

Chapter 2. Summary of the Fiscal Year 1994 General Inspection Survey of Chemical Substances on Environmental Safety

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 (Figure 2-1), and fishes were surveyed in 52 areas (Figure 2-1, excluding river within Utsunomiya City, Yokohama Port, mouth of Tsurumi River, and river within Yamato Koriyama City). 30 substances were surveyed in water, 24 in bottom sediments and 8 in fishes (Table 2-1). Among them, 4 substances of 2-butoxyethanol, 2,2,4-trimethyl-1,3-pentanediol diisobutyrate, 3,5,5-trimethyl-2-cyclohexen-1-one and 2-butanone were surveyed in all areas. Other substances were surveyed in 11 areas.

(2) Environmental Survey (air)

18 areas were subject to the survey from all over Japan (Figure 2-2), and 18 substances (Table 2-2) were surveyed. Among them, 5 substances of acetaldehyde, crotonaldehyde, acetone, 4-methyl-2-pentanone and 2-butanone were surveyed in all areas, and bis(2-ethylhexyl) adipate was surveyed in 16 areas. Other 12 substances were surveyed in 6 areas.

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)

6 substances in water, 15 substances in bottom sediments and 3 substances in fishes were detected (Table 2-1).

(2) Environmental Survey (air)

18 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-Butanol

- 1) 1-Butanol is used for paint solvents, dehydrating agents, extractants, demulsifiers and penetrants, but it is mainly used as a latent solvent for nitrocellulose lacquer. It is also used for plasticizers, medicines, stabilizers and perfumes. The production, exportation and importation volume in 1993 was 188,334 tons, 21,028 tons and 13,267 tons, respectively.
- 2) In the results of the fiscal year 1979 General Environmental Survey, 1-butanol was not detected in either water or bottom sediments.
- 3) In the results of this survey, 1-butanol was detected from 2 out of 11 areas in water (2 out of 33 samples), 2 out of 11 areas in bottom sediments (4 out of 33 samples) and the detection range was 2.3 ~ 3.7 ppb in water, 0.14 ~ 0.78 ppm in bottom sediments, and the unified detection limit was 2 ppb in water and 0.12 ppm in bottom sediments.
- 4) From the above survey results, 1-butanol was detected from both water and bottom sediments, but the detected concentration levels and frequencies were low, so it does not seem to pose any problems. In the previous survey (fiscal year 1979), it was not detected in water and bottom sediments, but in this survey the detection limit was lowered compared to past surveys, and was presumably detected for this reason.

Survey results of 1-butanol

		(sample)	(area)	detection range	detection limit
water	FY1979	0%(0/30)	0%(0/10)	not detected	100 ~ 1,000 ppb
	FY1995	6%(2/33)	18%(2/11)	2.3 ~ 3.7 ppb	2 ppb
Bottom sediments	FY1979	0%(0/30)	0%(0/10)	not detected	1.0 ~ 10.0 ppm
	FY1995	12%(4/33)	18%(2/11)	0.14 ~ 0.78 ppm	0.12 ppm

Results of acute toxicity tests etc. for 1-butanol

rat	LD ₅₀ (oral)	790 mg/kg
	LD ₅₀ (intraperitoneal)	1,122 mg/kg
mouse	LD ₅₀ (oral)	2,680 mg/kg
	LD ₅₀ (intraperitoneal)	377 mg/kg
	LC ₅₀ (inhalation)	8,000 ppm × 4 hours
rabbit	LD ₅₀ (dermal)	3,400 mg/kg
wild birds(kind unknown)	LD ₅₀ (oral)	2,500 mg/kg

The dermal irritancy was moderately observed and ophthalmological eye irritancy was markedly observed in rabbits.

After exposure of the vapor of this substance to mice, respiratory rate was dose-relatedly decreased at the concentration of 4,630 ~ 9,250 ppm within several minutes.

In a study exposing volunteers, irritation symptoms appeared at 24 ppm, and headaches occurred at 50 ppm. When workers were surveyed, irritation to the eyes occurred above 50 ppm, but no general symptoms appeared at 100 ppm. Workers exposed to 200 ppm had keratitis, deterioration of eyesight and lacrimation, but when the concentration was lowered to 100 ppm, there were no general symptoms, and irritation to the eye also disappeared.

There have been reports that workers exposed to 80 ppm of this substance had vestibular nerve disorders such as hearing loss and dizziness.

Mutagenicity: Negative in the Ames test (TA 98, TA 100)

1-Propanol

- 1) 1-Propanol is used as a solvent for lacquers or paints, a raw material for plasticizers, cosmetics, detergents, insecticides and adhesives, and used for inks and antifreezing agents.
- 2) In the results of this survey, 1-propanol was not detected in water (unified detection limit:3 ppb), but was detected from 2 out of 11 areas and 4 out of 33 samples in bottom sediments, and the detection range was 0.11 ~ 0.14 ppm (unified detection limit:0.09 ppm).
- 3) From the above survey results, although 1-propanol was detected in bottom sediments, the detected frequencies were low, so it does not seem to pose any problems.

Survey results of 1-propanol

		(samples)	(areas)	(detection range)	(detection limit)
water	FY1995	0%(0/33)	0%(0/11)	not detected	3 ppb
bottom sediments	FY1995	12%(4/33)	18%(2/11)	0.11 ~ 0.14 ppm	0.09 ppm

Results of acute toxicity tests etc. for 1-propanol

rat	LD ₅₀ (oral)	1,870 mg/kg
	LD ₅₀ (intraperitoneal)	2,164 mg/kg
mouse	LD ₅₀ (oral)	6,800 mg/kg
	LD ₅₀ (intraperitoneal)	3,125 mg/kg
	LC ₅₀ (inhalation)	48,000 mg/m ³ (hours unknown)
rabbit	LD ₅₀ (oral)	2,825 mg/kg
	LD ₅₀ (intraperitoneal)	515 mg/kg
	LD ₅₀ (dermal)	4,060 mg/kg

The dermal irritancy was slightly to moderately observed and ophthalmological eye irritancy was moderately observed.

After repeated oral administration of 1-propanol at the dose of 0.3 ml/kg/day for twice every 10 weeks, liver disorder and multiplication of hematopoietic organ was markedly observed in Wistar rats. The same change was observed after repeated subcutaneous administration at the dose of 0.06 ml/kg per time twice every week.

Tumorigenicity: When giving a repetitive oral dose to the above 18 wistar rats, 5 malignant tumors (2 cases of leukemia, 1 case of hepatocellar carcinoma, 2 cases of sarcoma) were reported, and 10 cases of benign tumor were observed(3 cases of benign tumor from the control group). Out of the 31 rats given a repetitive subcutaneous dose, 13 malignant tumors (4 leukemia cases, 6 cases of sarcoma, 1 case each for renal cancer, bladder cancer and uterus cancer occurred) and 7 benign tumors (in the control group, only 2 cases of benign tumor) were reported.

Mutagenicity: Negative in Ames test. Positive in E. Coli test (E. Coli CA 274)

2-Butanol

- 1) 2-Butanol is used as a paint solvent (lacquers, melamine resin paints etc.) and a raw material for butyl acetate, methyl ethyl ketone, plasticizers, organic compounds, ore floatation agents, surface active agents, antioxidants and perfumes, and used for modifiers of brake conditioners, extractants, dehydrating agents, detergents and antifoamers. The production volume in 1994 was 162,502 tons.
- 2) In the fiscal year 1979 General Environmental Survey, 2-butanol was not detected in both water and bottom sediments.
- 3) In the results of this survey, 2-butanol was not detected in water (unified detection limit:10 ppb), but was detected from 1 out of 11 areas and 2 out of 33 samples in bottom sediments, and the detection range was 0.029 ~ 0.049 ppm (unified detection limit:0.021 ppm).

4) From the above survey results, 2-butanol was detected in bottom sediments, but the detected frequencies were low, so it does not seem to pose any problems. In the previous survey (fiscal year 1979), it was not detected in bottom sediments, but in this survey the detection limit was lowered compared to past surveys, and was presumably detected for this reason.

Survey results of 2-butanol

		(samples)	(areas)	detection range	detection limit
water	FY1979	0%(0/30)	0%(0/10)	not detected	100 ~ 1,000 ppb
	FY1995	0%(0/33)	0%(0/11)	not detected	10 ppb
bottom sediments	FY1979	0%(0/30)	0%(0/10)	not detected	1.0 ~ 10.0 ppm
	FY1995	6%(2/33)	9%(1/11)	0.029 ~ 0.049 ppm	0.021 ppm

Results of acute toxicity tests etc. for 2-butanol

rat	LD ₅₀ (oral)	6,480 mg/kg
	LD ₅₀ (intraperitoneal)	1,193 mg/kg
mouse	LD ₅₀ (intraperitoneal)	771 mg/kg
rabbit	LD ₅₀ (oral)	4,893 mg/kg

The dermal irritancy was slightly observed and ophthalmological eye irritancy was markedly observed in rabbits.

The animals were mainly affected on the central nerves by 2-butanol and died after a process of ataxia, collapse and coma. 5 died out of 6 rats exposed to 16,000 ppm × 4 hours. Exposures of 10,670 ppm × 225 minutes and 16,000 ppm × 160 minutes leads lethal effect to rats. Mice exposed to 5,330 ppm repeatedly for a total of 117 hours entered coma, but did not die. Exposing mice to 3,300, 6,600, 9,900, 13,200, 16,500 and 19,800 ppm of 2-butanol, mice entered coma after 300 minutes with an exposure of 3,300 ppm, and 40 minutes with an exposure of 19,800 ppm. There were no deaths.

In a study giving 30 minutes inhalation to mice, the threshold value for irritation to the respiratory organs was estimated to be 640 ppm.

2-Propanol

- 1) 2-Propanol is used as a solvent for natural or synthetic resins and lacquers, an extractant for alkaloids and oils and a raw material for cosmetics, antiseptics, antifreezing agents and manufacturing acetone. The production volume in 1994 was 129,602 tons.
- 2) In the results of this survey, 2-propanol was not detected in water (unified detection limit:8 ppb), but was detected from 2 out of 11 areas and 4 out of 33 samples in bottom sediments.

The detection range was 0.50 ~ 2.64 ppm (unified detection limit: 0.27 ppm)

- 3) From the above survey results, although 2-propanol was detected in bottom sediments, the detected frequencies were low, so it does not seem to pose any problems.

Survey results of 2-propanol

		(samples)	(areas)	detection range	detection limit
water	FY1995	0%(0/33)	0%(0/11)	not detected	8 ppb
bottoms sediments	FY1995	12%(4/33)	18%(2/11)	0.50 ~ 2.64 ppm	0.27 ppm

Results of acute toxicity tests etc. for 2-propanol

rat	LD ₅₀ (oral)	5,045 mg/kg
	LC ₅₀ (inhalation)	16,000 ppm × 8 hours
mouse	LD ₅₀ (oral)	3,600 mg/kg
	LD ₅₀ (intraperitoneal)	4,477 mg/kg
rabbit	LD ₅₀ (oral)	6,410 mg/kg
	LD ₅₀ (dermal)	12,800 mg/kg

The dermal irritancy was slightly observed and ophthalmological eye irritancy was moderately to markedly observed in rabbits. In the experiment exposing volunteers, slight irritation was felt in the eyes, nose and pharynx at 400 ~ 800 ppm.

2-Propanol has narcotic effect similar to other lower alcohol such as methanol and ethanol, but the metabolic rate is lower compared to ethanol, and the duration of the narcotic effect is longer.

Tumorigenicity: 2-Propanol was manufactured by the strong-acid process, and this process has been judged to be carcinogenic. But the carcinogenicity of 2-propanol has not been proved.

Reproductive toxicity: In a two-generation toxicity study in rats which were dosed by oral gavage with 0, 100, 500, 1,000 mg/kg/day of 2-propanol, increased liver and kidney weights and hepatocyte hypertrophy were observed in the groups dosed at 500 mg/kg and 1,000 mg/kg. Although increased mortality was observed in the 1,000 mg/kg F1 group, but there were no pathological findings. A reduction was observed in the mating index of the 1,000 mg/kg P2 males, but histological abnormalities were not observed. The no-observed effect level was determined to be 500 mg/kg/day, based on the reduced mating index.

1-Nonanol

- 1) There are many isomers in C9 alcohol, but only 3,5,5-trimethyl-1-hexanol (also called isononyl alcohol or 7-methyl-1-octanol) and nonyl alcohol (a mixture of primary alcohol

whose major components are methyloctanol and dimethylheptanol) are synthesized for industrial purposes. Therefore, 1-nonanol is presumably not manufactured for industrial purposes. The production volume of synthetic higher alcohol above C9 in 1994 was 54,213 tons.

- 2) In the fiscal year 1979 General Environmental Survey, 1-nonanol was not detected in water and bottom sediments .
- 3) In the results of this survey, 1-nonanol was not detected in water (unified detection limit:4 ppb), but was detected from 1 out of 10 areas and 3 out of 30 samples in bottom sediments, and the detected range was 0.304 ~ 0.392 ppm (unified detection limit:0.1 ppm).
- 4) From the above survey results, although 1-nonanol was detected in bottom sediments, the detected frequencies were low, so it does not seem to pose any problems.

Survey results of 1-nonanol

		(samples)	(areas)	detection range	detection limit
water	FY1979	0%(0/27)	0%(0/9)	not detected	5 ~ 50 ppb
	FY1995	0%(0/33)	0%(0/11)	not detected	4 ppb
bottom sediments	FY1979	0%(0/27)	0%(0/9)	not detected	0.3 ~ 1 ppm
	FY1995	10%(3/30)	10%(1/10)	0.304 ~ 0.392 ppm	0.1 ppm

Results of acute toxicity tests etc. for 1-nonanol

rat	LD ₅₀ (intraperitoneal)	800 mg/kg
mouse	LD ₅₀ (oral)	6,400 mg/kg
	LD ₅₀ (intraperitoneal)	800 mg/kg
	LC ₅₀ (inhalation)	5,500 mg/m ³ × 2 hours
rabbit	LD ₅₀ (dermal)	5,660 mg/kg

Repeated oral administration to rabbits of 1,480 mg/kg on each of 67 days over a period of 83 days resulted in no signs of intoxication. Repeated application to the skin of rabbits at the dose of 1,600 ~ 2,000 mg/kg for 1 hr/day over a period of 75 days resulted in retard growth and erythema of the treated skin but no mortality.

In rats and rabbits repeatedly exposed to concentration of 33, 99 and 136 ppm of the vapor for 2 hr/day for 2 months, deformed or degenerated glial cells diffusely scattered in the cerebral cortex and subcortex were observed.

2-Butoxyethanol

- 1) 2-Butoxyethanol is a good solvent for resins and oils, so it is used for surface coating and

dry cleaning. It is also used for brake fluids and used as a raw material for plasticizers. The production volume in 1993 is estimated to be 20,000 tons, and importation volume 9,172 tons.

- 2) In the fiscal year 1976 environmental survey, 2-butoxyethanol was not detected in both water and bottom sediments.
- 3) In the results of this survey, 2-butoxyethanol was not detected in bottom sediments (unified detection limit:0.22 ppm), but was detected from 1 out of 56 areas and 1 out of 168 samples in water, and the detected concentration was 2.2 ppb (unified detection limit:2 ppb).
- 4) From the above survey results, although 2-butoxyethanol was detected in water, the detected concentration levels and frequencies were low, so it does not seem to pose any problems. In the previous survey (fiscal year 1976), it was not detected in both water and bottom sediments, but in this survey the detection limit was lowered compared to past surveys, and presumably detected for this reason.

Survey results of 2-butoxyethanol

		(samples)	(areas)	detection range	detection limit
water	FY1976	0%(0/60)	0%(0/2)	not detected	90 ~ 100 ppb
	FY1995	1%(1/168)	2%(1/56)	2.2 ppb	2.2 ppb
bottom sediments	FY1976	0%(0/20)	0%(0/1)	not detected	0.4 ppm
	FY1995	0%(0/168)	0%(0/56)	not detected	0.22 ppm

Results of acute toxicity tests etc. for 2-butoxyethanol

rat	LD ₅₀ (oral)	470 mg/kg
	LD ₅₀ (intraperitoneal)	220 mg/kg
	LC ₅₀ (inhalation)	450 ppm × 2 hours
mouse	LD ₅₀ (oral)	1,230 mg/kg
	LD ₅₀ (intraperitoneal)	536 mg/kg
	LC ₅₀ (inhalation)	700 ppm × 7 hours
rabbit	LD ₅₀ (oral)	300 mg/kg
	LD ₅₀ (intraperitoneal)	220 mg/kg
	LD ₅₀ (dermal)	220 mg/kg
guinea pig	LD ₅₀ (oral)	1,230 mg/kg
	LD ₅₀ (dermal)	230 mg/kg

The dermal irritancy was slightly observed and ophthalmological eye irritancy was moderately to markedly observed in rabbits.

After feeding with diet including 200, 950 ppm to rats or 500, 1000 ppm to mice, testicular atrophy was observed in rats and decrease of erythrocyte counts in mice.

Repeated exposure of rats to 62 ppm or above for 92 days, a tendency of erythrocyte hemolysis was observed. In a study of repeated dermal contact to rabbits for 6 hours per day for 5 days a week, hematuria was observed at 180 mg/kg as a minimum effective dose. In the 150 mg/kg group, no irritation to the skin or hematuria was observed.

Although butoxyacetic acid, the metabolite of 2-butoxyethanol, was responsible for the hemolytic effects, the metabolic rate was slower in humans than in rats and human erythrocyte was more tolerant compared to rats, so humans have less risk of hemolysis compared to rats.

Mutagenicity: Negative in a study of micronucleus tests and sister chromatid exchange tests using the peripheral blood of workers occupationally exposed to 0.5 ~ 0.6 ppm of this substance (and 2.1 ~ 2.9 ppm of ethoxyethanol and 0.1 ~ 0.5 ppm of ethoxyethyl acetate) in varnish production plant.

Teratogenicity: Teratogenicity was not observed in a study of repeated exposure of pregnant rats at 100 ppm vapor or rabbits at 200 ppm vapor during organogenesis.

Bis(2-chloroethyl) ether

- 1) Bis(2-chloroethyl) ether is used for intermediates of organic compounds and extractants, especially as synthetic raw material for morpholine and its derivatives. The production volume in 1989 is estimated to be 700 tons. It is also formed in the chlorination of water supply and drainage which contains ethyl ether.
- 2) In the fiscal year 1984 and 1977 General Environmental Survey, bis(2-chloroethyl) ether was not detected in both water and bottom sediments .
- 3) In the results of this survey, bis(2-chloroethyl) ether was not detected in bottom sediments or fishes (unified detection limit:0.01 ppm for bottom sediments and 0.6 ppm for fishes). But it was detected from 2 out of 9 areas and 6 out of 27 samples in water, and the detection range was 0.030 ~ 0.071 ppb (unified detection limit:0.02 ppb).
- 4) From the above survey results, although bis(2-chloroethyl) ether was detected in water, the detected frequencies were not so high. But since it was detected for the first time in this survey, environmental surveys should be conducted after a certain period of time to monitor its transition. In conducting the surveys, a more detailed surveys and evaluation with a lower detection limit should be investigated.

Survey results of bis(2-chloroethyl) ether

		(samples)	(areas)	detection range	detection limit
water	FY1977	0%(0/6)	0%(0/2)	not detected	2 ~ 5 ppb
	FY1984	0%(0/24)	0%(0/8)	not detected	0.07 ~ 0.1 ppb
	FY1995	22%(6/27)	22%(2/9)	0.030 ~ 0.071 ppb	0.02 ppb
bottom sediments	FY1977	0%(0/6)	0%(0/2)	not detected	0.5 ~ 0.6 ppm
	FY1984	0%(0/24)	0%(0/8)	not detected	0.003 ~ 0.008 ppm
	FY1995	0%(0/33)	0%(0/11)	not detected	0.01 ppm
fishes	FY1995	0%(0/33)	0%(0/11)	not detected	0.6 ppm

Results of acute toxicity tests etc. for bis(2-chloroethyl) ether

rat	LD ₅₀ (oral)	75 mg/kg
mouse	LD ₅₀ (oral)	209 mg/kg
	LC ₅₀ (inhalation)	650 mg/m ³ (approx.108 ppm) × 2 hours
rabbit	LD ₅₀ (oral)	126 mg/kg
	LD ₅₀ (dermal)	90 mg/kg
guinea pig	LD ₅₀ (dermal)	300 mg/kg
	LC ₅₀ (inhalation)	500 ppm × 1 hour

The skin irritancy was slightly observed and the ophthalmological irritancy was markedly observed in rabbits.

Tumorigenicity: Giving a repeated oral dose of this substance to 2 strains of mice at a dose of 100 mg/kg, for 7 ~ 28 days after birth, and then feeding a diet at a dose of 300 mg/kg body weight for 80 weeks, both strains showed significant increases of incidence of hepatoma compared to the control group. Giving a repeated subcutaneous or dermal dose of this substance to mice and rats, the incidence of tumorigenesis did not increase.

Mutagenicity: Negative in the Ames test (TA 100).

Positive in mutagenicity tests using fruit fly.

2-Methyl-2,4-pentanediol

1) 2-Methyl-2,4-pentanediol is used as a coupling agent by mixing with soap for dry cleaning, unctuous oil, industrial detergents and hydraulic fluid, and used as the solvent for lubricating oil, cutting oil, homogenizer, stabilizer, bactericides for wood and preservatives, and the solvent for ink made from dyestuff and synthetic resin, and as penetrants and softener for cork, casein, leather, paper and fiber. It is also used as high boiler for

perfumes, sensitive paper and paints. The production volume in 1993 was 1,000 tons.

- 2) In the fiscal year 1980 General Environmental Survey, 2-methyl-2,4-pentanediol was not detected in both water and bottom sediments .
- 3) In the results of this survey, 2-methyl-2,4-pentanediol was not detected in water (unified detection limit:0.2 ppb), but was detected from 2 out of 11 areas and 5 out of 32 samples in bottom sediments, and the detection range was 0.022 ~ 0.030 ppm (unified detection limit:0.0043 ppm).
- 4) From the above survey results, although 2-methyl-2,4-pentanediol was detected in bottom sediments, the detected frequencies were low, so it does not seem to pose any problems.

Survey results of 2-methyl-2,4-pentanediol

		(samples)	(areas)	detection range	detection limit
water	FY1980	0%(0/27)	0%(0/9)	not detected	2.5 ~ 30 ppb
	FY1995	0%(0/33)	0%(0/11)	not detected	0.2 ppb
bottom sediments	FY1980	0%(0/27)	0%(0/9)	not detected	0.025 ~ 1.4 ppm
	FY1995	16%(5/32)	18%(2/11)	0.022 ~ 0.030 ppm	0.0043 ppm

Results of acute toxicity tests etc. for 2-methyl-2,4-pentanediol

rat	LD ₅₀ (oral)	3,700 mg/kg
	LC ₅₀ (inhalation)	> 310 mg/m ³ × 1 hour
mouse	LD ₅₀ (oral)	3,097 mg/kg
	LD ₅₀ (intraperitoneal)	1,299 mg/kg
rabbit	LD ₅₀ (oral)	3,200 mg/kg
	LD ₅₀ (dermal)	12,300 mg/kg
guinea pig	LD ₅₀ (oral)	2,800 mg/kg

The skin irritancy was slightly to moderately observed and the ophthalmological eye irritancy was markedly observed in rabbits.

Most human beings exposed 15 min to 50 ppm in the air were able to detect the odor and a few noted eye irritataion. At a concentration of 100 ppm, the odor was plain and some noted nasal irritation and respiratory discomfort; at 1,000 ppm, there was irritation of the eyes, nose, and throat, and respiratory discomfort.

1,2-Butanediol

- 1) 1,2-Butanediol is used for surface active agents, anti-freezing agents and synthetic raw materials. The production volume in 1991 was 822 tons.

- 2) In the results of this survey, 1,2-butanediol was not detected in water (unified detection limit:0.2 ppb), but it was detected from 1 out of 11 areas and 3 out of 33 samples in bottom sediments, and the detection range was 0.009 ~ 0.013 ppm (unified detection limit:0.0061 ppm).
- 3) From the above survey results, although 1,2-butanediol was detected in bottom sediments, the detected frequencies were low, so it does not seem to pose any problems.

Survey results of 1,2-butanediol

		(samples)	(areas)	detection range	detection limit
water	FY1995	0%(0/33)	0%(0/11)	not detected	0.2 ppb
bottom sediments	FY1995	9%(3/33)	9%(1/11)	0.009 ~ 0.013 ppm	0.0061 ppm

Acute toxicity test results etc. for 1,2-butanediol

rat	LD ₅₀ (oral)	16,000 mg/kg
mouse	LD ₅₀ (inhalation)	3,720 mg/kg

When applied to the eyes of rabbits, irritancy was observed with undiluted liquid, whereas a 10% aqueous solution caused no response. The skin irritancy was not observed with the undiluted liquid. When rats were fed a diet substituted with this substance up to 30%, they survived until the substitution rate reached 30%, but when the rate was raised to 40%, rats died after 11 to 29 days.

Bis(2-ethylhexyl) adipate

- 1) Bis(2-ethylhexyl) adipate is an excellent cold resistant plasticizer for vinyl chloride resin. It is used as a plasticizer for leathers, film sheets for general use, extrusion and paste. The production volume in 1993 was 32,500 tons (including adipates).
- 2) In the results of the fiscal year 1978 General Environmental Survey, bis(2-ethylhexyl) adipate was not detected in both water and bottoms sediments .
- 3) In the results of this survey, bis(2-ethylhexyl) adipate was not detected in water (unified detection limit:0.7 ppb), but it was detected from 5 out of 10 areas and 11 out of 29 samples in bottom sediments. The detection range was 0.016 ~ 0.10 ppm (unified detection limit:0.012 ppm).
- 4) From the above survey results, although bis(2-ethylhexyl) adipate was not detected in water, it was detected with rather high detected frequencies in bottom sediments. Since the detected frequencies in bottom sediments were rather high in this survey, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey for bis(2-ethylhexyl) adipate in fishes should also be conducted together with other media.

Survey results of bis(2-ethylhexyl) adipate

		(samples)	(areas)	detection range	detection limit
water	FY1978	0%(0/30)	0%(0/10)	not detected	0.4 ~ 25 ppb
	FY1995	0%(0/33)	0%(0/11)	not detected	0.7 ppb
bottom sediments	FY1978	0%(0/33)	0%(0/10)	not detected	0.02 ~ 1 ppm
	FY1995	38%(11/29)	50%(5/10)	0.016 ~ 0.10 ppm	0.012 ppm

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

rat	LD ₅₀ (oral)	9,100 mg/kg
	LD ₅₀ (intraperitoneal)	> 50 ml/kg
mouse	LD ₅₀ (oral)	15,000 mg/kg
	LD ₅₀ (intraperitoneal)	> 100,000 mg/kg

The general toxicity of this substance was extremely low, and the results of experiments giving a large intraperitoneal dose to mice and applying undiluted liquid to the skin of humans were both negative. In experiments feeding rats with a diet containing 0.5%, 2.0% and 5.0% of this substance for a month and a dose of 2 g/kg/day to dogs for 2 months, growth inhibition was observed in the group of rats fed a diet containing 5%. Others were negative including the histopathological examination.

In experiments feeding rats and mice with a diet containing 0 ~ 25,000 ppm of this substance for 13 weeks, no abnormalities were observed by gross examination and histological examination.

Tumorigenicity: F344 rats and B6C3F1 mice were fed at dietary concentrations of 0, 1,000, 2,500 mg/kg of this substance for 103 weeks, slaughtered and examined in 104 to 107 weeks, no tumorigenicity was observed in rats, but in male mice hepatocellular carcinoma (7/50, 12/49, 12/29) and hepatic adenoma (6/50, 8/49, 15/49) and in female rats hepatocellular carcinoma (1/50, 4/49, 12/49) and hepatic adenoma (2/50, 5/50, 6/50) were observed. It has been concluded that the tumorigenicity (hepatocellular carcinoma) in female rats was obviously shown and tumorigenicity (hepatic adenoma) in male rats was probably shown.

Mutagenicity: Negative in the Ames test (TA 98, 100, 1535, 1537, 1538)

Teratogenicity: In an experiment giving an intraperitoneal dose to rats in 5, 10 and 15 days after pregnancy, embryotoxicity was observed and the no-observed effect level is estimated to be approximately 1/30 of the LD₅₀ value. Giving a single intraperitoneal dose of 9,200 mg/kg to male rats, decrease of reproductive activity was observed.

2,2,4-Trimethyl-1,3-pentanediol diisobutyrate

- 1) 2,2,4-Trimethyl-1,3-pentanediol diisobutyrate is used as plasticizers for vinyl chloride resin (especially paste resin), slip additives for vinyl chloride, ink solvents for pressure or heat sensitive paper, other solvents, and plasticizers for adhesives.
- 2) In the results of this survey, 2,2,4-trimethyl-1,3-pentanediol diisobutyrate was detected from 2 out of 55 areas and 5 out of 165 samples in water, and from 5 out of 56 areas and 6 out of 168 samples in bottom sediments, and from 6 out of 51 areas and 18 out of 156 samples in fishes. The detected range was 0.100 ~ 0.16 ppb in water (unified detection limit: 0.1 ppb), and 0.023 ~ 0.095 ppm in bottom sediments (unified detection limit: 0.02 ppm) and 0.0063 ~ 0.044 ppm in fishes (unified detection limit: 0.0062 ppm).
- 3) From the above survey results, although 2,2,4-trimethyl-1,3-pentanediol diisobutyrate was detected from water, bottom sediments and fishes, the detected concentration levels and frequencies were low, so it does not seem to pose any problems. But since it was detected from all 3 media, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey results of 2,2,4-trimethyl-1,3-pentanediol diisobutyrate

		(samples)	(areas)	detection range	detection limit
water	FY1978	0%(0/30)	0%(0/10)	not detected	0.4 ~ 25 ppb
water	FY1995	3%(5/165)	4%(2/55)	0.100 ~ 0.16 ppb	0.1 ppb
bottom sediments	FY1995	4%(6/168)	9%(5/56)	0.023 ~ 0.095 ppm	0.02 ppm
fishes	FY1995	12%(18/156)	12%(6/51)	0.0063 ~ 0.044 ppm	0.0062 ppm

Results of acute toxicity tests etc. for 2,2,4-trimethyl-1,3-pentanediol diisobutyrate

The dermal irritancy was slight in guinea pigs.

3,3,5-Trimethyl-2-cyclohexen-1-one

- 1) 3,3,5-Trimethyl-2-cyclohexen-1-one is used as a synthetic raw material of isophorone diamine which is used as the raw material for polyurethane, and as solvents. The production volume in 1993 is estimated to be 4,500 tons.
- 2) In the results of the fiscal year 1981 General Environmental Survey, 3,3,5-trimethyl-2-cyclohexen-1-one was detected from 6 out of 12 areas and 18 out of 36 samples in bottom sediments. It was not detected in water.
- 3) In the results of this survey, 3,3,5-trimethyl-2-cyclohexen-1-one was detected from 3 out of 55 areas and 6 out of 165 samples in water, from 36 out of 52 areas and 97 out of 154

samples in bottom sediments, and from 13 out of 46 areas and 32 out of 141 samples in fishes. The detection range was 0.031 ~ 0.048 ppb for water, 0.00014 ~ 0.81 ppm for bottom sediments and 0.00023 ~ 0.017 ppm for fishes. The unified detection limit was 0.0235 ppb for water, 0.00014 ppm for bottom sediments and 0.00021 ppm for fishes.

4) From the above survey results, although 3,5,5-trimethyl-2-cyclohexen-1-one was detected in all water, bottom sediments and fishes, the detected frequencies were low, so it does not seem to pose any problems. But since the detected frequencies in bottom sediments were high, and it was also detected in water and fishes, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey results of 3,5,5-trimethyl-2-cyclohexen-1-one

		(samples)	(areas)	detection range	detection limit
water	FY1978	0%(0/30)	0%(0/10)	not detected	0.4 ~ 25 ppb
water	FY1981	0%(0/36)	0%(0/12)	not detected	0.02 ~ 10 ppb
	FY1995	4%(6/165)	5%(3/55)	0.031 ~ 0.048 ppb	0.0235 ppb
bottom sediments	FY1981	50%(18/36)	50%(6/12)	0.0006 ~ 0.0066 ppm	0.0003 ~ 0.2 ppm
	FY1995	63%(97/154)	69%(36/52)	0.00014 ~ 0.81 ppm	0.00014 ppm
fishes	FY1995	23%(32/141)	28%(13/46)	0.00023 ~ 0.017 ppm	0.00021 ppm

Results of acute toxicity tests etc. for 3,5,5-trimethyl-2-cyclohexane-1-one

rat (male)	LD ₅₀ (oral)	2,700 mg/kg
(female)	LD ₅₀ (oral)	2,100 mg/kg
	LD ₅₀ (intraperitoneal)	400 ~ 800 mg/kg
mouse	LD ₅₀ (oral)	2,200 mg/kg
	LD ₅₀ (intraperitoneal)	400 mg/kg
rabbit	LD ₅₀ (dermal)	1,390 mg/kg

Marked irritation appears when applied to the eyes of rabbits.

In an experiment exposing volunteers at a dose of 0, 40, 85, 200, 400 ppm, irritation to the eyes, nose and pharynx was markedly observed at 200 and 400 ppm and accompanied by suffocation feeling, but at 40 and 85 ppm, the degree of irritation was slight. Exposure for 15 minutes to 23 ppm also brought irritation to the eyes, nose and pharynx.

Tumorigenicity: In an experiment gavaging a repeated dose of this substance dissolved in corn oil at a dose of 0, 250, 500 mg/kg/day for 5 days per week for 103 weeks, carcinogenicity was not observed in female rats and mice. But in male rats, it was concluded that there was some evidence of carcinogenicity activity due to increase in the occurrence of renal tubular epithelial carcinoma (0/50, 3/50, 1/

50), preputial gland carcinoma (0/50, 0/50, 5/50) and benign tumors. And in male mice, it was concluded that there was equivocal evidence of carcinogenicity activity due to observation of hepatocellular carcinoma (14/48, 13/50, 22/50), hepatic adenoma (6/48, 8/50, 14/50) and malignant lymphoma (7/48, 18/50, 5/50).

Mutagenicity: Negative in the Ames test (TA98,100,1535,1537) regardless of the addition of S9-Mix. Negative in chromosomal aberration tests using CHO cells obtained from Chinese hamsters regardless of the addition of S9-Mix. Negative in sister chromatid exchange test using CHO cells with S9-Mix, but was positive without S9-Mix.

2- Butanone

- 1) 2-Butanone is used as a solvent for nitrocellulose, synthetic resins, lacquers, adhesives, printing inks, synthetic leathers, and refining lubricating oils, and intermediate for vulcanizing agents, and used for cleaning fluids. The production, exportation and importation volume in 1993 was 198,739 tons, 98,633 tons and 7,945 tons, respectively.
- 2) In the results of the fiscal year 1980 General Environmental Survey, 2-butanone was not detected in water and bottom sediments.
- 3) In the results of this survey, 2-butanone detected from 4 out of 55 areas and 8 out of 165 samples in water, from 25 out of 53 areas and 66 out of 159 samples in bottom sediments. The detection range was 1.2 ~ 2.5 ppb for water and 0.03 ~ 0.93 ppm for bottom sediments. The unified detection limit was 1 ppb for water and 0.028 ppm for bottom sediments.
- 4) From the above survey results, although 2-butanone was detected in both water and bottoms sediments, the detected concentration levels were low, so it does not seem to pose any problems. But since it was detected for the first time in this survey, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey results of 2-butanone

		(samples)	(areas)	detection range	detection limit
water	FY1980	0%(0/24)	0%(0/8)	not detected	3 ~ 8 ppb
	FY1995	5%(8/165)	7%(4/55)	1.2 ~ 2.5 ppb	1 ppb
bottom sediments	FY1980	0%(0/24)	0%(0/8)	not detected	0.15 ~ 0.4 ppm
	FY1995	42%(66/159)	47%(25/53)	0.03 ~ 0.93 ppm	0.028 ppm

Results of acute toxicity tests etc. for 2-butanone

rat	LD ₅₀ (oral)	2,737 mg/kg
	LC ₅₀ (inhalation)	23,500 mg/m ³ × 8 hours
mouse	LD ₅₀ (oral)	4,050 mg/kg
	LC ₅₀ (inhalation)	40,000 mg/m ³ × 2 hours
rabbit	LD ₅₀ (dermal)	6,480 mg/kg

The irritation to the skin was slightly to moderately observed in rabbits.

Irritation to the eyes, nose and pharynx was markedly observed at low concentration, and narcotic effects were observed at a high concentration level. At 7 ppm, in humans half the number of participant felt the smell, and at 100 ~ 200 ppm, irritation was felt in the eyes, pharynx and nose, and at 1,000 ppm unbearable discomfort were observed.

In animal experiments, no apparent change was observed in guinea pigs at 3,000 ppm, but irritation symptoms appeared at 10,000 ppm, and anesthetic effect was observed after 4 ~ 5 hours.

In exposing volunteers to 200 ppm vapor for 4 hours, no significant neuroethological change was observed.

In repeated exposure of rats and mice to 1,500 ppm for 7 ~ 9 weeks, and rats to 1,125 ppm for 55 hours, abnormalities were not observed including neurotoxicity. In repeated exposure of rats to 200 ppm × 12 hours a day for 24 weeks, temporary increase in the neurotransmitting rate was observed, but no histopathological change was observed.

Mutagenicity: Negative in the Ames test. Negative in the experiment using human lymphocyte.

Teratogenicity: Repeated exposure of rats during 6 ~ 15 days after pregnancy at 0, 1,000, 3,000 ppm for 7 hours a day, increased incidence of abnormal jaw development and loss of tail were observed in the fetus in the 3,000 ppm group. In exposing rats in 6 ~ 15 days after pregnancy for 7 hours a day at 0, 400, 1,000, and 3,000 ppm, supernumerary rib and delayed porosis were observed in the 3,000 ppm group accompanied by dam toxicity. But these were also observed in the control group, so it was not judged to indicate tumorigenicity.

Triclosan

- 1) Triclosan is an antimicrobial substance, and is added as disinfectants to soap, detergents, and shampoo for skin. All are manufactured at Ciba-Geigy's and imported and are quasidrugs. Importation volume is estimated to be 20 tons.
- 2) In the results of this survey, triclosan was not detected in water or fishes (unified detection limit:0.05 ppb for water and 0.003 ppm for fishes). But it was detected from 7 out of 8 areas and 19 out of 24 samples in bottoms sediments, and the detection range was 0.005 ~ 0.079 ppm (unified detection limit:0.0046 ppm).

3) From the above survey results, although triclosan was not detected in water, it was detected in bottom sediments, and the detected frequencies were high. Since the detected frequencies were high in this survey and since there is the data to show that it has a relatively high toxicity to aquatic organisms and effects to the ecological system are concerned, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey results of triclosan

		(samples)	(areas)	detection range	detection limit
water	FY1995	0%(0/33)	0%(0/11)	not detected	0.05 ppb
bottom sediments	FY1995	79%(19/24)	88%(7/8)	0.005 ~ 0.079 ppm	0.0046 ppm
fishes	FY1995	0%(0/33)	0%(0/11)	not detected	0.003 ppm

Results of acute toxicity tests etc. for triclosan

rat	LD ₅₀ (oral)	3,700 mg/kg
	LD ₅₀ (oral)	4,300 mg/kg
	LD ₅₀ (intraperitoneal)	89 mg/kg
mouse	LD ₅₀ (oral)	4,530 mg/kg
	LD ₅₀ (intraperitoneal)	1,090 mg/kg
	LD ₅₀ (intraperitoneal)	184 mg/kg
rabbit	LD ₅₀ (dermal)	> 9,300 mg/kg

In the skin irritancy was slightly observed and ophthalmological eye irritancy was observed in rabbits.

In humans no toxicity was observed when repeated dose of 1, 10, 30 and 100 mg/kg/day for 4 weeks, or 3 mg/kg/day for 13 weeks was given. In the case of 30, 100, 300 mg/kg/day per 52 weeks, symptoms of vomiting and diarrhea were observed at the dose of 100 and 300 mg/kg group. But there were no pathological observations.

In experiments feeding rats at dietary concentrations of 0, 300, 1,000, 3,000, 6,000 ppm of this substance for 2 years (1 year for the 6,000 ppm group), the main target organ was the liver, and swelling of hepatocyte etc. was observed in the 3,000 and 6,000 ppm group.

Mutagenicity: Negative in the Ames test. Negative in the chromosomal aberration test. Negative in the micronucleus test. Both positive and negative results have been reported in the spot test.

Teratogenicity and reproductive toxicity: In experiments giving an oral dose of 0 ~ 100 mg/kg to mice in 1 ~ 16 days of pregnancy and to rabbits in 6 ~ 18 days of pregnancy, evident teratogenicity was not observed.

In feeding rats at dietary concentrations of 0 ~ 3,000 ppm of this substance (0

~ 150 mg/kg/day) for 2 generations, abnormalities were not observed in the reproductive functions. The toxicity was observed in fetus born from females in the 3,000 ppm group (decrease of survival rate and occurrence of hydronephrosis).

In an experiment giving this substance in oral doses of 0, 100, 250, 400 mg/kg/day to rabbits in 7 ~ 17 days of pregnancy, dam toxicity and increase of fetus deaths were observed in the 400 mg/kg group. Teratogenicity was not observed in all groups including the 400 mg/kg group.

Results of ecological effect tests for triclosan

zebra fish	96 hr LC ₅₀	0.5 mg/l
daphnia	48 hr EC ₅₀	0.4 mg/l
algae	72 hr EC ₅₀	0.2 mg/l

3-Chlorotriclosan, 5-Chlorotriclosan, 3,5-Dichlorotriclosan

- 1) 3-Chlorotriclosan, 5-chlorotriclosan and 3,5-dichlorotriclosan are not manufactured. There are reports that they are formed unintentionally on chlorine bleaching.
- 2) In the results of this survey, 3-chlorotriclosan was not detected in water and fishes (unified detection limit:0.04 ppb for water, 0.003 ppm for fishes), but was detected from 1 out of 11 areas and 3 out of 33 samples in bottom sediments, and the detected concentration level was 0.009 ppm (unified detection limit:0.005 ppm).

5-Chlorotriclosan was not detected in water and fishes (unified detection limit:0.06 ppb for water and 0.003 ppm for fishes), but was detected from 1 out of 11 areas and 3 out of 33 samples in bottom sediments, and the detected concentration level was 0.01 ppm (unified detection limit:0.005 ppm).

3,5-Dichlorotriclosan was not detected in water (unified detection limit:0.05 ppb), but was detected from 1 out of 11 areas and 1 out of 33 samples in bottom sediments, from 1 out of 11 areas and 1 out of 33 samples in fishes. The detected concentration level was 0.0080 ppm for bottom sediments (unified detection limit:0.0056 ppm), and 0.018 ppm for fishes (unified detection limit:0.0089 ppm).

- 3) Evaluation of survey results corresponds to that for triclosan.

Survey results of 3-chlorotriclosan

		(samples)	(areas)	detection range	detection limit
water	FY1995	0%(0/33)	0%(0/11)	not detected	0.04 ppb
bottom sediments	FY1995	9%(3/33)	9%(1/11)	0.09 ppm	0.005 ppm
fishes	FY1995	0%(0/33)	0%(0/11)	not detected	0.003 ppm

Survey results of 5-chlorotriclosan

		(samples)	(areas)	detection range	detection limit
water	FY1995	0%(0/33)	0%(0/11)	not detected	0.06 ppb
bottom sediments	FY1995	9%(3/33)	9%(1/11)	0.01 ppm	0.005 ppm
fishes	FY1995	0%(0/33)	0%(0/11)	not detected	0.003 ppm

Survey results of 3,5-dichlorotriclosan

		(samples)	(areas)	detection range	detection limit
water	FY1995	0%(0/33)	0%(0/11)	not detected	0.05 ppb
Bottom sediments	FY1995	3%(1/33)	9%(1/11)	0.0080 ppm	0.0056 ppm
fishes	FY1995	3%(1/33)	9%(1/11)	0.018 ppm	0.0089 ppm

Results of acute toxicity tests etc. for 3-chlorotriclosan

mouse LD₅₀ (intraperitoneal) 710 mg/kg

Results of acute toxicity tests etc. for 5-chlorotriclosan

mouse LD₅₀ (intraperitoneal) 650 mg/kg

Results of acute toxicity tests etc. for 3,5-dichlorotriclosan

mouse LD₅₀ (intraperitoneal) 170 mg/kg
LD₅₀ (intraperitoneal) 430 mg/kg

(2) Air

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

Acetaldehyde

- 1) Acetaldehyde is used as a raw material for acetic acid, acetic anhydride, ethyl acetate, pentaerythritol, ethyl alcohol, acetaldol (butanol, octanol and methoxybutanol), sorbic acid, trimethylolpropane, chloral and glyoxal. It is also used for preservatives, photographic development, fuel compounding ingredients, solvents (for sulfur and phosphorus triiodide etc.), reducing agents and a raw material for perfumes. The production volume in 1994 was 369,364 tons.
- 2) Acetaldehyde was detected in 11 out of 12 areas and 43 out of 57 samples in the fiscal year 1987 Environmental Survey for Air.
- 3) In the results of this survey, acetaldehyde was detected in 16 out of 16 areas and 46 out of 47 samples, and the detection range was 1,800 ~ 45,000 ng/m³ (unified detection limit:500 ng/m³).
- 4) From the above survey results, acetaldehyde should be surveyed and evaluated in more detail, judging from its high detected frequencies and concentration levels.

Survey results of acetaldehyde

	(samples)	(areas)	detection range	detection limit
FY1987	75%(43/57)	92%(11/12)	930 ~ 22,000 ng/m ³	800 ng/m ³
FY1995	98%(46/47)	100%(16/16)	1,800 ~ 45,000 ng/m ³	500 ng/m ³

Crotonaldehyde

- 1) Crotonaldehyde is used as a raw material for butanol, crotonic acid, sorbic acid and medicines. The production volume in 1993 was 5,000 tons.
- 2) Crotonaldehyde was not detected in the fiscal year 1987 Environmental Survey for Air.
- 3) In the results of this survey, crotonaldehyde was detected in 1 out of 18 areas and 3 out of 54 samples, and the detection range was 3,600 ~ 5,200 ng/m³ (unified detection limit:3,000 ng/m³).
- 4) From the above survey results, since crotonaldehyde was detected for the first time in this survey despite its low detected frequencies and it has irritant action, environmental surveys should be promptly conducted and its transition should be monitored.

Survey results of crotonaldehyde

	(samples)	(areas)	detection range	detection limit
FY1987	0%(0/61)	0%(0/10)	not detected	800 ng/m ³
FY1995	6%(3/54)	6%(1/18)	3,600 ~ 5,200 ng/m ³	3,000 ng/m ³

Acetone

- 1) Acetone is important as a low boiler, and is used as a solvent for fats and oils, waxes, lacquers and varnishes. It is also used as a synthetic raw material for many chemicals such as methyl methacrylate, bisphenol A, diacetone alcohol, mesityl oxide, methyl isobutyl ketone, hexylene glycol and isophorone etc. The production, exportation and importation volume in 1993 was 350,312 tons, 42,193 tons and 22,146 tons, respectively.
- 2) In the results of this survey, acetone was detected in 17 out of 17 areas and 49 out of 49 samples, and the detection range was 150 ~ 31,000 ng/m³ (unified detection limit:2 ng/m³).
- 3) From the above survey results, although the detected frequencies were high for acetone, it does not seem to pose any problems, judging from the detected concentration levels.

Survey results of acetone

	(samples)	(areas)	detection range	detection limit
FY1995	100%(49/49)	100%(17/17)	150 ~ 31,000 ng/m ³	2 ng/m ³

Results of acute toxicity tests etc. for acetone

rat	LD ₅₀ (oral)	5,800 mg/kg
	LC ₅₀ (inhalation)	50,100 mg/m ³ × 8 hours
mouse	LD ₅₀ (oral)	3,000 mg/kg
	LD ₅₀ (intraperitoneal)	1,297 mg/kg

The skin irritancy was slightly observed but ophthalmological eye irritancy was markedly observed in rabbits. In an experiment exposing volunteers for 2 ~ 4 hours, the smell was felt at 500 ppm but no subjective symptoms occurred. When volunteers were experimentally exposed to 250 ppm for 4 hours, neurobehavioral change for some of the examination items was observed compared to the control group. But no evident change took place as a whole. The inflammations in the respiratory and digestive organs were observed in workers undergoing occupational exposure of an average of 700 ppm acetone for 3 hours a day, for 7 ~ 15 years. In workers exposed to an average 950 ~ 1,060 ppm a day when cleaning the filter press, irritation in the eyes, nose and pharynx, a headache and a feeling of floatation were observed.

Mutagenicity: Negative in the Ames test (TA 98, 100, 1535, 1537).

Positive in a sister chromatid exchange test using CHL cells obtained from Chinese hamsters when the direct method was used.

4-Methyl-2-pentanone

- 1) 4-Methyl-2-pentanone is used as a solvent for nitrocellulose, synthetic resins, magnetic tapes and lacquers, and dewaxing solvents and deoiling agents for petroleum products, and used in the pharmaceutical industry and electroplating industry, and used for extractants of pyrethrin or penicillin. The production, exportation and importation volume in 1993 was 51,869 tons, 15,393 tons and 2,179 tons, respectively.
- 2) In the results of this survey, 4-methyl-2-pentanone was detected in 5 out of 17 areas and 10 out of 51 samples, and the detection range was 1,100 ~ 3,800 ng/m³ (unified detection limit: 1,100 ng/m³).
- 3) From the above survey results, 4-methyl-2-pentanone does not seem to pose any problems judging from its detected frequencies and concentration levels.

Survey results of 4-methyl-2-pentanone

	(samples)	(areas)	detection range	detection limit
FY1995	20%(10/51)	29%(5/17)	1,100 ~ 3,800 ng/m ³	1,100 ng/m ³

2-Butanone

- 1) 2-Butanone is used as a solvent for nitrocellulose, synthetic resins, lacquers, adhesives, printing inks, synthetic leathers, and refining lubricating oils, and intermediate for vulcanizing agents, and used for cleaning fluids. The production, exportation and importation volume in 1993 was 198,739 tons, 98,633 tons and 7,945 tons, respectively.
- 2) In the results of this survey, 2-butanone was detected in 13 out of 18 areas and 35 out of 53 samples, and the detection range was 500 ~ 16,000 ng/m³ (unified detection limit: 500 ng/m³).
- 3) From the above survey results, although the detected frequencies were high for 2-butanone, it does not seem to pose any problems at present, judging from the detected concentration levels.

Survey results of 2-butanone

	(samples)	(areas)	detection range	detection limit
FY1995	66%(35/53)	72%(13/18)	500 ~ 16,000 ng/m ³	500 ng/m ³

Ethyl acetate

- 1) Ethyl acetate is used as a solvent for printing inks, adhesives and lacquers, and used as a solvent for nitrocellulose in manufacturing synthetic leathers, films and floorings. It is also used as a component of detergents, lusters for sweets, perfumes, antiseptics, and spirit varnishes, and an extractant for camphor, fats and oils and antibiotics. The production, exportation and importation volume in 1993 was 156,431 tons, 11,505 tons and 16,328 tons, respectively.
- 2) In the results of this survey, ethyl acetate was detected in 6 out of 6 areas and 18 out of 18 samples, and the detection range was 99 ~ 11,800 ng/m³ (unified detection limit: 2 ng/m³).
- 3) From the above survey results, although ethyl acetate had high detected frequencies, it does not seem to pose any problems at present, judging from the detected concentration levels.

Survey results of ethyl acetate

	(samples)	(areas)	detection range	detection limit
FY1995	100%(18/18)	100%(6/6)	99 ~ 11,800 ng/m ³	2 ng/m ³

Results of acute toxicity tests etc. for ethyl acetate

rat	LD ₅₀ (oral)	5,620 mg/kg
mouse	LD ₅₀ (oral)	4,100 mg/kg
	LD ₅₀ (intraperitoneal)	709 mg/kg
	LC ₅₀ (inhalation)	4,500 mg/m ³ × 2 hours
rabbit	LD ₅₀ (oral)	4,935 mg/kg
guinea pig	LD ₅₀ (oral)	5,500 mg/kg

When exposing volunteers to vapor, the smell was felt at 200 ppm and irritation to the pharynx was felt at 400 ppm. Workers exposed to 375 ~ 1,500 ppm for several months were reported not to recognize any abnormalities in subjective or objective symptoms.

Mutagenicity: Positive in sister chromatid exchange tests using CHL cells obtained from Chinese hamsters when the direct method was used.

Vinyl acetate

- 1) Vinyl acetate is used as a raw material for polyvinyl acetate and used in copolymerization with various vinyl monomers. The production, exportation and importation volume in 1993 was 538,535 tons, 27,538 tons, and 31,674 tons, respectively.
- 2) In the results of this survey, vinyl acetate was detected in 2 out of 6 areas and 4 out of 18 samples, and the detection range was 55 ~ 5,000 ng/m³ (unified detection limit:50 ng/m³).
- 3) From the above survey results, environmental surveys for vinyl acetate should be conducted after a certain period to monitor its transition, judging from the detected frequencies and concentration levels.

Survey results of vinyl acetate

	(samples)	(areas)	detection range	detection limit
FY1995	22%(4/18)	33%(2/6)	55 ~ 5,000 ng/m ³	50 ng/m ³

Butyl acetate

- 1) Butyl acetate is used as a solvent for nitrocellulose lacquers and many other resins, as a solvent in the manufacturing of synthetic leathers, synthetic fibers and synthetic resins, as an extractant for fats and oils and medicines, and as a component of perfumes. The production, exportation and importation volume in 1993 was 57,537 tons, 11,199 tons and 989 tons, respectively.
- 2) In the results of this survey, butyl acetate was detected in 6 out of 6 areas and 18 out of 18 samples, and the detection range was 8.1 ~ 2,100 ng/m³ (unified detection limit:2 ng/m³).
- 3) From the above survey results, although butyl acetate was detected with high detected frequencies, it does not seem to pose any problems at present, judging from the detected concentration levels.

Survey results of butyl acetate

	(samples)	(areas)	detection range	detection limit
FY1995	100%(18/18)	100%(6/6)	8.1 ~ 2,100 ng/m ³	2 ng/m ³

Methanol

- 1) Methanol is used as a solvent, a solvent for chemical reactions, extractants, detergents, and an industrial raw material for formaldehyde, dimethyl sulfate, chloromethane etc. It is also used as a fuel for motor vehicles. The production, exportation and importation volume in 1993 was 57,675 tons, 777 tons and 1,772,312 tons, respectively.
- 2) In the results of this survey, methanol was detected in 5 out of 6 areas and 14 out of 18 samples, and the detection range was 3,100 ~ 49,000 ng/m³ (unified detection limit: 2,000 ng/m³).
- 3) From the above survey results, although methanol was detected with high detected frequencies, it does not seem to pose any problems at present, judging from the detected concentration levels. But since it is used as a fuel for motor vehicles and demand for this substance is expected to increase in the future, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey results of methanol

	(samples)	(areas)	detection range	detection limit
FY1995	77%(14/18)	83%(5/6)	3,100 ~ 49,000 ng/m ³	2,000 ng/m ³

Results of acute toxicity tests etc. for methanol

rat	LD ₅₀ (oral)	5,628 mg/kg
	LD ₅₀ (intraperitoneal)	7,529 mg/kg
	LC ₅₀ (inhalation)	64,000 ppm × 4 hours
mouse	LD ₅₀ (oral)	7,300 mg/kg
	LD ₅₀ (intraperitoneal)	10,765 mg/kg
rabbit	LD ₅₀ (oral)	14,200 mg/kg
	LD ₅₀ (dermal)	15,800 mg/kg

The skin irritancy and ophthalmological eye irritancy were moderately observed.

Most of the intoxication cases occur when swallowed by mistake (mistaking it for ethanol). After inebriation, the symptoms of headaches, vertigo, stomachaches, nausea, vomiting and visual disturbance occur in 6 ~ 30 hours. Recent reports indicated repeated inhalation of high concentration methanol (and methyl acetate) brought eyesight disorders including blindness in patients using methanol in glue-sniffing.

Teratogenicity: In experiments exposing rats in 1 ~ 19 days of pregnancy for 5,000 and 10,000 ppm for 7 hours a day, or 20,000 ppm for 7 hours a day in the 7 ~ 15 days of pregnancy, the effect of dam toxicity to the fetus (supernumerary rib etc.) was

observed in the 20,000 ppm group, and similar malformations were observed in the 10,000 ppm group (but the frequency was not more than the control group). Abnormalities were not observed in the 5,000 ppm group.

1-Butanol

- 1) 1-Butanol is used for paint solvents, dehydrating agents, extractants, demulsifiers and penetrants, but it is mainly used as a latent solvent for nitrocellulose lacquer. It is also used for plasticizers, medicines, stabilizers and perfumes. The production, exportation and importation volume in 1993 was 188,334 tons, 21,028 tons and 13,267 tons, respectively.
- 2) In the results of this survey, 1-butanol was detected in 3 out of 5 areas and 9 out of 15 samples, and the detection range was 51 ~ 1,300 ng/m³ (unified detection limit:50 ng/m³) .
- 3) From the above survey results, 1-butanol does not seem to pose any problems at present, judging from the detected frequencies and concentration levels.

Survey results of 1-butanol

	(samples)	(areas)	detection range	detection limit
FY1995	60%(9/15)	60%(3/5)	51 ~ 1,300 ng/m ³	50 ng/m ³

2-Propanol

- 1) 2-Propanol is used as a solvent for natural or synthetic resins and lacquers, an extractant for alkaloids and oils and a raw material for cosmetics, antiseptics, antifreezing agents and manufacturing acetone. The production volume in 1994 was 129,602 tons.
- 2) In the results of this survey, 2-propanol was detected in 6 out of 6 areas and 16 out of 18 samples, and the detection range was 90 ~ 10,000 ng/m³ (unified detection limit:50 ng/m³).
- 3) From the above survey results, although 2-propanol was detected with high detected frequencies, it does not seem to pose any problems at present, judging from detected concentration levels.

Survey results of 2-propanol

	(samples)	(areas)	detection range	detection limit
FY1995	89%(16/18)	100%(6/6)	90 ~ 10,000 ng/m ³	50 ng/m ³

2-Propen-1-ol

- 1) 2-Propen-1-ol is used in the manufacturing of glycerin which is used as a synthetic raw material for cosmetics and emulsifiers etc. It is also used as a raw material for diallyl phthalates, medicines, allyl glycidyl ethers, propane sultone, perfumes and flame retardants. The production, exportation and importation volume in 1993 was 45,000 tons (estimation), 3,009 tons and 347 tons, respectively.
- 2) In the results of this survey, 2-propen-1-ol was detected in 1 out of 5 areas and 3 out of 15 samples, and the detection range was 50 ~ 60 ng/m³ (unified detection limit: 50 ng/m³).
- 3) From the above survey results, although 2-propen-1-ol was detected with high detected frequencies, it does not seem to pose any problems judging from its detected concentration levels.

Survey results of 2-propen-1-ol

	(samples)	(areas)	detection range	detection limit
FY1995	20%(3/15)	20%(1/5)	5 ~ 60 ng/m ³	50 ng/m ³

Results of acute toxicity tests etc. for 2-propen-1-ol

rat	LD ₅₀ (oral)	64 mg/kg
	LC ₅₀ (inhalation)	76 ppm × 8 hours
mouse	LD ₅₀ (oral)	96 mg/kg
rabbit	LD ₅₀ (oral)	71 mg/kg
	LD ₅₀ (dermal)	45 mg/kg

The ophthalmological eye irritancy was markedly observed in rabbits.

Marked liver disorder was found after a high dose administration. Liver dysfunction was also observed after repeated oral administration in a low dose to rats (0.072 mg/kg/day).

In experiments exposing rats to vapor 5 days a week for 13 weeks, no evident change was observed at 5 and 10 ppm. But 10 times exposures brought death in some cases at 60 and 100 ppm.

The characteristic of effects to humans is evident local irritation. At 25 ppm, the irritation to the eyes is extremely marked, and at 5 ppm, there still was irritation. At 0.8 ppm, the smell was still felt.

Mutagenicity: Positive in the Ames test (TA 100 without S9-Mix, TA 1535 with and without S9-Mix).

Negative in the Ames test (TA 98, TA 1538).

2-Methyl-2-propanol

- 1) 2-Methyl-2-propanol is used for solvents, extractants, pesticides and antiseptics. The production volume in 1993 was 500 tons.
- 2) In the results of this survey, 2-methyl-2-propanol was detected in 5 out of 5 areas and 12 out of 14 samples and the detection range was 20 ~ 250 ng/m³ (unified detection limit:20 ng/m³).
- 3) From the survey results, although 2-methyl-2-propanol was detected with high detected frequencies, it does not seem to pose any problems, judging from the detected concentration levels.

Survey results of 2-methyl-2-propanol

	(samples)	(areas)	detection range	detection limit
FY1995	86%(12/14)	100%(5/5)	20 ~ 250 ng/m ³	20 ng/m ³

1-Propanol

- 1) 1-Propanol is used as a solvent for lacquers or paints, a raw material for plasticizers, cosmetics, detergents, insecticides and adhesives, and used for inks and antifreezing agents.
- 2) In the results of this survey, 1-propanol was detected in 1 out of 6 areas and 1 out of 18 samples, nad the detection range was 210 ng/m³ (unified detection limit:200 ng/m³).
- 3) From the above survey results, 1-propanol does not seem to pose any problems, judging from the detected frequencies and concentration levels.

Survey results of 1-propanol

	(samples)	(areas)	detection range	detection limit
FY1995	6%(1/18)	17%(1/6)	210 ng/m ³	200 ng/m ³

2-Octanol

- 1) 2-Octanol is used as a solvent for lacquers, resins and dyes, and as a raw material for demulsifiers, wetting agents and plasticizers.
- 2) In the results of this survey, 2-octanol was detected in 4 out of 6 areas and 10 out of 18 samples, and the detection range was 11 ~ 130 ng/m³ (unified detection limit:4 ng/m³).
- 3) From the above survey results, although 2-octanol was detected with high detected frequencies, it does not seem to pose any problems.

Survey results of 2-Octanol

	(samples)	(areas)	detection range	detection limit
FY1995	56%(10/18)	67%(4/6)	11 ~ 130 ng/m ³	4 ng/m ³

1,3-Dichloro-2-propanol

- 1) 1,3-Dichloro-2-propanol is used as an intermediate for epichlorohydrin which is a raw material for epoxy resins. The production, exportation and importation volume in 1993 was 195,104 tons, 18,250 tons and 6,912 tons, respectively.
- 2) 1,3-Dichloro-2-propanol was not detected in the fiscal year 1987 Environmental Survey for Air.
- 3) In the results of this survey, 1,3-dichloro-2-propanol was detected in 1 out of 6 areas and 1 out of 18 samples, and the detected concentration level was 5 ng/m³ (unified detection limit:5 ng/m³).
- 4) From the above survey results, 1,3-dichloro-2-propanol had low detected frequencies. But since it was detected for the first time in this survey, environmental surveys should be conducted after a certain period of time to monitor its transition.

Survey results of 1,3-dichloro-2-propanol

	(samples)	(areas)	detection range	detection limit
FY1987	0%(0/12)	0%(0/73)	not detected	40 ng/m ³
FY1995	6%(1/18)	17%(1/6)	5 ng/m ³	5 ng/m ³

1-Nonanol

- 1) There are many isomers in C9 alcohol, but only 3,5,5-trimethyl-1-hexanol (also called isononyl alcohol or 7-methyl-1-octanol) and nonyl alcohol (a mixture of primary alcohol whose major components are methyloctanol and dimethylheptanol) are synthesized for industrial purposes. Therefore, 1-nonanol is presumably not manufactured for industrial purposes. The production volume of synthetic higher alcohol above C9 in 1994 was 54,213 tons.
- 2) In the results of this survey, 1-nonanol was detected in 5 out of 6 areas and 14 out of 18 samples, and the detection range was 8.7 ~ 81 ng/m³ (unified detection limit:6 ng/m³).
- 3) From the above survey results, although 1-nonanol was detected with high detected frequencies, it does not seem to pose any problems.

Survey results of 1-nonal

	(samples)	(areas)	detection range	detection limit
FY1995	78%(14/18)	83%(5/6)	8.7 ~ 81 ng/m ³	6 ng/m ³

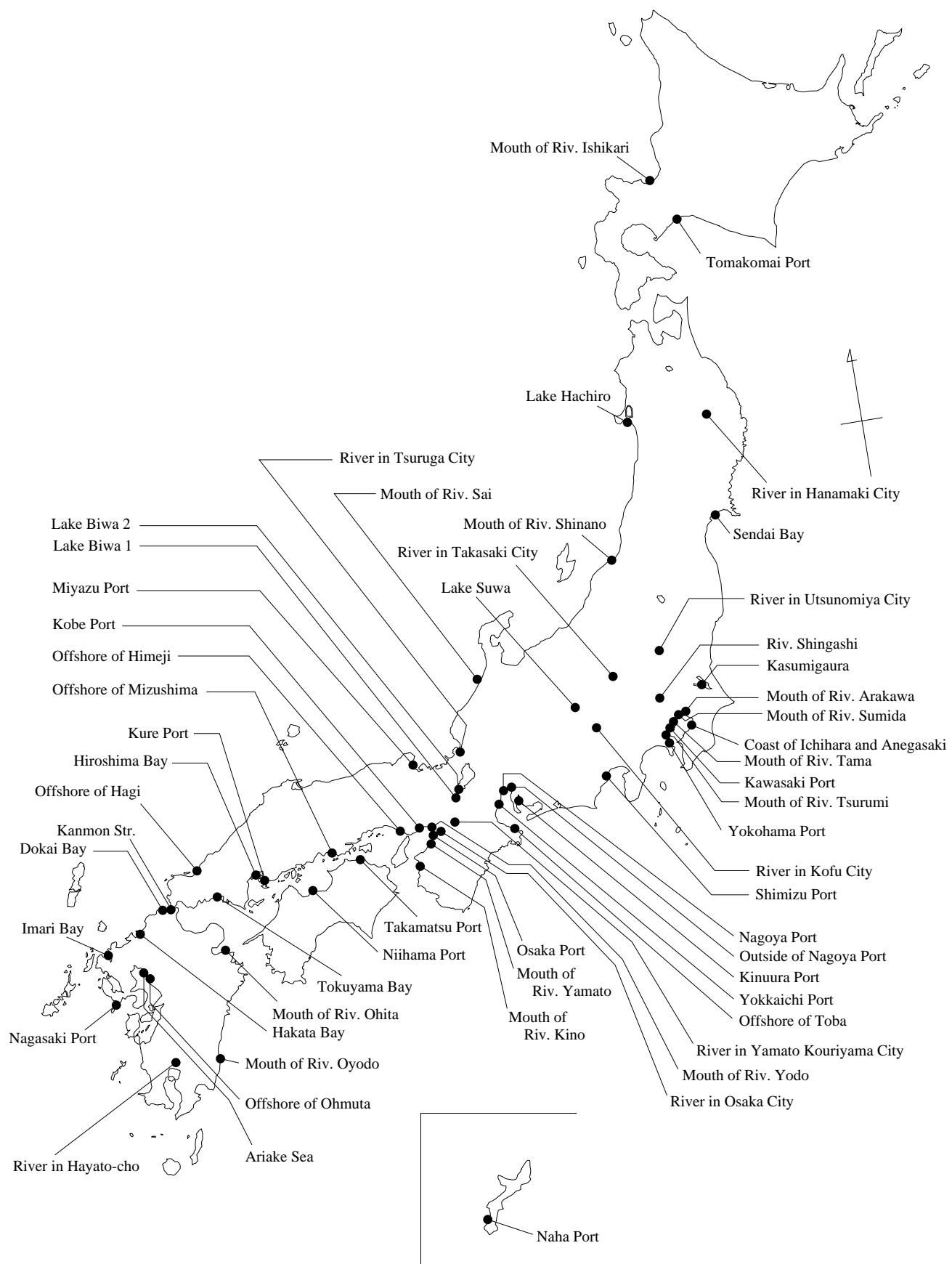
Bis(2-ethylhexyl) adipate

- 1) Bis(2-ethylhexyl) adipate is an excellent cold resistant plasticizer for vinyl chloride resin. It is used as a plasticizer for leathers, film sheets for general use, extrusion and paste. The production volume in 1993 was 32,500 tons (including adipates).
- 2) Bis(2-ethylhexyl) adipate was detected in 11 out of 12 areas and 47 out of 72 samples in the 1984 Environmental Survey for Air.
- 3) In the results of this survey, bis(2-ethylhexyl) adipate was detected in 13 out of 14 areas and 31 out of 41 samples, and the detection range was 1.0 ~ 22 ng/m³ (unified detection limit: 1 ng/m³).
- 4) From the above survey results, although bis(2-ethylhexyl) adipate was detected with high detected frequencies, it does not seem to pose any problems at present, judging from its detected concentration levels.

Survey results of bis(2-ethylhexyl) adipate

	(samples)	(areas)	detection range	detection limit
FY1984	65%(47/72)	92%(11/12)	0.23 ~ 16.7 ng/m ³	0.1 ~ 0.61 ng/m ³
FY1995	76%(31/41)	93%(13/14)	1.0 ~ 22 ng/m ³	1 ng/m ³

Fig. 2-1 Locations of the Environmental Survey for Water (Fiscal Year 1995)



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Fig. 2-2 Locations of the Environmental Survey for Air (Fiscal Year 1995)



Table 2-2 Outline of the Environmental Survey for Air (Fiscal Year 1995)Unit : ng/m³

Chemical Substances	Detected samples/ Total samples	Detected areas/ Total areas	Detection range	Unified detection limit
Acetaldehyde	46/47	16/16	1800 – 45000	500
Crotonaldehyde	3/54	1/18	3600 – 5200	3000
Acetone	49/49	17/17	150 – 31000	2
4-Methyl-2-pentanone	10/51	5/17	1100 – 3800	1100
2-Butanone	35/53	13/18	500 – 16000	500
Ethyl acetate	18/18	6/6	99 – 11800	2
Vinyl acetate	4/18	2/6	55 – 5000	50
Butyl acetate	18/18	6/6	8.1 – 2100	2
Methanol	14/18	5/6	3100 – 49000	2000
1-Butanol	9/15	3/5	51 – 1300	50
2-Propanol	16/18	6/6	90 – 10000	50
2-Propen-1-ol	3/15	1/5	50 – 60	50
2-Methyl-2-propanol	12/14	5/5	20 – 250	20
1-Propanol	1/18	1/6	210	200
2-Octanol	10/18	4/6	4.7 – 130	4
1,3-Dichloro-2-propanol	1/18	1/6	5	5
1-Nonanol	14/18	5/6	8.7 – 81	6
Bis(2-ethylhexyl) adipate	31/41	13/14	1.0 – 22	1