

that focus on air and water pollution. So it is desirable to improve the current legal systems by supplementing the provisions for regulation of offensive odors.

Moreover, the regulation should reflect the present states of the offensive odors in the source factories and the conditions of public damages around the factories. The government should establish the regulation and enforce it gradually by setting the feasible targets as well as fixing indispensable and sufficient periods for the factories to prepare the regulation and propagation.

(5) Improvement of central tanning wastewater treatment plant

Wastewater of tanneries, the most important sources of offensive odors in the factories, is not treated in each factories but introduced to the central wastewater treatment plant and treated all together. As the capacity of the plant has reached to the limit due to increase of the factories, it is required to improve the plant as well as wastewater canal.

(6) Strengthening of surveillance and control systems

In order to cope with the increase of public complaints about offensive odors, the government should strengthen surveillance and control system against odor source factories.

6.5.3 Long Term Program

(1) Enforcement of the regulation of offensive odors

Offensive Odor Regulation shall be enforced with adequate suspension periods after the term of promulgation.

Moratorium is set for the purpose of propagating the contents of regulation to the public and establishing or revising the related laws and regulations.

For small and medium scale factories and business establishments, it is necessary to take special concerns such as expansion of moratorium. Moreover, the government authority should establish surveillance and control systems, measurement and analysis systems, and technical and financial assistance systems to the private sectors in order to start the regulation.

(2) Establishment of odor measurement systems

The most important matter for the authority to enforce the regulation depends on the odor measurement systems to examine that the offensive odors from the factory satisfy the regulation standards. For this reason, the government should establish the official methods of odor measurement and develop the personnel and equipment for odor measurement in the administration before starting the regulation.

Odor measurement stations shall be developed in order before the enforcement of the regulation to cover all factories in the regulation area.

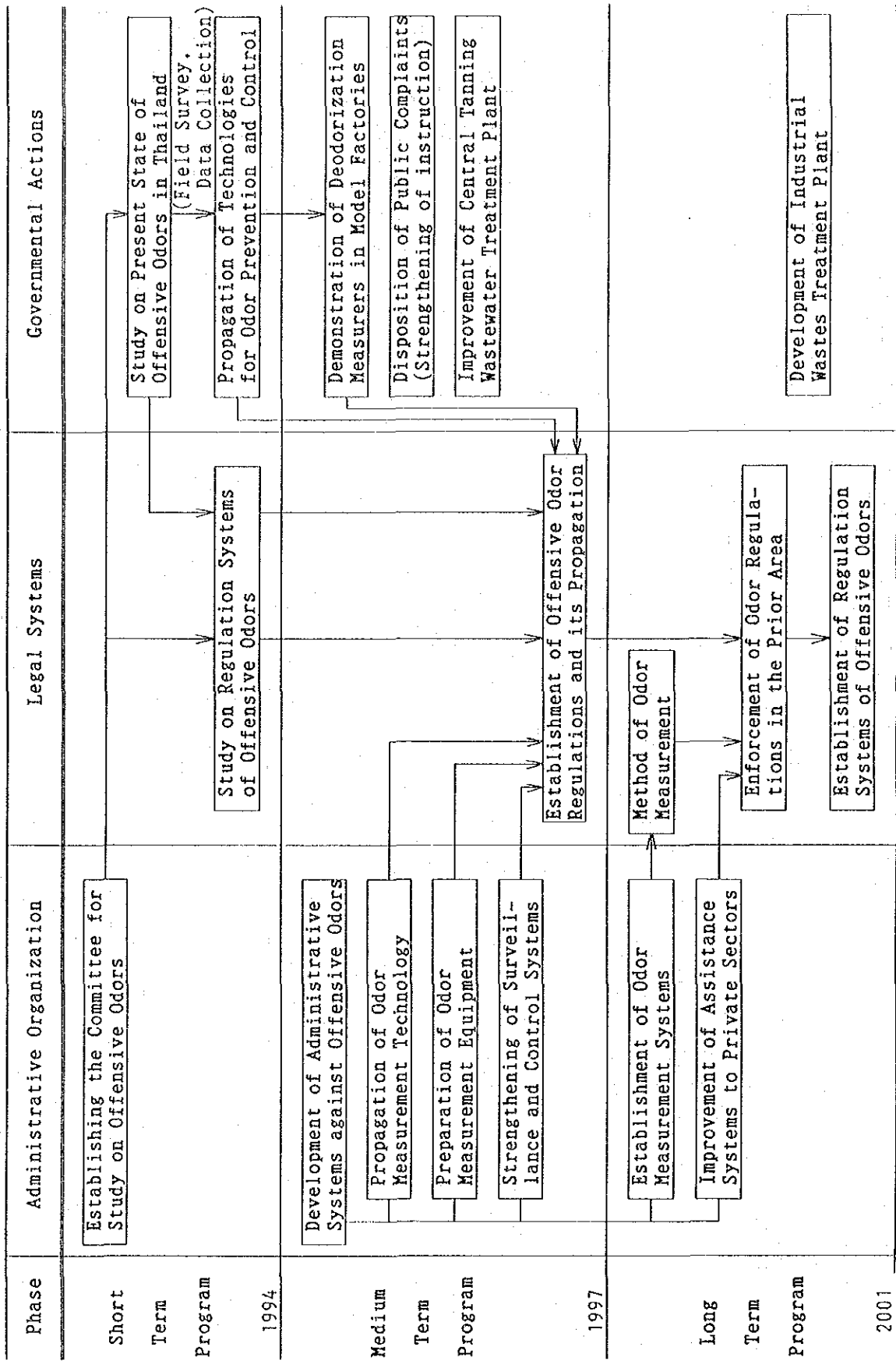
(3) Development of industrial wastes treatment plant

Every odor source factories should be responsible for the treatment of the wastewater and wastes, whereas some small and medium scale factories do not have enough capacity to provide the pollution control facility. The governmental authority should support and recommend installing the collective treatment facility or disposal plant which is more effective for pollution control than individual facilities in collaboration with the factories.

(4) Establishment of assistance systems to private sectors

The governmental authority shall improve and strengthen the technical and financial assistance systems which promote the installation of deodorization facilities in odor source factories. In order to take special consideration to small and medium scale factories, current assistance systems for pollution control should be reconsidered and reformed.

Table 6-4 Implementation Program of the Master Plan



APPENDIX

Appendix A

Outline of Preventive Measures of Offensive Odors in Japan

- A-1 History of Japanese Administration against
Offensive Odors
- A-2 Present State of Offensive Odors
- A-3 Offensive Odor Control Law
- A-4 Odor Emission Standards by Sensory Test in Local
Governments
- A-5 Outlines of Financing and Tax for Installation of
Pollution Control Facilities

A-1 History of Japanese Administration
Against Offensive Odors

Before World War II

Accompanied with the development of mining and manufacturing industries, public complaints on offensive odors increased.

Around 1955-1965

As the Japanese economy rises quickly, offensive odor problems came out around petroleum complexes and their industry.

Sep. 1965 Ministry of Health and Welfare stated studies on offensive odors. (continued to 1970)

Sep. 1965 MHW organized The National Committee of Pollution Control as an advisory organization for the Minister.

Apr. 1966 Miyagi Prefecture enacted the Regulation of Offensive Odors based on the salt water balance method in the Decrees for Pollution Prevention.

Oct. 1966 National Committee of Pollution Control published the Report. (Offensive odor was set down as an independent item among the environmental pollutions which should be taken up as the objects of Government administration.)

Aug. 1967 Basic Law for Environmental Pollution Control was promulgated.

1969 Number of the complaints about offensive odors to the local public institutions mounted to the second after noise and vibration.

May 1969 The first White Paper on Environmental Pollution was prepared and submitted to the Diet.

Sep. 1969 An inhabitants' voting was executed on the offensive odor problem of a livestock factory in Shioyama City, Yamanashi Prefecture. The majority voted for suspension of the factory.

- Nov. 1969 MHW established the Committee for Study of Offensive Odors as one of its advisory organizations.
- Mar. 1970 The Committee for Study of Offensive Odors submitted the intermediate report "Study on Offensive Odors."
- July 1970 The Head Quarter for Countermeasures Against Public Nuisances was established in the Government.
- Dec. 1970 The 69th Extraordinary Diet session was held. (the public nuisance session: establishment and revision of 14 laws related to environmental Pollution)
- Dec. 1970 The Prime Minister approved the Primary Plan for Prevention of Environmental Pollution.
- Mar. 1971 Bill of the Offensive Odor Prevention Law was submitted to the 65th ordinary session of the Diet and decided by the cabinet meeting.
- June 1971 The Offensive Odor Control Law was promulgated.
- July 1971 Environment Agency was inaugurated. (The administrations on offensive odor were transferred from Ministry of Health and Welfare to the Environment Agency. Thus, the administrations for prevention of environmental pollution were integrated to the agency.)
- 1972 Number of complaints about Offensive Odors exceeded 20,000 over the year. (highest record in the history)
- May 1972 The report on "Fundamental Principles of Offensive Odor Substance Designation and Regulation Range Setting" of the National Committee for Public Nuisance Countermeasures Examination was issued. (Five substances; ammonia, methyl mercaptan, hydrogen sulfide, methyl sulfide and trimethylamine; were

designated.)

May 1972 Cabinet Order for the Offensive Odor Control Law was promulgated.

May 1972 Ordinance of the Prime Minister's Office for the Offensive Odor Control Law was promulgated.

May 1972 Environment Agency notified the "methods for Measuring offensive odor substances."

May 1972 The Offensive Odor Control Law was enacted.

Oct. 1973 Soka City enacted the regulations of to offensive odors on basis of the triangle odor bag method.

Apr. 1975 Annual Survey on offensive odor was started by the EA. (Number of the complaints: 18,143; the survey conducted every year since this year)

Apr. 1976 The Committee of Study on Offensive Odor Evaluation Methods prepared (an intermediate report) Report on Study on Offensive Odor Evaluation Methods.

Aug. 1976 The report on "Fundamental Principles of Offensive Odor Substance Designation and Regulation Range Setting" of the Central Committee for Public Nuisance Countermeasures Examination was issued. (Three substances; dimethyl disulfide, acetic aldehyde and styrene; were added to the offensive odor substances.)

Sep. 1976 Offensive Odor Prevention Law was partially amended. (The three offensive odor substances were added.)

Sep. 1976 Offensive Odor Prevention Law was partially amended.

Sep. 1976 Environment Agency amended "the measurement method for offensive odor substances" partially.

Oct. 1976 The revised Ordinance was enacted.

Oct. 1977 Tokyo Metropolis enacted the regulation related to offensive odor control by the triangle odor bag method.

- Mar. 1978 Environment Agency prepared Survey Report on Sensory Test Methods.
- Mar. 1978 Environment Agency prepared Technical Manual for Offensive Odor Prevention (Part 1).
(Parts 2, 3 and 4 were since prepared by March, 1981.)
- Apr. 1978 Miyagi Prefecture enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- Apr. 1979 Sagamihara City enacted the regulation related to offensive odor control by the triangle odor bag method.
- Oct. 1979 Saitama Prefecture took the same action as the above.
- Nov. 1979 Ashikaga City enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- Apr. 1980 Fuji City took the same action as the above.
- Jan. 1981 Kusatsu City enacted the regulation related to offensive odor control by the triangle odor bag method.
- June 1981 Chiba Prefecture enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- Apr. 1982 Yokohama City took the same action as the above.
- June 1982 Environment Agency prepared Survey Report on Sensory Test Methods.
- July 1982 Niigata Prefecture enacted the regulation related to offensive odor control by the triangle odor bag method.
- Sep. 1982 Gumma Prefecture enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- Apr. 1983 Kanagawa Prefecture took the same action as the above.

June 1983 Yamaguchi Prefecture took the same action as the above.

Mar. 1984 Environment Agency notified the partial amendment of the measurement methods for offensive odor substances. (an amendment of measurement method for ammonia, and others)

Apr. 1984 Izumi-otsu City enacted the instruction guidance related to offensive odor control by the triangle odor bag method.

May 1984 Nagasaki Prefecture took the same action as the above.

May 1984 Kasugai City took the same action as the above.

June 1984 Kobe City took the same action as the above.

July 1984 Hokkaido Prefecture took the same action as the above.

Feb. 1985 Nagoya City took the same action as the above.

May 1985 Kyoto City took the same action as the above.

June 1985 Yao City took the same action as the above.

Apr. 1986 Osaka City took the same action as the above.

Aug. 1986 Yamagata City took the same action as the above.

Sep. 1986 Shimizu City took the same action as the above.

Apr. 1987 Establishment of Research Institute for Odor Measures, an incorporated body, was approved and registered.

May 1987 Higashi-osaka City enacted the instruction guidance related to offensive odor control by the triangle odor bag method.

June 1987 Study Report on Setting Standard for Regulation of Offensive Odor Substances Contained in Discharged Water was prepared.

July 1987 Fukushima Prefecture enacted the instruction guidance related to offensive odor control by the triangle odor bag method.

Apr. 1988 Nara Prefecture took the same action as the above.

- Nov. 1988 Environment Agency prepared Report on Improvement and Promotion of Offensive Odor Preventive Technologies and Result of Promotion, Part 1 (Coating factories).
(The following parts have since been published: Pt.2 (Swinery), Pt. 3 (Printing factories), Pt. 4 (Cattle and domestic fowls breeding), Pt. 5 (Fish entrails and bones disposal workshops), Pt. 6 (Marine products processing factories), Pt. 7 (FRP manufacturing factories), Pt. 8 (Rendering factories), Pt. 9 (Sewage facilities), and Pt. 10 (Sanitation tanks and building pits).
- Apr. 1989 Tochigi Prefecture enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- Apr. 1989 Shimane Prefecture took the same action as the above.
- July 1989 Hikone City took the same action as the above.
- Sep. 1989 The Central Committee for Public Nuisance Counter-measures Examination re-issued Report on Fundamental Principles of Offensive Odor Substance Designation and Regulation Range Setting. (Four substances such as propionic acid were added to the offensive odor substances.)
- Sep. 1989 The Ordinance for Execution of Offensive Odor Prevention Law was partially amended. (addition of the four offensive odor substances)
- Sep. 1989 The Rule for Execution of Offensive Odor Prevention Law was partially amended.
- Oct. 1989 Measurement Methods for Offensive Odor Substances, one of Environmental Agency notifications, was partially amended.
- Apr. 1990 The revised Ordinance was enacted.
- Apr. 1990 Environment Agency prepared Manual for Simple Measurement of Offensive Odor Substances.

- Apr. 1990 Sendai City enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- Dec. 1990 Hachinohe City took the same action as the above.
- Mar. 1991 Amagasaki City took the same action as the above.
- Mar. 1992 Environment Agency notified Rule for Examination and Certification of Knowledge and Skill Relating to Tests Judging Odor Using the Olfactory Sense.
- Mar. 1992 Environment Agency notified Methods of Test Judging Odor Using the Olfactory Sense.
- Jan. 1993 Environment Agency approved Services of Examination and Certification of Odor Judging Technician, offered by Research Institute for Odor Measures.
- May 1993 Otake City enacted the instruction guidance related to offensive odor control by the triangle odor bag method.
- June 1993 The Central Committee for Public Nuisance Counter-measures Examination re-issued Report on Setting Offensive Odor Substance Designation and Regulation Range. (Ten substances such as toluene were added to the offensive odor substances.)
- June 1993 The Ordinance for Execution of Offensive Odor Prevention Law was partially amended. (The ten offensive odor substances were added.)
- June 1993 The Rule for Execution of Offensive Odor Prevention Law was partially amended.
- June 1993 Iwate Prefecture enacted the instruction guidance related to offensive odor control by triangle odor bag method.
- Sep. 1993 Methods for Measurement of Offensive Odor Substances, one of Environment Agency notifications, was partially amended.
- Apr. 1994 The revised Ordinance will be enacted.

A-2 Present State of Offensive Odors in Japan

(1) Number of offensive odor grievances

Environment Agency receives reports on the state of offensive odor grievances and implementation of Offensive Odor Prevention Law every year from Metropolis, Prefectures and Government Ordinance Designated Cities and summarizes the data in order to prepare fundamental data sets for promotion of countermeasures against offensive odor.

Offensive odor is a popular public nuisance called the sensory nuisance together with noise and vibration. It has various causes and evolves to so many grievances as to be the second after noise among the typical seven sorts of public nuisance. (Figure 2-1)

The number of grievances is only slightly decreasing since 1980, whereas it was substantially decreasing after a peak in 1972. The number was 11,932 in 1990, about a half of that in 1972 (Figure 2-2).

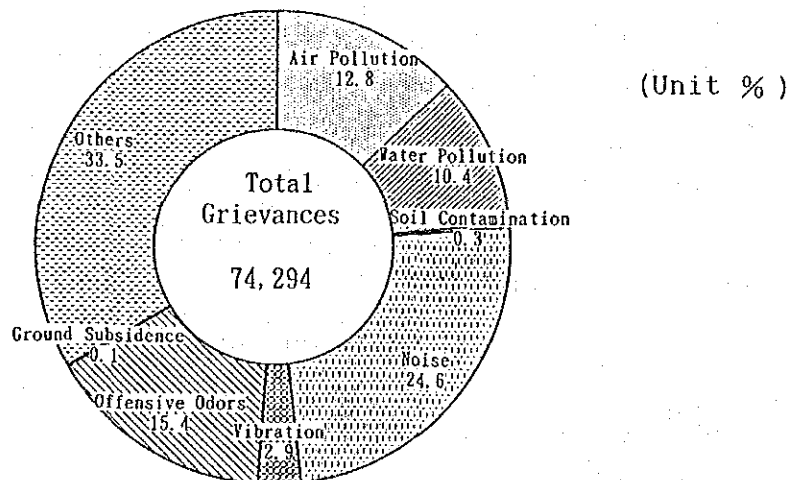


Figure 2-1 Number of Component Ratio of Grievances
(FY 1990)

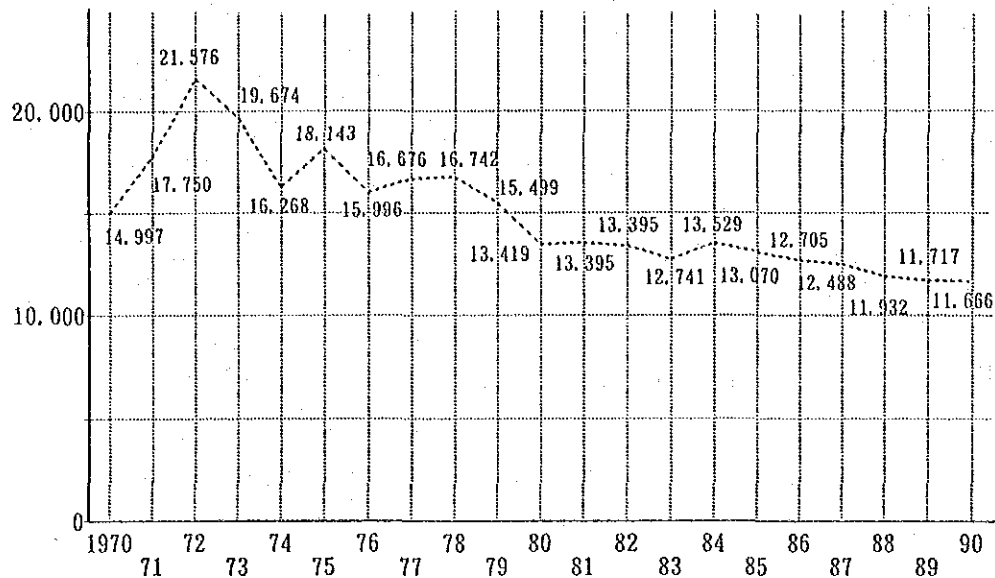


Figure 2-2 Trends in Number of Grievances

Note: The data between 1970 and 1974 were prepared by Committee for Public Nuisance Control, and those since 1975 by Environment Agency.

(2) Recent numbers of grievances

Line of metropolis and prefectures in the decending order of number of offensive odor grievances stands in the order: Tokyo Metropolis, Aichi Prefecture, Osaka Prefecture, Chiba Prefecture, Kanagawa Prefecture, and so on, with the Metropolis and prefectures including large cities appearing in the head.

Examining the data by business classification, stockbreeding comes at the top with a share of about 24 % with service business agriculture and others, about 22 %, at the next. The category relating to factories and other business places includes 8,666 grievances (74.3 %).

Dividing the number of grievances into those inside and outside the regulated areas, those of service business and others occupy the largest share in the inside whereas those of stockbreeding agriculture occupy about 49 % in the outside (Figure 2-4).

	Food Production Plants				Other Production Plants		Construction sites		Individual dwellings, apartments, dormitories		Unknown
	Feed and Chemical fertilizer plants		Chemical Plants		Mobile generation sources		Sewerage Water	Trash yards			
	Stockbreeding										
1986 (12,705)	3,266 (25.7%)	772 (6.1%)	642 (5.1%)	1,736 (13.7%)	2,613 (20.6%)	898 (7.1%)	1,314 (10.3%)	846 (6.6%)			
	284 (2.2%)				15 (0.1%)	261 (2.1%)	58 (0.4%)				
1987 (12,488)	3,356 (26.9%)	742 (5.9%)	618 (5.0%)	1,537 (12.3%)	2,572 (20.6%)	854 (6.8%)	1,425 (11.4%)	779 (6.2%)			
	267 (2.1%)				31 (0.2%)	272 (2.2%)	44 (0.4%)				
1988 (11,932)	3,192 (26.7%)	737 (6.2%)		1,595 (13.3%)	2,383 (20.0%)	687 (5.7%)	1,309 (11.0%)	849 (7.1%)			
	248 (2.1%)	548 (4.6%)			45 (0.4%)	297 (2.5%)	42 (0.4%)				
1989 (11,717)	2,990 (22.5%)	691 (5.9%)	606 (5.2%)	1,615 (13.8%)	2,407 (20.5%)	720 (6.1%)	1,273 (10.9%)	797 (6.8%)			
	249 (2.1%)				25 (0.3%)	306 (2.6%)	38 (0.3%)				
1990 (11,666)	2,826 (24.2%)	768 (6.6%)	652 (5.6%)	1,572 (13.5%)	2,554 (21.9%)	714 (6.1%)	1,153 (9.9%)	773 (6.6%)			
	294 (2.5%)				36 (0.3%)	278 (2.4%)	46 (0.4%)				

Figure 2-3 Breakdown of Grievances about Offensive Odors

	Food Production Plants				Other Production Plants		Construction sites		Individual dwellings, apartments, dormitories		Unknown
	Feed and Chemical fertilizer plants		Chemical Plants		Mobile generation sources		Sewerage Water	Trash yards			
	Stockbreeding										
Whole Japan (11,666)	2,826 (24.2%)	768 (6.6%)	652 (5.6%)	1,572 (13.5%)	2,554 (21.9%)	714 (6.1%)	1,153 (9.9%)	773 (6.6%)			
	284 (2.2%)				15 (0.1%)	261 (2.1%)	58 (0.4%)				
Inside Regulation Area (8,348)	1,205 (14.4%)	607 (7.3%)	548 (6.5%)	1,311 (15.8%)	1,011 (12.1%)	579 (7.0%)	817 (9.8%)	618 (7.4%)			
	199 (2.4%)				25 (0.3%)	306 (3.7%)	38 (0.5%)				
Outside Regulation Area (3,318)	1,621 (48.9%)				1,543 (46.8%)	135 (3.9%)	336 (9.9%)	159 (4.8%)			
					10 (0.3%)	55 (1.6%)	20 (0.6%)				

Figure 2-4 Breakdown of Grievances by Area (FY 1990)

(3) State of grievance management

Governors of metropolis and prefectures should designate the areas where discharge of offensive odor substances generated by business activities in factories and other business places is to be regulated, and set down the standard values for the regulation. (This authority is assigned to city governors in the Government ordinance designated cities.) The designated areas are located in the total of 1,460 (about 45 % of the total) cities, towns and villages; 548 cities, 783 towns, 106 villages and 23 special administrative sections; in the 47 metropolis and prefectures as of the end of FY 1990.

The metropolis or prefecture governor is authorized to issue recommendations of improvement or, if needed, orders of improvement for prevention of offensive odor to the person who has installed the specific business place if it discharges offensive odor in excess of the regulation standard accompanying to its business activities so that the inhabitants' lives are afflicted. (This authority is assigned to the office of city, town and village.)

The number of grievances handled in FY 1990 was 11,294, of which 8,193 (72.5 %) were inside regulation areas and 3,101 (27.5 %) outside. (Table 2-1)

Four thousand six hundred and sixty one (4,661) on-the-spot inspections were executed as the action based on the Law in the regulation area. The number of business places where measurement was conducted for management of the grievances was 331 (of which 37 resulted in noncompliance). Four (4) recommendations for improvement were issued, none of which evolved into order of improvement. Besides, 5,246 administrative instructions were executed against offensive

odor business places in regulation areas. Thus, most of the offensive odor grievances are being controlled with the administrative instruction, not with the recommendation or the order of improvement.

Actions based on ordinances or rules are taken also outside the regulation areas. Those included 1,162 on-the-spot inspections, 35 measurements, three recommendations and no orders of improvement in FY 1990.

No significant chronological changes are seen in ratios of each action to the total number of grievances, although with some variations. (Figure 2-5)

Table 2-1 State of Offensive Odor Grievance Management
(FY1990)

	Regulation Area		Total
	Inside	Outside	
Number of grievances	8,348	3,318	11,666
Grievances treated	8,193	3,101	11,294
Actions			
Field Inspection	4,661	1,162	5,823
Report	499	146	645
Measurement	331	35	366
Compliance	294	33	327
Uncompliance	37	2	39
Instruction	5,246	2,149	7,395
Recommendation	4	3	7
Improvement Order	0	0	0

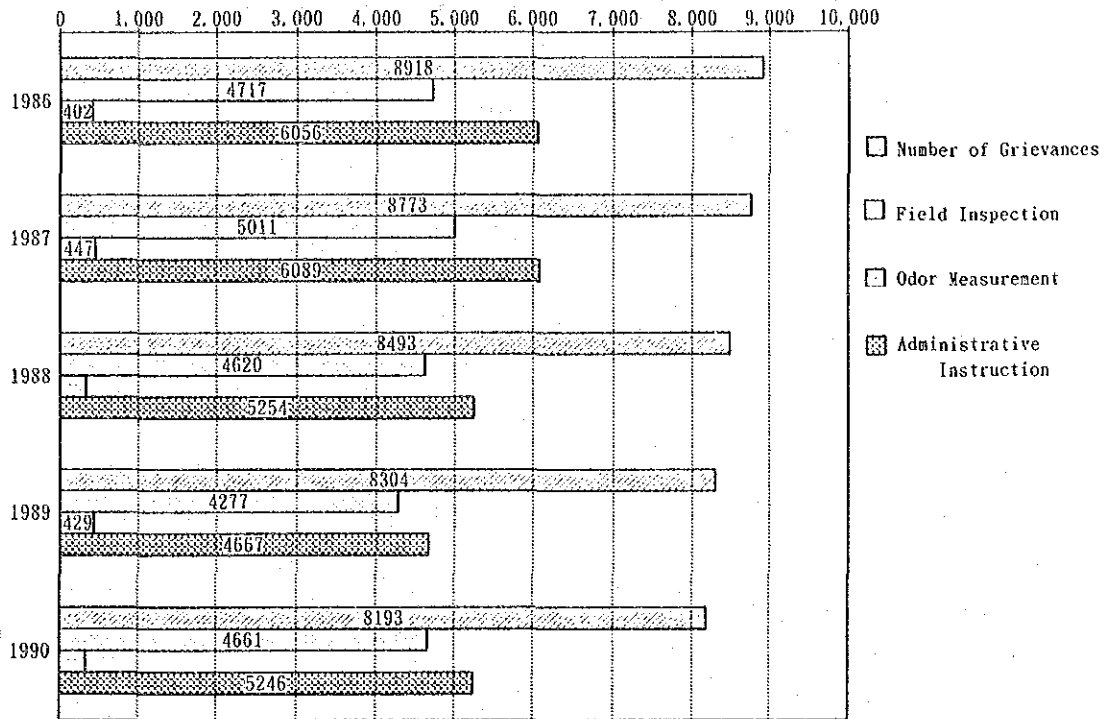


Figure 2-5 Change of Offensive Odor Grievance Management
(Inside Regulation Areas)

A-3 OFFENSIVE ODOR CONTROL LAW

Law No. 91 of 1971

- Chapter I General Provisions (Article 1 and Article 2)
- Chapter II Regulations (Article 3 ~13)
- Chapter III Miscellaneous Provisions (Article 14 ~19)
- Chapter IV Penal Provisions (Article 20 ~22)
- Schedule

CHAPTER I GENERAL PROVISIONS

(Purpose)

Article 1

This Law is enacted for the purpose of preserving living environment and contributing to protection of the people's health by regulating the discharge of offensive odor substances generated in the course of business activities at factories or other places of business.

(Definition)

Article 2

"Offensive odor substances" as used in this Law means ammonia, methyl melcaptan, and other substances as described in the Cabinet Order as likely to cause unpleasant odors and disrupt the living environment.

CHAPTER II REGULATIONS

(Regulation Area)

Article 3

The prefectural governors shall designate densely populated areas or other areas, in which control of offensive odor is needed to preserve the living environment of the residents, as "regulation areas" in which the discharge (including leakage, hereinafter the same shall apply) of offensive odor substances generated in the course of business activities at factories or other places of business (hereinafter referred to as simply "place of business").

(Regulation Standards)

Article 4

The prefectural governors shall establish regulation standards for offensive odor substances as indicated in the following regulation standards items and for each regulation area or each division of regulation area which shall be made in consideration of natural and social conditions of the areas.

(1) Regulation standards for offensive odor substances, generated in the course of business activities at a place of business, at the ground surface on the boundary line of the site of said place to business shall be established as standards of maximum permissible concentration in the air within the range stipulated by the ordinance of the Prime Minister's Office.

(2) Regulation standards for offensive odor substances, generated in the course of business activities at a place of business and discharged from smoke stacks or other gas emission facilities, shall be established, based on the permissible concentration established under the preceding Subparagraph, as standards of permissible flow rate or permissible concentration in the emitted gas according to the height of the stacks pursuant to the method provided for under the ordinance of the Prime Minister's Office.

(3) Regulation standards for offensive odor substances, generated in the course of business activities and discharged from a place of business included in the waste water, shall be established, based on the permissible concentration established under the Subparagraph 1, as standards of permissible concentration in the waste water pursuant to the method provided for under the ordinance of the Prime Minister's Office.

(Hearing of Opinion of Mayors of Municipalities)

Article 5

1. Should the prefectural governor intend to make a designation of a regulation area and stipulate regulation standards, he shall hear the opinions of the mayors of the municipalities (hereinafter including the mayors of special wards) having administrative jurisdiction over said regulation area. Such shall also apply to alteration, revocation of designation of regulation areas, or abolition of regulation standards.

2. In the cases of the preceding Paragraph, the prefectural governor may hear the opinions of the mayors of municipalities having administrative jurisdiction over the area surrounding said regulation area if he deems it necessary.

(Public Notice of Designation of Regulation Area, etc.)

Article 6

Should the prefectural governor designate a regulation area or set regulation standards, he shall give public notice to this effect in accordance with the provisions of the order of the Prime Minister's Office. Such shall also apply to alteration, revocation of designation of the regulation area, or abolition of regulation standards.

(Duty to Observe Regulation Standards)

Article 7

A person establishing a place of business within a regulation area shall observe the regulation standards for said regulation area.

(Improvement Recommendation and Order)

Article 8

1. Should the prefectural governor deem the living environment disrupted because the discharge of offensive odor substances generated in the course of business activities at a place of business in a regulation area does not conform to the regulation standards, he may recommend the person who has established said place of business to improve the operation of the facility causing the offensive odor substances, to improve the facility for preventing discharge of offensive odor substances, or to take other measures to diminish discharge of the offensive odor substances to the extent necessary for rectification of the situation and within a reasonable time to be set.

2. Should the person who is recommended under the preceding Paragraph not obey this recommendation the prefectural governor may order him to take the measures in said recommendation within a reasonable period to be set.

3. The measures under the stipulations of the preceding Paragraph shall not be taken against a person who has established his place of business within said regulation area within one (1) year of the date of its designation as a regulation area or against the discharge of offensive odor substances by a person who has established his place of business

within one (1) year of the new establishment of regulation standards for such offensive odor substances generated at said place of business.

4. Should the regulation standards be made stricter with respect to discharge of the offensive odor substances generated at said place of business the measures provided for in Paragraph 2 may not be taken for one year from the date of revision if said discharge conforms to the regulation standards before their revision.

5. Should the prefectural governor intend to take actions provided for in Paragraph 1 or Paragraph 2 against the operator of a small business, he shall take into consideration the effects upon said operator's business activities.

(Request to Governor of Prefectures, etc.)

Article 9

The mayor of a municipality may, if he deems it necessary to preserve the living environment of the residents, request the prefectural governor to designate a regulation area, to make regulation standards or to strengthen them, or to take actions under Paragraph 1 or Paragraph 2 of the preceding Article with respect to the place of business from which offensive odor substances are discharged.

(Measures to be Taken in Case of Accidents)

Article 10

Should an accident occur at the place of business and thereby discharge offensive odor substances inconsistent with or likely to be inconsistent with the regulation standards, the person who has established said place of business within the regulation area shall immediately take emergency measures to cope with said accident and to restore the original state before the accident.

(Measurement of Offensive Odor)

Article 11

The prefectural governor shall be required to measure the concentrations of offensive odor substances in the air within the regulation area in order to preserve the living environment of the residents.

(Prevention of Offensive Odor at Waterways, etc.)

Article 12

A person who assumes charge of a sewerage ditch, river, pond, swamp,

harbor, or other waterway or place into which sewerage flows shall taken proper care of said waterway or place so that the living environment of residents in the vicinity is not disrupted by the emission of offensive odors from said waterway or place.

(Prohibition of Combustion of Things Generating Offensive Odors)

Article 13

No person shall burn in the open air in a heavily populated area without cause great quantities of rubber, hides, synthetic resins, waste oil, or other things as will generate offensive odor during combustion.

CHAPTER III MISCELLANEOUS PROVISIONS

(Report and Inspection)

Article 14

1. Should the prefectural governor deem it to be necessary with respect to the measures to be taken in accordance with the provisions of Paragraph 1 or Paragraph 2 of Article 8, he may require the person who has established said place of business to report on the circumstances of operation of the facility generating offensive odor substances, conditions of establishment of the equipment for preventing discharge of offensive odor substances, or other necessary matters relating to prevention of offensive odors or he may have his official enter said place of business and inspect the facility generating offensive odor substances and other objects.

2. The official who enters and inspects in accordance with the provisions of the preceding Paragraph shall carry an identification card and present it to the person concerned.

3. The authority to enter and inspect under Paragraph 1 shall not be construed as authority for the purpose of a police search.

(Cooperation of Concerned Administrative Agencies, etc.)

Article 15

1. Should the prefectural governor deem it to be necessary in order to achieve the purpose of this Law, he may request the heads of concerned administrative agencies or the heads of concerned local public bodies to present data or information, to give their opinions, and to cooperate in

other manners with respect to business activities at the place of business generating offensive odor substances, techniques for preventing discharge of offensive odor substances, techniques for preventing discharge of offensive odor substances, and other matters necessary for preventing offensive odors.

2. For the purpose of harmonious and proper enforcement of this Law. The heads of administrative agencies concerned shall endeavor to give advice and assist the prefectural governor with respect to the methods of measurement of offensive odor substances, techniques for preventing the discharge of offensive odor substances, and other necessary matters relating to preventing offensive odors.

(State Assistance)

Article 16

The State shall endeavor to use its good offices in financial arrangements, to give technical advice, and to render other assistance for the establishment or improvement of facilities necessary for preventing offensive odors generated at the place of business.

(Promotion of Studies, etc.)

Article 17

The State shall promote studies for improving facilities generating offensive odors, studies on the effects of offensive odors on the living environment and health, studies on methods of measuring offensive odors, and other studies related to preventing offensive odors, and shall endeavor to propagate the results of such studies.

(Delegation of Administration)

Article 18

The administration within the authority of the prefectural governors authorized under this Law may be delegated to the mayors of municipalities in accordance with the provisions of the Cabinet Order.

(Relationship to Regulations)

Article 19

The provisions of this Law shall not prohibit local public bodies from enacting ordinances providing the necessary regulations for the discharge of substances which cause offensive odors in addition to those provided for under this Law.

CHAPTER IV PENAL PROVISIONS

Article 20

Any person who violates the order issued in accordance with the provisions of Article 8 Paragraph 2 shall be sentenced to imprisonment not to exceed one (1) year or to a fine not to exceed one hundred thousand (100,000) yen.

Article 21

Any person who fails to report as required under the provisions of Article 14 Paragraph 1; who submits a false report; or who has refused, hindered, or avoided the inspection based upon the provisions of the same Paragraph shall be sentenced to a fine not to exceed thirty thousand (30,000) yen.

Article 22

In case a representative of a juridical person or an agent, employee, or other worker of a juridical or natural person commits a violation as referred to in the preceding two Articles with respect to the business of said juridical or natural person, in addition to the punishment of the actual offender, said juridical or natural person shall also be subject to the penalty of fine under the relevant Article.

SCHEDULE

1. This Law shall become effective from the date to be set by Cabinet Order within not more than one (1) year after the date of promulgation (June 1, 1971).
2. The provisions of the preceding Paragraph notwithstanding, Article 8 Paragraph 2 shall not apply for two (2) years from the date of enforcement of this Law with respect to specific places of business to be stipulated by Cabinet Order.

CABINET ORDER FOR THE OFFENSIVE ODOR CONTROL LAW

No. 207 of 1972

The Cabinet enacts this Cabinet Order on the basis of provisions of Article 2, Article 18, and Paragraph 2 of the Schedule of the Offensive Odor Control Law (Law No.91 of 1971).

(Offensive Odor Substances)

Article 1

The substances to be stipulated by Cabinet Order pursuant to Article 2 of the Offensive Odor Control Law (hereinafter referred to as the "Law") shall be the substances as designated below.

- (1) Ammonia
- (2) Methyl mercaptan
- (3) Hydrogen sulfide
- (4) Methyl sulfide
- (5) Methyl disulfide
- (6) Trimethylamine
- (7) Acetaldehyde
- (8) Propionaldehyde
- (9) Normal-butyraldehyde
- (10) Isobutyraldehyde
- (11) Normal-valeraldehyde
- (12) Isovaleraldehyde
- (13) Isobutyl alcohol
- (14) Ethyl acetate
- (15) Methyl isobutyl ketone
- (16) Toluene
- (17) Styrene
- (18) Xylene
- (19) Propionic acid
- (20) Normal-butyric acid
- (21) Normal-valeric acid
- (22) Isovaleric acid

(Delegation of Administration)

Article 2

1. Among the administrative functions entrusted to the prefectural governors as provided for in the Law, that relating to the recommendation to be given under Article 8 Paragraph 1 of the Law, that relating to measurements to be carried out under Article 11 of the Law, and that relating to the collection of reports and actual inspections to be conducted under Article 14 Paragraph 1 of the Law shall be delegated to the mayors of municipalities (excluding the mayors as designated in the next Paragraph).

2. Among the administrative functions of the preceding Paragraph and other administrative functions entrusted to the prefectural governors under the Law, that relating to the designation of regulation areas under Article 3 of the Law, that relating to the establishment of regulation standards under Article 4 of the Law, that relating to the hearing of opinions under Article 5 Paragraph 2 of the Law, and that relating to the public notice to be given under Article 6 of the Law shall be delegated to the mayors of the designated cities provided for in Article 252-19 Paragraph 1 of the Local Government Law (Law No.67 of 1947).

(Places of Business to Be Stipulated by Cabinet Order under Paragraph 2 of the Schedule of the Law)

Article 3

Places of business to be stipulated by Cabinet Order under Paragraph 2 of the Schedule of the Law shall be the following places of business.

- (1) Any place of business where animals are raised.
- (2) Any place of business where sweet potato starch or potato starch starch is made.
- (3) Any place of business where compound fertilizer, including animal and plant organic materials, is produced.
- (4) A place of chemical treatment referred to in Article 1 Paragraph 5 of the Law Concerning Dead Animals Treating Plant, Etc (Law No.140 of 1948) or place of business as provided for in Article 8 of the same Law where a facility for the production of oil, fat, glue, fertilizer, feed, or the like is established.

(5) Any place of business other than those described in the preceding Subparagraphs where glue or gelatin is produced.

(6) Any place of business other than those described in item (4) where hides are produced.

SCHEDULE

This Cabinet Order shall become effective from the date of implementation of the Law (May 31, 1972).

SCHEDULE (Cabinet Order No. 242 of 1976)

This Cabinet Order shall become effective from October 1, 1976.

SCHEDULE (Cabinet Order No. 277 of 1989)

This Cabinet Order shall become effective from April 1, 1990.

SCHEDULE (Cabinet Order No. 201 of 1993)

This Cabinet Order shall become effective from April 1, 1994.

ORDINANCE OF THE PRIME MINISTER'S OFFICE
FOR THE OFFENSIVE ODOR CONTROL LAW

Ordinance of the Prime Minister's Office No. 39 of 1972

The Implementation Regulations for the Offensive Odor Control Law shall be enacted as follows under provisions of Article 4 Subparagraph 1 and Subparagraph 2 and Article 6 of the Offensive Odor Control Law (Law No.91 of 1971) and for the purpose of implementing said Law.

(Range of Regulation Standards on the Boundary Line of Sites)

Article 1

The range to be stipulated by Ordinance of the Prime Minister's Office under Article 4 Subparagraph 1 of the Offensive Odor Control Law (hereinafter referred to as the "Law") shall be that illustrated on the right-hand side of the Separate List for each kind of offensive odor substance referred to in Article 2 of the Law (hereinafter referred to as "offensive odor substances").

(Method of Setting Regulation Standards for Smoke Stacks)

Article 2

1. The method to be provided for by Ordinance of the Prime Minister's Office under Article 4 Subparagraph 2 of the Law shall be that of calculating the flow rate with the following equation for each kind of offensive odor substance (excluding methyl mercaptan, methyl sulfide, methyl disulfide, acetaldehyde, styrene, propionic acid, normal-butyric acid, normal-valeric acid and isovaleric acid).

$$q = 0.108 \times He^2 \cdot Cm$$

Where

q = Flow rate (unit: m³/hour calculated at 0°C and at 1 atmospheric pressure)

He = Height of stack adjusted using the method described in the next Paragraph (unit: meters)

Cm=Value set as regulation standard in Article 4 Subparagraph 1 of the Law (unit: parts per million [ppm])

Provided however that this formula shall not apply if the height of the stack adjusted using the method described in the next Paragraph is less than 5 meters.

2. The adjustment of height of the stack shall be done in accordance with the following equation.

$$H_e = H_o + 0.65 (H_m + H_t)$$

$$H_m = \frac{0.795 Q \cdot V}{1 + \frac{2.58}{V}}$$

$$H_t = 2.01 \times 10^{-3} \cdot Q \cdot (T - 288) \cdot \left(2.30 \log J + \frac{1}{J} - 1 \right)$$

$$J = \frac{1}{Q \cdot V} \left(1.460 - 296 \times \frac{V}{T - 288} \right) + 1$$

Where

H_e=Adjusted height of stack (unit: meters)

H_o=Actual height of stack (unit: meters)

Q=Flow rate of exhaust gas at 15°C (unit: m³/second)

V=Exhaust velocity of exhaust gas (unit: meters/second)

T=Temperature of exhaust gas (unit: absolute temperature)

(Methods of Measurement)

Article 3

The methods of measurement of the offensive odor substance when the regulation standards apply under Article 4 of the Law shall be those as stipulated by the Director General of Environment Agency.

(Public Notice)

Article 4

The public notice to be given in accordance with Article 6 of the Law shall be published in the official Gazette of the prefecture or the city

referred to in Article 2 Paragraph 2 of the Implementation Order for the Offensive Odor Control Law (Cabinet Order No.207 of 1972).

(Identification Card for Actual Inspection)

Article 5

The form of the Identification Card referred to in Article 14 Paragraph 2 of the Law shall be as shown separately.

SCHEDULE

This Ordinance of the Prime Minister's Office shall become effective from the date of implementation of the Law (May 31, 1972).

SCHEDULE (Ordinance of the Prime Minister's Office No. 49 in 1976)

This Ordinance of the Prime Minister's Office shall become effective from October 1, 1976.

SCHEDULE (Ordinance of the Prime Minister's Office No. 50 in 1989)

This Ordinance of the Prime Minister's Office shall become effective from April 1, 1990.

SCHEDULE (Ordinance of the Prime Minister's Office No. 34 in 1993)

This Ordinance of the Prime Minister's Office shall become effective from April 1, 1994.

Table

(1) Ammonia	The concentration in the air to be not less than 1 ppm but not more than 5 ppm.
(2) Methyl mercaptan	The concentration in the air to be not less than 0.002 ppm but not more than 0.01 ppm.
(3) Hydrogen sulfide	The concentration in the air to be not less than 0.02 ppm but not more than 0.2 ppm.

(4) Methyl sulfide	The concentration in the air to be not less than 0.01 ppm but not more than 0.2 ppm.
(5) Methyl disulfide	The concentration in the air to be not less than 0.09 ppm but not more than 0.1 ppm.
(6) Trimethylamine	The concentration in the air to be not less than 0.005 ppm but not more than 0.07 ppm.
(7) Acetaldehyde	The concentration in the air to be not less than 0.05 ppm but not more than 0.5 ppm.
(8) Propionaldehyde	The concentration in the air to be not less than 0.05 ppm but not more than 0.5 ppm.
(9) Normal-butyraldehyde	The concentration in the air to be not less than 0.009 ppm but not more than 0.08 ppm.
(10) Isobutyraldehyde	The concentration in the air to be not less than 0.02 ppm but not more than 0.2 ppm.
(11) Normal-valeraldehyde	The concentration in the air to be not less than 0.009 ppm but not more than 0.05 ppm.
(12) Isovaleraldehyde	The concentration in the air to be not less than 0.003 ppm but not more than 0.01 ppm.
(13) Isobutyl alcohol	The concentration in the air to be not less than 0.9 ppm but not more than 20 ppm.
(14) Ethyl acetate	The concentration in the air to be not less than 3 ppm but not more than 20 ppm.
(14) Methyl isobutyl ketone	The concentration in the air to be not less than 1 ppm but not more than 6 ppm.
(16) Toluene	The concentration in the air to be not less than 10 ppm but not more than 60 ppm.
(17) Styrene	The concentration in the air to be not less than 0.4 ppm but not more than 2 ppm.
(18) Xylene	The concentration in the air to be not less than 1 ppm but not more than 5 ppm.
(19) Propionic acid	The concentration in the air to be not less than 0.03 ppm but not more than 0.02 ppm.
(20) Normal-butyric acid	The concentration in the air to be not less than 0.001 ppm but not more than 0.006 ppm.
(21) Normal-valeric acid	The concentration in the air to be not less than 0.0009 ppm but not more than 0.004 ppm.
(22) Isovaleric acid	The concentration in the air to be not less than 0.001 ppm but not more than 0.01 ppm.

A-4 Odor Emission Standards by Sensory Test
in Local Governments

1) Odor emission standards by local governments' decrees

Name of city or prefecture	Category of area	Odor emission standards	
		On boundary line	At smoke stack
Miyagi Pref. (1966)	Whole area	Odor Index < 10	Odor Index < 25
Soka City (1973)	I	10	300
	II	15	500
	III	20	1,000
Tokyo Metropolis (1977)	I	10	10
	II	15	15
	III	20	20
Sagamihara City (1979)	Whole area	—	300
Saitama City (1979)	Whole area	10, 20, 30 (**)	300, 500, 1,000 (**)
Kusatsu City (1981)	I	10	300
	II	15	500
	III	20	1,000
Niigata Pref. (1982)	I	10	1,000
	II	15	2,000
	III	20	3,000

2) Odor emission standards by local governments' guidelines

Name of city or prefecture	Category of area	Odor emission standards	
		On boundary line	At smoke stack
Miyagi Pref. (1978)	Whole area	Odor Intensity 1.8	—
Ashikaga City (1979)	I	10	300 and TOER 10^5
	II	20	500 and TOER 5×10^5
	III	30	1,000 and TOER 10^6
Fuji City (1980)	I	30	Regulation by TOER
	II	50	
	III	90	
Chiba Pref. (1981)	Whole area	10~25 (**)	500~2,000 (**)
Yokohama City (1982)	Whole area	Odor Index < 10~17	Odor Index < 20~40

Odor emission standards by local governments' guidelines (cont.)

Name of city or prefecture	Category of area	Odor emission standards	
		On boundary line	At smoke stack
Gunma Pref. (1982)	A	10	300 ~ 2,000 (*)
	B	70	2,100 ~ 14,000 (*)
Kanagawa Pref. (1983)	Densely urban	10	600 ~ 1,000 (*)
	Other urban	30	1,000 ~ 1,800 (*)
	Rural area	—	—
Yamaguchi Pref. (1983)	A	Odor Index <10	Odor Index 25 ~ 33 (*)
	B	" <14	" 29 ~ 37 (*)
	C	" <18	" 33 ~ 41 (*)
	Other area	" <14	" 29 ~ 37 (*)
Izumiotsu City (1984)	Whole area	Odor Index <10	Odor Index <30
Nagasaki Pref. (1984)	I	20	500
	II	30	1,000
Kasugai City (1984)	Whole area	10 ~ 20 (**)	300 ~ 1,000 (**)
Kobe City (1984)	A	10	600 ~ 2,000 (*)
	B	70	4,200 ~ 14,000 (*)
Hokkaido (1984)	Control area A	10	30
	B	14	34
	C	18	38
	Uncontrol area	—	—
Nagoya City (1985)	I	10	300
	II	20	500
	III	30	1,000
Kyoto City (1985)	Control area	10	600 ~ 2,000 (*)
	Uncontrol area	—	—
Yao City (1985)	I	10	300
	II	20	500
	III	30	1,000
Osaka City (1986)	Whole area	10	150 ~ 1,000 (*)
Yamagata City (1986)	A	10	500 ~ 2,000 (*)
	B	15	1,000 ~ 3,000 (*)
	C	20	1,000 ~ 4,000 (*)
	Uncontrol area	—	—
Shimizu City (1986)	I	10	300
	II	15	500
	III	20	1,000

Odor emission standards by local governments' guidelines (cont.)

Name of city or prefecture	Category of area	Odor emission standards	
		On boundary line	At smoke stack
Higashi-osaka City (1987)	Whole area	10	150~1,000 (*)
Fukushima Pref. (1987)	I	Odor Index < 10	Odor Index 28~33 (*)
	II	" < 15	" 33~38 (*)
	III	" < 18	" 36~41 (*)
Nara Pref. (1988)	General area	10	300
	Adapting area	20	500
	Other area	30	500
Tochigi Pref. (1989)	I	10	24~33 (*)
	II	14	29~37 (*)
Shimane Pref. (1989)	I	10	28~33 (*)
	II	15	33~38 (*)
Hikone City (1990)	Whole area	10	300~2,000 (*)
Sendai City (1990)	Whole area	10	300~2,000 (*)
Hachinohe City (1990)	I	Odor Index 10 (10)	Odor Index 25 (300)
	II	" 15 (30)	" 30(1,000)
	III	" 18 (60)	" 35(3,000)
Amagasaki City (1991)	I	10	600~2,000 (*)
	II	30	1,800~6,000 (*)
Otake City (1993)	Whole area	Odor Index < 10	Odor Index < 25~33
Iwate Pref. (1993)	Whole area	10~30 (**)	—

- Notes: 1. Odor emission standards without comments in particular designate the values of odor concentration.
 2. The value with an asterisk (*) is enacted within the range in accordance with the height of stack.
 3. The value with an asterisk (**) is enacted within the range in accordance with the category of area.

A-5 Outlines of Financing and Tax Schemes
for Public Nuisance Preventive Facilities

(1) Financing scheme for public nuisance preventive facilities

The financing scheme of long terms and low interest rates through the governmental financial institutions (Japan Development Bank, Hokkaido and Tohoku Development Public Loan Corporation, Okinawa Promotion and Development Public Loan Corporation, Medium and Small Enterprise Financing Public Corporation, National People's Financing Public Corporation, Public Nuisance Prevention Institute, Medium and Small Enterprise Institute, Metropolis and Prefectures) for enterprises' installations of public nuisance preventive facilities responding to regulations.

Medium and Small Enterprise Financing Public Corporation and National People's Financing Public Corporation offer loans to such entrepreneurs on installations of public nuisance preventive facilities or moves of medium and small factories. The enterprises (manufacturers) objective of these financings are those with a capital of ¥100 millions or less and employees not more than 300 or those with a capital of ¥10 millions or less and employees not more than 100.

Medium and small enterprise modernization financing scheme offers loans to such enterprises through Metropolis or Prefecture in order to promote facilities modernization.

Medium and small enterprises' improvement financing scheme aims at raising enterprise qualities radically by cooperation, grouping or conversion of businesses through such means as forming associations for the sake of such

Table 5-1 Outline of Financing Through Governmental Institutions

Institution and objective facilities	Financing conditions			Max. amount (\$ million)
	Financing ratio(%)	Interest rate (%)	Term of repayment	
Public Nuisance Prevention Institute (loaning service) Group's facilities	up to 80	initial: 5.25 since 4th year: 5.55	max. 15 years (unredeemed for 2 years)	---
Individual's facilities	ditto	6.0	ditto	---
Public Nuisance Prevention Institute (construction transfer service) Buildings for group use	5 or more	6.0	max. 20 years (unredeemed for 2 years)	---
Moving of factories	ditto	ditto	ditto	---
Common welfare facilities	ditto	ditto	ditto	---
Medium and Small Enterprise Financing Public Corporation Financing for industrial nuisance prevention	----	initial: 6.6 since 4th year: 7.1	max. 15 years (unredeemed for 2 years)	520
Financing for moving	----	7.1	----	---
National People's Financing Public Corporation Financing for industrial nuisance prevention	----	initial: 6.6 since 4th year: 7.1	max. 15 years (unredeemed for 2 years)	52
Financing for moving	----	7.1	----	---
Metropolis and Prefectures (fund for equipment modernization)	50	no interest	max. 12 years (unredeemed for 1 year)	30
Medium and Small Enterprise Institute Fund for common nuisance prevention project	up to 80	no interest	max. 20 years (unredeemed for 3 years)	---
Fund for common nuisance preventive facilities leasing project	up to 65	2.7	max. 15 years (unredeemed for 2 years)	---

(Notes) 1. The financing conditions listed here apply for medium and small enterprises.

The interest rates as of Mar. 1, 1993.

2. Preliminary consultations on details of the scheme are required with the financing institution because it sometimes designates sorts of objective facilities.

enterprises that their individual potential cannot promote business modernization. This scheme offers loans of long terms and low interest rates to common public nuisance preventive projects of business associations or projects of associations by leasing nuisance preventive equipment to member enterprises.

Public Nuisance Prevention Institute, established in October 1965, is an institution assisting public nuisance prevention plans exclusively. It promotes assistance actively about public nuisance preventive measures of enterprises by transferring or leasing constructions in order to prevent public nuisances such as air pollution and water quality contamination.

The construction transferring business includes ① build- ings for group use, ② common welfare facilities (green areas or park facilities), ③ green areas against air pollution, ④ national park facilities and ⑤ lands for factory movement. The Institute receives commissions from enterprises who want to install those facilities, carries out the overall businesses related to construction works, and transfers the completed constructions on the basis of bare cost under the reimburse conditions of long term and low interest rate.

Lending business offers funds necessary for enterprises or local public institutions to install facilities preventing industrial public nuisances.

Japan Development Bank's financing scheme deals with large enterprises mainly of a capital of ¥100 million or more and employees not less than 300. Hokkaido and Tohoku Development Public Loan Corporation and Okinawa Promotion and Development Public Loan Corporation offer loans for

arrangement of public nuisance preventive facilities in Hokkaido and Tohoku Region and Okinawa Region, respectively, for the purpose of contributing to promotion and development of industries.

(2) Tax schemes for public nuisance preventive facilities

Special national tax schemes for public nuisance preventive measures include ① the special depreciation scheme accompanying to acquisition of public nuisance preventive facilities, ② specially short installation lives, and ③ special tax for replacement of business installations accompanying to counter-measures to public nuisances. Special local tax schemes include waiving or special standards of real estate tax for public nuisance preventive facilities and waiving of business place tax or special land owner's tax.

The special depreciation scheme admits special depreciation for a specific portion of the price of the newly acquired equipment for public nuisance prevention in the initial fiscal year in case when an enterprise has installed such equipment.

As for specially short installation lives, lives of smoke treating equipment and waste water treating equipment are allowed to be estimated considerably shorter than the ordinary depreciation calculation.

Application of the special tax for replacement of business installation accompanying to countermeasures to public nuisances is restricted to only three sorts of nuisances; air pollution, water contamination and noise hazard. In cases when factories in areas with air pollution or water contamination or with special discharge standards

have move to areas where no possibility of public nuisances is foreseen, the factories' profits are only partially charged with the tax. This aims at promotion of moving-out of nuisance generating facilities.

Schemes lowering or waiving of local taxes relate to taxes on fixed assets, business places and owning special lands, all relating to public nuisance preventive facilities.

Appendix B

Outlines of Offensive Odor Substances

B Outline of Offensive Odor Substances

ammonia [INORG CHEM] NH_3 A colorless gaseous alkaline compound that is very soluble in water, has a characteristic pungent odor, is lighter than air, and is formed as a result of the decomposition of most nitrogenous organic material; used as a fertilizer and as a chemical intermediate.

methyl mercaptan [ORG CHEM] CH_3SH Colorless, toxic, flammable gas with unpleasant odor; boils at 6.2°C ; insoluble in water, soluble in organic solvents; used as a chemical intermediate.

hydrogen sulfide [INORG CHEM] H_2S Flammable, toxic, colorless gas with offensive odor, boiling at -60°C ; soluble in water and alcohol; used as an analytical reagent, as a sulfur source, and for purification of hydrochloric and sulfuric acids. Also known as hydrogen disulfide.

methyl sulfide [ORG CHEM] $(\text{CH}_3)_2\text{S}$ Flammable, colorless liquid with disagreeable aroma; soluble in ether and alcohol, insoluble in water; boiled at 38°C ; used as a chemical intermediate. Also known as dimethyl sulfide.

methyl disulfide [ORG CHEM] $(\text{CH}_3)_2\text{S}_2$ Flammable, colorless liquid with disagreeable aroma; soluble in ether and alcohol; boiled at 110°C ; used as a chemical intermediate. Also known as dimethyl disulfide.

trimethylamine [ORG CHEM] $(\text{CH}_3)_3\text{N}$ A colorless, liquefied gas with a fishy odor and a boiling point of -4°C ; soluble in water, ether, and alcohol; used as a warming agent for natural gas, a flotation agent and insect attractant. Abbreviated TMA.

acetaldehyde [ORG CHEM] C_2H_4O A colorless, flammable liquid used chiefly to manufacture acetic acid.

styrene [ORG CHEM] $C_6H_5CH=CH_2$ A colorless, toxic liquid with a strong aroma; insoluble in water, soluble in alcohol and ether; polymerizes rapidly, can become explosive; boils at $145^\circ C$; used to make polymers and copolymers, polystyrene plastics, and rubbers. Also known as phenylethylene; styrene monomer; vinylbenzene.

propionic acid [ORG CHEM] CH_3CH_2COOH Water- and alcohol-soluble, clear, colorless liquid with pungent aroma; boils at $140.7^\circ C$; used to manufacture various propionates, in nickel-electroplating solution, for perfume esters and artificial flavors, for pharmaceuticals, and as a cellulose solvent. Also known as methylacetic acid; propanoic acid.

normal-butyric acid [ORG CHEM] $CH_3CH_2CH_2COOH$ A colorless, combustible liquid with boiling point $163.5^\circ C$ (757mmHg); soluble in water, alcohol, and ether; used in synthesis of flavors, in pharmaceuticals, and in emulsifying agents.

normal-valeric acid [ORG CHEM] $CH_3(CH_2)_3COOH$ A combustible, toxic, colorless liquid with a penetrating aroma; soluble in water, alcohol, and ether; boils at $185^\circ C$; used to make flavors, perfumes, lubricants, plasticizers, and pharmaceuticals. Also known as valerianic acid.

isovaleric acid [ORG CHEM] $(CH_3)_2CHCH_2COOH$ Colorless liquid with disagreeable taste and aroma; boils at $176^\circ C$; soluble in alcohol and ether; found in valeriana, hop, tobacco, and other plants; used in flavors, perfumes, and medicines.

toluene [ORG CHEM] $C_6H_5CH_3$ A colorless, aromatic liquid

derived from coal tar or from the catalytic reforming of petroleum naphthas; insoluble in water, soluble in alcohol and ether, boils at 111°C; used as a chemical intermediate, for explosives, and in high-octane gasoline. Also known as methylbenzene; phenylmethane; toluol.

xylene [ORG CHEM] $C_6H_4(CH_3)_2$ Any one of the family of isomeric, colorless aromatic hydrocarbon liquids, produced by the destructive distillation of coal or by the catalytic reforming of petroleum naphthenic fractions; used for high-octane and aviation gasolines, solvents, chemical intermediates, and the manufacture of polyester resins. Also known as dimethylbenzene; xylol.

ethyl acetate [ORG CHEM] $CH_3COOC_2H_5$ A colorless liquid, slightly soluble in water; boils at 77°C; a medicine, reagent, and solvent. Also known as acetic ester; acetic ether; acetidin.

methyl isobutyl ketone [ORG CHEM] $(CH_3)_2CHCH_2COCH_3$ Flammable colorless liquid with pleasant aroma; boils at 116°C, miscible with most organic solvents; used as a solvent, extractant, and chemical intermediate. Also known as hexone.

isobutyl alcohol [ORG CHEM] $(CH_3)_2CHCH_2OH$ A colorless liquid that is a by-product of the synthetic production of methanol, boils at 107°C; soluble in water, ether, and alcohol; used as a solvent in paints and lacquers, in organic synthesis, and in resin coatings. Also known as isobutanol; isopropylcarbinol; 2-methyl-1-propanol.

propionaldehyde [ORG CHEM] C_2H_5CHO Flammable, water-soluble, water-white liquid, with suffocating aroma; boils at 48.8°C; used to manufacture acetals, plastics, and rubber

chemicals, and as a disinfectant and preservative.

normal-butyraldehyde [ORG CHEM] $\text{CH}_3(\text{CH}_2)_2\text{CHO}$ A colorless liquid boiling at 75.7°C ; soluble in ether and alcohol, insoluble in water; derived from the oxo process.

isobutyl aldehyde [ORG CHEM] $(\text{CH}_3)_2\text{CHCHO}$ Colorless, transparent liquid with pungent aroma; soluble in alcohol, insoluble in water; boils at 64°C ; used as a chemical intermediate. Also known as isobutyraldehyde.

normal-valeraldehyde [ORG CHEM] $\text{CH}_3(\text{CH}_2)_3\text{CHO}$ A flammable liquid, soluble in ether and alcohol, slightly soluble in water; boils at 102°C ; used in flavors and as a rubber accelerator.

isovaleraldehyde [ORG CHEM] $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$ A colorless liquid with an applelike odor and a boiling point of 92°C ; soluble in alcohol and ether; used in perfumes and pharmaceuticals and for flavoring.

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