Chapter 2.

Summary of the Fiscal Year 1998 General Inspection Survey of Chemical Substances on Environmental Safety

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1. Purpose of the Survey

The purpose of this survey is to discover the persistence of chemical substances in the general environment at an early stage, and to grasp its concentration level.

2. Surveyed substances and areas

(1) Environmental Survey (water)

From all over Japan, water and bottom sediments were surveyed in 56 areas (Figure2-1), and fishes were surveyed in 14 areas. 24 substances(and groups) were surveyed in water and in bottom sediments and 3 in fishes. Among them, 6 substances(and groups) i.e. phenyltin compounds, diphenyltin compounds, aniline, o-chloroaniline, m-chloroaniline and p-chloroaniline were surveyed in the 56 areas. Other substances(and group) were surveyed in 12 to 15 areas.

(2) Environmental Survey (air)

11 to 17 areas (Figure 2-2) were subject to the survey and 32 substances (Table 2-2) were surveyed.

3. Sampling method and analytical method

Sampling method and analytical method are shown in Appendix C and Appendix D respectively.

4. Survey results

(1) Environmental Survey (water)

8 substances(and groups) in water, 16 in bottom sediments and 2 in fishes were detected (Table 2-1).

(2) Environmental Survey (air)

29 substances were detected (Table 2-2).

5. Summary of Each Detected Substance

(1) Water

The summary of each detected substance in water is as follows.

① Dibutyltin Compounds

1) Dibutyltin compounds are used for stabilizers for polyvinyl chloride(PVC) and copolymers of
mainly PVC as well as polymer blends of PVC and modifying resins for PVC. The production volume in FY1997 was 8,351 tons(as total of organotin stabilizers).

2) In the results of the fiscal year 1983 General Environmental Survey, dibutyltin compounds were not detected in water but detected from 2 out of 25 areas in bottom sediments(3 out of 75 samples). As for FY1984, they were detected in neither water nor bottom sediments but were detected from 2 out of 46 areas in bottom sediments(6 out of 138 samples). (Detection limit : 0.08 to 10 ppb for water, 0.003 to 0.07 ppm for bottom sediments and 0.003 to 0.05 ppm for fishes)

3) In the results of this survey, dibutyltin compounds were detected from 8 out of 13 areas in water (20 out of 39 samples), 12 out of 12 areas in bottom sediments (36 out of 36 samples) and the detection range was 0.003 to 0.017 ppb in water, 0.002 to 0.27 ppm in bottom sediments (unified detection limit: 0.0021 ppb in water and 0.002 ppm in bottom sediments).

4) From the above survey results, dibutyltin compounds were detected in both water and bottom sediments and the detection frequency was so high that it is necessary to conduct more detailed survey for future and to observe the change and at the same time to endeavor to collect information.

○ Survey results of dibutyltin compounds

		(sample)	(area)	detection range	detection limit
water	FY1983	0%(0/75)	0%(0/25)	not detected	0.1 to 0.4 ppb
	FY1984	0%(0/138)	0%(0/46)	not detected	0.1 to 0.4 ppb
	FY1998	51%(20/39)	62%(8/13)	0.003 to 0.017ppb	0.0021ppb
bottom sediments	FY1983	4%(3/75)	8%(2/25)	0.02 to 0.03ppm	0.01 to 0.044ppb
	FY1984	4%(6/138)	4%(2/46)	0.004 to 0.11 ppm	0.003 to 0.07 ppm
	FY1998	100%(36/36)	100%(12/12)	0.002 to 0.27 ppm	0.002 ppm
fishes	FY1984	0%(0/138)	0%(0/42)	not detected	0.003 to 0.05 ppm

② Phenyltin Compounds

1) Phenyltin compounds are unintentionally formed by decomposition of triphenyltin compounds and some of the compounds(oxo-diphenyltin) were used in past as stabilizers for PVC.

2) In the results of the fiscal year 1989 General Environmental Survey, they were detected from 9 out of 23 areas in water(14 out of 67 samples), from 11 out of 19 areas in bottom sediments(28 out of 55 samples) and 11 out of 18 areas in fishes(28 out of 54 samples)
(unified detection limits: 0.03ppb for water, 0.015 ppm for bottom sediments and 0.015 ppm for fishes).

3) In the results of this survey, phenyltin compounds were detected from 14 out of 46 areas in bottom sediments(31 out of 134 samples) and not detected in water. Detection range was 0.016 to 0.76 ppm for bottom sediments (unified detection limits: 0.01 ppb for water and 0.016 ppm for bottom sediments).

4) From the above survey results, detection frequency for phenyltin compounds tends to decline in comparison with the results of 1989 survey. In the present survey they were only detected in bottom sediments. In future it is required to conduct environmental survey at a certain interval and at the same time to endeavor to collect information.

○ Survey results of phenyltin compounds

		(sample)	(area)	detection range	detection limit
water	FY1989	21%(14/67)	39%(9/23)	0.03 to 47.3 ppb	0.03 ppb
	FY1998	0%(0/156)	0%(0/52)	not detected	0.01 ppb
bottom sediments	FY1989	51%(28/55)	58%(11/19)	0.019 to 1.1 ppm	0.015ppm
	FY1998	23%(31/134)	30%(14/46)	0.016 to 0.76ppm	0.016 ppm
fishes	FY1989	52%(28/54)	61%(11/18)	0.015 to 1.1 ppm	0.015 ppm

③ Diphenyltin Compounds

1) Diphenyltin compounds are unintentionally formed by decomposition of triphenyltin compounds and some of the compounds(oxo-diphenyltin) were used in past as stabilizers for PVC.

2) In the results of the fiscal year 1989 General Environmental Survey, they were detected from 4 out of 24 areas in water(5 out of 72 samples), from 13 out of 19 areas in bottom sediments(31 out of 53 samples) and 17 out of 20 areas in fishes(48 out of 59 samples)
(unified detection limits: 0.06ppb for water, 0.005 ppm for bottom sediments and 0.005 ppm for fishes).

3) In the results of this survey, diphenyltin compounds were detected from 6 out of 45 areas in water (12 out of 133 samples) and from 30 out of 46 areas in bottom sediments (79 out of 138 samples). Detection range was 0.000037 to 0.0017 ppb for water and 0.00079 to 0.21 ppm for bottom sediments (unified detection limits: 0.0003 ppb for water and 0.00072 ppm for bottom sediments).

4) From the above survey results, diphenyltin compounds were detected in water and bottom sediments and the detection frequency for bottom sediments was high. Although the detected concentration level tends to decline as a whole, in future it is required to conduct environmental survey at a certain interval and at the same time to endeavor to collect information.

○ Survey results of diphenyltin compounds

		(sample)	(area)	detection range	detection limit
water	FY1989	7%(5/72)	17%(4/24)	0.38 to 27 ppb	0.06 ppb
	FY1998	9%(12/133)	13%(6/45)	0.00037 to 0.0017ppb	0.0003 ppb
bottom sediments	FY1989	58%(31/53)	68%(13/19)	0.007 to 0.5 ppm	0.005ppm
	FY1998	57%(79/138)	65%(30/46)	0.00079 to 0.21ppm	0.00072 ppm
fishes	FY1989	81%(48/59)	85%(17/20)	0.005 to 0.99 ppm	0.005 ppm

④ Aniline

1) Aniline is used for dyestuffs, mordants, intermediates(aniline salts, diethylanine, sulfanilic acid, acetanilid, etc.), vulcanization-accellerater for rubber, medicines, organic syntheses, raw material for gunpowder, reagent for detection of pentoses, reagent for determination of iron, chromium, lead etc.. The production volume in 1997 was 249,579 tons.

2) In the results of the fiscal year 1976 General Environmental Survey, aniline was detected from 13 out of 22 areas in water(40 out of 68 samples), 15 out of 22 areas in bottom sediments(48 out of 68 samples) (detection limits: 0.02 to 0.2 ppb for water and 0.000 8ppm for bottom sediments). And in the FY1990, from 15 out of 37 areas in water(33 out of 104 samples), from 28 out of 39 areas in bottom sediments(81 out of 116 samples) and from 10 out of 30 areas in fishes(27 out of 89 samples) (unified detection limits: 0.02 ppb for water, 0.002ppm bottom sediments and 0.001 ppm for fishes).

3) In the results of this survey, aniline was detected from 1 out of 47 areas in water(1 out of 141 samples), 36 out of 43 areas in bottom sediments(95 out of 120 samples). Detection range were 0.074ppb for water and 0.0021 to 0.21 ppm for bottom sediments (unified detection

limits: 0.06 ppb for water and 0.002 ppm for bottom sediments).

4) From the above survey results, aniline was detected from both water and bottom sediments, and the detection frequency in bottom sediments is so high that environmental survey is required to be conducted at a certain interval.

○ Survey results of aniline

		(sample)	(area)	detection range	detection limit
water	FY1976	59%(40/68)	59%(13/22)	0.02 to 28 ppb	0.02 to 0.2 ppb
	FY1990	32%(33/104)	41%(15/37)	0.02 to 0.33 ppb	0.02 ppb
	FY1998	1%(1/141)	2%(1/47)	0.0074 ppb	0.06ppb
bottom sediments	FY1976	71%(48/68)	68%(15/22)	0.0007 to 0.5ppm	0.0008 ppm
	FY1990	70%(81/116)	72%(28/39)	0.003 to 0.24 ppm	0.002 ppm
	FY1998	79%(95/120)	84%(36/43)	0.0021 to 0.21 ppm	0.002 ppm
fishes	FY1990	30%(27/89)	33%(10/30)	0.001 to 0.0077ppm	0.001 ppm

○ Results of acute toxicity tests etc. for aniline

・rat	LD50 (oral)	250 mg/kg
・mouse	LD50 (oral)	464 mg/kg
・mouse	LD50 (inhalation)	175 ppm×7 hr

・Instillation of 20mg to an eye causes medium strong irritancy and that of 100mg strong irritancy.

・Teratogenicity: No teratogenicity was found in rats at the dose showing apparent maternal toxicity.

・Tumorigenicity: In the experiments of 103 weeks administration of aniline haydrochloric acid salt added to foods, no tumorigenicity was found in Fischer 344 rats (concentration in the feed 0.3% and 0.6%), however for B6C3F_1 rats angiosarcoma in spleen and fibrosarcoma in spleen and several parts of bodies were produced and thus it was judged that there is tumorigenicity.

・ Mutagenicity: negative in Ames test. There are reports reporting negative in chromosomal abberation tests using Chinese hamster cultured cells, but positive at doses of 1.0, 2.0mg of aniline/ml with S9Mix. In a test for sister chromatid exchanges negative when chinese hamster cultured cells are used. And positive in a case of rat hepato- fibrocyte cultured cells without activation system. And negative in a cell transformation test using Syrian hamster cultured cells.

○ Results of ecological effect tests for aniline

・ rainbow trout	96hr LC50	36.2mg/l
・ fathead minnow	96hrLC50	32mg/l

・ Oryzias latipes	96hrLC50	4,108mg/l
・ Daphnia	96hrLC50	0.21mg/l

⑤ 4-Ethoxyaniline

1) 4-Ethoxyaniline is used as intermediates for food additives, pharmaceuticals , dyestuffs, and dyestuff intermediates. The import/production volume in 1997 was 1,000 tons(estimated).

2) In the results of the fiscal year 1977 General Environmental Survey, 4-ethoxyaniline was not detected in water and bottom sediments (detection limits: 1 to 5 ppb for water and 0.5 to 1.0 ppm for bottom sediments) and in FY 1985 not detected in water and bottom sediments (unified detection limits: 0.05 ppb for water and 0.005 ppm for bottom sediments).

3) In the results of this survey, 4-ethoxyaniline was detected from 1 out of 13 areas and 1 out of 39 samples in water and not detected in bottom sediments. Detection range for water was 0.36ppb (unified detection limit: 0.3 ppb for water and 0.02 ppb for bottom sediments).

4) From the above survey results, although 4-ethoxyaniline was detected in water, but at present it does not seem to pose any problems.

○ Survey results of 4-ethoxyaniline

		(sample)	(area)	detection range	detection limit
water	FY1977	0%(0/6)	0%(0/2)	not detected	1 to 5 ppb
	FY1985	0%(0/33)	0%(0/11)	not detected	0.05 ppb
	FY1998	3%(1/39)	8%(1/13)	0.36 ppb	0.3ppb
bottom sediments	FY1977	0%(0/6)	0%(0/2)	not detected	0.5 to 1.0 ppm
	FY1985	0%(0/33)	0%(0/11)	not detected	0.005 ppm
	FY1998	0%(0/39)	0%(0/13)	not detected	0.02 ppm

○Results of acute toxicity tests etc. for 4-ethoxyaniline

・rat	LD50 (oral)	540 mg/kg
・mouse	LD50 (oral)	530 mg/kg
・rabbit	LD50 (oral)	7,000 mg/kg
・rat	LC50 (inhalation)	250 mg/m3
・mouse	LD50 (intraperitoneal)	692 mg/kg

・In 28 days repeated dose tests using F344 rats at 0, 10, 40, 160 mg/kg/day doses, followings were observed and NOEL is judged to be 10 mg/kg/day: increase in urobilinogen in urine and reduction in numbers of red blood cells and increase in net shape red blood cells both for

male and female group of 40, 160 mg/kg doses; methemoglobineemia for male and female groups of 160 mg/kg dose; increase of spleen weight for male and female groups of 40, 160 mg/kg doses; histopathologically, deposition of hemosiderin, increase in extramedullary hematopoiesis, and congestion; additionally, rise in hematopoiesis, slight deposition of hemosiderin on liver and rise in extramedullary hematopoiesis.

・Reproductive toxicity: In a reproduction/developmental toxicity screening test (OECD test guideline) using SD rats at 0, 3, 12, 50, 200 doses, significant decrease in fertility rate and effects on development of newborns for 200 mg/kg group. The NOEL on male reproduction is considered to be 200 mg/kg/day and NOEL for female and child animals 50 mg/kg/day.

・Mutagenicity: negative in Ames test but positive in chromosomal abberation test (in vitro, CHL cells) and micronucleus test.

○ Results of ecological effect tests for 4-ethoxyaniline

・ Selenastrum capricornutum	72hr EC50 (growth inhibition)	5.1 ppm
・ Daphnia magna	24hr EC50 (immobilization)	170 ppm
	21days NOEC(proliferation inhibition)	0.19 ppm
・ Oryzias latipes	96hr LC50	240 ppm(w/v)

⑥ o-Chloroaniline

1) o-Chloroaniline is known as Fast Yellow G Base and is used for intermediates for naphthol dyes, a raw material of 3-hydroxy-diphenylene oxide etc., intermediates for pharmaceuticals and agricultural chemicals, and a cross-linking agent. The importation/production volume in 1997 was 500 tons (estimated).

2) In the results of fiscal year 1976 General Environmental Survey, o-chloroaniline was not detected in fishes and detected from 5 out of 38 areas in water (12 out of 120 samples) and from 12 out of 39 areas in bottom sediments (29 out of 113 samples) (detection limits: 0.02 to 100 ppb for water, 0.0003 to 1.0 ppm for bottom sediments and 1.0 ppm for fishes).
In the results of FY 1990 General Environmental Survey, it was detected from 4 out of 26 areas (7 out of 78 samples) in water and from 10 out of 22 areas (25 out of 64 samples) in bottom sediments and from 1 out of 24 areas (2 out of 72 samples) (Unified detection limits:0.02 ppb for water, 0.003 ppm for bottom sediments and 0.001 ppm for fishes).

3) In the results of this survey, o-chloroaniline was detected from 7 out of 45 areas (17 out of 133 samples) in bottom sediments and not detected in water. Detection range was 0.0051 to 0.056 ppm for bottom sediments (unified detection limit: 0.09 ppb for water and 0.005 ppm for bottom sediments).

4) From the above survey results, although o-chloroaniline was detected in bottom sediments, the detected frequencies were low, so it does not seem to pose any problems at present. But for environmental effects, it is necessary to continue to collect more detailed information. (This evaluation on environmental effects was derived from the fact that PNEC for aquatic organisms is 0.0003 mg/l.)

○ Survey results of o-chloroaniline

		(sample)	(area)	detection range	detection limit
water	FY1976	10%(12/120)	13%(5/38)	0.028 to 0.35ppb	0.02 to 100 ppb
	FY1990	9%(7/78)	15%(4/26)	0.02 to 0.56 ppb	0.02 ppb
	FY1998	0%(0/144)	0%(0/48)	not detected	0.09 ppb
bottom sediments	FY1976	26%(29/113)	31%(12/39)	0.0007 to 0.098ppm	0.003 to 1.0 ppm
	FY1990	39%(25/64)	45%(10/22)	0.0032 to0.028ppm	0.003 ppm
	FY1998	13%(17/133)	16%(7/45)	0.0051 to 0.056ppm	0.005 ppm
fishes	FY1976	0%(0/2)	0%(0/1)	not detected	1.0 ppm
	FY1990	3%(2/72)	0%(1/24)	0.0012 to 0.0025ppm	0.001 ppm

○Results of acute toxicity tests etc. for o-chloroaniline

・rat LD50(oral) 256mg/kg

・cat LD50(subcutaneous) 310mg/kg

・Gives damage to kidney and liver. In a single dose test on rats at intraperitoneal administration of 50 to 190 mg/kg, such renal damage as rise of BUN in serum was observed.

・Mutagenicity: Negative on a cell transformation test using Syrian hamster derived cells.

○ Results of ecological effect tests for o-chloroaniline

・ Chlorella pyrenoidosa	96hr EC50 (growth inhibition)	32 mg/l
・ Scenedesmus subspicatus	72hr EC50 (growth inhibition)	40 mg/l
・ Daphnia magna	48hr LC50	0.13mg/l
	24hr EC50 (immobilization)	6.0 mg/l
	21days NOEC(proliferation inhibition)	0.032 mg/l
・ Poecilia reticulata	14days LC50	6.30 mg/l
・ fathead minnow	96hr LC50	5.65 mg/l

⑦ m-Chloroaniline

1) In the fiscal year 1976 General Environmental Survey, m-chloroaniline was not detected in fishes and was detected from 4 out of 40 areas (10 out of 128 samples) in water and from 12 out of 41 areas (34 out of 121 samples) in bottom sediments (detection limit: 0.04

to 100 ppb for water, 0.0001 to 1.2 ppm and 1.0 ppm for fishes). In FY1990, it was not detected in fishes and was detected from 2 out of 15 areas (3 out of 45 samples) in water and from 10 out of 15 areas (24 out of 43 samples) in bottom sediments (unified detection limit: 0.02 ppb for water, 0.003 ppm for bottom sediments and 0.002 ppm for fishes).

2) In the results of this survey, m-chloroaniline was detected from 5 out of 44 areas (11 out of 130 samples) in bottom sediments and not detected in water. Detection range was 0.0046 to 0.022 ppm for bottom sediments. (unified detection limit:0.11 ppb for water and 0.0045 ppm for bottom sediments).

3) From the above survey results, although m-chloroaniline was detected in bottom sediments, the detection frequencies in bottom sediments was low, so it does not seem to pose any problems at present. But for ecological effects it is required to continue to collect more detailed information. This evaluation on ecological effects was derived from the fact that PNEC for aquatic organisms is 0.001 mg/l.

○ Survey results of m-chloroaniline

		(sample)	(area)	detection range	detection limit
water	FY1976	8%(10/128)	10%(4/40)	0.013 to 0.34ppb	0.04 to 100 ppb
	FY1990	7%(3/45)	13%(2/15)	0.029 to 0.06 ppb	0.02 ppb
	FY1998	0%(0/153)	0%(0/51)	not detected	0.11 ppb
bottom sediments	FY1976	28%(34/121)	29%(12/41)	0.0003 to 0.067ppm	0.0001 to 1.2ppm
	FY1990	56%(24/43)	67%(10/15)	0.003 to 0.043ppm	0.003 ppm
	FY1998	8%(11/130)	11%(5/44)	0.0046 to 0.022ppm	0.0045 ppm
fishes	FY1976	0%(0/2)	0%(0/1)	not detected	1.0 ppm
	FY1990	0%(0/51)	0%(0/18)	not detected	0.002 ppm

○Results of acute toxicity tests etc. for m-chloroaniline

・ rat	LD50 (oral)	256 mg/kg
・ mouse	LD50 (oral)	334 mg/kg
・ rat	LC50 (inhalation)	150 ppm/4 hr
・ mouse	LC50 (inhalation)	550 mg/m3/4 hr
	LD50 (intraperitoneal)	200 mg/kg

○ Results of ecological effect tests for m-chloroaniline

・ Chlorella pyrenoidosa	96hr EC50 (growth inhibition)	21.0 mg/l
・ Scenedesmus subspicatus	48hr EC50 (growth inhibition)	26.1 mg/l
・ Daphnia magna	48hr EC50 (immobilization)	0.35mg/l
	48hr LC50	0.10 mg/l

	21days EC50(proliferation inhibition)	0.013 mg/l
・ Brachyodanio rerio	28days LC50	6.8 mg/l
	21days NOEC (proliferation)	5.6mg/l

⑧ p-Chloroaniline

1) p-chloroaniline is used for dyestuff intermediates.

2) In the fiscal year 1976 General Environmental Survey, p-chloroaniline was not detected in fishes and was detected from 5 out of 40 areas (9 out of 128 samples) in water and from 12 out of 41 areas (39 out of 121 samples) in bottom sediments (detection limit: 0.02 to 100 ppb for water, 0.0005 to 1.2 ppm for bottom sediments and 1.0 ppm for fishes). In FY 1990, it was not detected in both water and fishes and was detected from 7 out of 15 areas (15 out of 42 samples) in bottom sediments (unified detection limit: 0.05 ppb for water, 0.008 ppm for bottom sediments and 0.005 ppm for fishes).

3) In the results of this survey, p-chloroaniline was detected from 9 out of 45 areas (24 out of 135 samples) in bottom sediments and not detected in water. Detection range was 0.0053 to 0.020 ppm for bottom sediments. (unified detection limit:0.07 ppb for water and 0.0053 ppm for bottom sediments)

4) From the above survey results, although p-chloroaniline was detected in bottom sediments, the detection frequency was not so high. So that it does not seem to pose any problem at present. But for ecological effects it is required to continue to collect more detailed information. This evaluation on ecological effects was derived from the fact that PNEC for aquatic organisms is 0.0001 mg/l.

○ Survey results of p-chloroaniline

		(sample)	(area)	detection range	detection limit
water	FY1976	7%(9/128)	13%(5/40)	0.024 to 0.39ppb	0.02 to 100 ppb
	FY1990	0%(0/54)	0%(0/18)	not detected	0.05ppb
	FY1998	0%(0/135)	0%(0/45)	not detected	0.07 ppb
bottom sediments	FY1976	32%(39/121)	29%(12/41)	0.001 to 0.27ppm	0.0005 to 1.2ppm
	FY1990	36%(15/42)	47%(7/15)	0.0089 to0.05ppm	0.008 ppm
	FY1998	18%(24/135)	20%(9/45)	0.0053 to 0.020ppm	0.005 ppm
fishes	FY1976	0%(0/2)	0%(0/1)	not detected	1.0 ppm
	FY1990	0%(0/57)	0%(0/19)	not detected	0.005 ppm

○Results of acute toxicity tests etc. for p-chloroaniline

・ rat LD50 (oral) 300 mg/kg
・ mouse LD50 (oral) 100 mg/kg
・ rat LD50 (intraperitoneal) 420 mg/kg
・ mouse LD50 (intraperitoneal) 200 mg/kg
・ Forms methemoglobins. In a single dose test on rats at intraperitoneal administration of 191 mg/kg, renal damage was observed.
・Mutagenicity: Negative on a cell transformation test using Syrian hamster derived cells.

○ Results of ecological effect tests for p-chloroaniline

・ Chlorella pyrenoidosa	96hr EC50 (growth inhibition)	4.1 mg/l
・ Scenedesmus subspicatus	48hr EC50 (growth inhibition)	2.2 mg/l
・ Daphnia magna	48hr EC50 (immobilization)	0.31mg/l
	21days NOEC(proliferation inhibition)	0.010 mg/l
・ Lepomis machrochirus	96hr LC50	2.4 mg/l
・ Brachyodanio rerio	56days NOEC (growth)	0.2mg/l

⑨ 2,4-Dichloroaniline

1) In the fiscal year 1976 General Environmental Survey, 2,4-dichloroaniline was detected from 4 out of 24 areas (7 out of 68 samples) in water and from 7 out of 22 areas (12 out of 68 samples) in bottom sediments (detection limit: 0.02 to 0.3 ppb for water and 0.0005 to 0.001 ppm for bottom sediments).

2) In the results of this survey, 2,4-dichloroaniline was not detected in both water and bottom sediments (unified detection limit:0.07 ppb for water and 0.008 ppm for bottom sediments).

3) From the above survey results, it does not seem to pose any problems at present.

○ Survey results of 2,4-dichloroaniline

		(sample)	(area)	detection range	detection limit
water	FY1976	10%(7/68)	17%(4/24)	0.032 to 0.53ppb	0.02 to 0.3 ppb
	FY1998	0%(0/39)	0%(0/13)	not detected	0.07 ppb
bottom sediments	FY1976	18%(12/68)	32%(7/22)	0.0005 to 0.034ppm	0.0005 to 0.001ppm
	FY1998	0%(0/36)	0%(0/12)	not detected	0.008 ppm

○Results of acute toxicity tests etc. for 2,4-dichloroaniline
・ rat LD50 (oral) 1,600 mg/kg
・ mouse LD50 (oral) 400 mg/kg

・ rat	LD50 (intraperitoneal)	400 mg/kg
・ mouse	LD50 (intraperitoneal)	400 mg/kg

○ Results of ecological effect tests for 2,4-dichloroaniline

・ Anacystis aeruginosa	96hr EC50 (growth)	0.96 mg/l
・ Chlorella pyrenoidosa	96hr EC50 (growth)	10.0 mg/l
・ Daphnia magna	48hr EC50 (immobilization)	1.3 mg/l
	48hr LC50	0.50 mg/l
	16days NOEC(growth)	0.015 mg/l
・ Brachyodanio rerio	96hr LC50	9.0mg/l
・ Gasterosteus aculeatus	96hr LC50	9.3 mg/l
	35days NOEC (lethal)	0.58 mg/l
・ Oryzias latipes	7days LC50	1.0 mg/l

⑩ 2,5-Dichloroaniline

1) 2,5-Dichloroaniline is used for intermediates for paints and pigments. The importation/production volume in 1997 was 200 tons (estimated).

2) In the fiscal year 1984 General Environmental Survey, 2,5-dichloroaniline was not detected in water and was detected from 1 out of 6 areas (1 out of 18 samples) in bottom sediments. (detection limit: 0.05 to 0.1 ppb for water and 0.0006 to 0.012 ppm for bottom sediments)

3) In the results of this survey, 2,5-dichloroaniline was detected from 1 out of 12 areas (1 out of 36 samples) in bottom sediments and not detected in water. The detected figure was 0.010 ppm in bottom sediments (unified detection limit:0.07 ppb for water and 0.005 ppm for bottom sediments).

4) From the above survey results, although 2,5-dichloroaniline was detected in bottom sediments, the detection frequency in bottom sediments was so low that it does not seem to pose any problems at the moment. However, for ecological effects, it is required to continue to collect more detailed information. (This evaluation on ecological effects was derived from information on ecotoxicology.)

○ Survey results of 2,5-dichloroaniline

		(sample)	(area)	detection range	detection limit
water	FY1984	0%(0/18)	0%(0/6)	not detected	0.05 to 0.1 ppb
	FY1998	0%(0/39)	0%(0/13)	not detected	0.07 ppb

bottom sediments	FY1984	6%(1/18)	17%(1/6)	0.0006ppm	0.0006 to 0.012ppm
	FY1998	3%(1/36)	8%(0/12)	0.010 ppm	0.005 ppm

○Results of acute toxicity tests etc. for 2,5-dichloroaniline

- rat LD50 (oral) 1,600 mg/kg
- mouse LD50 (oral) 1,600 mg/kg
- rabbit LD50 (oral) 3,750 mg/kg
- mouse LD50 (intraperitoneal) 400 mg/kg

○ Results of ecological effect tests for 2,5-dichloroaniline

- Chlorella pyrenoidosa 96hr EC50 (growth inhibition) 10.0 mg/l
- Daphnia magna 48hr LC50 2.92 mg/l
- Poecilia reticulata 14days LC50 1.7 mg/l
- Oncorhynchus kisutch, silver salmon 24hr LC50 1.0 to 10.0mg/l

⑪ 3,4-Dichloroaniline

1) 3,4-Dichloroaniline is used for intermediates for dyestuffs and agricultural chemicals. The importation/production volume in 1997 was 500 tons (estimated).

2) In the fiscal year 1976 General Environmental Survey, 3,4-dichloroaniline was detected from 2 out of 24 areas (4 out of 68 samples) in water and from 10 out of 22 areas (31 out of 68 samples) in bottom sediments. (detection limit: 0.04 to 0.3 ppb for water and 0.0008 to 0.003 ppm for bottom sediments) And in FY 1984, it was not detected in water and was detected from 1 out of 6 areas (1 out of 18 samples) in bottom sediments (detection limit: 0.03 to 0.1 ppb for water and 0.0003 to 0.012 ppm for bottom sediments).

3) In the results of this survey, 3,4-dichloroaniline was detected from 2 out of 13 areas (4 out of 39 samples) in bottom sediments and not detected in water. Detection range was 0.012 to 0.015 ppm in bottom sediments (unified detection limit:0.09 ppb for water and 0.01 ppm for bottom sediments).

4) From the above survey results, although 3,4-dichloroaniline was detected in bottom sediments, the detection frequency in bottom sediments was so low that it does not seem to pose any problems at the moment. However, for ecological effects, it is required to continue to collect more detailed information. (This evaluation on ecological effects was derived from the data that PNEC for aquatic organism is 0.00002 mg/l.)

○ Survey results of 3,4-dichloroaniline

		(sample)	(area)	detection range	detection limit
water	FY1976	6%(4/68)	8%(2/24)	0.24 to 0.42 ppb	0.04 to 0.3 ppb
	FY1984	0%(0/18)	0%(0/6)	not detected	0.03 to 0.1 ppb
	FY1998	0%(0/39)	0%(0/13)	not detected	0.09 ppb
bottom sediments	FY1976	46%(31/68)	45%(10/22)	0.0045 to 0.11ppm	0.0008 to 0.003ppm
	FY1984	6%(1/18)	17%(1/6)	0.0016ppm	0.0003 to 0.012ppm
	FY1998	10%(4/39)	15%(2/13)	0.012 to 0.015ppm	0.01 ppm

○Results of acute toxicity tests etc. for 3,4-dichloroaniline

・ rat	LD50 (oral)	545 mg/kg
・ mouse	LD50 (oral)	740 mg/kg
・ rat	LD50 (intraperitoneal)	280 mg/kg
・ mouse	LD50 (intraperitoneal)	310 mg/kg
・ rat	LC50 (inhalation)	65 mg/m3/4hr

○ Results of ecological effect tests for 3,4-dichloroaniline

・ Scenedesmus subspicautus	72hr EC50 (growth)	15 mg/l
	72hr NOEC (growth)	0.5 mg/l
・ Chlamydomonas reinhardtii	96hr NOEC (growth)	0.26 mg/l
・ Daphnia magna	14days NOEC (proliferation effect)	0.0025 mg/l
・ Artemia salina	28days LC50	0.03 mg/l
・ Aedes aegypti	24hr LC50	0.012 mg/l
	96hr LC50	0.005 mg/l
・ Brachdanio rerio	24hr LC50	10.7 mg/l
	96hr LC50	8.5 mg/l
	42days LC50 (growth)	0.002 to 0.1 mg/l
・ Poecilia reticulata	98days LOEC (proliferation)	2.3 mg/l

⑫ o-Toluidine

1) o-Toluidine is used for azo-, sulfurdyes, pigment raw materials, organic syntheses and solvents. The importation volume in 1997 was 599 tons.

2) In the results of the fiscal year 1976 General Environmental Survey, o-toluidine was detected from 4 out of 22 areas (8 out of 68 samples) in water and from 11 out of 22 areas (27 out of 68 samples) in bottoms sediments (detection limit: 0.1 to 0.6 ppb for water and 0.002 to 0.012 ppm for bottom sediments).

3) In the results of this survey, o-toluidine was detected from 3 out of 12 (7 out of 36

samples) in bottom sediments and was not detected in water. The detection range was 0.054 to 0.074 ppm for bottom sediments (unified detection limit: 0.08 ppb for water and 0.0043 ppm for bottom sediments).

4) From the above survey results, although o-toluidine was detected in bottom sediments, in view of the detection frequency and concentration level, it does not seem to pose any problems at present.

○ Survey results of o-toluidine

		(sample)	(area)	detection range	detection limit
water	FY1976	12%(8/68)	18%(4/22)	0.14 to 20 ppb	0.1 to 0.6 ppb
	FY1998	0%(0/39)	0%(0/13)	not detected	0.08 ppb
bottom sediments	FY1976	40%(27/68)	50%(11/22)	0.002 to 0.013ppm	0.002 to 0.012ppm
	FY1998	19%(7/36)	25%(3/12)	0.0054 to 0.00074ppm	0.0043 ppm

○Results of acute toxicity tests etc. for o-toluidine

・ human	TCLo (inhalation)	25 mg/m3
・ rat	LC50 (inhalation)	862 ppm/4hr
	LD50 (oral)	670 mg/kg
・ mouse	LD50 (oral)	520 mg/kg
・ rabbit	LD50 (oral)	840 mg/kg
・ mouse	LD50 (intraperitoneal)	150 mg/kg

・ Toluidine is capable of of formation of methemoglobin and the systemic symptom is similar to poisoning caused by aniline. Although anemia appears, hematuria is to be noted as a specific clinical symptom.

・ Case history: A tank truck fell down into a paddy field and during the lifting operation two workers were poisoned by o-toluidine leaked and went into breathing difficulty, hyperhidrosis, cyanosis symptom and hematuria.

○ Results of ecological effect tests for o-toluidine

・ Chlorella pyrenoidosa	96hr EC50 (growth inhibition)	55.0 mg/l
・ Scenedesmus quadricauda	7days EC50 (growth inhibition)	6.3mg/l
・ Daphnia magna	24hr LC50	26.0 mg/l
	21days LC50	2.2 mg/l
	21days REP(Proliferation effects)	0.1 mg/l
・ Poecilia reticulata	14days LC50	81.3 mg/l
・ Cyprinodontidae, Killifish	48hr LC50	100 mg/l

⑬ m-Toluidine

1) In the results of the fiscal year 1976 General Environmental Survey, m-toluidine was detected from 3 out of 22 areas (4 out of 68 samples) in water and from 12 out of 22 areas (32 out of 68 samples) in bottoms sediments (detection limit: 0.08 to 0.2 ppb for water and 0.001 to 0.004 ppm for bottom sediments).

2) In the results of this survey, m-toluidine was not detected in water and bottom sediments (unified detection limit: 0.2 ppb for water and 0.01 ppm for bottom sediments).

3) From the above survey results, in consideration of the envisaged concentration level, it does not seem to pose any problems at present.

○ Survey results of m-toluidine

		(sample)	(area)	detection range	detection limit
water	FY1976	6%(4/68)	14%(3/22)	0.096 to 0.26 ppb	0.08 to 0.2 ppb
	FY1998	0%(0/39)	0%(0/13)	not detected	0.2 ppb
bottom sediments	FY1976	47%(32/68)	55%(12/22)	0.002 to 0.056ppb	0.001 to 0.004ppm
	FY1998	0%(0/39)	0%(0/13)	not detected	0.01 ppm

○Results of acute toxicity tests etc. for m-toluidine

・ rat	LD50 (oral)	450 mg/kg
・ mouse	LD50 (oral)	740 mg/kg
・ rabbit	LD50 (oral)	750 mg/kg
・ mouse	LD50 (intraperitoneal)	116 mg/kg

・ Toluidine is capable of of formation of methemoglobin and the systemic symptom is similar to poisoning caused by aniline. Although anemia appears, hematuria is to be noted as a specific clinical symptom.

○ Results of ecological effect tests for m-toluidine

・ Scenedesmus quadricauda	96hr EC50 (growth inhibition)	10.0mg/l
・ Daphnia magna	48hr LC50	0.73 mg/l
	16days EC50 (proliferation)	0.043 mg/l

⑭ p-Toluidine

1) p-Toluidine is used for a raw material for organic syntheses and a special solvent for dyestuff manufacturing.

2) In the results of the fiscal year 1976 General Environmental Survey, p-toluidine was

detected from 6 out of 22 areas (11 out of 68 samples) in water and from 14 out of 22 areas (35 out of 68 samples) in bottoms sediments (detection limit: 0.02 to 0.2 ppb for water and 0.0004 to 0.0008 ppm for bottom sediments).

3) In the results of this survey, p-toluidine was not detected in water and bottom sediments (unified detection limit: 0.09 ppb for water and 0.007 ppm for bottom sediments).

4) From the above survey results, in consideration of the envisaged concentration level, it does not seem to pose any problems at present.

○ Survey results of p-toluidine

		(sample)	(area)	detection range	detection limit
water	FY1976	16%(11/68)	27%(6/22)	0.032 to 0.18 ppb	0.02 to 0.2 ppb
	FY1998	0%(0/39)	0%(0/13)	not detected	0.09 ppb
bottom sediments	FY1976	51%(35/68)	64%(14/22)	0.0007 to 0.090ppb	0.0004 to 0.0008ppm
	FY1998	0%(0/36)	0%(0/12)	not detected	0.007 ppm

○Results of acute toxicity tests etc. for p-toluidine

・ rat	LD50 (oral)	336 mg/kg
	LD50 (inhalation)	>640 mg/m3/1hr
・ mouse	LD50 (oral)	330 mg/kg
・ rabbit	LD50 (oral)	270 mg/kg
・ mouse	LD50 (intraperitoneal)	50 mg/kg

・ Toluidine is capable of of formation of methemoglobin and the systemic symptom is similar to poisoning caused by aniline. Although anemia appears, hematuria is to be noted as a specific clinical symptom.

○ Results of ecological effect tests for p-toluidine

・ Selenastrum capricornutum	14days EC50 (growth inhibition)	0.20mg/l
・ Scenedesmus quadricauda	96hr EC50 (growth inhibition)	8.0mg/l
・ Oryzias latipes	24hr LC50	60.0 mg/l
	48hr LC50	42.0 mg/l

⑮ Acrylamide

1) Acrylamide is used for flocculants, soil conditioners, modification and resin processing of textiles, paper strength resins, adhesives, paints, raw materials for oil recovering agents, sizing agents, drilling mud additives and cement slurry additives. The importation/production volume in 1997 was 56,500 tons.

2) In the results of the fiscal year 1975 General Environmental Survey, acrylamide was not detected in water (detection limit: 1 ppm). In FY1991 it was not detected in fishes and detected from 5 out of 51 areas (11 out of 153 samples) in water and from 7 out of 50 areas (20 out of 150 samples) in bottom sediments (unified detection limit: 0.05 ppb for water, 0.0005 ppm for bottom sediments and 0.0013 ppm for fishes).

3) In the results of this survey, acrylamide was not detected in water and in bottom sediments (unified detection limit: 0.15 ppb for water and 0.009 ppm for bottom sediments).

3) From the above survey results, in consideration of the enviaged concentration, it is required to improve the analytical method and to resume the environmental survey.

○ Survey results of acrylamide

		(sample)	(area)	detection range	detection limit
water	FY1975	0%(0/95)	0%(0/19)	not detected	1 ppb
	FY1991	7%(11/153)	10%(5/51)	0.05 to 0.1 ppb	0.05 ppb
	FY1998	0%(0/33)	0%(0/11)	not detected	0.15 ppb
bottom sediments	FY1991	13%(20/150)	14%(7/50)	0.00052 to 0.003ppb	0.0005 ppm
	FY1998	0%(0/30)	0%(0/10)	not detected	0.009 ppm
fishes	FY1991	0%(0/147)	0%(0/49)	not detected	0.0013 ppm

○ Results of acute toxicity tests etc. for acrylamide

・ rat	LD50 (oral)	124 mg/kg
・ mouse	LD50 (oral)	107 mg/kg
・ rabbit	LD50 (oral)	150 mg/kg
・ mouse	LD50 (intraperitoneal)	170 mg/kg
・ rat	LD50 (intraperitoneal)	90 mg/kg

・ Acrylamide is locally irritant and causes dermatitis by exposure of human with 1% aq. solution.

・ Teratogenicity: In an experiment where pregnant mice are exposed with acrylamid, no teratogenicity was observed but at the dose of 45 mg/kg/day developmental disturbances in mother animals and fetuses were observed.

・ Tumorigenicity: Dermal administration of acrylamid gives sencar mice squamous cell carcinoma. And oral and intraperitoneal administration gives A/J mice adenoma in lung. Carcinogenicity was confirmed for ICR-Swiss mice.

・ Mutagenicity: Negative in an Ames test. Positive in a mouse bone-marrow chromosomal abberation test. Positive in a micronucleus test. Positive for eukariyotic cells and negative for prokaryotic cells.

・ Case histories: According to Fujita et al. dysesthesia at terminal four limbs, difficulty in walking due to cataplexy in four limbs, lowering in grip strength, disappearance or lowering of tendon reflex, slight abnormality in electromyogram were observed but no abnormality in central nerve system. As subjective symptoms, languor in feet, palsy in fingers, languor in whole body, twist in tongue etc. are appealed in high rate.

Disorder in skin does not accompany irritating symptom and leucoderma is first formed followed by swelling of keratin and then after desquamation or exfoliation. In a case reported by Takahashi et al., disappearance of deep sensation reflex, lowering of sense and vibrational sense and abnormality in electromyogram were observed, and abnormality in electroencephalogram was observed especially for employees of long years service.

According to a study on 71 workers exposed to acrylamide, cataplexy in four limbs was the first symptom and 73% were found to be neurophysiologically abnormal. In an epidemiological study on a cohort of 8,854 humans, it was not recognaized that acrylamide causes specific cancers more frequently.

○ Results of ecological effect tests for acrylamide

・ Daphnia magna	24hr LC50	230 mg/l
	48hr LC50	230 mg/l
	21days NOEC	60 mg/l
・ Oncorhynchus mykiss	24hr LC50	>300 mg/l
	48hr LC50	210 mg/l
	72hr LC50	170 mg/l
	96hr LC50	162 mg/l

⑯ Pyridine

1) Pyridine is used for a basic solvent in rubber/paint industries, industrial raw materials , denaturalization of ethanol, analytical reagents, pharmaceuticals (sulfonamides, antihistamines, sedatives), solvents and reaction media for anhydrous metal salts, surfactants, and vulcanization accelerators. The production volume in 1997 was 4,000 tons (estimated).

2) In the results of the fiscal year 1980 General Environmental Survey, pyridine was detected from 1 out of 3 areas (2 out of 9 samples) in water and from 2 out of 3 areas (6 out of 9 samples) in bottom sediments (detection limit: 0.1 to 0.2 ppb for water and 0.002 to 0.01 ppm for bottom sediments). And in FY1991, it was detected from 2 out of 12 areas (6 out of 36 samples) in water and from 6 out of 13 areas (18 out of 39 samples) in bottom sediments and from 7 out of 13 areas (19 out of 39 samples) in fishes (unified detection limit: 0.1 ppb for water, 0.005 ppm for bottom sediments and 0.003 ppm for fishes).

3) In the results of this survey, pyridine was detected from 2 out of 11 areas (6 out of 33 samples) in water and from 2 out of 11 areas (6 out of 33 samples) in bottom sediments. The detection range was 0.29 to 0.41 ppb for water and 0.013 to 0.019 ppm for bottom sediments (unified detection limit: 0.1 ppb for water and 0.0092 ppm for bottom sediments).

4) From the above survey results, although pyridine was detected in water and bottom sediments, the detected frequency was low. But since it was detected in multiple media, it is desirable to conduct environmental surveys at a certain interval in future.

○ Survey results of pyridine

		(sample)	(area)	detection range	detection limit
water	FY1980	22%(2/9)	33%(1/3)	0.3 to 0.4 ppb	0.1 to 0.2 ppb
	FY1991	17%(6/36)	17%(2/12)	0.13 to 0.2 ppb	0.1 ppb
	FY1998	18%(6/33)	18%(2/11)	0.29 to 0.41 ppb	0.1 ppb
bottom sediments	FY1980	67%(6/9)	67%(2/3)	0.006 to 0.031ppm	0.002 to 0.01 ppm
	FY1991	46%(18/39)	46%(6/13)	0.0068 to 0.1 ppm	0.005 ppm
	FY1998	18%(6/33)	18%(2/11)	0.013 to 0.019 ppm	0.0092 ppm
fishes	FY1984	49%(19/39)	54%(7/13)	0.0045 to 0.075 ppm	0.003 ppm

○ Results of acute toxicity tests etc. for pyridine

- rat LD50 (oral) 891 mg/kg
- mouse LD50 (oral) 1,500 mg/kg
- rat LC50 (inhalation) 28,500 mg/m3×1hr

・Instillation of 2 mg of this substance to an eye of rabbit shows strong irritancy and application of 500 mg of the substance to skin shows weak irritancy.

・ In an animal experiment, acute toxicity is mainly anesthetic influence and irritating influence to mucous membrane and skin.

・Teratogenicity: Positive in teratogenicity in an experiment using eggs of hens. Positive in an experiment using embryos of horned frogs and 96hr ED50 is 1,200 mg/l.

・ Tumorigenicity: No tumorinogenicity was observed at a repeated subcutaneous administration. But a preliminary report of a 2 years test on rats and mice where the substance is added to drinking water states that a clear evidence showing carcinogenicity was found for male and female mice and some evidence for male rats and an equivocal evidence for female rats.

・ Mutagenicity: Negative in an Ames test, a chromosomal abberation test using Chinese hamster culture cells and a syster chromatid exchange test.

・ Case histories: Symptoms in central nervous system and gastro-intestinal are reported. Main symptoms are headache, dizziness, anxiety, insomnia, nausea and vomitting.

In case of a man exposed at 125 ppm concentration for 4 hours a day and for 1 to 2 weeks, transient symptom in central nervous system was observed but no damages in liver and kidney.

○ Results of ecological effect tests for pyridine

・ Oryzias latipes	24hr LC50	400 mg/l
・ fathead minnow	48hr LC50	115 mg/l

⑰ N,N-Dimethylformamide

1) N,N-Dimethylformamide is used for manmade leathers or urethanic synthetic leathers, Spandex fibers, solvents for analytical chemistry and for syntheses of pharmaceuticals, agricultural chemicals and dyestuffs intermediates, solvents for various polymers, gas absorbants and solvents for coloring materials. The production volume in 1997 was 36,000 tons (estimated).

2) In the results of the fiscal year 1978 General Environmental Survey, N,N-dimethylformamide was not detected in water and bottom sediments (detection limit: 10 to 50 ppb for water and 0.1 to 0.3 ppm for bottom sediments) . And in FY1991, it was detected from 7 out of 16 areas (18 out of 48 samples) in water and from 3 out of 16 areas (9 out of 48 samples) in bottom sediments (unified detection limit: 0.1 ppb for water and 0.013 ppm for bottom sediments).

3) In the results of this survey, N,N-dimethylformamide was detected from 2 out of 12 areas (5 out of 36 samples) in water and from 4 out of 12 areas (10 out of 36 samples) in bottom sediments. The detection range was 0.08 to 0.11 ppb for water and 0.0033 to 0.03 ppm for bottom sediments (unified detection limit: 0.07 ppb for water and 0.003 ppm for bottom sediments).

4) From the above survey results, although N,N-dimethyformamide was detected in both water and bottoms sediments, the detected concentration levels are decreasing in comparison with the results of FY1991 survey. But since the production volume is large and it was detected in multiple media, it is desirable to conduct environmental surveys at a certain interval in view of the tendencies of production and usage.

○ Survey results of N,N-dimethylformamid

		(sample)	(area)	detection range	detection limit
water	FY1978	0%(0/24)	0%(0/8)	not detected	10 to 50 ppb
	FY1991	38%(18/48)	44%(7/16)	0.1 to 6.6 ppb	0.1 ppb

	FY1998	14%(5/36)	17%(2/12)	0.08 to 0.11 ppb	0.07 ppb
bottom sediments	FY1978	0%(0/24)	0%(0/8)	not detected	0.1 to 0.3 ppm
	FY1991	19%(9/48)	19%(3/16)	0.03 to 0.11 ppm	0.013 ppm
	FY1998	28%(10/36)	33%(4/12)	0.0033 to 0.03 ppm	0.003 ppm

○ Results of acute toxicity tests etc. for N,N-dimethylformamid

- rat LD50 (oral) 2,800 mg/kg
- mouse LD50 (oral) 3,700 mg/kg
- rat LC50 (inhalation) 5,000 ppm×6hr
- mouse LC50 (inhalation) 9,400 mg/m3×2hr
- In experiments where mice, rats, guinea pigs, rabbits, dogs were exposed at 23 ppm×5.5hr and 426 ppm×0.5hr in total 6 hr a day for 58 times, increase of weight of liver and liver function disturbance were observed and histologically changes were observed in liver, pancreas, kidney adrenal gland and thymus.
- Teratogenicity: Minimal toxic level at oral administration is reported to be 182 mg/kg for mouse and 166 mg/kg for rat. For inhalation test of rabbit it is reported to be 150 mg.

In an experiment of oral administration to rats on the 6th through 20th day of pregnancy, suppression of weight increase and lowering of feed intake of mother animals were observed at the doses of 100 mg/kg or higher, and lowering of weight of fetuses was observed at the doses of 100 mg/kg or higher, and delay in ossification of parietal bones and sterna was caused in fetuses at 200 and 300 mg/kg doses. Accordingly, NOAEL was judged to be 50 mg/kg for both mother animals and fetuses.

- Mutagenicity: Negative in an Ames test (TA1535, TA1538, TA98, TA100). Negative in a syster chromatid exchange test. Negative in unscheduled DNA synthesis test using rat liver cells.
- Case histories: Concerning chronic poisoning in workplace, workers who have been exposed with dimethylformamid at the concentration of not higher than 10 ppm, mostly not higher than 20 ppm, rarely 30 ppm in the production field of polyacryolnitril fibers from acrylonitril have subjective symptoms of stomachache, headache, anorexia, nausea etc. and there was a case of changes in electrocardiogram although the change was within the normal range. No disturbance in function of liver was not observed.

○ Results of ecological effect tests for N,N-dimethylformamid

- Oncorhynchus mykiss 96hr LC50 1,020 mg/l
- Daphnia magna 48hr LC50 13 mg/l

⑱ N-tert-butyl-2-benzothiazolesulfenamide

1) N-tert-butyl-2-benzothiazolesulfenamide is used as a vulcanization accelerator for

organic rubbers.

2) In the results of this survey, N-tert-butyl-2-benzothiazolesulfenamide was not detected in water and bottom sediments (unified detection limit:0.1 ppb for water and 0.0047 ppm for bottom sediments).

3) From the above survey results, it does not seem to pose any problems at present.

○ Survey results of N-tert-butyl-2-benzothiazolesulfenamide

		(sample)	(area)	detection range	detection limit
water	FY1998	0%(0/39)	0%(0/13)	not detected	0.1 ppb
bottom sediments	FY1998	0%(0/36)	0%(0/12)	not detected	0.0047 ppm

○Results of acute toxicity tests etc. for N-tert-butyl-2-benzothiazolesulfenamide

・ rat	LD50 (oral)	7,940 mg/kg
・ mouse	LD50 (oral)	5,000 mg/kg
	LD50 (subcutaneous)	180 mg/kg

⑲ N-Cyclohexyl-2-benzothiazolesulfenamide

1) N-Cyclohexyl-2-benzothiazolesulfenamide is used as a vulcanization accelerator for rubbers.

2) In the results of the fiscal year 1977 General Environmental Survey, N-cyclohexyl-2-benzothiazolesulfenamide was not detected in water and bottom sediments (detection limit: 0.02 to 0.08 ppb for water and 0.0023 to 0.02 ppm for bottom sediments).

3) In the results of this survey, N-cyclohexyl-2-benzothiazolesulfenamide was not detected in water and bottom sediments (unified detection limit:0.21 ppb for water and 0.01 ppm for bottom sediments).

4) From the above survey results, it does not seem to pose any problems at present.

○ Survey results of N-cyclohexyl-2-benzothiazolesulfenamide

		(sample)	(area)	detection range	detection limit
water	FY1977	0%(0/12)	0%(0/6)	not detected	0.02 to 0.08 ppb
	FY1998	0%(0/36)	0%(0/12)	not detected	0.21 ppb
bottom sediments	FY1977	0%(0/12)	0%(0/6)	not detected	0.0023 to 0.02ppm
	FY1998	0%(0/39)	0%(0/13)	not detected	0.01 ppm

○Results of acute toxicity tests etc. for N-cyclohexyl-2-benzothiazolesulfenamide

・ rat	LD50 (oral)	5,300 mg/kg
・ mouse	LD50 (oral)	>8,000 mg/kg
・ mouse	LD50 (subcutaneous)	32 mg/kg

⑳ N,N-Dicyclohexyl-2-benzothiazolesulfenamide

1) N,N-Dicyclohexyl-2-benzothiazolesulfenamide is used as a vulcanization accelerator for rubbers (estimated).

2) In the results of this survey, N,N-dicyclohexyl-2-benzothiazolesulfenamide was not detected in water and bottom sediments (unified detection limit:0.3 ppb for water and 0.01 ppm for bottom sediments).

3) From the above survey results, it does not seem to pose any problems at present.

○ Survey results of N,N-dicyclohexyl-2-benzothiazolesulfenamide

		(sample)	(area)	detection range	detection limit
water	FY1998	0%(0/39)	0%(0/13)	not detected	0.3 ppb
bottom sediments	FY1998	0%(0/39)	0%(0/13)	not detected	0.01 ppm

○Results of acute toxicity tests etc. for N,N-dicyclohexyl-2-benzothiazolesulfenamide

・ rat	LD50 (oral)	6,420 mg/kg

(21) Benzothiophene

1) Benzothiophene is used as a raw material for pharmaceuticals production and intermediates for thioindigo dyes.

2) In the results of this survey, benzothiophene was detected from 4 out of 12 areas (11 out of 36 samples) in bottom sediments and not detected in water and fishes. The detection range was 0.0023 to 0.023 ppm for bottom sediments(unified detection limit:0.05 ppb for water, 0.002 ppm for bottom sediments and 0.001 ppm for fishes).

3) From the above survey results, since the detection frequency of benzothiophene in bottom sediments is rather high, it is required to conduct environmental surveys at a certain interval and to endeavor to collect more detailed information.

○ Survey results of benzothiophene

		(sample)	(area)	detection range	detection limit
water	FY1998	0%(0/42)	0%(0/14)	not detected	0.05 ppb
bottom sediments	FY1998	31%(11/36)	33%(4/12)	0.0023 to 0.23 ppm	0.002 ppm
fishes	FY1998	0%(0/42)	0%(0/14)	not detected	0.001 ppm

○ Results of ecological effect tests for benzothiophene

・ Selenastrum capricornutum	10days EC50 (growth)	10,000 mg/l
・ Daphnia magna	48hr LC50	2.90 mg/l
	48hr LC50	59.0 mg/l
・ Artemia salina	48hr HAT(hatch inhibition)	10 mg/l
・ Poecilia reticurata	96hr LC50	13.6 mg/l

(22) Dibenzothiophene

1) Dibenzothiophene is used for intermediates of cosmetics and pharmaceuticals.

2) In the results of the fiscal year 1983 General Environmental Survey, dibenzothiophene was not detected in water and was detected from 2 out of 15 areas (6 out of 45 samples) in bottom sediments (detection limit: 0.05 to 0.1 ppb for water and 0.001 to 0.007 ppm for bottom sediments).

3) In the results of this survey, dibenzothiophene was detected from 10 out of 13 areas (28 out of 39 samples) in bottom sediments and from 5 out of 13 areas (15 out of 39 samples) in fishes and not detected in water. The detection range was 0.0022 to 0.14 ppm for bottom sediments and 0.00071 to 0.013 ppm for fishes (unified detection limit: 0.02 ppb for water, 0.0021 ppm for bottom sediments and 0.00034 ppm for fishes).

4) From the above survey results, dibenzothiophene was detected in bottom sediments and fishes and since the detection frequency is high for bottom sediments and rather high for fishes, it is required to conduct more detailed environmental surveys and to endeavor to collect information.

○ Survey results of dibenzothiophene

		(sample)	(area)	detection range	detection limit
water	FY1983	0%(0/45)	0%(0/15)	not detected	0.05 to 0.1 ppb
	FY1998	0%(0/42)	0%(0/14)	not detected	0.02 ppb
bottom sediments	FY1983	13%(6/45)	13%(2/15)	0.001 to 0.005 ppm	0.001 to 0.007ppm
	FY1998	72%(28/39)	77%(10/13)	0.0022 to 0.14ppm	0.0021 ppm

fishes	FY1998	38%(15/39)	38%(5/13)	0.00071 to 0.013ppm	0.00034 ppm

○Results of acute toxicity tests etc. for dibenzothiophene

・ mouse	LD50 (oral)	470 mg/kg
	LD50 (intraperitoneal)	>500 mg/kg

○ Results of ecological effect tests for dibenzothiophene

・ Selenastrum capricornutum	10days EC50 (growth)	8,000 mg/l
・ Daphnia magna	48hr LC50	0.466 mg/l
・ Artemia salina	48hr HAT(hatch inhibition)	10 mg/l
・ Poecilia reticurata	96hr LC50	0.70 mg/l

(23) nonionic surfactants

1) In the results of the fiscal year 1982 General Environmental Survey, nonionic surfactants were detected from 8 out of 24 areas (17 out of 72 samples) in water and was from 22 out of 24 areas (54 out of 72 samples) in bottom sediments (detection limit: 3 to 10 ppb for water and 0.1 to 0.2 ppm for bottom sediments).

2) In the results of this survey, nonionic surfactants were detected from 3 out of 15 areas (7 out of 45 samples) in water and from 10 out of 14 areas (29 out of 42 samples) in bottom sediments. The detection range was 3.5 to 22 ppb for water and 0.0086 to 12 ppm for bottom sediments (unified detection limit: 3 ppb for water and 0.082 ppm for bottom sediments).

3) From the above survey results, nonionic surfactants were detected in water and bottom sediments and since the detection frequency is high for bottom sediments, it is required to investigate to develop analytical methods for individual components and to conduct more detailed environmental surveys.

○ Survey results of nonionic surfactants

		(sample)	(area)	detection range	detection limit
water	FY1982	24%(17/72)	33%(8/24)	5 to 50 ppb	3 to 10 ppb
	FY1998	16%(7/45)	20%(3/15)	3.5 to 22 ppb	3 ppb
bottom sediments	FY1982	75%(54/72)	92%(22/24)	0.16 to 12.4 ppm	0.1 to 0.2ppm
	FY1998	69%(29/42)	71%(10/14)	0.0086 to 12ppm	0.082 ppm

【 major nonionic surfactants 】

< polyoxyethylene sorbitan aliphatic acid esters >

○Results of acute toxicity tests etc. for polyoxyethylene sorbitan aliphatic acid esters

・ rat	LD50 (oral)	>60 ml/kg
・ rat	LD50 (intraperitoneal)	7.5 ml/kg
・ mouse	LD50 (intraperitoneal)	6.3 ml/kg

・ In an experiment of 2 years oral administration to rats, increase in the weight of digestive tract and liver was observed. In a case of 95 weeks oral administration to mice, effects on blood system were observed. In experiments on carcinogenesis by skin application to rats (7 weeks) and mice (35weeks), tumorigenesis was observed at the place of application in both cases. In reproductive toxicity tests using rats and mice, effects on growth of newborns were observed.

＜ polyoxyethylene alkyl ethers ＞

○Results of acute toxicity tests etc. for polyoxyethylene alkyl ethers

・ Acute toxicity on mammalian is dependent on length of alkyl group and number of added oxyethylene molecules. LD50 (oral) for rat and mouse is not less than 1,000 mg /kg and LD50 (intraperitoneal) for rat is 125 to 250 mg/kg and LD50 (dermal) for rabbit is not less than 1,000mg/kg and LC50 (inhalation, 4hr) for rat is not less than 1,500 mg/m3. LC50 (96hr) for fishes depends on structure and sort of fishes but approximately in the range of 0.7 to 3 mg/l.

・ In a 91 days experiment where rats were fed by foods to which $C_{13}AE_6$ (This means that the number of carbon atoms in the alkyl group is 13 and the number of added mols of oxyethylene is 6., the same hereinafter) is added at the concentration of 0, 5, 50, 500 ppm, no appreciable changes were observed except slight change in seminiferous tubuli at 500 ppm dose administration(The reporter judges this independent of the exposure.) and for the cases of $C_{13}AE_6$ and $C_{14}AE_7$ at the concentration of 0, 0.1, 0.5 and 1.0% of foods, suppression of body weight increase and increase in relative weight of liver, etc. were observed for 0.5% dose group and 1.0% dose group. On the other hand no appreciable changes were observed in the case where rats were bred with foods containing max. ca. 2% of $C_{12}AE_7$. In a case of dermal application of $C_{13}AE_6$ for 4 to 13 weeks at 20 to 50 mg /kg/day rate, irritation to skin and death of sepsis due to infection were observed for rabbits. No carcinogenesis was observed in the following experiments: repeated dermal application of 50% aqueous solution of the substance to mice 2 times a week for 1 year; dermal application of 5 and 20% solution of the substance to rats 2 times a week for 18 months; ingestion of $C_{14\text{-}15}AE_7$ at the concentration of 0, 0.1, 0.5, 1.0% in foods to rats for 2 years.

・ It is negative in Ames test and no teratogenicity was observed in an experiment of dermal application of 4% solution at the rate of 0.05 ml/10 g mouse once a day on the 7th through 12th days of pregnancy.

○ Results of ecological effect tests for polyoxyethylene alkyl ethers

・ 24hr LC50 for fishes are approximately in the range of 1 to 6 ppm. (There are exceptions, e.g. for Poecilia reticurata 0.7 ppm and cod >0.5 ppm.)

・ On 50% inhibition concentration for growth of algae there are reports of 38, 52 and 56 ppm and on lethal concentration of algae there is a report of 100 ppm.

＜ polyoxyethylene alkylamids ＞

＜ polyoxyethylene alkylamines ＞

＜ polyoxyethylene alkylphenylethers＞

○Results of acute toxicity tests etc. for polyoxyethylene alkylphenylethers

・ LD50(oral) for rat is minimum (LD50 = 1 to 3 g/kg) at the number of oxyethylene of approximately 10 and increases some 10 times at about 40 of the number of oxyethylene. Toxicity (dermal) on rabbit is 1 to 10 g/kg in a case where number of oxyethylene lies in 5 to 12. Irritancy to rabbit skin is moderate to medium. A threshold concentration of a substance having 1 to 13 number of oxyethylene on irritancy to rats eye mucous membrane was 15%.

・In a 2 years experiment of rats fed by foods containing 1.4% of polyoxyethylene(40) octylphenylether, no toxicity and carcinogenicity were observed. It is reported that in 2 years experiments of rats and dogs fed by foods containing 0.27% of polyoxyethylene(4) nonylphenylether, no toxicity and carcinogenicity were observed.

○ Results of ecological effect tests for polyoxyethylene alkylphenyl ethers

・ LC50 for fishes are largely in the range of 4 to 12 ppm. Brown trout is the most sensitive and 96hr LC50 is 1 ppm and the least sensitive was himehaya at 65 ppm. Planktons in sea was inhibited at 10 to 1000 ppm.

(24) Phenol

1) Phenol is used as a raw material for bisphenol A, aniline, 2,6- xylenol, phenolic resins (phenol formaldehyde resin), disinfectants, dental local anesthetics, picric acid, salicylic acid, phenacetin, dyestuff intermediates, 2,4-dichloro-phenoxyacetic acid(2,4-DA) , synthetic fragrances, agricultural chemicals, stabilizers, plasticizers and surfactants. The production volume in 1997 was 832,731 tons.

2) In the fiscal year 1977 General Environmental Survey, phenol was not detected in water and was detected from 1 out of 3 areas (3 out of 9 samples) in bottom sediments (detection limit: 0.2 to 10 ppb for water and 0.01 to 0.1 ppm for bottom sediments). And in FY 1996, it was detected from 34 out of 46 areas (76 out of 136 samples) in water and from 45 out of 49

areas (110 out of 129 samples) in bottom sediments and from 27 out of 45 areas (63 out of 133 samples) in fishes (unified detection limit: 0.03 ppb for water, 0.0054 ppm for bottom sediments and 0.02 ppm for fishes).

3) In the results of this survey, phenol was detected from 5 out of 10 areas (15 out of 30 samples) in water, from 8 out of 10 areas (23 out of 29 samples) in bottom sediments and from 8 out of 11 areas (16 out of 30 samples) in fishes. The detection range was 0.066 to 0.70 ppb for water, 0.012 to 0.50ppm for bottom sediments and 0.024 to 0.062 ppm for fishes (unified detection limit: 0.03 ppb for water, 0.0054 ppm for bottom sediments and 0.02 ppm for fishes).

4) From the above survey results, phenol was detected in all media of water, bottom sediments and fishes, and detection frequency is high and since the tendency is similar to the previous FY1996 survey, it is required to conduct detailed environmental surveys in future and at the same time risk assessment.

○ Survey results of phenol

		(sample)	(area)	detection range	detection limit
water	FY1977	0%(0/9)	0%(0/3)	not detected	0.2 to 10 ppb
	FY1996	56%(76/136)	74%(34/46)	0.030 to 1.47ppb	0.03 ppb
	FY1998	50%(15/30)	50%(5/10)	0.066 to 0.70 ppb	0.03 ppb
bottom sediments	FY1977	33%(3/9)	33%(1/3)	0.03 to 0.04ppm	0.01 to 0.01ppm
	FY1996	85%(110/129)	92%(45/49)	0.0055 to 0.94ppm	0.0054 ppm
	FY1998	79%(23/29)	80%(8/10)	0.012 to 0.50ppm	0.0054 ppm
fishes	FY1996	47%(63/133)	60%(27/45)	0.020 to 0.586ppm	0.02 ppm
	FY1998	53%(16/30)	73%(8/11)	0.024 to 0.062 ppm	0.02 ppm

○Results of acute toxicity tests etc. for phenol

・ rat	LD50 (oral)	317 mg/kg
	LD50 (dermal)	669 mg/kg
	LC50 (inhalation)	316 mg/m3×time not known
・ mouse	LD50 (oral)	270 mg/kg
	LC50 (inhalation)	177 mg/m3×time not known

・ Irritancy on rabbit skin is strong.

・ There is a report that states minimum oral lethal level for human (infant) is 10 mg/kg and that for human adult is 140 mg/kg. If contacted with skin, local damage is strong and various phases ranging from inflammation to necrosis is observed.

According to an experience with human, no irritancy and other unpleasant sensation were observed for volunteers and workers at 5.2 ppm level.

・ Tumorigenicity: In an experiment where B6C3F$_1$ mice and Fischer344 rats are bred for 104 to 105 weeks, with drinking water to which phenol is added at 0, 2,500, 5,000 mg/l concentration, tumorigenicity was not observed for mice. But for the rats and only at 2,500mg/l dose, tendency of rise in pheocromocytoma on adrenal cortex, leukemia and C-cell cancer on thyloid.

・ Mutagenicity: Negative in Ames test. Negative in micronucleus test using CHO cells.

○ Results of ecological effect tests for phenol

・ fresh water fish	96hr LC50 (min. value)	1.6 ppm
・ marine fish	96hr LC50	10 ppm
・ fresh water crustacea	96hr LC50	4.0 to 230 ppm
・ fresh water shellfish	96hr LC50	69 to 129 ppm
・ Oryzias latipes (fresh water)	96hr LC50	38.8 ppm

(2) Air

The summary of each detected substance in air is as follows.

① Methyl bromide

1) Methyl bromide is used as a fumigant for foods and soil and a feedstock in organic syntheses.

2) In the results of the fiscal year 1980 General Environmental Survey, Methyl bromide was detected at 3 out of 6 areas and in 5 out of 27 samples(detection limit: 0.015 to 0.1 ppb).

3) In the results of this survey, methyl bromide was detected at 13 out of 14 areas and in 36 out of 39 samples, and the detection range was 49 to 340 ng/m3 (unified detection limit: 41 ng/m3).

4) From the above survey results, detection frequency of methyl bromide is high and since there is a tendency of increase in comparison with the previous survey of 1980, it is required to conduct more detailed environmental survey in future and to observe the change and at the same time to make risk assessment.

○ Survey results of methyl bromide

	(samples)	(areas)	detection range	detection limit
FY1980	19%(5/27)	50%(3/6)	0.015 to 0.031 ppb (59 to 122 ng/m3)	0.015 to 0.1 ppb (59 to 395 ng/m3)
FY1998	92%(36/39)	93%(13/14)	49 to 340 ng/m3	41 ng/m3

○Results of acute toxicity tests etc. for methyl bromide

・ human	TDLo (inhalation)	35 ppm
	TDLo (dermal)	35 g/m3/40months
・ rat	LD50 (oral)	214 mg/kg
	LC50 (inhalation)	302 ppm/8hr
・ rabbit	LC50 (inhalation)	2,000 mg/m3/11hr
・ mouse	LC50 (inhalation)	1,540 mg/m3/2hr

・ Target of toxicity is summarized in irritancy to skin and respiratory organs, and effect on central nervous system, and renal damage.

・ Case history: In a case of a worker exposed during ventilation work after housing fumigation, vomiting and feeling of asphyxia was observed during the work. During medical attendance in hospital, epilepsy like spasm was observed. For several of colleagues of him, ataxia or convulsion in four limbs or whole body were observed on the day of exposure or the

following day.

② Ethyl bromide

1) Ethyl bromide is used as a raw material for pharmaceuticals, stabilizers of polyvinyl chloride, agricultural chemicals, refrigerant. The production volume in 1997 was 100 tons (estimated).

2) In the results of the fiscal year 1983 General Environmental Survey, Ethyl bromide was detected at 5 out of 34 areas and in 15 out of 101 samples (detection limit: 0.001 to 0.017 ppb) and in FY1997 at 3 out of 10 areas and in 5 out of 30 samples. The detection range was 5.9 to 53 ng/m3 (unified detection limit: 5.4 ng/m3).

3) In the results of this survey, ethyl bromide was not detected (unified detection limit: 40 ng/m3).

4) From the above survey results, it does not seem to pose any problems at present.

○ Survey results of ethyl bromide

	(samples)	(areas)	detection range	detection limit
FY1983	15%(15/101)	15%(5/34)	0.002 to 0.059 ppb (9.1 to 268 ng/m3)	0.001 to 0.017 ppb (4.5 to 77 ng/m3)
FY1997	17%(5/30)	30%(3/10)	5.9 to 53 ng/m3	5.4 ng/m3
FY1998	0%(0/36)	0%(0/12)	not detected	40 ng/m3

○ Results of acute toxicity tests etc. for ethyl bromide

・ rat LC50 (inhalation) 26,980 ppm×1hr
・ mouse LC50 (inhalation) 16,230 ppm×2hr

・ At higher concentration there is an influence of suppression in central nervous system and exposure of guinea pigs at 6,500 ppm for 270 min. produced death and exposure at 24,000 ppm for 30 min. brought death and pathophysiological changes in lung and spleen.
Exposure at 50,000 ppm for 100 min. brought loss of consciousness.

・ Reproductive toxicity: In an 14 weeks repeated dose experiment on rats and mice at 100 to 1,600 ppm and 6 hours a day and 5 days a week, there were observations of strong testicular atrophy in the 1,600 ppm dose group of rats and lowering of size and number of corpus luteum in the 800 ppm and 1,600 ppm dose groups of mice.

・ Tumorigenicity: In an 104 weeks repeated dose experiment on $B6C3F_1$ mice and Fischer 344 rats at 0, 100, 200, 400 ppm and 6 hours a day and 5 days for 104 weeks, tumorigeneses at endometrium rose depending on the concentration in mice. Although tumorigeneses at

liver were observed in males, its statistical significance was marginal. Although a rise in geneses of pheochromocytoma was observed in male rats, there was no dose dependence.

・ Mutagenicity: Positive in Ames test. Positive in sister chromatid exchange test using Chinese hamster CHO cells. But negative in chromosomal abberation test.

・ Case history: When exposed at 6,500 ppm for 5 min., dizziness, slight headache and slight irritancy at eyes were observed. At 200 ppm concentration, ether-like odor was sensed.

③ vinyl chloride

1) Vinyl chloride is used for manufacturing of polyvinyl chloride resin, vinyl chloride copolymers (with ethylene, vinylidene chloride, vinyl propionate, etc.) and latices (ordinally paints, ship bottom paints, paper glazing agents, adhesives, moisture proof cellophane etc.). The production / importation volume in 1997 was 3,124,222 tons.

2) In the results of the fiscal year 1979 General Environmental Survey, vinyl chloride was detected in 3 out of 17 areas and 7 out of 45 samples (detection limit: 0.002 to 2 ppb), and in FY 1980 it was detected in 3 out of 22 areas and 10 out of 117 samples (detection limit: 0.02 to 2 ppb), and in FY 1997 it was detected in 15 out of 18 areas and 40 out of 53 samples (unified detection limit: 15ng/m3).

3) In the results of this survey, vinyl chloride was detected in 12 out of 13 areas and 31 out of 36 samples, and the detection range was 16 to 1,300 ng/m3 (unified detection limit: 14 ng/m3).

4) From the above survey results, the detection frequency was high for vinyl chloride, and since the level of detected concentration remains at the same level as in the previous surveys,
it is required to conduct detailed surveys including the surroundings of discharge sources and to observe its change and to make risk assessment at the same time.

○ Survey results of vinyl chloride

	(samples)	(areas)	detection range	detection limit
FY1979	16%(7/45)	19%(3/17)	0.022 to 4.0 ppb (57 to 10,400 ng/m3)	0.002 to 2 ppb (5.2 to 5,200 ng/m3)
FY1980	16%(10/117)	9%(3/22)	0.02 to 1.35 ppb (52 to 3,510 ng/m3)	0.02 to 2 ppb (52 to 5,200 ng/m3)
FY1997	75%(40/53)	83%(15/18)	18 to 2,000 ng/m3	15 ng/m3
FY1998	86%(31/36)	92%(12/13)	16 to 1,300 ng/m3	14 ng/m3

○ Results of acute toxicity tests etc. for vinyl chloride

・ rat LD50 (inhalation) 18,000 mg/kg

・ Reproductive toxicity: It is suggested that mortality rate of fetuses rises, when its fathers are exposed with vinyl chloride at workplaces. However, this is not yet conclusive in teratogenicity experiments using animals.

・ Tumorigenicity: All positive in animal experiments using rats, mice and hamsters. Reported sorts of tumors are hepatocellular carcinoma, Zymbal gland carcinoma and neuroblastoma etc., other than hemangioma of liver.

・ Case history: It is internationally known that workplace exposure to vinyl chloride develops hemangioma, tipically for workers cleaning polymerization vessels, and the cases were reported from Japan, too. The latent period in average is estimated to be 18 years.

④ 1,2-Dibromoethane

1) In the results of the fiscal year 1983 General Environmental Survey, 1,2-dibromoethane was detected in 10 out of 12 areas and 71 out of 108 samples (detection limit: 0.0003 to 0.001 ppb), and in FY 1997 it was not detected (unified detection limit: 90 ng/m3).

2) In the results of this survey, 1,2-dibromoethane was not detected (unified detection limit: 71 ng/m3).

3) From the above survey results, 1,2-dibromoethane does not seem to pose any problems at present.

○ Survey results of 1,2-dibromoethane

	(samples)	(areas)	detection range	detection limit
FY1983	66%(71/108)	83%(10/12)	0.001 to 0.067 ppb (7.8 to 524 ng/m3)	0.0003 to 0.001 ppb (2.3 to 7.8 ng/m3)
FY1997	0%(0/57)	0%(0/19)	not detected	90 ng/m3
FY1998	0%(0/39)	0%(0/13)	not detected	71 ng/m3

○ Results of acute toxicity tests etc. for 1,2-dibromoethane

・ rat LD50 (oral) 108 mg/kg

LC50 (inhalation) 4,300 mg/m3×30min

・ In repeated vapor exposure experiments using animals, there were cases observed where exposure to rats, Guinea pigs, rabbits and monkeys at 50 to 100 ppm for several days caused fatty degeneration of liver and renal damage leading to death. Nontoxic concentration was 25 ppm (max.200 days repeated dose test) for Guinea pigs, rabbits and monkeys.

・ Tumorigenicity: In experiments of exposure to male and female rats at about 40 mg/kg/day

for 110 weeks and to male and female mice at 62 mg/kg/day and 107 mg/kg/day for 78 to 90 weeks, rise in incidence of squamous cell carcinoma at proventriculus for all groups and of lung cancer additionally for mice. And thus carcinogenicity was confirmed.

・ Reproductive toxicity: Administration of 4 mg/kg/day repeated administration to oxen developed disturbance in sperm formation. In an experiment of subcutaneous administration to male rabbits at 0, 15, 30 and 45 mg/kg/day for 5 days, ejaculation volume decreased depending on doses and for the 45 mg/kg dose lowering of sperm movement was confirmed. But there were no changes in capability to impregnate and in development of fetuses.

・ Mutagenicity: Positive in Ames test.

⑤ 2-Bromopropaane

1) 2-Bromopropane is used for intermediates of pharmaceuticals, agricultural chemicals, photosensitive agents and for various organic syntheses and for solvents. The production volume in 1997 was 100 tons (estimated).

2) In the results of the fiscal year 1997 General Environmental Survey, 2-bromopropane was not detected (unified detection limit: 200 ng/m3).

3) In the results of this survey, 2-bromopropane was not detected (unified detection limit:170 ng/m3).

4) From the above survey results, 2-bromopropane does not seem to pose any problems at present.

○ Survey results of 2-bromopropane

	(samples)	(areas)	detection range	detection limit
FY1997	0%(0/57)	0%(0/19)	not detected	200 ng/m3
FY1998	0%(0/39)	0%(0/13)	not detected	170 ng/m3

○ Results of acute toxicity tests etc. for 2-bromopropane

・ mouse LC50 (inhalation) 31,171 ppm×4 hr

・ Reproductive toxicity: In a repeated dose experiment on male rats at 300, 1,000 and 3,000 ppm and 8hr/day and 7 days a week for 9 weeks (max. up to 11 weeks for 3,000 ppm group), inhibition of sperm formation and lowering of hemopoietic function at bone marrow were observed. In another repeated dose experiment on female rats at 100, 300 and 1,000 ppm and 8 hr/day and 7 days a week for 9 weeks, disturbance in sexual cycle (prolonged anestrus etc.) developed and at ovary, increase in follicular atresia and decrease in number of corpus luteums were observed.

・ Mutagenicity: Positive independent of addition of S9-mix for the strains of TA100 and TA1535. Negative in chromosomal abberation test and micronucleus test.
・ Case history: It is reported that in Summer of 1995 there was a high incidence of irregularity of menstruation in female workers who had started cleaning work of parts using the substance in February 1994. The total number of workers (age of 19 to 49) were 25 women and 8 men and through subjective symptoms and clinical investigations ovary disfunction was observed for 17 women and oligozoospermia for 6 men, among the workers. In view of this, Japanese Ministry of Labor requested end of 1995 the manufacturers of 2-bromopropane and other related industries to take necessary measures for prevention of the health impairment.

⑥ 1-Chlorobutane

1) 1-Chlorobutane is used for organometallic compounds intermediates,manufacturing of pharmaceuticals, alkyl amines, surfactants, alkyl sodium sulfonates, stabilizers for polyvinyl chloride resin, butyl mercaptan, vermicides.

2) In the results of the fiscal year 1997 General Environmental Survey, 1-chlorobutane was detected in 1 out of 19 areas and 2 out of 57 samples (unified detection limit: 200 ng/m3).

3) In the results of this survey, 1-chlorobutane was detected in 9 out of 13 areas and 19 out of 37 samples, and the detection range was 38 to 1,400 ng/m3 (unified detection limit: 37 ng/m3).

4) From the above survey results, the level of detection concentration of 1-chlorobutane is not the one which poses problems but since its detection frequency is high, it is required to conduct environmental surveys at a certain interval in future.

○ Survey results of 1-chlorobutane

	(samples)	(areas)	detection range	detection limit
FY1997	4%(2/57)	5%(1/19)	21 to 290 ng/m3	200 ng/m3
FY1998	51%(19/37)	69%(9/13)	38 to 1,400 ng/m3	37 ng/m3

○ Results of acute toxicity tests etc. for 2-bromopropane
・ rat LD50 (oral) 2,670 mg/kg
・ Instillation of 500 mg to an eye of rabbits shows slight irritancy. And irritancy when 500 mg are applied to skin of rabbits is slight.

⑦ 3,4-Dichloro-1-butane

1) In the results of the fiscal year 1997 General Environmental Survey, 3,4-dichloro-1-butane was not detected (unified detection limit: 60 ng/m3).

2) In the results of this survey, 3,4-dichloro-1-butane was detected in 1 out of 12 areas and 1 out of 36 samples, and the value detected was 80 ng/m3 (unified detection limit: 60 ng/m3).

3) From the above survey results, detection frequency for 3,4-dichloro-1-butane is low and at present it does not seem to pose any problems.

○ Survey results of 3,4-dichloro-1-butane

	(samples)	(areas)	detection range	detection limit
FY1997	0%(0/57)	0%(0/19)	not detected	60 ng/m3
FY1998	3%(1/36)	8%(1/12)	80 ng/m3	60 ng/m3

○ Results of acute toxicity tests etc. for 3,4-dichloro-1-butane

・ rat LC50 (inhalation) 2,100 ppm×4hr

⑧ Toluene

1) Toluene is used for dyestuffs, fragrances, powders (TNT), organic pigments, cresols, sweeteners, bleaching agents, TDI (raw material of polyurethenes), raw material of terephtharic acid, raw material of benzene and xylenes (disproportionation method), paints, solvents for inks. The production volume for 1997 was 1,418,694 tons (derived from petroleum).

2) In the results of this survey, toluene was detected in 14 out of 14 areas and 42 out of 42 samples, and the detection range was 1,100 to 85,000 ng/m3 (unified detection limit: 80 ng/m3).

3) From the above survey results, since the detection frequency of toluene is high and the level of detection concentration is relatively high, it is required to conduct environmental surveys in future and to observe the change and to make risk assessment at the same time.

○ Survey results of toluene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(42/42)	100%(14/14)	1,100 to 85,000 ng/m3	80 ng/m3

○ Results of acute toxicity tests etc. for toluene

・ human	LDLo (oral)	25 mg/kg
	LDLo (inhalation)	100 ppm
・ rat	LD50 (oral)	636 mg/kg
	LDLo (inhalation)	49 g/m3/4hr
・ mouse	LC50 (inhalation)	400 ppm

・ Toluene influences on central nervous system and has stimulating action at low concentration and depressing action at high concentration.

・ Toluene has no mutagenicity and no carcinogenicity is observed.

・ Case history: Although toluene is one of the most widely used solvents in industries, it is mostly used as mixed solvents and thus cases of exposure with toluene alone are rare. Symptoms mostly seen in workers handling organic solvents are headache, malaise in lower limbs etc. and subjective symptoms of workers who had been engaged in manufacturing of inks, paints and painting with them (concentration of toluene : 100 to 2,300 ppm) and who visited university hospitals were headache, vomiting, dizziness, palpitation etc. and other than these several cases of abnormal sensation in four limbs were observed. In a case of a housewife who had been engaged in painting as a private occupation and exposed with extremely high concentration of a mixed solvent the main component of which is toluene, the symptom was very severe beginning from malaise in the whole body, amnesia and vomiting. After 3 months of further work, degree of headache, coxalgia and choking became increased and electroencephalogram during hyperventilation showed a high tension slow wave group and a sharp wave. When the work was continued for further 3 months, the electroencephalogram even at rest began to show minor slow waves and the subjective symptoms became stronger. Within 7 months after stopping the work, the subjective symptoms and the abnormal electroencephalogram almost disappeared. In these periods no significant changes were observed in hemogram and liver function test results.

⑨ Chlorobenzene

1) Chlorobenzene is used for intermediates for dyestuffs, phenol and aniline, and solvent for paints and lacquers, raw materials for pharmaceuticals and fragrances, solvent for ethyl cellulose, heat transfer medium. The production volume in 1997 was 27,203 tons.

2) In the results of the fiscal year 1983 General Environmental Survey, chlorobenzene was detected in 12 out of 12 areas and 91 out of 91 samples (unified detection limit: 0.001 ppb).

3) In the results of this survey, chlorobenzene was detected in 10 out of 11 areas and 24 out of 32 samples, and the detection range was 20 to 160 ng/m3 (unified detection limit: 20 ng/m3).

4) From the above survey results, although the concentration level of chlorobenzene detected is not so high as to pose immediate problems, since the detection frequency is high, it is required in future to conduct environmental survey at a certain interval.

○ Survey results of chlorobenzene

	(samples)	(areas)	detection range	detection limit
FY1983	100%(91/91)	100%(12/12)	0.001 to 0.022 ppb (4.7 to 103 ng/m3)	0.001 ppb (4.7 ng/m3)
FY1998	75%(24/32)	91%(10/11)	20 to 160 ng/m3	20 ng/m3

○ Results of acute toxicity tests etc. for chlorobenzene

・ rat	LD50 (oral)	1,100 mg/kg
・ mouse	LD50 (oral)	2,300 mg/kg
・ rabbit	LD50 (oral)	2,250 mg/kg

・When applied to skin, only medium grade erythema and slight necrosis of epithelium were observed even in continuous contact for a week. For eyes, it causes pain and slight fugitive symptom of irritation in conjunctiva.

・ Major symptoms are depression of central nervous system and anesthetic influence.

・ Nontoxic value (NOAEL) for dog in 13 weeks repeated oral administration for 5 days a week was 19 mg/kg/day, and the same for rat for 13 weeks was 250 mg/kg/day and for 2 years was 120 mg/kg/day. In each case target organ was liver and centrilobular hepatocellular disorder and necrosis was observed.

・ Mutagenicity: Negative in tests using TA98, TA100 and TA1537 strains, regardless of addition of S9-Mix.

⑩ o-Xylene

1) 0-Xylene is used for a raw material in organic syntheses. The production volume in 1997 was 212,355 tons.

2) In the results of this survey, o-xylene was detected in 14 out of 14 areas and 42 out of 42 samples, and the detection range was 330 to 9,500 ng/m3 (unified detection limit: 60 ng/m3).

3) From the above survey results, although the concentration level of o-xylene detected is not so high as to pose immediate problems, since the detection frequency and the production volume is high, it is required in future to conduct environmental survey at a certain interval and to endeavor to collect information.

○ Survey results of o-xylene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(42/42)	100%(14/14)	330 to 9,500 ng/m3	60 ng/m3

○ Results of acute toxicity tests etc. for o-xylene

・ human	LCLo (inhalation)	6,125 ppm/12hr
・ rat	LDLo (oral)	5,000 mg/kg
	LCLo (inhalation)	6,125 ppm/12 hr
・ mouse	LD50 (oral)	30,000 mg/kg
	LD50 (intraperitoneal)	1,550 μl/kg

・Toxicity of o-xylene is considered to be substantially not different from those of other isomers and their mixtures. Although acute toxicity in experimental animals is relatively week, in human there is a report of death caused by exposure at high concentration. In take in body via oral and inhalation routes is high and it mainly causes depression in central nervous system, and exposure with large volume or in long term causes functional disorder in liver and kidney. Furthermore, it has irritancy against eyes, upper respiratory tract and skin, and dermatitis is developed by repeated and prolonged contact. For both human and animals, it has capability of placental transmission and there are reports that fetotoxicity and teratogenicity are observed in experimental animals. For human, although correlation between exposure during pregnancy and congenital malformation is suspected, many of the cases are by mixed exposure with various solvents and thus teratogenicity of xylenes is not clear.

・ Xylenes are not mutagenic and there is a report that xylenes are negative in animal carcinogenicity experiments using rats and mice. For human, although there is a report of epidemiological study which shows occurrence of marignant tumor in hematopoietic organs increases with exposure with xylenes, data suggesting correlation between the exposure and carcinogenesis are not sufficient, accordingly IARC classified this into Group 3.

・Case history: Since xylenes are used generally as a component of solvent mixture, poisoning cases of xylenes themselves is rare. In an indoor painting work in a narrow space using 90% xylene containing solvent, 1 out of 3 workers who had been exposed at such a high concentration as 10,000 ppm (estimated) died and the other two lost consciousness. Through oxygen inhalation the two recovered the consciousness after several hours, however, memories just before the loss of consciousness had been lost for both of them. For the case of death, the autopsy report described congestion, edema and interstitial concealed hemorrhage in lung, congestion and cytopathy in liver, minute hemorrhage and cytopathy due to oxygen deficiency in brain alba and cinerea.

⑪ m-Xylene + p-Xylene

1) m-Xylene is used for a raw material in organic syntheses, a raw material for

xylene-formaldehyde resin and solvent. p-Xylene is used as a raw material for organic syntheses and solvent. The production volume in 1997 was 2,927,704 tons (p-isomer).

2) In the results of this survey, m-xylene + p-xylene was detected in 14 out of 14 areas and 42 out of 42 samples, and the detection range was 550 to 35,000 ng/m3 (unified detection limit: 100 ng/m3).

3) From the above survey results, although the concentration level of m-xylene + p-xylene detected is not so high as to pose immediate problems, since the detection frequency and the production volume is high, it is required in future to conduct environmental survey at a certain interval and to endeavor to collect information.

○ Survey results of m-xylene + p-xylene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(42/42)	100%(14/14)	550 to 35,000 ng/m3	100 ng/m3

○ Results of acute toxicity tests etc. for m-xylene

・ human	LCLo (inhalation)	424 mg/m3/6hr/6days
・ rat	LCLo (inhalation)	8,000 ppm/4hr
	LD50 (oral)	5,000 mg/kg
・ mouse	LC50 (inhalation)	2,010 ppm/24h

・Toxicity of m-xylene is considered to be substantially not different from those of other isomers and their mixtures. Although acute toxicity in experimental animals is relatively week, in human there is a report of death caused by exposure at high concentration. In take in body via oral and inhalation routes is high and it mainly causes depression in central nervous system, and exposure with large volume or in long term causes functional disorder in liver and kidney. Furthermore, it has irritancy against eyes, upper respiratory tract and skin, and dermatitis is developed by repeated and prolonged contact. For both human and animals, it has capability of placental transmission and there are reports that fetotoxicity and teratogenicity are observed in experimental animals. For human, although correlation between exposure during pregnancy and congenital malformation is suspected, many of the cases are by mixed exposure with various solvents and thus teratogenicity of xylenes is not clear.

・ Xylenes are not mutagenic and there is a report that xylenes are negative in animal carcinogenicity experiments using rats and mice. For human, although there is a report of epidemiological study which shows occurrence of marignant tumor in hematopoietic organs increases with exposure with xylenes, data suggesting correlation between the exposure and carcinogenesis are not sufficient, accordingly IARC classified this into Group 3.

・case history: Since xylenes are used generally as a component of solvent mixture, poisoning

cases of xylenes themselves is rare. In an indoor painting work in a narrow space using 90% xylene containing solvent, 1 out of 3 workers who had been exposed at such a high concentration as 10,000 ppm (estimated) died and the other two lost consciousness. Through oxygen inhalation the two recovered the consciousness after several hours, however, memories just before the loss of consciousness had been lost for both of them. For the case of death, the autopsy report described congestion, edema and interstitial concealed hemorrhage in lung, congestion and cytopathy in liver, minute hemorrhage and cytopathy due to oxygen deficiency in brain alba and cinerea.

○ Results of acute toxicity tests etc. for p-xylene

・ rat	LD50 (oral)	5,000 mg/kg
	LC50 (inhalation)	4,550 ppm/4hr
	LD50 (intraperitoneal)	3,810 mg/kg
・ mouse	LC50 (inhalation)	15,000 mg/m3
	LD50 (intraperitoneal)	2,400 μg/kg

⑫ Styrene

1) Styrene is used for polystyrene, synthetic rubbers, unsaturated polyester resins, AS resins, ABS resins, ion exchange resins emulsions, synthetic resin colorants. The importation/production volume in 1997 was 3,102,667 tons.

2) In the results of this survey, styrene was detected in 14 out of 14 areas and 42 out of 42 samples, and the detection range was 39 to 2,700 ng/m3 (unified detection limit: 33 ng/m3).

3) From the above survey results, although the concentration level of styrene detected is not so high as to pose immediate problems, since the detection frequency and the production volume is high, it is required in future to conduct environmental survey at a certain interval and to endeavor to collect information.

○ Survey results of styrene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(42/42)	100%(14/14)	39 to 2,700 ng/m3	33 ng/m3

○ Results of acute toxicity tests etc. for styrene

・ rat	LD50 (oral)	2,650 mg/kg
	LD50 (inhalation)	12 g/m3/4hr
・ mouse	LD50 (oral)	316 mg/kg

・ Instillation of 100 mg to eye of rabbits shows strong irritancy.

・ In 78 weeks experiments on Fischer 344 rats (doses: 500, 1,000, 2,000 mg/kg) (103 weeks for the low dose group) using stomach tube and on $B6C3F_1$ mice (doses: 150, 300 mg/kg) by oral administration, incidence rate of broncogenic carcinoma and pulmonary adenoma rose for male mice depending on doses, however no conclusion was reached on tumorigenicity when compared with the historical control. Taking into consideration of the findings on male mice and male and female rats also, it was concluded that from the experiments no evidence for tumorigenicity was obtained.
・ Mutagenicity: Negative in Ames tests (TA98, TA100, TA1535, TA1537, TA1538 strains). Negative in Chinese hamster tests (CHL, S9-Mix added).

⑬ Dichloromethane

1) Dichloromethane is used for paint remover, print board cleaner, metal degreasing agent, polyurethene blowing agent, aerosol propellant, low boiling solvents (flame resistant film, oil solution, resins, rubbers, wax, and blending materials for cellulose esters/ethers), reaction solvent for polycarbonate, coolant, lacquers, extraction for analysis of textiles, leathers, abd fragrances), linoleum, ink. The importation/production volume in 1997 was 109,881 tons.

2) In the survey of the fiscal year 1979 General Environmental Survey, dichloromethane was detected in 10 out of 17 areas and 25 out of 46 samples (detection limit: 0.006 to 10 ppb), and in FY 1980 it was detected in 18 out of 44 areas and 47 out of 135 samples (detection limit: 0.005 to 8 ppb), and in FY 1983 it was detected in 12 out of 12 areas and 99 out of 101 samples (detection limit: 0.001 to 0.01 ppb).

3) In the results of this survey, dichloromethane was detected in 14 out of 14 areas and 42 out of 42 samples and the detection range was 280 to 24,000 ng/m3 (unified detection limit: 70 ng/m3).

4) From the above survey results, detection frequency of dichloromethane is high and since the concentration level detected tends to rise compared with the previous survey results, it is required to conduct detailed environmental survey including surroundings of discharge sources and to observe the change and to make risk assessment at the same time.

○ Survey results of dichloromethane

	(samples)	(areas)	detection range	detection limit
FY1979	54%(25/46)	59%(10/17)	0.07 to 1.5 ppb (247 to 5,300 ng/m3)	0.006 to 10 ppb (21.2 to 35,300 ng/m3)
FY1980	35%(47/135)	41%(18/44)	0.026 to 0.8 ppb (92 to 2,830 ng/m3)	0.005 to 8 ppb (17.7 to 28,300 ng/m3)

FY1983	98%(99/101)	100%(12/12)	0.001 to 0.01 ppb (3.5 to 35 ng/m3)	0.002 to 5.6 ppb (7.1 to 19,800 ng/m3)
FY1998	100%(42/42)	100%(14/14)	280 to 24,000 ng/m3	70 ng/m3

○ Results of acute toxicity tests etc. for dihloromethane

・ human	LDLo (oral)	375 mg/kg
	TCLo (inhalation)	550 ppm/ 1year
	TCLo (inhalation)	500 ppm/8hr
・ rat	LD50 (oral)	1,600 mg/kg
	LC50 (inhalation)	52,000 ppm/m3
・ rabbit	LD50 (oral)	1,900 mg/kg
・ mouse	LD50 (intraperitoneal)	437 mg/kg

・ In an irritation test at 490 to 500 ppm, it caused slight irritanncy such as irritative reaction, cornea thickening, rise of intraocular pressure.

・ As for repeated dose animal experiments, effects on liver (centrilobular fatty change) by oral administration, and effects on liver by inhalation (fatty infiltration, liver weight increase, centrilobular edematous change), effects on immune system (fiblosation of rat spleen, atrophia of dog spleen) and effects on central nervous system (lowering of enzyme level of cerebellum for rat) were reported.

・ Mutagenicity: In many test systems it was reported as negative. But in vivo tests there were reports that inhalation of mice with higher than 4,000 ppm concentration for 10 days induced significantly sister cromatid exchange in pulmonary cells and peripheral blood, chromosomal abberation in pulmonary cells, and chromosomal abberation in bone marrow cells.

・ Reproductive toxicity: In experiments exposing mice and rats with 1,250 ppm, increase in abnormality in bone structure such as delay in sternum formation and condyloid sternum. In experiments exposing rats with 4,500 ppm, increase in liver weight of mother animals and decrease in body weight of fetuses were observed but no teratogenicity. In a long term two generation experiment using rats at 1,500 ppm, there were no major changes except lowering of body weight of mother animals.

・ Carcinogenicity: In oral dose experiments on mice at 60 to 250 mg/kg and on rats at 5 to 250 mg/kg, slight increase in rate of incidence of liver cell adenoma / carcinoma was observed in male mice and female rats, but no sufficient evidence of carcinogenicity was suggested. Furthermore, in 64 days oral administration tests on mice and rats at 500 mg/kg/day, it is reported that there was an increase in pulmonary tumor for male mice and in malignant tumor in lacteal gland for female rats. In the other hand in 2 years inhalation tests using rats at 500, 1,500, 3,500 ppm and 6 hrs a day and 5 days a week, there observed an increase in incidence rate or total number of incidence of benignant lacteal gland tumor for both male and female. And for male a tendency of increase in cervical sarcoma was observed.

・ Case history: A problem in workplace where dichloromethane is handled is drunkenness, which tends to cause casualty. At high exposure dizziness, vomiting, dysesthesia in four limbs etc. occurs and coma or drunkenness.

⑭ 1,2,4-Trimethylbenzene

1) 1,2,4-Trimethybenzene is used for syntheses of trimellitic acid vitamin E, intermediates for dyestuffs, pigments, pharmaceuticals and a raw material for pyromellitic acid via durene (after methylation). The importation/production volume in 1997 was 3,000 tons (estimated).

2) In the results of this survey, 1,2,4-trimethybenzene was detected in 13 out of 14 areas and 39 out of 42 samples, and the detection range was 370 to 10,000 ng/m3 (unified detection limit: 370 ng/m3).

3) From the above survey results, since the detection frequency is high and the concentration level detected is relatively high, it is required in future to conduct environmental survey and to observe the change and to endeavor to collect information.

○ Survey results of 1,2,4-trimethylbenzene

	(samples)	(areas)	detection range	detection limit
FY1998	93%(39/42)	93%(13/14)	370 to 10,000 ng/m3	370ng/m3

○ Results of acute toxicity tests etc. for 1,2,4-trimethylbenzene

・ rat	LD50 (oral)	5,000 mg/kg
・ mouse	LD50 (intraperitoneal)	1,752 mg/kg

⑮ 1,3,5-Trimethylbenzene

1) 1,3,5-Trimethybenzene is used for dyestuffs, pigments, pharmaceuticals and industrial chemicals.

2) In the results of this survey, 1,3,5-trimethybenzene was detected in 13 out of 13 areas and 38 out of 38 samples, and the detection range was 90 to 3,200 ng/m3 (unified detection limit: 40 ng/m3).

3) From the above survey results, since the detection frequency is high and the concentration level detected is relatively high, it is required in future to conduct environmental survey and to observe the change and to endeavor to collect information.

○ Survey results of 1,3,5-trimethylbenzene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(38/38)	100%(13/13)	90 to 3,200 ng/m3	40ng/m3

○ Results of acute toxicity tests etc. for 1,3,5-trimethylbenzene

・ human	LDLo (inhalation)	100 ppm
・ rat	LC50 (inhalation)	24 g/m3/4hr

⑯ Polychlorinated naphthalenes

1) In the results of this survey, polychlorinated naphthalenes were detected in 14 out of 14 areas and 42 out of 42 samples, and the detection range was 0.011 to 0.86 ng/m3.

2) From the above survey results, since the detection frequency is high and the substances are chemical substances structures of which are similar to PCBs, it is required in future to conduct environmental survey and to observe the change and to endeavor to collect information.

○ Survey results of polychlorinated naphthalenes

	(samples)	(areas)	detection range
FY1998	100%(42/42)	100%(14/14)	0.011 to 0.86 ng/m3

○ Results of acute toxicity tests etc. for polychlorinated naphthalenes

・ 1-chloronaphthalene		
・ rat	LD50 (oral)	1,540 mg/kg
・ mouse	LD50 (oral)	1,091 mg/kg
・ 2-chloronaphthalene		
・ rat	LD50 (oral)	2,078 mg/kg
・ mouse	LD50 (oral)	886 mg/kg
・ trichloronaphthalene		
・ human	TCLo (inhalation)	30 mg/kg

・ For human, chloracne is known professionally and experimentally.

・ Case history: It was in the ages of World War I, when chloronaphthalenes were started to be used as a water proof agent and there were reports already in 1918 on frequent occurrence of chloracne in workers handling the substances. Since about 1937 highly chlorinated compounds were used as an insulating oil and incidence of hepaopathy accompanying icterus was reported. Among 3 of the deads 2 were exposed with pentachloro- and hexachloronaphthalene and 1 was exposed with vapor of wax containing tetrachloro- and pentachloronaphthalene and several %of PCBs. In Japan the first report was issued in 1938

on dermal disturbance of workers handling the substances.

⑰ Tris (2-chloroethyl) phosphate

1) Tris(2-chloroethyl) phosphate is used for flame retardant of polyvinyl chloride, polyurethane foam, epoxy-resins and polyesters.

2) In the survey of the fiscal year 1993 General Environmental Survey, tris(2-chloroethyl) phosphate was detected in 8 out of 13 areas and 21 out of 39 samples (unified detection limit: 1 ng/m3).

3) In the results of this survey, tris(2-chloroethyl) phthalate was detected in 12 out of 15 areas and 24 out of 37 samples and the detection range was 0.3 to 1.4 ng/m3 (unified detection limit: 0.24 ng/m3).

4) From the above survey results, detection frequency of tris(2-chloroethyl) phthalate is high, it is required in future to conduct environmental survey and to observe the change and to endeavor to collect information at the same time.

○ Survey results of tris(2-chloroethyl) phthalate

	(samples)	(areas)	detection range	detection limit
FY1993	54%(21/39)	62%(8/13)	1 to 7.4 ng/m3	1 ng/m3
FY1998	65%(24/37)	80%(12/15)	0.3 to 1.4 ng/m3	0.24 ng/m3

○ Results of acute toxicity tests etc. for tris(2-chloroethyl) phosphate

・ rat	LD50 (oral)	1,230 mg/kg
・mouse	LD50 (oral)	1,866 mg/kg
	LD50 (intraperitoneal)	250 mg/kg

⑱ Tributyl phosphate

1) Tributyl phosphate is used for vinyl butylal, solvents, metal extractants, plasticizers and softening agents of synthetic rubbers, antifoaming agents in textile processing for paper mills.

2) In the survey of the fiscal year 1993 General Environmental Survey, tributyl phosphate was detected in 6 out of 14 areas and 9 out of 39 samples (unified detection limit: 1 ng/m3).

3) In the results of this survey, tris(2-chloroethyl) phthalate was detected in 13 out of 15

areas and 29 out of 40 samples and the detection range was 0.22 to 7.5 ng/m3 (unified detection limit: 0.2 ng/m3).

4) From the above survey results, detection frequency of tributyl phthalate is high, it is required to conduct environmental survey in future and to observe the change and to endeavor to collect information.

○ Survey results of tributyl phthalate

	(samples)	(areas)	detection range	detection limit
FY1993	23%(9/39)	43%(6/14)	1.2 to 45 ng/m3	1 ng/m3
FY1998	73%(29/40)	87%(13/15)	0.22 to 7.5 ng/m3	0.2 ng/m3

○ Results of acute toxicity tests etc. for tributyl phosphate

・ rat LD50 (oral) 3,000 mg/kg
LC50 (inhalation) 28,000 mg/m3/1hr

・mouse LD50 (oral) 1,189 mg/kg
LC50 (inhalation) 1,300 mg/m3
LD50 (intraperitoneal) 159 mg/kg

・ Local irritancy is strong and irritates eyes, skins or respiratory organs.

・ This is a cholinesterase inhibitor and dizziness, headache, ptyalism, miosis etc. are seen. Furthermore, inhalation of vapor causes pulmonary edema and since the pulmonary edema occurs 2 to 3 hours after exposure, rest and observation of the progress in this period are important.

・ In a 14 days repeated dose experiment at doses 0, 0.14, 1.42 ml/kg, once a day, no significant changes were observed except for change in seminiferous tubule of testis seen for 0.42 ml/kg group in histological investigation. As for the experiment at 0, 0.28, 0.42 ml/kg, lowering of nerve conduction velocity at tail nerve was observed for 0.42 ml/kg group.

・ Tumorigenicity: In a 18 weeks repeated oral dose experiment on rat at 0, 200, 300, 350 ml/kg/day doses, hyperplasia of bladder epitherium was observed for both male and female of administered groups. However, no malignant tumor were found.

⑲ Tricresyl phosphate

1) Tricresyl phosphate is used for plasticizer of vinyl polymer film for agriculture, electrical wire compounds and vinyl polymers for building use, softner for synthetic rubber compounds, plasticizers, and other flame retardants, flame resistant working fluid, gasoline additives and lubicants additives. The importation/production volume for 1997 was 17,426 tons(as phosphates plasticizers).

2) In the survey of the fiscal year 1993 General environmental survey, tricresyl phosphate was detected in 4 out of 14 areas and 7 out of 42 samples (unified detection limit: 3 ng/m3).

3) In the results of this survey, tricresyl phosphate was detected in 5 out of 16 areas and 8 out of 46 samples and the detection range was 1.2 to 2.6 ng/m3 (unified detection limit: 1 ng/m3).

4) From the above survey results, detection frequency of tricresyl phthalate is low, and it does not seem to pose any problems now.

○ Survey results of tricresyl phthalate

	(samples)	(areas)	detection range	detection limit
FY1993	17%(7/42)	29%(4/14)	3 to 17 ng/m3	3ng/m3
FY1998	17%(8/46)	31%(5/16)	1.2 to 2.6 ng/m3	1 ng/m3

○ Results of acute toxicity tests etc. for tricresyl phosphate

- human LDLo (oral) 1,800 mg/kg
- rat LD50 (oral) 3,000 mg/kg
- mouse LD50 (oral) 3,900 mg/kg
- rabbit LD50 (oral) 100 mg/kg
- Center of toxicity is neuropathy of peripheral nervous system. When orally ingested, the incipient symptom is gastrointestinal trouble and several hours later nausea, vomiting, abdominal pain, diarrhea etc. start and these symptoms fade out in 1 to several days. Then appears after 10 to 20 days of latent period peripheral dominant dyskinesia(acute retardative neurotoxicity).
- Tumorigenicity: In a long term oral administration experiment using rats and mice, no tumorigenicity was observed for each group of male and female rats and male and female mice.
- Reproductive toxicity: In a repeated oral dose experiment on rats at max. 350 mg/kg/day at the 6 to 18 day of pregnancy, no teratogenicity was observed even at the dose toxic to mother animals. No toxicity to fetuses were also found.
- Mutagenicity: Negative in Ames tests using TA98, TA100, TA1535 and TA1537 regardless of addition of S9-Mix.
- Case history: In a case where about 1.8 liter of olive oil estimated to contain max. 1.59% of the substance was consumed for cooking by a family of 6 members in about 1.5 months beginning the beginning of December, the whole family presented the symptom. In the worst case (for the17years old, man), at the end of January pain at triceps surae and gait disorder occurred and in the middle of February walking became impossible. Amyotrophia in lower limbs and feet were observed and movement of feet were impossible. Dyskinesia of knee joint

was slight and no abnormality was found in hip joint. As for upper limbs, there were no disturbance in movement of shoulder and cubital joint but there was a slight disorder in wrist joint and it was impossible to throw strength in fingers. But, no amyotrophia was observed. In mid March patellar reflex was accentuated and became convulsive and sustained clonus in ancons appeared, and amyotrophia in lower limbs and hands became significant. There was no disturbance in bladder and rectum. In July gradual improvement was seen and walking became possible with the help of a stick. Even a year after the occurrence, movement of ankles was impossible, although feet could be moved slightly. In this case the patient died of an accident 11 years after occurrence and the autopsy confirmed that there was a significant degeneration in pyramidal tracts of spinal cord. For the other cases the symptom of which was slight at the time of occurrence, 3 cases were completely cured but for others symptom on pyramidal tract of lower limbs was significant and in a part damage in peripheral nervous system remained. The olive oil was the cause of this case and this was confirmed by an experiment where the above olive oil was fed to hens and neuropathy in peripheral nervous system could be created.
Cases similar to the above occurred frequently in Morocco in 1959. Number of the patients is at least more than 2,000 and it is concluded that this was caused because lubricating oil for jet engines containing this substance was used for cooking. As for the symptoms, the incipient symptom were pain in lower limbs and then after lowering of sensation at the end of four limbs. In a couple of days the lowering of sensation was recovered but then dyskinesia appeared above all in the end of lower limbs, and sometime dyskinesia in hands was seen. Amyotrophia was not rare. Systemic symptom was not clear but in one third of the patients diarrhea was observed prior to occurrence of the disease.

⑳ Bis(2-ethylhexyl) adipate

1) Bis(2-ethyhexyl) adipate is used for plasticizer of polyvinyl chloride (leather, film, sheet, hose, gloves for industrial use), softner for synthetic rubber (hose, sealants), synthetic lubricant. The importation/production volume for 1997 was 33,282 tons(as total adipates plasticizers).

2) In the survey of the fiscal year 1984 General Environmental Survey, bis(2-ethylhexyl) adipate was detected in 11 out of 12 areas and 47 out of 72 samples (detection limit: 0.1 to 0.61 ng/m3) and in FY 1995 it was detected in 13 out of 14 areas and 31 out of 41 samples (unified detection limit: 1 ng/m3).

3) In the results of this survey, bis(2-ethylhexyl) adipate was detected in 11 out of 12 areas and 26 out of 33 samples and the detection range was 1.0 to 26 ng/m3 (unified detection limit: 1 ng/m3).

4) From the above survey results, detection frequency of bis(2-ethylhexyl) adipate is high, and since the results of this survey shows similar results in FY 1995, it is required to conduct in future environmental survey and to observe the change and at the same time to make risk assessment. Furthermore, since it is pointed out that the substance is suspected to have endocrine disruptive effects, endeavor to collect information is required.

○ Survey results of bis(2-ethylhexyl) adipate

	(samples)	(areas)	detection range	detection limit
FY1984	65%(47/72)	92%(11/12)	0.23 to 16.7 ng/m3	0.1 to 0.61 ng/m3
FY1995	76%(31/41)	93%(13/14)	1.0 to 22 ng/m3	1 ng/m3
FY1998	79%(26/33)	92%(11/12)	1.0 to 26 ng/m3	1 ng/m3

○ Results of acute toxicity tests etc. for bis(2-ethylhexyl) adipate

・ rat LD50 (oral) 9,100 mg/kg

・mouse LD50 (oral) 15,000 mg/kg

・ General toxicity of this substance is extremely weak and in a test of intraperitoneal administration of large amount of the substance to mice and in a test of application of the substance itself to human skin, no change was observed. And in a 1 month feeding test on rats at the concentration of 0.5, 2.0 and 5.0% of the food and in a 2 months oral administration tests on dogs at 2g/kg/day, no abnormality including histopathological examination were observed except for suppression in growth seen for 5% dose group rats. Additionaly, in a 13 weeks experiment where rats and mice were fed with the food to which the substance was added at 0 to 25,000 ppm concentration, no abnormality were observed in both macroscopic finding and histological examination.

・ Tumorigenicity: In an experiment where F344 rats and B6C3F1 mice were fed for 103 weeks with food containing the substance at 0, 1,000 and 2,500 mg/m3 and sacrificed at the 104th and 107th week and examined, tumorigenicity was not found for rats. But for male mice hepatocellular carcinoma (7/50, 12/49, 12/49) and hepatocellular adenoma (1/50, 8/49, 15/49) were observed and for female mice hepatocellular caricinoma (1/50, 14/49, 12/49) and hepatocellular adenoma (2/50, 5/50, 6/50). Consequently, it was concluded that the substance is irrevocably tumorigenic for female mouse (occurrence of hepatocellular carcinoma) and is probably tumorigenic for male mouse (occurrence of hepatocellular adenoma).

・ Negative in Ames tests (TA98, TA100, TA1535, TA1538).

・ Reproductive/developmental toxicity: In an experiment where several adipate esters were intraperitoneally administered to rats on the 5th, 10th and 15th day of pregnancy, toxicity on fetuses were observed and NOEL is estimated to be about 1/30th of LD50. And it was observed that intraperitoneal single dose administration of 9,200 mg/kg of the substance to male mice lowered the reproductive ability.

(21) 1-Methylnaphthalene, 2-Methylnaphthalene

・ 1-Methylnaphthalene

1) 1-Methylnaphthalene is used for a raw material for organic syntheses and heating medium.

2) In the survey of the fiscal year 1984 General Environmental Survey, 1-methylnaphthlene was detected in 12 out of 12 areas and 65 out of 72 samples (detection limit: 0.4 to 5 ng/m3) .

3) In the results of this survey, 1-methylnaphthlene was detected in 10 out of 10 areas and 29 out of 30 samples and the detection range was 5.1 to 150 ng/m3 (unified detection limit: 2 ng/m3).

4) From the above survey results, the concentration level detected for 1-methylnaphthalene is not so high as to pose immediate problems but since the detection frequency is high and the results of this survey shows similar results in FY 1984, it is required in future to conduct environmental surveys at a certain interval and at the same time to endeavor to collect information.

○ Survey results of 1-methylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1984	90%(65/72)	100%(12/12)	1.9 to 280 ng/m3	0.4 to 5 ng/m3
FY1998	97%(29/30)	100%(10/10)	5.1 to 150 ng/m3	2 ng/m3

○ Results of acute toxicity tests etc. for 1-methylnaphthalene

・ rat LD50 (oral) 1,840 mg/kg

・ 2-Methylnaphthalene

1) 2-Methylnaphthalene is used for heating medium and vitamin K_3.

2) In the survey of the fiscal year 1984 General Environmental Survey, 2-methylnaphthlene was detected in 12 out of 12 areas and 66 out of 72 samples (detection limit: 0.5 to 8 ng/m3) .

3) In the results of this survey, 2-methylnaphthlene was detected in 10 out of 10 areas and 30 out of 30 samples and the detection range was 3.2 to 310 ng/m3 (unified detection limit: 1.7 ng/m3).

4) From the above survey results, the concentration level detected for 2-methylnaphthalene is not so high as to pose immediate problems but since the detection frequency is high and the results of this survey shows similar results in FY 1984, it is required in future to conduct environmental surveys at a certain interval and at the same time to endeavor to collect information.

○ Survey results of 2-methylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1984	92%(66/72)	100%(12/12)	2.6 to 530 ng/m3	0.5 to 8 ng/m3
FY1998	100%(30/30)	100%(10/10)	3.2 to 310 ng/m3	1.7 ng/m3

○ Results of acute toxicity tests etc. for 2-methylnaphthalene

・ rat LD50 (oral) 1,630 mg/kg

(22) 1,2-Dimethylnaphthalene, 1,3-+1,6-Dimethylnaphthalene, 1,4-Dimethylnaphthalene, 1,5-Dimethylnaphthalene, 1,7-Dimethylnaphthalene, 1,8-Dimethylnaphthalene, 2,3-Dimethylnaphthalene, 2,6-Dimethylnaphthalene, 2,7-Dimethylnaphthalene

1) Dimethylnaphthalenes are used for solvents, ore floatation agent, heating media.

2) In the results of this survey,

・ 1,2-dimethylnaphthalene was detected in 10 out of 10 areas and 28 out of 30 samples and the detection range was 0.37 to 9.9 ng/m3 (unified detection limit: 0.3 ng/m3).

・ 1,3-+1,6-dimethylnaphthalene was detected in 9 out of 9 areas and 26 out of 27 samples and the detection range was 2.0 to 70 ng/m3 (unified detection limit: 0.56 ng/m3).

・ 1,4-dimethylnaphthalene was detected in 10 out of 10 areas and 29 out of 30 samples and the detection range was 0.27 to 7.2 ng/m3 (unified detection limit: 0.23 ng/m3).

・ 1,5-dimethylnaphthalene was detected in 10 out of 10 areas and 28 out of 30 samples and the detection range was 0.4 to 8.9 ng/m3 (unified detection limit: 0.33 ng/m3).

・ 1,7-dimethylnaphthalene was detected in 9 out of 9 areas and 27 out of 27 samples and the detection range was 0.13 to 23 ng/m3 (unified detection limit: 0.1 ng/m3).

・ 1,8-dimethylnaphthalene was detected in 7 out of 7 areas and 21 out of 21 samples and the detection range was 0.09 to 51 ng/m3 (unified detection limit: 0.08 ng/m3).

・ 2,3-dimethylnaphthalene was detected in 10 out of 10 areas and 28 out of 30 samples and the detection range was 0.4 to 13 ng/m3 (unified detection limit: 0.4 ng/m3).

・ 2,6-dimethylnaphthalene was detected in 9 out of 9 areas and 26 out of 27 samples and the detection range was 1.2 to 30 ng/m3 (unified detection limit: 0.61 ng/m3).

・ 2,7-dimethylnaphthalene was detected in 9 out of 9 areas and 27 out of 27 samples and the

detection range was 0.31 to 22 ng/m3 (unified detection limit: 0.3 ng/m3).

3) From the above results, since the detection frequency is high for dimethylnaphthalenes, it is required in future to conduct environmental surveys and to observe the change and at the same time to endeavor to collect information.

○ Survey results of 1,2-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	93%(28/30)	100%(10/10)	0.37 to 9.9 ng/m3	0.3 ng/m3

○ Survey results of 1,3-+1,6-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	96%(26/27)	100%(9/9)	2.0 to 70 ng/m3	0.56 ng/m3

○ Survey results of 1,4-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	97%(29/30)	100%(10/10)	0.27 to 7.2 ng/m3	0.23 ng/m3

○ Survey results of 1,5-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	93%(28/30)	100%(10/10)	0.4 to 8.9 ng/m3	0.33 ng/m3

○ Survey results of 1,7-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(27/27)	100%(9/9)	0.13 to 23ng/m3	0.1 ng/m3

○ Survey results of 1,8-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(21/21)	100%(7/7)	0.09 to 5.1 ng/m3	0.08 ng/m3

○ Survey results of 2,3-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	93%(28/30)	100%(10/10)	0.4 to 13 ng/m3	0.4 ng/m3

○ Survey results of 2,6-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	96%(26/27)	100%(9/9)	1.2 to 30 ng/m3	0.61 ng/m3

○ Survey results of 2,7-dimethylnaphthalene

	(samples)	(areas)	detection range	detection limit
FY1998	100%(27/27)	100%(9/9)	0.31 to 22 ng/m3	0.3 ng/m3

○ Results of acute toxicity tests etc. for 1,2-dimethylnaphthalene

・ 1,2-Dimethylnaphthalene added to water at 3 ppm concentration (reduced to 0.8 to 1.6 ppm in 6 days) showed toxicity to sea urchins and fish spawns. But its toxic degree is weaker than that of 1,3- isomer and is stronger than that of 1,4-isomer.

・ Carcinogenicity: There is a report of negative.

○ Results of acute toxicity tests etc. for 1,3-dimethylnaphthalene

・ 1,3-Dimethylnaphthalene added to water at 3 ppm concentration (reduced to 0.8 to 1.6 ppm in 6 days) showed toxicity to sea urchins and fish spawns. Its toxic degree is the strongest of 1,2-, 1,4- , 1,6- and 1,8- isomers.

・ Carcinogenicity: There is a report of negative.

・ Mutagenicity: Negative in Ames tests and the tests using yeast.

○ Results of acute toxicity tests etc. for 1,4-dimethylnaphthalene

・ 1,4-Dimethylnaphthalene added to water at 3 ppm concentration (reduced to 0.8 to 1.6 ppm in 6 days) showed toxicity to sea urchins and fish spawns. But its toxic degree is weaker than that of 1,2- and 1,3-isomers and is almost same as that of 1,6- and 1.8-isomers.

・ Carcinogenicity: There is a report of negative.

○ Results of acute toxicity tests etc. for 1,5-dimethylnaphthalene

・ Carcinogenicity: There is a report of negative.

○ Results of acute toxicity tests etc. for 2,3-dimethylnaphthalene

・ Carcinogenicity: There is a report of negative.

○ Results of acute toxicity tests etc. for 2,6-dimethylnaphthalene

・ Carcinogenicity: There is a report of negative.

○ Results of acute toxicity tests etc. for 2,7-dimethylnaphthalene

・ Carcinogenicity: There is a report of negative.

(23) Crotonaldehyde

1) Crotonaldehyde is used for raw material for chemicals such as butanol, crotonic acid, sorbic acid and pharmaceuticals. The production volume for 1997 was 8,000 tons (estimated).

2) In the survey of the fiscal year 1987 General Environmental Survey, crotonaldehyde was not detected (unified detection limit: 800 ng/m3). And in FY 1995 it was detected in 1 out of 18 areas and 3 out of 54 samples (unified detection limit: 3,000 ng/m3) and in FY 1997 it was detected in 1 out of 14 areas and 1 out of 42 samples (unified detection limit: 1,000 ng/m3).

3) In the results of this survey, crotonaldehyde was detected in 8 out of 10 areas and 21 out of 29 samples and the detection range was 15 to 330 ng/m3 (unified detection limit: 15 ng/m3).

4) From the above survey results, detection frequency of crotonaldehyde is high, and since the concentration level detected is relatively high, it is required to conduct in future more detailed environmental survey and to observe the change and at the same time to make risk assessment.

○ Survey results of crotonaldehyde

	(samples)	(areas)	detection range	detection limit
FY1987	0%(0/61)	0%(0/10)	not detected	800 ng/m3
FY1995	6%(3/54)	6%(1/18)	3,600to 5,200 ng/m3	3,000 ng/m3
FY1997	2%(1/42)	7%(1/14)	1,600 ng/m3	1,000 ng/m3
FY1998	72%(21/29)	80%(8/10)	15 to 330 ng/m3	15 ng/m3

○ Results of acute toxicity tests etc. for crotonaldehyde

・ rat LD50 (oral) 206 mg/kg

・mouse LD50 (oral) 104 mg/kg

・ Tumorigenicity: In a 113 week experiment where rats were bred with water to which crotonaldehyde was added at 0, 0.6, 6.0 mM, hepatocellular carcinoma was observed for 2 out of 27 rats in the 0.6 mM dose group and for 9 rats including the above neoplasmic nodus in liver was observed. But no tumor was observed for 0.6mM group.

・ Mutagenicity: Positive in Ames test using TA100 with or without addition of S9Mix. But negative with TA98, TA1535, TA1537 and TA1538 under both conditions.

Fig. 2-1 Locations of the Environmental Survey for Water (Fiscal Year 1998)

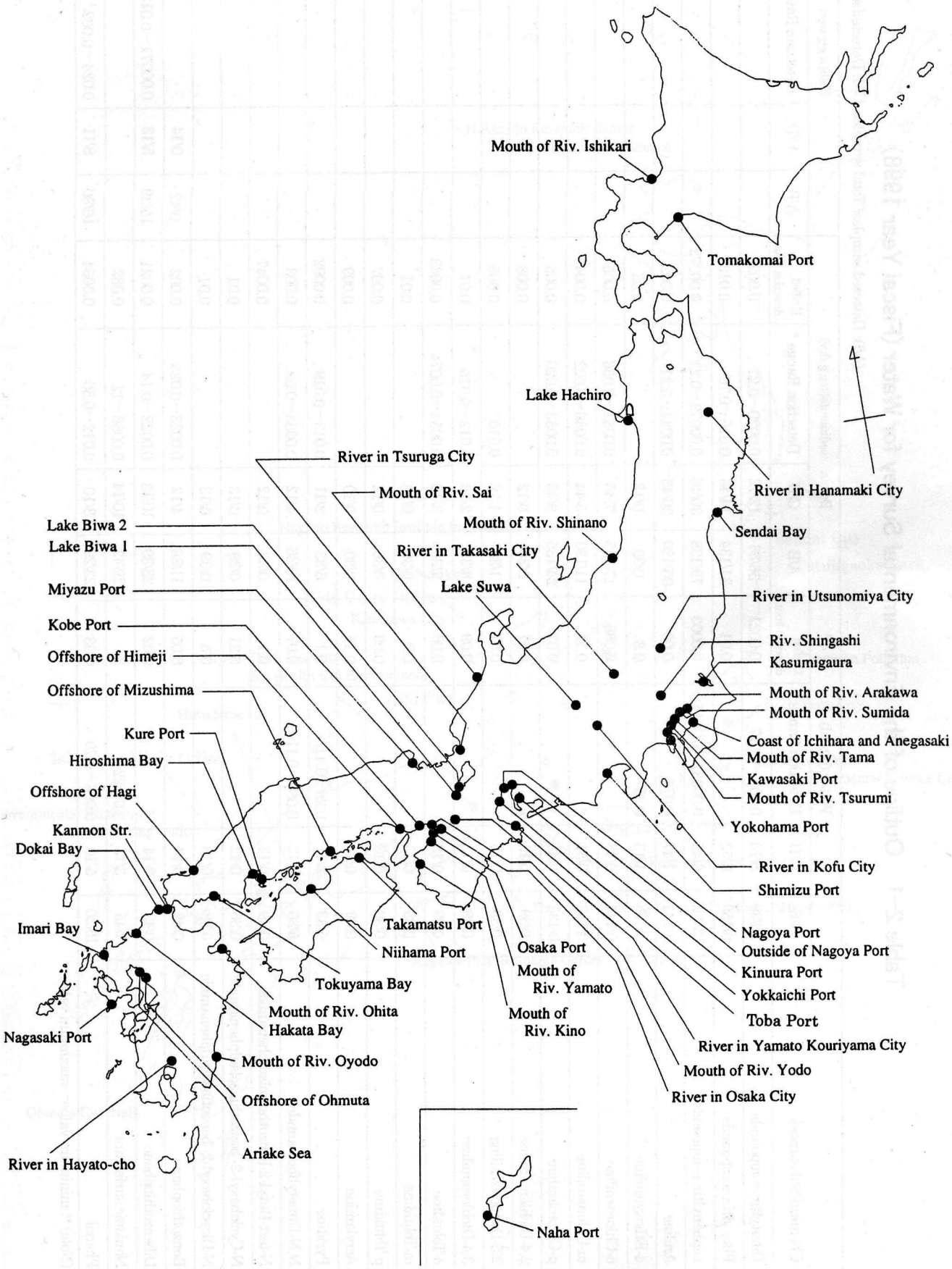

Table 2-1　Outline of the Environmental Survey for Water (Fiscal Year 1998)

(A/B: Detected samples/ Total samples, C/D: Detected areas/ Total areas)

Chemical Substances	Water (ng/ml)				Botom sediments(μg/g dry)				Fish(μg/g wet)			
	A/B	C/D	Detection Range *	Unified detection limit	A/B	C/D	Detection Range *	Unified detection limit	A/B	C/D	Detection Range *	Unified detection limit
Dibutyltin compounds	20/39	8/13	0.003—0.017	0.0021	36/36	12/12	0.0020—0.27	0.002				
Phenyltin compounds	0/156	0/52		0.01	31/134	14/46	0.016—0.76	0.016				
Diphenyltin compounds	12/133	6/45	0.00037—0.0017	0.0003	79/138	30/46	0.00079—0.21	0.00072				
Aniline	1/141	1/47	0.074	0.06	95/120	36/43	0.0021—0.21	0.002				
4-Ethoxyaniline	1/39	1/13	0.36	0.3	0/39	0/13		0.02				
o-Chloroaniline	0/144	0/48		0.088	17/133	7/45	0.0051—0.056	0.005				
m-Chloroaniline	0/153	0/51		0.11	11/130	5/44	0.0046—0.022	0.0045				
p-Chloroaniline	0/135	0/45		0.07	24/135	9/45	0.0053—0.020	0.005				
2,4-Dichloroaniline	0/39	0/13		0.07	0/36	0/12		0.008				
2,5-Dichloroaniline	0/39	0/13		0.07	1/36	1/12	0.010	0.005				
3,4-Dichloroaniline	0/39	0/13		0.09	4/39	2/13	0.012—0.015	0.01				
o-Toluidine	0/39	0/13		0.08	7/36	3/12	0.0054—0.0074	0.0043				
m-Toluidine	0/39	0/13		0.2	0/39	0/13		0.01				
p-Toluidine	0/39	0/13		0.09	0/36	0/12		0.007				
Acrylamide	0/39	0/13		0.15	0/30	0/10		0.009				
Pyridine	6/33	2/11	0.29—0.41	0.1	6/33	2/11	0.013—0.019	0.0092				
N,N-Dimetylformamide	5/36	2/12	0.080—0.110	0.07	10/36	4/12	0.0033—0.03	0.003				
N-tert-Butyl-2-benzothiazolsulphenamide	0/39	0/13		0.1	0/36	0/12		0.0047				
N-Cyclohexyl-2- benzothiazolsulphenamide	0/36	0/12		0.21	0/39	0/13		0.01				
N-Dicyclohexyl-2- benzotiazolsulphenamide	0/39	0/13		0.3	0/39	0/13		0.01				
Benzothiophene	0/42	0/14		0.05	11/36	4/12	0.0023—0.023	0.002	0/42	0/14		0.001
Dibenzothiophene	0/42	0/14		0.02	28/39	10/13	0.0022—0.14	0.0021	15/39	5/13	0.00071—0.013	0.00034
Nonionic surfactant	7/45	3/15	3.5—22	3	29/42	10/14	0.0086—12	0.082				
Phenol	15/30	5/10	0.066—0.70	0.03	23/29	8/10	0.012—0.50	0.0054	16/30	8/11	0.024—0.062	0.02

(Note) *: minimum value—maximum value

Fig. 2-2 Locations of the Environmental Survey for Air (Fiscal Year 1998)

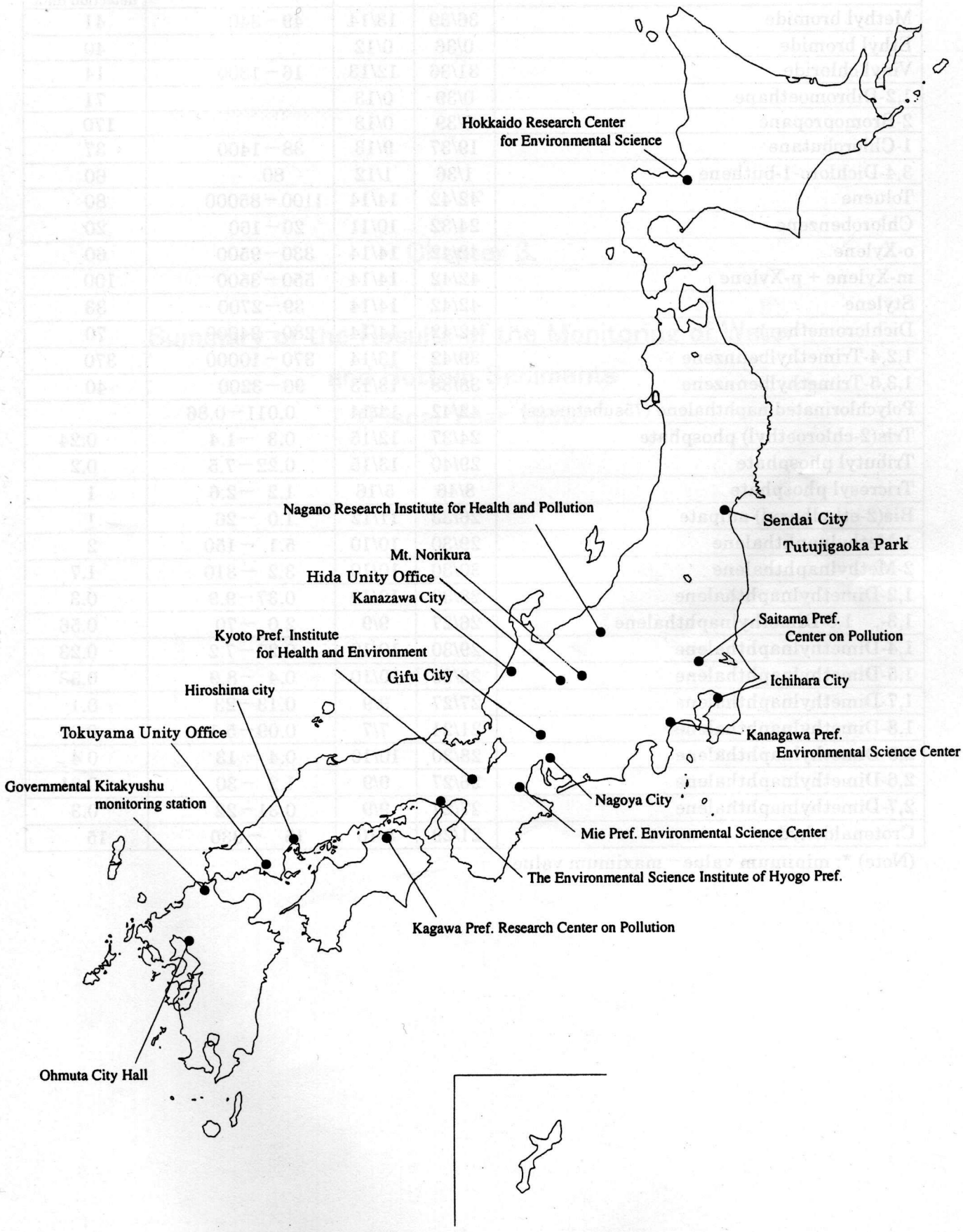

Table 2-2 Outline of the Environmental Survey for Air (Fiscal Year 1998)

Unit : ng/m^3 (A/B: Detected samples/ Total samples, C/D: Detected areas/ Total areas)

Chemical Substances	A/B	C/D	Detection Range *	Unified detection limit
Methyl bromide	36/39	13/14	49－340	41
Ethyl bromide	0/36	0/12		40
Vinyl chloride	31/36	12/13	16－1300	14
1,2-Dibromoethane	0/39	0/13		71
2-Bromopropane	0/39	0/13		170
1-Chlorobutane	19/37	9/13	38－1400	37
3,4-Dichloro-1-buthene	1/36	1/12	80	60
Toluene	42/42	14/14	1100－85000	80
Chlorobenzene	24/32	10/11	20－160	20
o-Xylene	42/42	14/14	330－9500	60
m-Xylene + p-Xylene	42/42	14/14	550－3500	100
Stylene	42/42	14/14	39－2700	33
Dichloromethane	42/42	14/14	280－24000	70
1,2,4-Trimethylbennzene	39/42	13/14	370－10000	370
1,3,5-Trimethylbennzene	38/38	13/13	90－3200	40
Polychlorinated naphthalene (75substances)	42/42	14/14	0.011－0.86	
Tris(2-chloroethyl) phosphate	24/37	12/15	0.3 －1.4	0.24
Tributyl phosphate	29/40	13/15	0.22－7.5	0.2
Tricresyl phosphate	8/46	5/16	1.2 －2.6	1
Bis(2-ethylhexyl) adipate	26/33	11/12	1.0 －26	1
1-Methylnaphthalene	29/30	10/10	5.1 －150	2
2-Methylnaphthalene	30/30	10/10	3.2 －310	1.7
1,2-Dimethylnaphthalene	28/30	10/10	0.37－9.9	0.3
1,3-, 1,6-Dimethylnaphthalene	26/27	9/9	2.0 －70	0.56
1,4-Dimethylnaphthalene	29/30	10/10	0.27－7.2	0.23
1,5-Dimethylnaphthalene	28/30	10/10	0.4 －8.9	0.33
1,7-Dimethylnaphthalene	27/27	9/9	0.13－23	0.1
1,8-Dimethylnaphthalene	21/21	7/7	0.09－5.1	0.08
2,3-Dimethylnaphthalene	28/30	10/10	0.4 －13	0.4
2,6-Dimethylnaphthalene	26/27	9/9	1.2 －30	0.61
2,7-Dimethylnaphthalene	27/27	9/9	0.31－22	0.3
Crotonaldehyde	21/29	8/10	15 －330	15

(Note) *: minimum value－maximum value