	x	
		82	x	x		
		83				A○
1, 2-Dibromoethylene	540-49-8	81	x	x		
Dibromomethane	74-95-3	81	x	x		
Di-n-butylamine	111-92-2	86	x	x		

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(*3) α -isomer(upper port) β -isomer (lower port)

Substance	CAS No.	Year	W	S	F	O
Dibutyldiglycol adipate	141-17-3	78	×	×		
2,6-Di- <i>t</i> -butyl-4-ethylphenol	4130-42-1	84	×	○		
2,5-Di- <i>t</i> -butylhydroquinone	88-58-4	80	×	×		
2,6-Di- <i>t</i> -butyl-4-methylphenol (BHT)	128-37-0	76	×	○		
		77	×	○	○	
		85				AO
Di- <i>n</i> -butyl phthalate	84-74-2	74	○	○	○	RO
						P×
		75	○			
		82	○	○		
Dibutyl sebacate	109-43-3	81	×	×		
		83	×	○		
Dibutyltin compounds		84	×	○	×	
Dichloroacetic acid	79-43-6	84	×	×		
2,3-Dichloroaniline	608-27-5	84	×	×		
2,4-Dichloroaniline	554-00-7	76	○	○		
2,5-Dichloroaniline	95-82-9	84	×	○		
2,6-Dichloroaniline	608-31-1	84	×	×		
		76	○	○		
3,4-Dichloroaniline	95-76-1	84	×	○		
3,5-Dichloroaniline	626-43-7	84	×	×		
<i>o</i> -Dichlorobenzene	95-50-1	75	×	×	×	R×
		83				AO
<i>m</i> -Dichlorobenzene	541-73-1	75	×	○	×	R×
		83				AO
<i>p</i> -Dichlorobenzene	106-46-7	75	○	○	×	R×
		83				AO
3,3'-Dichlorobenzidine	91-94-1	79	×	×		
Dichlorobromomethane	75-27-4	80				AO
		81	○	×		
		83				AO
3,3'-Dichloro-4,4'-diaminodiphenylmethane	101-14-4	79	×	×		
		85	×	×		
Dichlorodifluoromethane (Freon 12)	75-71-8	76				AO
		77				AO
1,1-Dichloroethane	75-34-3	77	×	×		
		79				A×
		87	○	○		AO
		88	○	○		
1,2-Dichloroethane	107-06-2	76	×	×	×	
		79				AO
		80				AO
		87	○	○		AO
		88	○	○		AO

1,1-Dichloroethylene	75-35-4	79	×	×		
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Substance	CAS No.	Year	W	S	F	O
<i>cis</i> -1,2-Dichloroethylene (*4)	156-59-2	77	×	×		
		87	○	○		AO
<i>trans</i> -1,2-Dichloroethylene(*4)	156-60-5	77	×	×		
		87	○	○		AO
Dichloromethane	75-09-2	79				AO
		80				AO
		83				AO
2,3-Dichloro-1,4-naphthoquinone	117-80-6	82	×	×		
2,3-Dichloro-nitrobenzene	3209-22-1	81	×	×		
2,4-Dichloro-nitrobenzene	611-06-3	81	×	×		
		94	×	×	×	A×
2,5-Dichloro-nitrobenzene	89-61-2	81	×	×		
		94	×	×	×	A×
3,4-Dichloro-nitrobenzene	99-54-7	81	×	×		
3,5-Dichloro-nitrobenzene	618-62-2	81	×	×		
2,3-Dichlorophenol	576-24-9	78	×	×		
2,4-Dichlorophenol	120-83-2	78	×	×		
2,5-Dichlorophenol	583-78-8	78	×	×		
2,6-Dichlorophenol	87-65-0	78	×	×		
3,4-Dichlorophenol	95-77-2	78	×	×		
3,5-Dichlorophenol	591-35-5	78	×	×		
2,4-Dichlorophenoxy-acetic acid	94-75-7	83	×	×		
1,2-Dichloropropane	78-87-5	76	×	×	×	
1,3-Dichloro-2-propanol	96-23-1	87	○	×	×	A×
2,3-Dichloro-1-propanol	616-23-9	87	×	×	×	A×
1,3-Dichloropropene	542-75-6	84	×	×		
2,3-Dichloro-1-propene	78-88-6	88	×	×		A×
		80	×	×		
2,2-Dichloropropionic acid	127-20-8	84	○	×		
2,4-Dichlorotoluene	95-73-8	81	×	×		
2,6-Dichlorotoluene	118-69-4	81	×	×		
3,4-Dichlorotoluene	95-75-0	81	×	×		
Dicyclohexyl phthalate	84-61-7	85	×	×		
Dicyclopentadiene	77-73-6	78	×	○		
		89	×	×		
Dieldrin	60-57-1	74	×	×	×	
Diethanolamine	111-42-2	78	×			
Diethylamine	109-89-7	81	×	×		
N,N-Diethylaniline	91-66-7	77	×	×		
Diethylbiphenyl	28575-17-9	76	×	×	×	
Di(2-ethylhexyl) adipate	103-23-1	78	×	×		
		84				AO

(*4) The atmospheric sample of 1,2-dichloroethylene is the total of *cis* and *trans* isomers.

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Substance	CAS No.	Year	W	S	F	O	
Di (2-ethylhexyl) phthalate	117-81-7	74	○	○	○	R○	
						P○	
		75	○				
		82	○	○			
		85				A○	
Diethyl phthalate	84-66-2	85	×	×			
Di-n-heptyl phthalate	3648-21-3	82	○	○			
Diisobutylene	107-40-4	78	×	×			
Diisobutyl phthalate	84-69-5	74	○	○	○	R○	
						P×	
Diisodecyl adipate	6938-94-9	78	×	×			
Diisodecyl phthalate	26761-40-0	74	×	×	×	R×	
						P×	
Diisoheptyl phthalate	3648-21-3	74	○	○	○	R○	
						P×	
Diisopropylamine	108-18-9	81	×	×			
m-Diisopropylbenzene	99-62-7	77	×	×			
p-Diisopropylbenzene	100-18-5	77	×	×			
Diisopropyl fluorophosphate	55-91-4	93				A×	
Diisopropyl-naphthalene	38640-62-9	75	×	○	○		
		77	×	○	○		
		80	×	○	○		
Dilauryl phthalate	2432-90-8	85	×	×			
Dilaurylthiodipropionate	123-28-4	81	×	×			
Dimethoate (O, O-Dimethyl-S-methylcarbamoylmethyl dithiophosphate)	60-51-5	86	×	×			
		93	×	×	×		
4, 4'-Dimethoxy-diphenylamine	101-70-2	77	×	×			
Dimethylamine	124-40-3	86	×	○			
		91				A×	
4-Dimethyl-aminoazobenzene	60-11-7	86	×	×			
2, 3-Dimethylaniline (2, 3-Xylidine)	87-59-2	76	×	○			
		90	×	×	×	A×	
2, 4-Dimethylaniline	95-68-1	77	×	×			
2, 5-Dimethylaniline	95-78-3	76	×	○			
3, 4-Dimethylaniline	95-64-7	76	×	○			
		77	×	×			
3, 5-Dimethylaniline	108-69-0	76	○	○			
N, N-Dimethylaniline	121-69-7	76	○	○			
		90	×	○	×	A○	
Di (α-methylbenzyl) phenol	2769-94-0	81	×	○			
Dimethyl-2, 2-dichloro-1, 2-dibromoethyl phosphate	300-76-5	84	×	×			
N, N-Dimethylformamide	68-12-2	78	×	×			

Substance	CAS No.	Year	W	S	F	O
1, 2-Dimethyl-naphthalene	573-98-8	91	○	○		A○
		84	○	○		
		85	×	○	○	
1, 3-Dimethyl-naphthalene	575-41-7 571-58-4 571-61-9	84	○	○		
		85	×	○	○	
1, 4-Dimethylnaphthalene; 1, 5-Dimethyl-naphthalene; 2, 3-Dimethylnaphthalene (*5)	581-40-8	84	○	○		
		85	×	○	○	
1, 8-Dimethyl-naphthalene	569-41-5	85	×	○	×	
2, 6-Dimethyl-naphthalene	581-42-0	84	○	○		
		85	×	○	○	
N, N-Dimethyl-p-nitrosoaniline	138-89-6	80	×			
2, 4-Dimethylphenol	105-67-9	82	×	×		
2, 5-Dimethylphenol	95-87-4	82	×	×		
3, 5-Dimethylphenol	108-68-9	82	×	○		
Dimethyl phthalate	131-11-3	85	×	×		
Dimethyl sulfoxide (DMSO)	67-68-5	92	○	○	○	
Dimethyl terephthalate	120-61-6	75	○			
		82	×	×		
2, 4-Dinitroaniline	97-02-9	90	×	○	×	
o-Dinitrobenzene	528-29-0	76	×	○	×	
		91	×	×		
m-Dinitrobenzene	99-65-0	76	×	○	×	
		91	×	×	×	
p-Dinitrobenzene	100-25-4	94	×	×	×	
2, 6-Dinitro-p-cresol	609-93-8	94	×	×	×	
4, 6-Dinitro-2-methylphenol	534-52-1	84	×	×		
1, 5-Dinitronaphthalene	605-71-0	85	×	×		
1, 8-Dinitronaphthalene	602-38-0	85	×	×		
2, 4-Dinitrophenol	51-28-5	84	×	×		
		94	×	×	×	
1, 3-Dinitropyrene	75321-20-9	90	×	×	×	
1, 6-Dinitropyrene	42397-64-8	90	×	×	×	
1, 8-Dinitropyrene	42397-65-9	90	×	×	×	A×
2, 4-Dinitrotoluene	121-14-2	76	×	×	×	
		91	×	×	×	
2, 6-Dinitrotoluene	606-20-2	76	○	○	×	
		91	×	×	×	
3, 4-Dinitrotoluene	610-39-9	76	×	×	×	
Di-n-octyl phthalate	117-84-0	74	○	○	×	R○
						P×
		82	×	×		
Diocetyl sebacate	122-62-3	81	×	×		

(*5) Figures indicate the total of the three types of dimethylnaphthalene

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Substance	CAS No.	Year	W	S	F	O
Diocetyl tin compounds		84	×	×		
Dioxane	123-91-1	76	×	×		
Dipentamethylene-thiuram tetrasulfide	120-54-7	80	×	×		
Diphenylamine	122-39-4	76	×	×	×	
		90	○	○	○	
Diphenyldisulfide	882-33-7	83	×	×		
Diphenylguanidine	102-06-7	78	×	×		
1, 1-Diphenylhydrazine	530-50-7	82	×	×		
N, N'-Diphenylhydrazine	122-66-7	86	×	×		
		83	×	○		
Diphenylmethane	101-81-5	84	○	○	○	
Diphenyltin compounds		89	○	○	○	
Distearyl thiodipropionate	693-36-7	81	×	×		
Dodecachlorododeca-hydr odimethanodibenzo-cyclo octene	13560-89-9	76	○	×	×	
Edifenphos (EDDP)	17109-49-8	93	×	×		
Endosulfan sulfate	1031-07-8	83	×	×		
Endrin	72-20-8	74	×	×	×	
Epichlorohydrin	106-89-8	77	×	×		
		86	×	×		
EPN	2104-64-5	86	×	×		
		93				A×
1, 2-Epoxy-3-phenoxy-propa ne	122-60-1	84	×	×		
2, 3-Epoxy-1-propanol	556-52-5	83	×	×		
Ethanolamine	141-43-5	80	×	×		
		94	○	○		A○
4-Ethoxyaniline (p-Phenetidine)	156-43-4	77	×	×		
		85	×	×		
6-Ethoxy-1, 2-dihydro-2, 2, 4-trimethylquinoline	91-53-2	80	×	×		
2-Ethoxyethanol	110-80-5	76	×	×		
2-Ethoxyethyl acetate	111-15-9	86	×	×		
Ethyl acrylate	140-88-5	80	×	×		
Ethylamine	75-04-7	81	×	×		
		76	○	○		
N-Ethylaniline	103-69-5	90	×	×	×	A○
2-Ethylanthraquinone	84-51-5	85	×	×		
Ethylbenzene	100-41-4	77	×	×		
		85	×	○		
		86	○	○	○	
Ethyl biphenyl	40529-66-6	76	×	×	×	
Ethyl bromide (Bromoethane)	74-96-4	76	×	×	×	
		83				A○
Ethyl chloride	75-00-3	77	×	×		

(Chloroethane)		79				A
		80				A○
		83				A○
Substance	CAS No.	Year	W	S	F	O
Ethyl p, p'-dichloro-benzilate	510-15-6	87	×	×	×	
Ethylene	74-85-1	77	○	○		
Ethylenechlorohydrin	107-07-3	80	×	×		
Ethylenediamine	107-15-3	87	×	○		
Ethylenediamine tetraacetic acid (EDTA)	60-00-4	79	×	○		
		94	○	×	×	
Ethylene glycol	107-21-1	77	×	×		
		86	○	×		
Ethylene oxide	75-21-1	80	×	×		
Ethyl formate	109-94-4	81	×	×		
2-Ethylhexanol	104-76-7	79	×	×		
2-Ethylhexyl acrylate	103-11-7	80	×	×		
Ethyl methacrylate	97-63-2	79	×	×		
N-Ethylmorpholine	100-74-3	79	×	×		
o-Ethylphenol	90-00-6	83	×	×		
m-Ethylphenol	620-17-7	83	×	×		
p-Ethylphenol	123-07-9	83	×	×		
Ethylthiometon	298-04-4	93				A×
Fenitrothion [O, O-Dimethyl-O-(3-methyl-4-nitrophenyl) phosphorothioate]	122-14-5	83	×	×		
		93				A○
Fenthion (MPP)	55-38-9	93	×	×	×	A×
Fluorene	86-73-7	83	×	○		
		84	○	○	○	
Fluorobenzene	462-06-6	84	×	×		
Formaldehyde	50-00-0	75	×			
Fumaric acid	110-17-8	83	×	×		
Glycidyl methacrylate	106-91-2	86	×	×		
Glyoxal	107-22-2	80	○	○		
Glyphosate	1071-83-6	93	×	×	×	
α-HCH (α-Hexachloro-cyclohexa ne)	319-84-6	74	○	○	○	
β-HCH (β-Hexachloro-cyclohexan e)	319-85-7	74	×	○	○	
γ-HCH (γ-Hexachloro-cyclohexan e)	58-89-9	74	×	○	○	
δ-HCH (δ-Hexachloro-cyclohexan e)	319-86-8	74	×	○	×	
Heptachlor	76-44-8	82	×	○	○	
		86				A×
Heptachloroepoxide	1024-57-3	82	×	○	○	
		86				A×
Heptanol	111-70-6	79	×	×		
Hexabromobenzene	87-82-1	77	×	×		
		81	×	○		

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		82	x	○	x	
Hexabromobiphenyl	36355-01-8	89	x	x	x	Ax
Hexabromocyclododecane	25637-99-4	87	x	○	○	

Isophthalonitrile	626-17-5	77	x	x		
Isoprene	78-79-5	78	x	x		
Isopropanolamine	78-96-6	80	x	x		

Substance	CAS No.	Year	W	S	F	O
Hexabromodiphenyl ether	36483-60-0	87	x	○	○	
		88	x	○	○	
Hexachlorobenzene (HCB)	118-74-1	74	x	x	○	
		75	x	○	○	
		78	○	○	○	
		94				A○
Hexachloro-1,3-butadiene	87-68-3	81	x	x		
Hexachlorocyclopentadiene	77-47-4	81	x	x		
Hexachloroethane	67-72-1	76	x	x	x	
Hexachlorophene	70-30-4	81	x	○		
		82	x	○	x	
Hexamethyleneimine	111-49-9	86	x	x		
Hexamethylenetetramine	100-97-0	83	x	x		
Hexylene glycol	107-41-5	80	x	x		
4-(4-Hexylphenyl) benzonitrile	41122-70-7	85	x	x		
Hydrazine	302-01-2	86	x	x		
2-(2'-Hydroxy-3,5'-di-t-butylphenyl)-5-chloro-benzotriazole	3864-99-1	80	x	x		
2-Hydroxy-3-naphtho-anilide (Azoic Coupling Component 2)	92-77-3	84	x	x		
2-Hydroxy-3-naphtho-(3-chloro-4,6-dimethoxy) anilide (Azoic Coupling Component 12)	92-72-8	84	x	x		
2-Hydroxy-3-naphtho-(5-chloro-2-methoxy) anilide (Azoic Coupling Component 41)	137-52-0	84	x	x		
2-Hydroxy-3-naphtho-(4-chloro-2-methyl) anilide (Azoic Coupling Component 8)	92-76-2	84	x	x		
2-Hydroxy-3-naphtho-(3-nitro) anilide (Azoic Coupling Component 17)	135-65-9	84	x	x		
Iprobenfos (IBP)	26087-47-8	93	○	○	○	Ax
Isobutyronitrile	78-82-0	77	x	x		
		87	x	x		Ax
Isocyanuric acid	108-80-5	83	x	x		
Isophorone (3,5,5-Trimethyl-2-cyclohexene-1-one)	78-59-1	81	x	○		
Isophthalic acid	121-91-5	83	x	x		

Substance	CAS No.	Year	W	S	F	O
Isopropylamine	75-31-0	80	x	x		
		81	x	x		
Isopropylbenzene	98-82-8	77	x	x		
		85	x	○		
		86	○	○	○	
2-Isopropyl-naphthalene	2027-17-0	84	x	○		
		85	x	○	○	
Isoprothiolane (Diisopropyl 1,3-dithiolane-2-ylidenemalonate)	50512-35-1	92	○	○	○	Ax
Isoxathion	18854-01-8	93				Ax
Malathion	121-75-5	93	x	x	x	Ax
Maleic acid	110-16-7	83	x	x		
Melamine	108-78-1	86	○	○		
		87	○	○	○	
		88			○	
		94	○	○	○	A○
2-Mercaptobenzimidazole	583-39-1	78	x	x		
2-Mercaptobenzothiazole	149-30-4	77	○	○		
		78	x	○	x	
2-Mercaptoimidazoline	96-45-7	83	x	x		
Methacrylic acid	79-41-4	87	x	x		
Methacrylonitrile	126-98-7	87	x	x		Ax
Methidathion (DMTP)	950-37-8	93	x	x	x	Ax
Methomyl {S-methyl-N-[(methylcarbamoyl)oxy]thioacetimidate}	16752-77-5	92	x	x	x	
Methoxybutanol	2517-43-3	80	x	x		
Methoxychlor [1,1,1-Trichloro-2,2-bis(4-methoxyphenyl)ethane]	72-43-5	85	x	x		
Methoxybutyl acetate	4435-53-4	80	x	x		
2-Methoxyethanol	109-86-4	76	x	x		
2-Methoxyethyl acetate	110-49-6	86	x	x		
2-Methoxyphenol	90-05-1	86	x	○		
3-Methoxyphenol	150-19-6	86	x	x		
4-Methoxyphenol	150-76-5	86	x	x		
Methyl acrylate	96-33-3	80	x	x		
Methylamine	74-89-5	86	x	○		
		76	x	○		
N-Methylaniline	100-61-8	90	○	○	x	A○
		90	○	○	x	A○
α-Methylbenzylphenol	1988-89-2	78	x	x		
Methyl bromide	74-83-9	76	x	x	x	
		80				A○
Methyl chloride	74-87-3	79				A○

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(Chloromethane)		80				A○
		83				A○
Methyl ethyl ketone	78-93-3	80	×	×		

1-Naphthol	90-15-3	77	×	×		
2-Naphthol	135-19-3	77	×	×		

Substance	CAS No.	Year	W	S	F	O
Methyl ethyl ketone oxime	96-29-7	78	×	×		
Methyl formate	107-31-3	81	×	×		
Methyl iodide	74-88-4	80				A○
Methylisobutylcarbinol	108-11-2	80	×	×		
Methyl isobutyl ketone	108-10-1	80	×	×		
Methyl mercaptan	74-93-1	92				A×
Methyl methacrylate	80-62-6	79	×	×		
1-Methylnaphthalene	90-12-0	76	×	×		
		84				A○
2-Methylnaphthalene	91-57-6	76	×	×		
		84				A○
2-Methyl-4-nitroaniline	99-52-5	85	×	×		
4-Methyl-2-nitroaniline	119-32-4	85	×	×		
4-Methyl-3-pentene-2-one	141-79-7	80	×	×		
2-Methylpiperidine	109-05-7	86	×	×		
		86	×	○		
2-Methylpyridine (α-Picoline)	109-06-8	87	○	○	○	
		94	○	○	○	A○
		94	○	○	○	A○
3-Methylpyridine (β-Picoline)	108-99-6	94	○	○	○	A○
4-Methylpyridine (γ-Picoline)	108-89-4	94	○	○	○	A○
3-Methylpyridine 4-Methylpyridine (*6)	108-99-6 108-89-4	86	×	○		
		87	○	○	○	
α-Methylstyrene	98-93-9	77	×	×		
β-Methylstyrene	5013-15-4	77	×	×		
m-Methylstyrene	100-80-1	77	×	×		
p-Methylstyrene	622-97-9	77	×	×		
MIPC (2-Isopropylphenyl-methylcarbamate)	114-26-1	88	×	×		A×
		94	×	×	×	
Molinate (S-Ethyl hexahydro-1H-azepine-1-carbothioate)	2212-67-1	92	○	○	×	A×
2-(Morpholiniothio) benzothiazole	102-77-2	77	×	×		
Morpholine	110-91-8	79	×	×		
		94	○	○	×	A×
Mirex	2385-85-5	83	×	×		
MTMC (m-Tolyl methylcarbamate)	1129-41-5	88	×	×		A○
		94	×	×	×	
Naphthalene	91-20-3	76	×	×		
1-Naphthaleneacetic acid	86-87-3	84	×	×		
NAC (1-Naphthyl-N-methylcarbamate)	63-25-2	83	×	×		
		88	×	×		A×

Substance	CAS No.	Year	W	S	F	O
1, 4-Naphthoquinone	130-15-4	85	×	×		
		76	×	○		
1-Naphthylamine	134-32-7	79	×	○	×	
		85		×		
		83	×	○		
2-Naphthylamine	91-59-8	85		○		
		85		○		
Neopentyl glycol	126-30-7	77	×	×		
Nereistoxin	1631-58-9	93	×	×	×	
Nitrilotriacetic acid (NTA)	139-13-9	80	○	○		
		94	○	×	×	
3-Nitroacenaphthene	3807-77-0	84	×	×		
5-Nitroacenaphthene	602-87-9	84	×	×		
o-Nitroaniline	88-74-4	78	×	×		
		90	×	×	×	
m-Nitroaniline	99-09-2	78	×	×		
p-Nitroaniline	100-01-6	78	×	×		
		90	×	×	×	
o-Nitroanisole	91-23-6	76	○	○	×	
		91	×	○	○	
m-Nitroanisole	555-03-3	76	○	○	×	
p-Nitroanisole	100-17-4	76	×	×	○	
		91	×	×		
Nitrobenzene	98-95-3	76	○	○	○	
		77	○	○	○	
		86				A○
		91	○	○	○	A○
m-Nitrobenzoic acid	121-92-6	85	×	×		
5-Nitrobenzoimidazole	94-52-0	85	×	×		
Nitroethane	79-24-3	86	×	×		
Nitrofen (2, 4-Dichlorophenyl-4'-nitrophenyl ether)	1836-75-5	82	○	×		
		82	○	×		
3-Nitrofluoranthene	892-21-7	90	×	×	×	A○
Nitromethane	75-52-5	86	×	×		
2-Nitro-4-methylphenol	119-33-5	84	×	×		
3-Nitro-4-methylphenol	2042-14-0	84	×	×		
4-Nitro-3-methylphenol	2581-34-2	84	×	×		
5-Nitro-2-methylphenol	5428-54-6	84	×	×		
1-Nitronaphthalene	86-57-7	80	×	×		
o-Nitrophenol	88-75-5	78	×	×		
		79	×	×	×	
		94	×	×	○	A○
m-Nitrophenol	554-84-7	78	×	×		
		79	×	×	×	
p-Nitrophenol	100-02-7	94	×	×	×	A×
		78	○	×		
		79	×	×	×	

I Monitoring Chemical Substances

		94	x	x	x	A○
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(*6) The values are the total of the two compounds.

Substance	CAS No.	Year	W	S	F	O
p-Nitrophenyl diethyl phosphate	311-45-5	93	x	x	x	
1-Nitropropane	108-03-2	79	x	x		
		86	x	x		
2-Nitropropane	79-46-9	79	x	x		
		86	x	x		
1-Nitropyrene	5522-43-0	90	x	x	x	A○
N-Nitrosodiethanolamine	116-54-7	94				A○
N-Nitrosodiethylamine	55-18-5	81	x	x		
N-Nitrosodimethylamine	62-75-9	81	x	x		
4-Nitrosodiphenylamine	156-10-5	77	x	x		
o-Nitrotoluene	88-72-2	90	○	x	○	
		76	○	○	x	
		86				A○
m-Nitrotoluene	99-08-1	91	x	x	x	A○
		76	○	○	x	
		86				Ax
p-Nitrotoluene	99-99-0	91	x	x	x	
		76	○	○	x	
		86				Ax
cis-Nonachlor	5103-73-1	91	○	x	x	
		82	x	○	○	
trans-Nonachlor	39765-80-5	86				Ax
		82	x	○	○	
Nonanol	143-08-8	79	x	x		
Nonylphenol	25154-52-3	76	x	x		
		77	x	○		
Octabromodiphenyl ether	32536-52-0	87	x	○	x	
		88	x	○	x	
Octanol	111-87-5	79	x	x		
n-Octylamine	111-86-4	88	x	x		
p-Octylphenol	1806-26-4	77	x	○		
Octyltin compounds		84	x	x		
Organosilicone compounds		79	x	○		
		80	x	○	○	
Organotin compounds		75	x			
Oxamyl [Methyl N', N'-dimethyl-N (methylcarbamoyl) oxy-1-thio-oxamimidate]	23135-22-0	92	x	x	x	
		82	x	○	○	
Oxychlorthane	26880-48-8	86				Ax
PAP (O, O-Dimethyl-S-α-ethoxyca rbonylbenzyl phosphorodithioate)	2597-03-7	88	x	x	x	Ax
Pentabromobenzene	608-90-2	81	x	x		
Pentachloroaniline	527-20-8	81	x	x		

Substance	CAS No.	Year	W	S	F	O
Pentachlorobenzene	608-93-5	75	x	x	○	Rx
		79	x	○	○	
		94				A○
Pentachloroethane	76-01-7	84	x	x		
Pentachlorophenol	87-86-5	74	○	○		
PHC (o-Isopropoxyphenyl-met hylcarbamate)	2631-40-5	88	x	x		Ax
Phenanthrene	85-01-8	77	x	○		
Phenol	108-95-2	77	x	○		
Phenothiazine	92-84-2	86	x	x		
1-Phenyl-1-(2, 4-dimethylphenyl) ethane	6165-52-2	80	x	○	x	
1-Phenyl-1-(3, 4-dimethylphenyl) ethane	6196-95-8	75	x	○	x	
		77	x	○	○	
		80	x	○	x	
o-Phenylenediamine	95-54-5	78	x	x		
m-Phenylenediamine	108-45-2	78	x	x		
p-Phenylenediamine	106-50-3	78	x	x		
Phenylhydrazine	100-63-0	86	x	x		
N-Phenyl-1-naphthyl-am ine	90-30-2	80	x	○		
		81	x	x	x	
N-Phenyl-2-naphthyl-am ine	135-88-6	76	x	x	x	
		80	x	○		
		81	x	○	x	
o-Phenylphenol	90-43-7	78	x	x		
m-Phenylphenol	580-51-8	78	x	x		
p-Phenylphenol	92-69-3	78	x	x		
Phenyltin compounds		89	○	○	○	
Phorone (Diisopropylidene acetone)	504-20-1	81	x	x		
Phosalone	2310-17-0	93	x	x	x	Ax
Phosmet (PMP)	732-11-6	93				Ax
Phoxim (α-Cyanobenzyliden-ami no O, O-diethyl phosphoro-thioate)	14816-18-3	88	x	x	x	Ax
Total phthalates		75	○			
Phthalic acid	88-99-3	83	x	x		
o-Phthalonitrile	91-15-6	77	x	x		
Picric acid	88-89-1	80	x	x		
Piperazine	110-85-0	86	x	○		
Piperidine	110-89-4	86	x	x		
Piperophos	24151-93-7	93				Ax
Polybrominated biphenyl (PBB)		81	x	x		
Polychlorinated naphtalene (PCN)		76	○	○	○	
		78	○	○	○	
Polychlorinated terphenyl (PCT)	6178-33-8	74	x	x	○	
		76	x	○	x	
		78	x	○	○	

I Monitoring Chemical Substances

Polyethyleneglycol aliphatic ester		82	×				
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Substance	CAS No.	Year	W	S	F	O
Polyoxyethylene alkyl-amide		83	×	×		
Polyoxyethylene alkyl-amine		83	×	×		
Polyoxyethylene alkyl ether	27306-79-2	82	×	○		
Polyoxyethylene alkyl phenyl ether		77	○	○		
		78	○	○		
		82	○	○		
Polyoxyethylene-type nonionic surface active agents		82	○	○		
Probenazole (3-Allyloxy-1, 2-benzothiazole-1, 1-dioxide)	27605-76-1	92	×	×	×	
Propanil (N-3,4-Dichloro-phenyl propionamide)	709-98-8	80	×	×		
n-Propanolamine	156-87-6	80	×	×		
Propionaldehyde	123-38-6	87	×			A○
Propionitrile	107-12-0	87	×	×		A×
n-Propylamine	107-10-8	80	×	×		
Propylene	115-07-1	77	○	×		
		77	×	×		
Propylene glycol	57-55-6	86	○	○		
		86	○	○		
Propylene imine	75-55-8	86	×	×		
Propylene oxide	75-56-9	80	×	×		
Pyrene	129-00-0	89	○	○	○	A○
		89	○	○	○	A○
Pyridine	110-86-1	80	○	○		
		91	○	○	○	A○
Pyrrole	109-97-7	81	×	×		
Pyrrolidine	123-75-1	86	×	×		
Quinoline	91-22-5	84	○	○		
		91	×	○	×	
Quintozene (Pentachloro-nitrobenzene)	82-68-8	81	×	×		
		91	×	×	×	A○
Salithion (Dioxabenzofos)	3811-48-2	93				A×
Simazine [2-Chloro-4, 6-bis (ethylamino)-s-triazine]	122-34-9	80	×	×		
		91	×	×		
Simetryn [2,4-Bis (ethylamino)-6-methylthio-1, 3, 5-triazine]	1014-70-6	92	○	○	×	
Sodium alkylbenzene-sulfonate (branched chain)		77	×	×		
Sodium alkylbenzene-sulfonate (straight chain)		77	○	○		

Substance	CAS No.	Year	W	S	F	O
Sodium 4, 4'-bis (4-anilino-6-morpholino-1, 3, 5-triazine-2-yl) aminostilbene-2, 2'-disulfonate (Fluorescent-260)	16090-02-1	82	×	○		
Sodium 4, 4'-bis (2-sulfostryl) biphenyl (Fluorescent-351)	27344-41-8	82	○	○		
Sodium m-nitrobenzene-sulfonate	127-68-4	77	×	×		
Sodium 4-[2-(5-nitro-2-furanyl) ethenyl] benzoate	54992-23-3	83	×	×		
Sodium salt of naphthalenesulfonic acid-formalin condensate		79	×	×		
Solvent Yellow 14	842-07-9	88	×	×		
Styrene	100-42-5	77	×	×		
		85	×	○		
		86	○	○	○	
Telodrin	297-78-9	74	×	×	×	
Terephthalic acid	100-21-0	75	○			
		83	×	×		
o-Terphenyl	84-15-1	76	×	○	×	
		77	×	○	×	
m-Terphenyl	92-06-8	76	×	○	×	
		77	×	○	○	
p-Terphenyl	92-94-4	76	×	○	×	
		77	×	○	×	
1, 2, 4, 5-Tetrabromo-benzene	636-28-2	81	×	×		
Tetrabromobiphenyl	40088-45-7	89	×	×	×	A×
		77	×	×		
		87	○	○	×	
Tetrabromobisphenol A	79-94-7	88	×	○	×	
		88	×	○	×	
1, 1, 2, 2-Tetrabromo-ethane	79-27-6	76	×	×	×	
Tetrabromomethane	558-13-4	81	×	×		
1, 2, 3, 4-Tetrachloro-benzene	634-66-2	75	×	×	×	R×
1, 2, 3, 5-Tetrachloro-benzene	634-90-2	75	×	×	×	R×
1, 2, 4, 5-Tetrachloro-benzene	95-94-3	75	×	×	×	R×
2, 2', 3, 3'-Tetrachloro-4, 4'-diaminodiphenyl-methane	42240-73-3	85	×	×		
3, 3', 5, 5'-Tetrachloro-4, 4'-diaminodiphenyl-methane	25464-95-3	85	×	×		

I Monitoring Chemical Substances

1, 3, 5-Tribromobenzene	626-39-1	81	x	x		
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Substance	CAS No.	Year	W	S	F	O
1, 1, 2, 2-Tetrachloro-ethane	79-34-5	76	x	x	x	
Tetrachloroethylene	127-18-4	74	○			Rx
		75	○			RO
		79				AO
		80				AO
		83				AO
2, 3, 4, 6-Tetrachloro-phenol	58-90-2	78	x	x		
Tetraethoxysilane	78-10-4	92				Ax
Tetraethylthiuram disulfide [Bis (diethyl-thiocarbamoyl) disulfide]	97-77-8	92	x			
2, 2, 3, 3-Tetrafluoropropionic acid	756-09-2	84	x	x		
Tetrahydrofuran	109-99-9	79	x	x		
Tetrahydronaphthalene	119-64-2	77	x	x		
Tetrahydrothiophene-1, 1-dioxide	126-33-0	76	x	x	x	
Tetramethylthiuram disulfide [Bis (dimethyl-thiocarbamoyl) disulfide]	137-26-8	85	x	x		
		92	x			
Tetramethylthiuram monosulfide [Bis (dimethylthiocarbamoyl) sulfide]	97-74-5	85	x	x		
		92	x	x		
Thiabendazole	148-79-8	86	x	x		
4, 4'-Thiobis (6-t-butyl-3-methylphenol)	96-69-5	81	x	x		
Thiophene	110-02-1	85	x	○		
Thiourea	62-56-6	77	x	x		
o-Tolidine	119-93-7	77	x	x		
Toluene	108-88-3	77	x	x		
		85	○	○		
		86	○	○	○	
		77	x	x		
o-Toluenesulfonamide	88-19-7	92	○	○		
p-Toluenesulfonamide	70-55-3	92	○	○		
p-Toluenesulfonyl chloride	98-59-9	77	x	x		
		76	○	○		
o-Toluidine	95-53-4	85				Ax
		76	○	○		
m-Toluidine	108-44-1	85				Ax
		76	○	○		
p-Toluidine	106-49-0	85				Ax
		76	○	○		
p-Toluidine-2-sulfonic acid	88-44-8	80	x	x		
Toxophene	8001-35-2	83	x	x		
Triallylamine	102-70-5	81	x	x		

Substance	CAS No.	Year	W	S	F	O
Tribromomethane (Bromoform)	75-25-2	76	x	x	x	
		80				Ax
2, 4, 6-Tribromophenol	118-79-6	86	x	○		
2, 4, 6-Tribromophenyl (2-methyl-2, 3-dibromopropyl) ether	36065-30-2	79	x	x		
Tri-n-butylamine	102-82-9	86	x	x		
2, 4, 6-Tri-s-butylphenol	5892-47-7	84	x	x		
2, 4, 6-Tri-t-butylphenol	732-26-3	84	x	○		
Tributyl phosphate	126-73-8	75	○	○	○	
		77	○	○	○	
		93	○	○	○	AO
Tributyltin compounds		83	x	○		
		84	x	○	○	
Trichlorfon (DEP)	52-68-6	93	x	x	x	
Trichloroacetic acid	76-03-9	84	x	x		
2, 4, 5-Trichloroaniline	636-30-6	81	x	x		
2, 4, 6-Trichloroaniline	634-93-5	81	x	x		
1, 2, 3-Trichlorobenzene	87-61-6	75	x	x	x	Rx
		79	○	○	x	
		86				AO
1, 2, 4-Trichlorobenzene	120-82-1	75	x	○	○	Rx
		79	○	○	○	
		86				AO
1, 3, 5-Trichlorobenzene	108-70-3	75	x	x	x	Rx
		79	○	○	○	
		86				AO
1, 1, 1-Trichloroethane	71-55-6	74	x			Rx
		75	○			Rx
		79				AO
		80				AO
83				AO		
1, 1, 2-Trichloroethane	79-00-5	76	x	x	x	
2, 2, 2-Trichloro-1, 1-ethanediol	302-17-0	86	x	x		
Trichloroethylene	79-01-6	74	○			Rx
		75	○			RO
		79				AO
		80				AO
83				AO		
Trichlorofluoromethane (Freon 11)	75-69-4	76				AO
		77				AO
Trichloromethane (Chloroform)	67-66-3	74	○			RO
		75	○			RO
		79				AO
		80				AO
83				AO		

I Monitoring Chemical Substances

1, 1, 1-Trichloro-2-methyl-2-propanol	57-15-8	80	x	x		
		88	x	x		AO

Substance	CAS No.	Year	W	S	F	O
2, 4, 6-Trichloro-nitrobenzene	18708-70-8	84	x	x		
2, 4, 5-Trichlorophenol	95-95-4	78	x	x		
2, 4, 6-Trichlorophenol	88-06-2	78	x	○		
2, 4, 5-Trichlorophenoxy-acetic acid	93-76-5	83	x	x		
1, 2, 3-Trichloropropane	96-18-4	76	x	x	x	
1, 1, 2-Trichloro-1, 2, 2-trifluoromethane (Freon 113)	76-13-1	81	x	x		
		83				AO
Tricresyl phosphate (TCP)	1330-78-5	75	x	○	x	
		78	x	○	x	
		93	x	○	○	AO
Tricyclohexyltin compounds	13121-70-5	86	x	x		
Tridecyl alcohol	112-70-9	77	x	x		
Triethanolamine	102-71-6	78	x			
Triethylamine	121-44-8	81	x	x		
		91	○	○		
Triethylbiphenyl	42347-17-9	76	x	x	x	
Triethylene glycol ethyl ether	112-50-5	88	x	x		
Triethylene glycol methyl ether	112-35-6	88	x	x		
Triethyl phosphate	78-40-0	82	x	x		
Trifluralin	1582-09-8	94	x	x	x	
Trimellitic acid	528-44-9	86	x	x		
Trimethylamine	75-50-3	86	x	○		
		91				AO
1, 2, 3-Trimethylbenzene	526-73-8	76	x	x		
1, 2, 4-Trimethylbenzene	95-63-6	76	x	x		
1, 3, 5-Trimethylbenzene	108-67-8	76	x	x		
Tri (α-methylbenzyl) phenol	18254-13-2	81	x	○		
2, 2, 4-Trimethyl-1, 2-dihydroquinoline	147-47-7	80	x	x		
Trimethyl phosphate	512-56-1	82	x	x		
		84	x	x		
Trioctylamine	1116-76-3	81	x	x		
Trioctyl phosphate	1806-54-8	75	x	○	x	
Trioctyltin compounds		84	x	x		
Triphenyl hydride	61788-32-7	77	x	x		
Triphenylmethane	519-73-3	83	x	x		
Triphenyl phosphate	115-86-6	75	x	x	x	
Triphenyltin compounds		82	x	x		
		88	○	○	○	
Tripropyltin compounds		82	x	x		

Tris (2-bromoethyl) phosphate	27568-90-7	84	x	x		
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Substance	CAS No.	Year	W	S	F	O
Tris (2-butoxyethyl) phosphate	78-51-3	75	x	○	x	
		78	x	x	x	
		93	○	○	○	AO
Tris (2-chloroethyl) phosphate	115-96-8	75	○	○	x	
		78	○	x	○	
		93	○	○	○	AO
Tris (2-chloroethyl) phosphite	140-08-9	84	x	x		
Tris (2-chloropropyl) phosphate	6145-73-9	84	x	x		
Tris (dibromopropyl) phosphate	126-72-7	75	x	x	x	
Tris (1, 3-dichloro-2-propyl) phosphate	13674-87-8	75	x	x	○	
		78	x	x	x	
		84	x	x		
Tris (2-ethylhexyl) phosphate	78-42-2	81	x	○		
1, 3, 5-Tris (2'-hydroxy-ethyl) isocyanurate	839-90-7	79	x	x		
Tris (2-hydroxypropyl) amine	122-20-3	81	x	x		
Tris (isopropylphenyl) phosphate	26967-76-0	78	x	○		
Trixylenyl phosphate	25155-23-1	81	x	○		
Vinyl bromide	593-60-2	81	x	x		
Vinyl chloride	75-01-4	75	○			
		79				AO
		80				AO
2-Vinylpyridine	100-69-6	91				AO
XMC (3, 5-Xylyl methylcarbamate)	2655-14-3	88	x	x		Ax
o-Xylene	95-47-6	77	x	x		
		85	○	○		
		86	○	○	○	
m-Xylene	108-38-3	77	x	x		
		85	○	○		
		86	○	○	○	
p-Xylene	106-42-3	77	x	x		
		85	○	x		
		86	○	○	○	

I.4 Basic information and activities involved in environmental monitoring

(1) Toxicological information

Toxicological information is required to evaluate chemical effects on human health or other organisms in the environment. There are some databases available. The best organized, most comprehensive and most accessible is the World Health Organization's Environmental Health Criteria series. This series includes toxicological information on 160 chemicals.

(2) Preservation of environmental samples

From the chemical analytical standpoint, the main purpose of environmental sample preservation is to keep samples for further investigation in the future i.e. to re-check contaminant levels using new analytical methods, and to provide historical samples when new substances are to be analyzed. From the biological point of view, it is also important that samples are available for taxonomic analysis in the future. It is well known that these checks are only possible for samples which are filters passed through air samples, water samples, and biological samples. Such sample preservation is partly available in some conventional museums, but it is required to be ready for the long-term preservation system to freeze samples. Also registration of preserved samples is necessary in order to utilize samples for international monitoring.

(3) Understanding past environmental pollution - specimen banking

It is sometimes useful to understand historical trends in chemical environment pollution through analyzing preserved samples for pollution impacts. Historical pollution profiles and levels may be understood by chemical analysis of aged stratified materials, e.g. ocean or lake sediments, peat and glacier (ice) columns. Coral, annual rings in trees and other organisms, and historical museum collections can also provide further information. To extend this activity, it is fundamentally important to develop preservation methods for collected samples to enable their use as environmental records. It will then become possible to understand how pollution changes with the time by analyzing frozen or otherwise preserved soil, water, and biological samples, and even preserved air filters.

(4) Data Handling Systems

A wide variety of operations are involved in data handling, i.e. data accumulation, processing, transfer, publishing, storage, etc. Each operation has its own approach, for example whether each function is needed to be monitored. Therefore, data handling systems must include several measurement items and have to be designed with inherent flexibility to allow addition of historical data.