No.3 ENVIRONMENTAL WATER QUALITY MANAGEMENT IN JAPAN PART 2. AREAWIDE TOTAL POLLUTANT LOAD CONTROL SYSTEM

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1. BOTTOM SEDIMENTS CONTROL IN JAPAN

1.1 Introduction

To control water pollution by toxic substances, Environmental Water Quality Standards and Effluent Standards were established. But these standards were not always enough for the protection of human health from toxic substances in the water areas where bottom sediments contain many toxic substances, since bottom sediments pollute water, fish and shell fish through the release and bio-accumulation of toxic substances.

Therefore Environment Agency also set up "Provisional Removal Standard" and "Interim Guidelines for Treatment and Disposal" for bottom sediments containing toxic substances.

In this paper, the control of mercury and PCB in bottom sediments is cited an instance.

1.2 Control of Mercury in Bottom Sediments

1.2.1 Provisional Removal Standard

With the view to prevent the pollution of fishery products caused by mercury-contaminated bottom sediments, provisional removal standard, relating to the removal of mercury-contaminated bottom sediments, was established on August 31, 1973. This standard was established, taking into consideration the permissible limits of mercury concentration in fishery products (0.4 ppm of total mercury and 0.3 ppm of methyl mercury), food balance, biological accumulation of mercury (overall accumulation coefficient 1,000), release of mercury from bottom sediments, its diffusion and mixing and other factors in the water area.

1.2.2 State of Bottom Sediments Pollution

The nationwide comprehensive environmental survey was conducted with respect to the fishery products, water, bottom sediments, soil, and agricultural products in areas where contamination of fishery products was reported with high concentration of mercury by investigations conducted

during the year prior to 1973, and in those areas adjacent to mercury handling factories and mercury mines.

Regarding the quality of bottom sediments, a total of 5,656 samples taken from 678 water areas, consisting of 341 rivers, 158 harbors and 148 sea water areas were examined. As a result, the bottom sediments taken from 27 water areas consisting of 16 rivers and 11 bays were found to contain mercury in excess of provisional removal standards.

The survey for bottom sediments has been conducted every year since then. As of July 1987, bottom sediments in 42 water areas were found contaminated by mercury in excess of the provisional removal standards. Removal work of bottom sediments were completed in 41 water areas and are underway in 1 water area.

1.3 Control of PCB in Bottom Sediments

1.3.1 Provisional Removal Standard

From the same standpoint taken with respect to mercury pollution, provisional removal standard for the removal of PCB-contaminated bottom sediments was established. To start with, the government sets, on the basis of the findings of the investigations conducted in 1972, the provisional removal standard at 100 ppm for the base of dry bottom sediments. Subsequently, an increased amount of data became available, and on the basis of the findings of a statistical analysis of the data relating to PCB concentration in bottom sediments, generated by the nationwide environmental survey conducted in fiscal 1973 and the permissible limits on PCB concentration in fishery products (3 ppm), the removal standard was lowered on February 28, 1975 to 10 ppm for the base of dry bottom sediments.

1.3.2 State of Bottom Sediments Pollution

As the result of investigation, bottom sediments in 78 water areas were found to contain PCB in excess of the provisional removal standard and in need of removal. Of these, projects for the removal of the contaminated bottom sediments were completed 73 water areas, and removal projects which

are being planned and so on for 5 water areas (as of March 1988).

1.4 Prevention of Secondary Pollution in the Course of Disposal of Contaminated Bottom Sediments

With a view to averting the secondary pollution in the course of disposal of contaminated bottom sediments, the Environment Agency adopted on May 30, 1974 "Interim Guidelines relating to the Treatment and Disposal of Contaminated Bottom Sediments". The guidelines are addressed primarily to the technical aspects involved in the treatment and disposal of such bottom sediments, with particular attention to the monitoring of secondary pollution and to the methods of final disposal of removed bottom sediments.

The monitoring is divided into two areas of the public water areas and the dredging water areas, taking into consideration the conditions of the sea (such as the current and tide), the quality and conditions of the bottom sediments, dredging methods employed and the state of fishing activities in the given water areas and other factors. The term "public water area" refers to those which must be protected from the effects of dredging operations, and the term "dredging water areas" refers to those which are inevitably allowed to be affected by dredging operations (see Fig. 1). On the borderline, between a public water area and a dredging area, master monitoring stations are established, and between the master monitoring stations and the site of dredging operation, an adequate number of auxiliary monitoring stations are established.

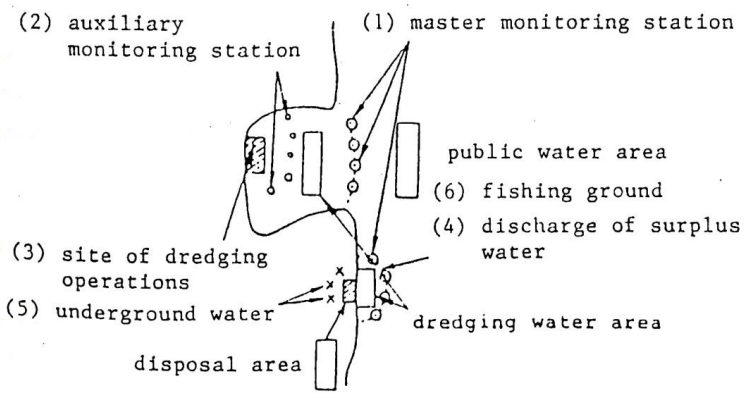

Figure 1.

Monitoring should also be directed to the items for the conservation of living environment such as BOD, COD, SS in addition to toxic substances which are the primary object of removal work. Monitoring, in principle, will be guided in relation to the environmental quality standards applicable to the given situation. However, in case the concentration of toxic substances might be found in excess of the environmental standard values, removal works would be controlled by the interim guidelines, since the aim of the monitoring is to prevent further pollution of the water beyond that existing before. Guidelines for the final disposal of removed bottom sediments are drawn up along the lines of policy for the disposal of sludge, set forth in the Waste Management Law and the Marine Pollution Prevention Law.

2. CONTROL OF GROUNDWATER CONTAMINATION BY CHEMICAL SUBSTANCES

2.1 Extent of Groundwater Contamination

2.1.1 Results of National Survey in Fiscal 1982 and 1983

In Fiscal 1982, the national survey planned by the Environment Agency was carried out in 15 major cities across the nation. As a result of the survey, it was revealed that groundwater was contaminated by Trichloroethylene (TCE) and other chemical substances of which provisional guideline values were established by the World Health Organization (WHO).

In Fiscal 1983, the Agency conducted a follow-up survey on polluted wells and their vicinity in 13 major cities. As a result of the survey, it was revealed that most of the wells were still polluted and their vicinity was extensively polluted.

2.2 Tentative Drinking Water Quality Standards on TCE, PCE, and MC

2.2.1 Outlines

The Health and Welfare Ministry announced Tentative Drinking Water Quality

Standards on Trichloroethylene (TCE), Tetrachloroethylene (PCE), and 1.1.1-Trichloroethane (MC) on Feb., 1984, and instructed the prefectural authorities to take necessary measures.

The Standards on the three substances were set for the following reasons:

(1) Cases of pollution of drinking water source by TCE, PCE, and MC have come to be often reported. These chemicals turned up in larger amounts than others in a survey on the groundwater contamination, conducted by the Environment Agency in fiscal 1982 and 1983.

(2) Whether TCE and PCE may cause cancer in human beings has not been established. But measurement of them for potential hazard is needed from the viewpoint of safeguard of human health.

(3) Measurement of MC that is used as a substitute of TCE and PCE is also needed.

2.2.2 Tentative Drinking Water Quality Standards

(1) Tentative Drinking Water Quality Standards

TCE	to be held below 0.03 mg/l
PCE	to be held below 0.01 mg/l
MC	to be held below 0.3 mg/l

(2) Monitoring requirement

The quality of tap water from respective water purification plants is to be examined with respect to TCE, PCE, and MC at the interval of less than a year.

(3) Countermeasures of contamination

When water quality shows a level of contamination in excess of the tentative standard values, countermeasures to reduce the level of TCE, PCE, and MC should be taken such as changing water sources and introducing additional water purification processes, including aeration

and filtration with activated carbon.

2.3 Provisional Guidelines for Discharge of TCE, PCE, and MC

2.3.1 Outlines

The Environment Agency's fiscal 1982 and 1983 surveys revealed that groundwater had been extensively polluted by TCE, PCE, and MC. Specific cases of contamination have also been ascertained in various parts of the country.

While the mechanism whereby groundwater is contaminated has not been cleared up, measures are required to control pollution resulting from the penetration of water containing TCE, PCE, and MC, and also to curb the amount of these substances discharged into public bodies of water.

Under these circumstances, the Environment Agency has laid down provisional guidelines for discharge of these substances and has instructed the local authorities to exercise guideline on factories and other business establishments on basis of these guidelines as a countermeasure for the time being.

2.3.2 Provisional Guidelines for Discharge of TCE, PCE, and MC

(1) Objects of application

The guidelines should be applied to factories and other business establishments handling TCE, PCE, MC, and substances containing them.

(2) Measures against penetration

Appropriate measures should be taken to prevent the water containing TCE, PCE, and MC from penetration into the ground. The water with contaminants of which the concentrations are over the control targets given in Table 1, should not be allowed to penetrate into the ground.

Table 1 Control Targets to Prevent Penetration

TCE	0.03 mg/l or less
PCE	0.01 mg/l or less
MC	0.3 mg/l or less

(3) Controlling discharge into public bodies of water

Measuring to be taken at factories and other business establishments which discharge wastewater containing TCE, PCE, and MC into public water bodies, should included efforts to prevent the pollutants from getting mixed in the outgoing water and to separate and recover them before waste water is discharged. They should be directed at making the pollutant concentrations in water discharged into public bodies of water conform to the control targets in Table 2.

Table 2 Control Targets for Discharge into Public Water Bodies

TCE	0.3 mg/l or less
PCE	0.1 mg/l or less
MC	3 mg/l or less

2.4 Results of Survey Conducted by Municipal Authorities

The survey of groundwater contamination have been conducted by municipal authorities since Fiscal 1984. The data of surveys have been gathered by the Environment Agency and are summarized in Table 3.

Table 3 Results of the Survey Conducted by Municipal Authorities (1984 - 1986)

Fiscal year	Contaminants	Number of surveyed municipalities	All surveyed wells			Drinking water wells		
			Number of surveyed wells	Number of samples which exceeded the Standards		Number of surveyed wells	Number of samples which exceeded the Standards	
1984	TCE	833	5720	122	(2.1%)	1646	48	(2.9%)
	PCE		5733	185	(3.2%)	1658	76	(4.6%)
	MC		5476	4	(0.1%)	1559	0	(0.0%)
1985	TCE	468	3461	123	(3.6%)	1780	45	(2.5%)
	PCE		3459	140	(4.0%)	1780	56	(3.1%)
	MC		3455	8	(0.2%)	1778	2	(0.1%)
1986	TCE	303	2794	146	(5.2%)	1602	69	(4.3%)
	PCE		2777	109	(3.9%)	1592	60	(3.8%)
	MC		2763	3	(0.1%)	1591	0	(0.0%)

In Fiscal 1986, the survey of groundwater contamination were conducted by 303 municipalities, and the excess ratios of surveyed wells for Tentative Drinking Water Quality Standards were 5.2% for TCE, 3.9% for PCE and 0.1% for MC.

In the table, the compliance status for the Standards showed no sign of any significant improvement. It should be noted that a simple comparison is not valid, as surveyed wells are not the same every year.

3. SOIL POLLUTION CONTROL IN JAPAN

3.1. Concept of Soil Pollution

Soil is very important as one of the elements in the living environment along with water and air, providing the basis for the production of foodstuffs and forest resources, also playing an important role in the conservation of the regional environment.

However, if toxic chemicals are accumulated in soil beyond the self-purification capacity of the soil, it will disturb the growth of crops and produce farm and dairy products harmful to human health. Further, particularly in urban areas, toxic substances will directly influence the environment and human health through various media such as air and water.

For this reason, with soil pollution, unlike "air pollution" and "water pollution," unless the pollution is removed, its influence will continue to remain; this is "cumulative pollution." Further, soil pollution itself is arising from air pollution and water pollution, and the effect of soil pollution appears through various media such as air and water; it is also called "indirect or secondary pollution."

In Japan a number of measures are being taken to prevent such soil pollution from occurring and also remove pollutants.

3.2. Agricultural Soil Pollution Control Measures

3.2.1 History of Soil Pollution in Japan

The typical region where soil pollution caused a big problem is the basin of the River Jintsu in Toyama Prefecture. In this region, crop damage by heavy metals accumulated in the soil had been a problem even before the World War II, and special measures had been neglected. However, it was clarified in 1968 that "Itai-itai disease" was chronic cadmium poisoning, and this became a very grave social problem.

Under such circumstances, the "Basic Law for Environmental Pollution Control" was partly revised at the 64th extraordinary Diet meeting held in November 1970 (the so-called Pollution Diet), and as one of the typical

types of pollution, "soil pollution" was added, and as a law for its implementation, the "Agricultural Land Soil Pollution Prevention Law" was established, based on which a number of measures have been implemented.

3.2.2 Outline of Agricultural Land Soil Pollution Prevention Measures

This law designates substances likely to cause soil pollution as specific harmful substances by the Cabinet Order. As such specific harmful substances, cadmium and its compounds, copper and its compounds, and arsenic and its compounds have been designated to date.
The prefectural governor is to conduct measurement surveys with regard to the state of the pollution of agricultural land soil by specific harmful substances within the prefecture and can designate a region which corresponds to the condition for designation provided by the Cabinet Order (Table 4) as an agricultural land soil pollution policy area.

After he designates the policy area, he is to design, without delay, agricultural land soil pollution measure plan for agricultural land soil pollution prevention and removal, and the rationalized use of polluted agricultural land.

The cost of soil pollution control work implemented based on a policy project is to be wholly or partly borne by any person responsible for such pollution in accordance with the Law Concerning Industrialists' Bearing of the Cost of the Public Pollution Control Works, and, as regards the remaining cost, the majority shall be borne by the central government and the prefectural government.

When the prefectural governor has designated the policy area, from the viewpoint of the prevention of repollution, if necessary he may determine stricter standards than the effluent standards or emission standards stipulated in accordance with the Water Pollution Control Law or Air Pollution Control Law, etc.

As regards the state of pollution by the three substances designated as specific harmful substances, Table 5 indicates the results of detailed surveys by prefectures.

Table 4 Specific Harmful Substances and Requirements for Designation as Agricultural Land Soil Pollution

Specific harmful substance	Date specified	Requirements for designation
Cadmium and its compounds	24 June 1971	(1) Area where it is determined that the content of cadmium in rice is 1 ppm or more (2) Area adjacent to (1) where it is determined that the content of cadmium in rice is likely to be 1 ppm or more, since the quantity of cadmium in its soil is equal or greater than (1) while the nature of its soil is roughly equal to (1).
Copper and its compounds	17 Oct. 1972	Area where it is determined that the content of coper in the soil is 125 ppm or more (0.1 NHCl extraction) (for paddy fields only)
Arsenic and its compounds	4 Apr. 1975	Area where it is determined that the content of arsenic in the soil is 15 ppm or more (1 NHCl extraction) (other values between 10–20 ppm to be specified by prefectural governor with approval of Director-general. Environment Agency in cases where this value is not feasible for special reasons peculiar to the area's natural condition) (paddy fields only).

Table 5 Outline the Progress of Agricultural Land Soil Pollution Policy Plan (as of 20 Nov. 1987)

Specific harmful substance	(1) Area where basic of higher data value detected	Breakdown			(5) Designated areas for which policy project was mapped out	(6) Areas at left for which project was completed	(7) Areas at left for which designation was cancelled
		(2) Designated area	(3) Already processed by independent prefectural project, etc.	(4) Under survey			
Cadmium	91 (Approx. 6490 ha)	51 (5900 ha)	31 (310 ha)	20 (280 ha)	28 (3000 ha)	27 (1360 ha)	25 (1680 ha)
Copper	37 (Approx. 1430 ha)	13 (1250 ha)	15 (50 ha)	9 (130 ha)	8 (780 ha)	8 (410 ha)	7 (470 ha)
Arsenic	14 (Approx. 390 ha)	7 (160 ha)	1 (40 ha)	6 (190 ha)	7 (160 ha)	7 (150 ha)	–
Total	128 (Approx. 7030 ha)	60 (Approx. 6050 ha)	44 (Approx. 390 ha)	34 (Approx. 590 ha)	34 (Approx. 3120 ha)	33 (Approx. 1440 ha)	28 (Approx. 1710 ha)

Note 1. Differences in the vertical columns between the total of no. of areas and their area and their total at the bottom is due to the incidence of compound pollution. Horizontal discrepancies between the total no. of areas under breakdown and that under (1) in due to the designation of divided areas.

2. The source of (1) is the results of detailed surveys, etc. up to 1986.

3.2.3 Temporary Control Standards for Use of Sludge and Urban Refuse Compost

Recently with the development of industrial activity, and the promotion of facilities for environmental protection, the volume of waste such as sludge and urban refuse has increased considerably, and its disposal has become very great social problem.

As regards the use of sludge and urban refuse for agricultural land, while some of it may be effectively used as fertilizer and soil amendment by appropriate processing and application, depending on their composition some of them contain a fairly large quantity of such toxic substances as heavy metals and foreign materials which inhibit the growth of crops, and special care will be necessary in its application.

For this reason, for the promotion of the appropriate use of recycled organic materials for agricultural land and for the prevention of negative effects on the growth of crops by the accumulated of heavy metals in agricultural land soil, the Environment Agency temporarily established in 1984 the "Control Standards for Prevention of Accumulation of Heavy Metals in Agricultural Land Soil."

In this standard, zinc is selected as the control parameter so that it is contained more relatively in the recycled organic materials, is more likely to accumulate in soil, and therefore its concentration reaches a natural residual quantity much quicker than other heavy metals. The control standard values is 120mg of zinc per one kilogram of dry soil which is about 95 percent the concentrated value of zinc content natural residual quantity distribution and is recognized as harmless to crops.

The prefecture then provides guidance to farmers not to overuse recycled organic substances in accordance with this control standard.

3.3. Urban Soil Pollution Control Measures

3.3.1 History of Urban Land Soil Pollution Problems

With the discovery of a large quantity of reclamation of hexavalent chromium slag in Tokyo in 1975 as a turning point, environmental pollution at recla-

mation sites for the disposal of chromium slag and the surrounding area of nine plants had become a big social problem.

As a measure for the pollution like this, the "Waste Disposal and Public Cleansing Law" was enacted in 1970; by its revision in 1976 new standards for final disposal sites were established and an order for measures for the violation of the disposal standards was institutionalized and with regard to environmental pollution arising from the disposal of wastes including hexavalent chromium, emission control and environmental restoration were to be promoted by this law.

It was also discovered in 1984 that the soil of previous sites of some national laboratories was polluted by mercury, arsenic and lead.

As a measure for this type of soil pollution control, in the case of the conversion of the land use of such government property such as the use for a school of the previous laboratories sites, provisional guidelines for soil pollution control measures were compiled in January 1986, and the disposal of polluted soil of government owned land is being conducted in accordance with these guidelines.

3.3.2 Provisional Guidelines for Urban Land Soil Pollution Measures

(1) Applicable substance (Table 3)

From the viewpoint of the prevention of negative effects on human health, nine substances designated to be health items in the environmental quality standards with respect to water pollution control, were specified. If there is any toxic chemical which is likely to cause pollution and which, from the angle of the project of its future use, may become a problem, it will also be included.

(2) Criterion standards (Table 6)

Standards for judging whether clean-up measures are needed or not are as follows:

1) With regard to mercury, cadmium, lead and arsenic and their compounds, which exist extensively in nature, survey results in ordinary urban

areas were converted by logarithm, and based on its distribution, the mean value of the existing quantity in nature +3 sigma (three times the standard deviation) content was established. This is based on the idea that, if the value is below this value it is considered as manmade pollution, land is sufficiently safe from trial calculation with respect to the effects on human health.

2) With an extremely limited quantity of hexavalent chromium, alkyl mercury compound, organic phosphorous compound, cyanides and PCB, in consideration of the effects on public water and groundwater, the values of environmental quality standards with respect to water pollution in elution was established as the standards.

Table 6 Criterion Standard Value of Polluted Soil Requiring Measures (Standard Value for Content)

Substance	Criterion standard value
Alkyl mercury compound	No detection after elution test
Mercury and its compounds	3 mg of mercury per 1 kg of dry soil
Cadmium and its compounds	9 mg of cadmium per 1 kg of dry soil
Lead and its compounds	600 mg of lead per 1 kg of dry soil
Organic phosphorous compound	No detection after elution test
Hexavalent chromium compounds	0.05 mg of hexavalent chromium per 1 liter of test liquid after elution test
Arsenic and its compounds	50 mg of arsenic per 1 kg of dry soil
Cyanide compound	No detection after elution test
PCB	No detection after elution test

Notes: 1. Analysis of criterion standard value is per method determined by the Environment Agency.

2. "No detection" means that when measured by the method in the above 1, the value is below the quantitative limit.

(3) Clean-up measures

In consideration of the varying effects on the environment depending on the extent of pollution, criterion standards for the selection of clean-up measures (Table 7) were established. Its basis is as follows:

Elution quantity standard I ... the same level as environmental quality standards. However, with regard to mercury, cadmium and lead, as they are easily adsorbed soil, the value is three times as much as the values of environmental quality standards.

Elution quantity standard I' ... the same level as environmental quality standards: this standard used to place where the effects on groundwater are seen.

Elution quantity standard II ... the same level as criterion standards for industrial wastes including metals.

Clean-up measures are also divided into the following three stages in accordance with the above standards.

1) in the event of values lower than elution standard I and I': soil covering and vegetation to prevent the dispersion of soil and surface spillage of soil.

2) in the event of values exceeding the elution standard I or I' but below II: water insulation work with impermeable sheets or clay to prevent effects on groundwater.

3) in the event of values exceeding elution standard II: First of all, after treatment for safety disposal, the elution test is necessary again. If it becomes below elution standard II, the same measure as 2) is necessary, while if it still continues to exceed elution standard II, insulation work to contain it in a concrete vessel to insulate it from the environment is necessary.

(4) Implementation procedure for urban land soil pollution control measures

Table 7 Criterion Standard Value for Selection of Clean-up Measures (Elution standard value)

Substance	Criterion Standard Value		
	Elution quantity standard value I	Elution quantity standard value I'	Elution quantity standard value II
Alkyl mercury compound	No detection		No detection
Mercury and its compounds	0.0015 mg of mercury per 1 liter of test liquid	Mercury content over 0.0005 mg below 0.0015 mg per 1 liter of test liquid, and 0.0005 mg of mercury per 1 liter of underground water	0.005 mg of mercury per 1 liter of test liquid
Cadmium and its compounds	0.03 mg of cadmium per 1 liter of test liquid	Cadmium content over 0.01 mg below 0.03 mg per 1 liter of test liquid, and 0.01 mg of cadmium per 1 liter of underground water	0.3 mg of cadmium per 1 liter of liquid
Lead and its compounds	0.3 mg of lead per 1 liter of test liquid	Lead content over 0.1 mg below 0.3 mg per 1 liter of test liquid, and 0.1 mg of lead per 1 liter of underground water	3 mg of lead per 1 liter of test liquid
Organic phosphorous compound	No detection		1 mg of organic phosphorous compound per 1 liter of test liquid
Hexavalent chromium compound	0.05 mg of hexavalent chromium per 1 liter of test liquid		1.5 mg of hexavalent chromium per 1 liter of test liquid
Arsenic and its compounds	0.05 mg of arsenic per 1 liter of test liquid		1.5 mg of arsenic per 1 liter of test liquid
Cyanide compound	No detection		1.5 mg of cyanide per 1 liter of test liquid
PCB	No detection		0.0003 mg of PCB per 1 liter of test liquid

Notes: 1. Analysis of criterion standard value is per method determined by the Environment Agency.
2. "No detection" means that when measured by the method in 1 above, the value is below the quantitative limit.
3. Elution quantity standard value I' means that as a result of the elution test, the elution quantity is within the above range in the respective column, and the quality of underground water analyzed when the polluted soil layer is either within the variable range of underground water level, or it is close to that range.

Urban land soil pollution control measures are implemented in accordance with the procedure illustrated in Fig. 2.

3.3.3 Response of Local Government

The Tokyo metropolitan government having enacted the "Disposal Standards for Polluted Soil by Heavy Metals in Connection with the Acquisition of Public Lnad" for the acquisition of metropolitan land, instructs the landowner to conduct surveys to check whether the soil is polluted or not, and if polluted, instructs the owner also to take the necessary measures.

On the other hand, Yokohama, having established "Guidelines for Soil Pollution Measures in Connection with the Previous Site of a Plant," provides guidance to conduct surveys and the disposal of soil pollution even in private land transactions.

3.4 Future Problems for Protection of Soil Environment

3.4.1 Strengthened Maintenance of Environmental Protection Function of Soil

With increasing brisk industrial activity and the development of urbanization in recent years, it has been feared that various impact will be placed on soil beyond the environmental capacity of soil, and the deterioration of the soil and surrounding environment, and the expansion of pollution have generated serious concern.

For this reason, study and evaluation of changing soil conditions and the effect of the soil ecosystem on the environmental protection function, also the effect on human health and living activities through the changing environmental protection function are being conducted. It has become an urgent problem from such results to re-evaluate the role of soil environmental protection in the promotion of the stable development of human society, such as agricultural and forestry production, and urban life, and also to establish technology for soil protection, and formulation of administrative measures as quickly as possible.

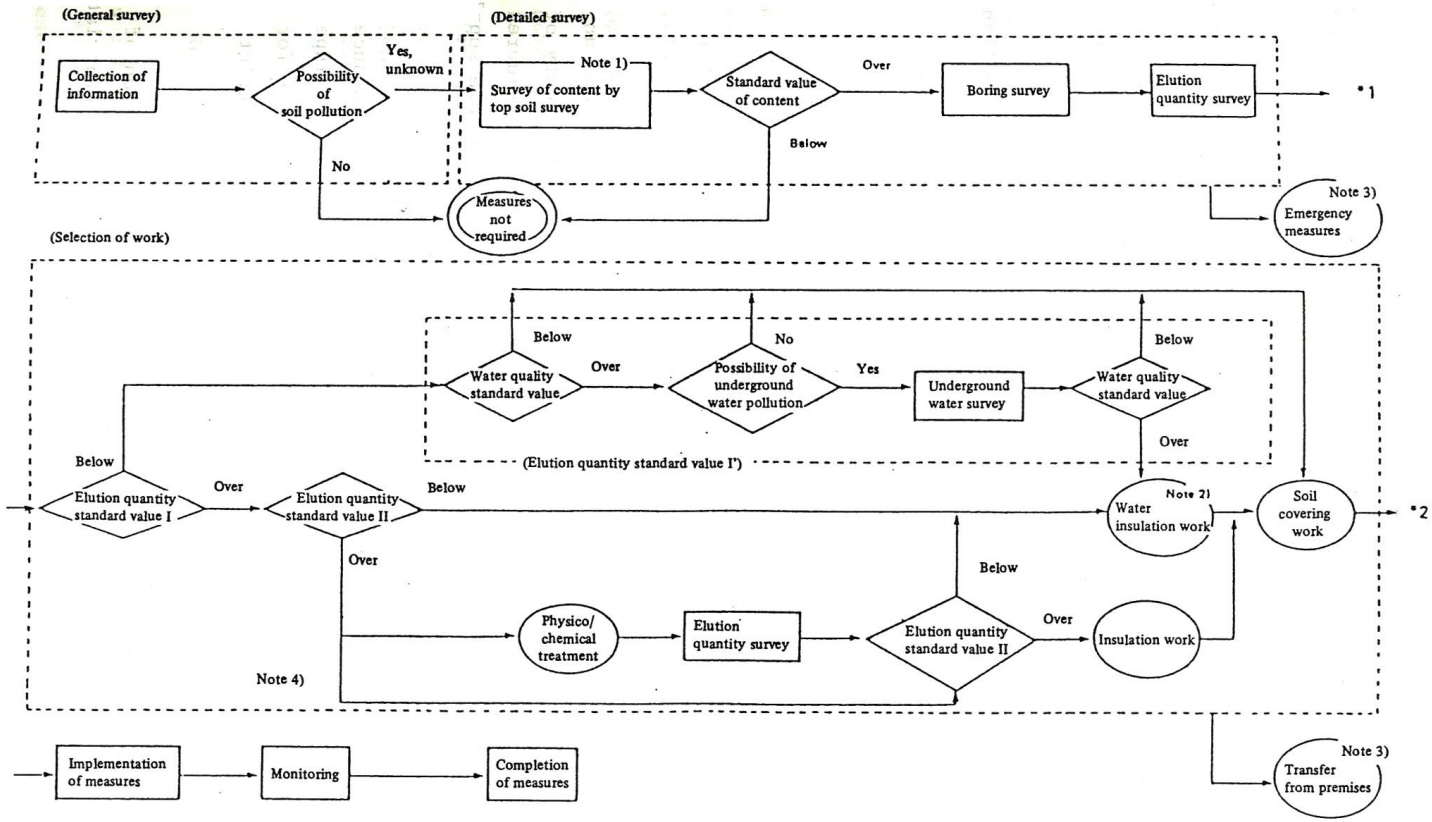

Figure 2 Implementation Procedure of Urban Ground Soil Pollution Measures

3.4.2 Deterioration of Soil Due to Acid Rain

While the issue of soil deterioration due to acid rain has become a serious social problem in Europe and America, this has not been serious in Japan yet. However, the rain of which PH value is below ph 5.6 has been frequently observed throughout this country. In some parts of the Kanto region, the phenomenon of the decline of cedar has been spreading, and its possible connection with acid rain is suspected. Therefore, while surveys are now being conducted to determine the relationship between acid deposition and soil, it is also necessary to progress the surveys and make clear the process of the generation of acid rain.

(Reference) "Agricultural Land Soil Pollution Prevention Law" (English version)

4. PESTICIDE POLLUTION CONTROL IN JAPAN

4.1. Problem of Use of Pesticides

It is obvious that pesticides continue to assume a vital role as the necessary material for increased food production throughout the world.

Particularly, in a country like Japan with limited arable land and an insufficient labor force as well as a temperate climate with plenty of rainfall prompting outbursts of pests, use of pesticides is considered inevitable for increased agricultural productivity and the stable supply of foodstuffs.

On the other hand, since pesticide is not only an effective substance on agricultural products but also is a bioactive substance that is dispersed in the environment, it is necessary to secure a wide range of safety for the pesticide users, the environment the food products, etc., and strict control and an administrative response have become necessary.

In particular, the following matters have called for the attention of society in recent years, and it has become necessary to take appropriate steps to secure their safety.

(1) Effects on human health

Not only the prevention of acute intoxication, but also the prevention of chronic intoxication arising from residual pesticides in crops as food products, is important. There has been growing interest in the safety of food products lately among general consumers. With regard to the residual pesticides in food products, transfer routes through soil persistence and water pollution have also become problems.

(2) Effects on serviceable animals

Particularly in the aerial application of agricultural chemicals, thorough implementation of preventive measures for damage to sericultural industry, beekeeping and aquatic products cultivation in the surrounding areas is required.

(3) Effects on the ecosystem

Recently, especially for the prevention of the effects of the application of agricultural chemicals on the ecosystem, measures to minimize both the direct and indirect effects on nontarget organisms is necessary. The effects through the food chain are also considered important.

(4) Improved evaluation methods for safety

With the higher accuracy of analysis technology and the development of new toxicity test methods through advanced scientific technology, an administrative response for more accurate evaluation of the safety of pesticides is necessary.

4.2. Present State of Control for Prevention of Pesticide Pollution

4.2.1 Regulatory History of Pesticides

It was only after World War II that the extensive use of synthetic pesticides began in Japan. It has greatly improved productivity and the expansion of Japanese agriculture heavily damaged by the war, and also contributed considerably to reduce agricultural labor.

Wide use of organochlorine insecticides such as DDT and BHC started in 1948 - 49, and in 1952 organophosphorous insecticides like parathion, and from 1953 the use of organomercury fungicides began in a large quantity for control of the rice blast disease.

About the same time, the use of herbicides also started mainly for paddy fields. These agricultural chemicals resulted in environmental pollution, residual pesticides in food products, poisoning by strong toxicity to humans and animals, and the death of fish beginning in the early 1960s. Fear about the effects of agricultural chemicals on health and environmental pollution became intensified among the people, and in 1970 it became a great social problem.

The Agricultural Chemicals Regulation Law was established in 1948 shortly after the war to control agricultural chemicals of poor quality and to maintain and improve quality, and then large scale amendment was made in 1971 reflecting the postwar development. The agricultural chemicals registration system was tightened and the use control system was expanded. Also, use of the preceding harmful agricultural chemicals was banned one after another about this time.

The Environment Agency, newly established in July 1971, was assigned to part of the work under the Agricultural Chemicals Regulation Law.

4.2.2 Administrative Agency in Charge of the Control of Agricultural Chemicals

In Japan agricultural chemicals are controlled mainly by the Environment Agency, the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of Health and Welfare.

4.2.3 Control by the Agricultural Chemicals Regulation Law

(1) Purposes of the Agricultural Chemicals Regulation Law

Article 1 of the Agricultural Chemicals Regulation Law stipulates the purpose of this law as follows: "The purposes of this law are to conduce to stabilization of agricultural production and protection of people's health and to contribute to environmental conservation of the life of the people, intending for normalization of quality of

agricultural chemical and ensurance of their safe and due use by establishing the registration system and exercising the control over sale and use concerning agricultural chemicals." Thus this law aims at the optimization of the quality of agricultural chemicals, the safety and proper use by a registration system for the achievement of the object of stable agricultural production, protection of people's health and conservation of the living environment.

The control of pesticides by the Agricultural Chemicals Regulation Law is divided into two steps. Namely: (1) a registration step to conduce a prior check of an agricultural chemical before its registration so that any suspicious pesticide which is likely to cause a problem will not be used; and (2) a step to supervise and control the use and sale of an agricultural chemical after its registration to ensure its proper use. Hereafter these two steps will be explained in detail. (See Table 8)

(2) Agricultural Chemical Registration System

1) Outline of registration system

In accordance with the Agricultural Chemicals Regulation Law, the manufacturer (importer) shall not sell a manufactured or imported agricultural chemical without registration with the Minister of Agriculture, Forestry and Fisheries. This registration remains valid for three years, and it becomes null and void after the above period. If the registration holder desires to continue to sell after the expiration of the above validity, he shall apply then for registration. Registration requires the applicant to submit specified data for examination by the Ministry of Agriculture, Forestry and Fisheries, and registration is granted upon compliance with specified requirements. A major portion of the requirements is established by the Environment Agency. The registered manufacturer or importer shall indicate the scope of applicable pest, use and others registered for agricultural chemicals to manufacture and sell. After registration if it falls under a condition subject to the withholding of registration, the Minister of Agriculture, Forestry and Fisheries may amend or cancel registration. Fig. 3 illustrates the system of registration.

Table 8 Structure of Agricultural Chemicals Regulation Law

Step of control	Under control of Ministry of Agriculture, Forestry and Fisheries	Under control of Environment Agency
Registration	Application for registration ↓ Examination for registration (documentary examination and inspection of pesticide sample) ↓ If application falls under any of the following, such registration will be withheld. 1) False description in application 2) Crop damage from use 3) Likely to be harmful to humans and livestock even with normal preventive measures 4) – 7) 8) Others, including considerably inferior effect of pesticide ↓ Instruction for amendment of application items or quality improvement ↓ Registration (issuance of registration certificate) Dismissal of application for registration	Establishment of standards for withholding registration (notification of standards) 4) Persistence in crops 5) Persistence in soil 6) Damage to aquatic animals and plants 7) Water pollution
Sale	Description of pesticide (true description is to be provided) Restriction or prohibition of sale (only products with true description are to be sold) Reports on sale of pesticides and on-the-spot inspections as regards manufacturer	
Use	Registration for amendment of spectrum of applicable pest and cancellation of registration by authority Establishment of safe use standards for pesticides Guidance for proper use of pesticides Report on sale of pesticides and on-the-spot inspections as regards manufacturer	Designation of persistent pesticides and control of use (designated by cabinet order) 1) Crop-persistent pesticides 2) Soil-persistent pesticides 3) Water-pollutant pesticides

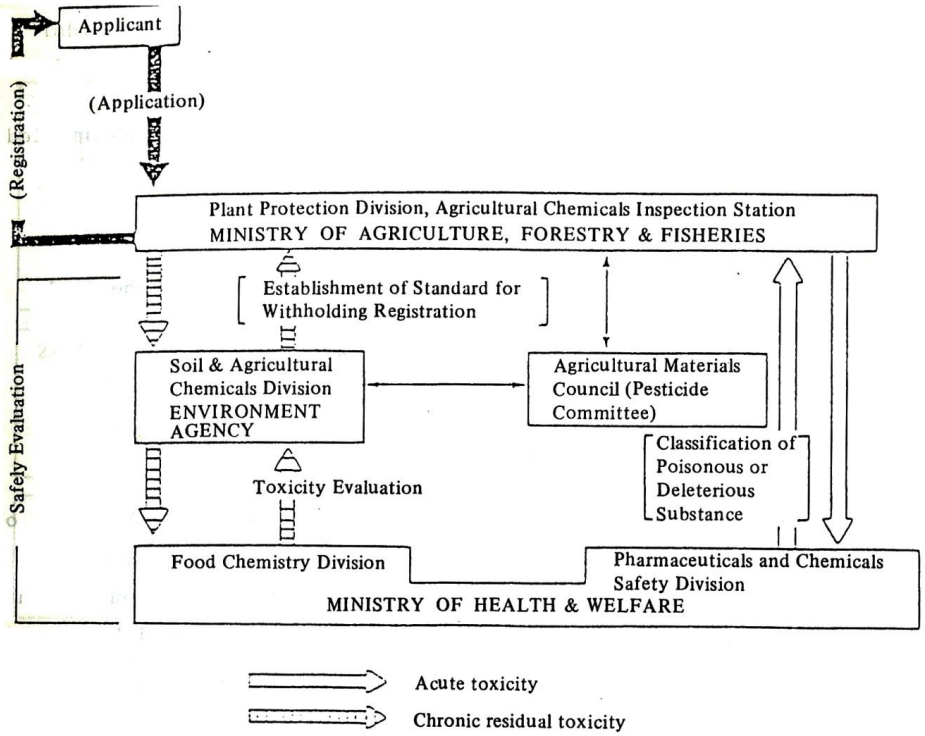

Figure 3 Procedure of Pesticide Registration

2) Application for registration

The applicant for registration of an agricultural chemical shall apply with the following data:

a. Data on toxicity to humans and animals

a) Acute toxicity test data on more than two species of mammals
b) Chronic toxicity test data on more than two species of mammals
c) Generation test data including reproduction test and teratogenicity test
d) Mutagenicity test record
e) Any other necessary toxicity data

b. Toxicity data on fish

At present the submission of an acute toxicity test data on carp and water fleas is required.

c. Data on persistence in crops and soil

a) Crop-persistence test data
Data on persistence in the use of pesticides for crops applied for registration

b) Soil-persistence test data
Half-life measurement data on soil

c) Data on the effectiveness and the phytotoxicity of chemicals

d) Others
Data on metabolism and life in the environment

3) Standards for withholding registration

The applied agricultural chemical will be examined by the Ministry of Agriculture, Forestry and Fisheries. If it falls under any of the following, registration will be withheld, and an instruction for the amendment of the application, or quality improvement, will be provided.

a. False description in application

b. Crop damage from use

c. Likely to be harmful to humans and livestock even with normal preventive measures

d. Damage will result in humans and livestock by use from persistence in crops
Detailed standards are to be established by the Environment Agency. If the agricultural chemical persistence level in crops fails to comply with the food standards in accordance with the Food Hygiene Law, or the standards established by the Environment Agency, or concentrates in livestock through cattle feed, registration shall be withheld. Currently the Ministry of Health and Welfare specifies food standards for 26 pesticides, while the Environment Agency specifies standards for 214 pesticides (up to the end of Jun. 1983). (See Table 9.)

Table 9 Standards for Withholding Registration of Pesticides for Persistence in Crops (an example)

3-(3, 4-dichlorophenyl)-1, 1-dimethyl urea (or DCMU, Diuron)	Rice	0.05 ppm
	Wheat and cereals	0.05 ppm
	Fruits	0.05 ppm
	Vegetables	0.05 ppm
	Taro and potato	0.05 ppm
	Pulses	0.05 ppm
	Sugar cane	0.05 ppm
	Tea	1 ppm
2-(1-allyloxi amino butyliden)-5, 5-dimethyl- 4-methoxicarbonyl cyclohexane-1, 3-sodium base of zion cathodic ion (or axizin sodium)	Fruits Vegetables Taro and potato Pulses Sugar beet	1 ppm
3, 5-dimethylphenyl N-methyl carbamate (or XMC)	Rice	0.2 ppm
	Wheat and cereals	0.2 ppm
	Fruits	0.2 ppm
	Tea	10 ppm
2-isopropoxiphenyl N-meth carbamate (or PHC Propoxisul)	Rice	1 ppm
	Wheat and cereals	0.5 ppm
	Fruits	1 ppm
	Vegetables	2 ppm
	Taro and potato	0.5 ppm

e. Likely to be harmful to humans and livestock through absorption in crops cultivated in agricultural land by long persistence in soil

f. Strong toxicity to aquatic animals and plants for possible damage is likely

At present toxicity shall be determined by an acute toxicity test using carp. Since aquatic animals have different sensitivity to pesticides according to their species; in addition to carp, water fleas are also recommended for testing.

g. Likely to cause damage to humans and livestock using water by the pollution of water in public waters

h. The name of the pesticide is likely to create misunderstanding

i. The effectiveness of the pesticide is considerably inferior

4) Description of agricultural chemicals

Upon registration, the importer or manufacturer is to provide a correct description of the registered contents in the sale of the pesticide. The major contents include registration no., kind name, trade name, ingredients and contents, spectrum of applicable pests, use, etc.

(3) Control of Use of Persistent Pesticides (Control After Registration)

In Japan agricultural chemicals are given a prior check in accordance with the preceding various standards from the aspect of texicity to humans and animals, and environmental pollution, before granting registration. By this check, use and application are also specified and indicated accordingly. While strict compliance with this use and application should cause no problem, after registration, as a result of failure to comply or extremely extensive use, such pesticides causing damage to humans and livestock by persisting in soil or crops are to be designated as crop-persistent pesticides or soil-persistent pesticides for strict control of their use. The government shall establish applicable pests and standards for use as well as more strick application for designated pesticide, and the user is not to use such pesticides breaching the standard. For extensive use in a large quantity which is likely to result in the damage of aquatic animals and plants, and damage to humans and livestock by water pollution, such pesticides are to be designated as water pollutant pesticides and to be subject to an approval system for restricting the applicable area. Such pesticides designated as persistent pesticides include the following, the majority of which are no longer in use today.

Crop-persistent pesticides	lead arsenate, endrin
Soil-persistent pesticides	aldrin, dieldrin
Water-pollutant pesticides	telodrin, endrin, benzoepin, rotenone, and PCP herbicide

(4) Others

As measures after registration, in addition to the establishment of safe use standards for pesticides, and guidance for the proper use of pesticides, amendment and cancellation of registration shall also be effected.

5. CHEMICAL SUBSTANCES CONTROL

5.1 Chemical Substances Control Law

With the environmental pollution caused by PCB, the Law Concerning the Examination and Regulation of manufacture etc. of Chemical Substances (hereinafter cited as the Chemical Substances Control Law) was enacted in October 1973 (enforced in April, 1974). According to the law, new chemical substances difficult to decompose through the natural process of micro-organism (are not easily biodegradable), easily accumulated in bodies, and which may pose injury to the health of humans were subject to examination before manufacture or import (premanufacture examination of new chemical substances). Control of the manufacture, import, and use etc., of those chemical substances which have all the above-mentioned characteristics (specified chemical substances) was also conducted.

However, a situation not foreseen at the time of the enactment of the Chemical Substances Control Law in 1973 has arisen. The contamination of ground water by chlorinated solvents such as trichloroethylene exemplifies the above situation. The potential risk of chemical substances which do not possess all the characteristics similar to PCB, but may pose significant risk of injury to human health through environmental pollution depending on the manner of its manufacture, import, and use etc., have been pointed out recently.

As a consequence the above law was amended in May, 1986 and was enforced in April, 1987.

According to the new Law, those chemical substances which have low bioaccumulation but are not easily biodegradable and are suspected of chronic toxicity are designated as Designated Chemical Substances, and its manufacture and import are regulated. When there exists risk to human health through the environment by such Designated Chemical Substances, classification as Class II Specified Chemical Substances is required if a positive result is obtained from study of risk, and manufacture and import is regulated as such. (Fig. 4)

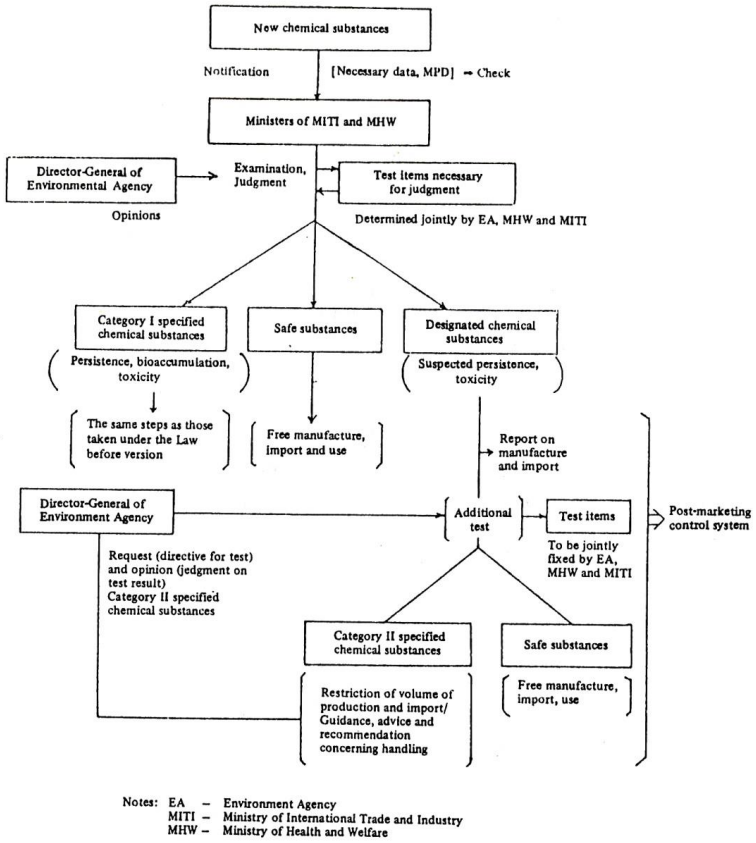

Figure 4 Implementation of the Revised Chemical Substances Control Law

5.2 Environmental Survey on Chemicals

There are millions of chemical substances which have been identified so far, and at least tens of thousands of substances are said to be in commercial use at present. Many of these chemical substances are presumed to be discharged into the environment including the atmosphere, water, soil, etc. through the processes of their manufacture, use and disposal.

After the enactment of the Chemical Substances Control Law (in 1973) as a turning point, the Environment Agency has investigated the levels of chemical substances in the environment since 1974. And since 1979 it has been examining the environmental safety of chemical substances in accordance with comprehensive study program on environmental safety of chemicals, in order to investigate efficiently and systematically the existing chemical

substances, which are said to amount to the number of tens of thousands, and assess their safety in the environment.

5.2.1 Environmental Survey

(1) General environmental survey

Field surveys are to be performed on the concentrations in the water and bottom sediments of about 20 substances which have been selected as chemical substances assumed to be highly persistent in the environment and the analytical methods of which have been developed in the previous year. The surveys are conducted at 25 and other several locations all over Japan for each of these substances.

(2) Detailed environmental survey

As for the several substances determined necessary to be investigated in more detail based on the results of the general environmental survey in the previous year, their field surveys on environmental pollution in the water, bottom sediments and fish are to be conducted in about 50 locations all over the country.

(3) Survey of chemicals in atmospheric environment

In order to obtain basic data for examining distribution and movement of chemical substances in each medium of the environment, the concentration in the atmosphere of those chemical substances considered to be persistent in the atmosphere are to be investigated in urban and rural areas of 6 prefectures in Japan.

5.2.2 Wildlife Monitoring

With respect to the specified chemical substances designated under the Chemical Substances Control Law and those chemical substances considered necessary to be monitored carefully for preventing the increase in environmental pollution caused by them, yearly monitoring of environmental pollution on wildlife (fish, shellfishes and birds) is to be conducted at 17 locations all over Japan.

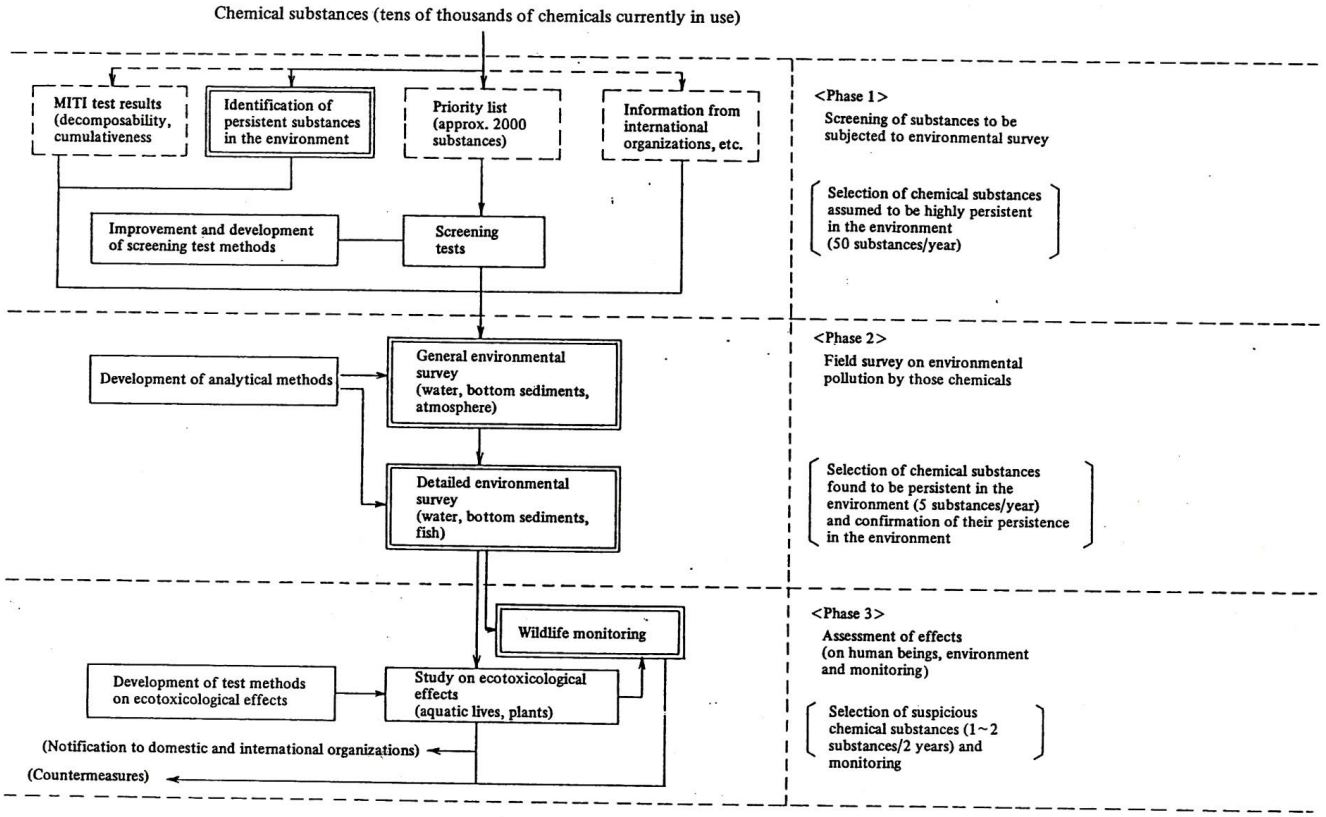

Figure 5 Schematic Illustration of Comprehensive Study Program on Environmental Safety of Chemicals

Remarks:

- Available information, documented information
- Field surveys
- Laboratory studies

Appendix 1. Provisional Removal Standard for Mercury-contaminated Bottom Sediments

The provisional removal standard applicable to sea water areas shall be the value that is calculated in accordance with the following formula, while those for water areas of rivers, lakes and marshes shall be 25 rpm. However, the standard values applicable to bottom deposits of estuaries, where the water is substantially affected by the tide, shall be identical to those of sea water areas. On the other hand, the standard of sea water areas where are exposed to a strong coastal current shall be identical to those applicable to rivers, lakes and marshes. The formula is:

$$C = 0.18 \cdot \frac{H}{J} \cdot \frac{1}{S} \text{ (ppm)}$$

where,

H = average tide difference (m)

J = release rate

S = safety factor

(a) The term "average tide difference" means that of the water area concerned. However, in the case of sea water areas which are affected more strongly by secondary undulation than by the tide, the value calculated in accordance with the following formula shall apply in place of the average tide difference

H = average secondary undulation width (m)

$$\times \frac{12 \times 60 \text{ (min.)}}{\text{average cycle (min.)}}$$

(b) Release rate is determined by release test conducted in accordance with "the method for the examination of bottom sediments" with respect to those taken at four points, which are suspected to contain relatively high concentration of mercury.

(c) The safety factors shall be the values established in manner described below, which are geared to the situation of fishing industry existing in different water areas and those surrounding them. The local authorities may incorporate additional safety factors to reflect the

special circumstances peculiar to the locality, such as food habits of the inhabitants.

(i) For water areas where no fishing operation is conducted, the safety factor shall be 10.

(ii) For those where fishing operations are conducted and where such fishery products (lobsters, prawns, shrimps, crabs, squillas, trepangs, gray mullets and roll-shells, etc.) which feed on the living things in or on the bottom sediments, account for less than one half of the total catches of the area, the safety factor shall be 50.

(iii) For those where the ratio of fishery products referred to in (ii) above account for more than one half of the total catches of the area, the safety factor shall be 100.

Appendix 2 Minamata Bay Clean-up Project

1. Formulation of Project Plan

Minamata Bay is a stagnant body of water facing the Shiranui Sea, and is totally contaminated with mercury discharged from a chemical plant of Chisso Corporation. Sludge, with a concentration as high as several hundred ppm of T-Hg, has been deposited 4 m deep in the inner most part of the bay. The bay contains several types of fish and shell fish polluted with mercury in excess of the limits specified in the Interim Mercury Standard. The mercury deposited in the innermost part of the bay was discharged from the chemical plant manufacturing acetaldehyde and other products for 40 years since 1932, and the total amount of mercury discharged is estimated to exceed 150 tons. Although the chemical plant has not employed the mercury process since 1971, the bottom life and marine life in the bay are incurably poisoned with mercury. The bottom sediments are believed to be a cause of this problem. The bottom sediments near the most recessed part of the bay are exposed at the time of low tide and subject to aerobic action, causing methylation of the inorganic mercury. If the bottom sediments are not controlled, the pollution will continue at Minamata in the future. To counteract this problem, the Kumamoto prefectural

government has decided to treat the mercury-contaminated bottom sediments in Minamata Bay.

In 1971, the Kumamoto prefectural government commissioned Kumamoto University to study viable methods for treatment of the bottom sediments. During the vigorous research and study program, a committee was formed in 1974 to formulate a plan for a bottom sediments treatment project. Scholars in medical sciences, chemistry, biology, civil engineering, and various other fields, and officials of the Ministry of Transport, the Environment Agency, the Fisheries Agency, Kumamoto prefectural government, and other related government authorities joined the committee. The committee formulated a bottom sediments treatment plan and a basic plan for concentration in the sludge to be removed was calculated to be 25 ppm according to the Provisional Removal Standard for mercury containing bottom sediments, after completion of hearings by the Kumamoto Environmental Pollution Control Council. Expenses, to be borne, are determined in accordance with the Law Concerning Entrepreneurs' Bearing the Costs of Public Pollution Control Works. A plan to defray costs was decided after completion of hearings by the Council. The total project cost was estimated at about 19,300 million yen, with the polluter obligated to pay about 65%. The balance is to be defrayed equally by the central government and the Kumamoto prefectural government.

2. Basic Removal Process

Taking into account the properties of the bottom sediments, it is believed that secondary pollution can be prevented if dredging is performed carefully. The diffusion of pollutants as a result of dredging has been simulated numerically. It is predicted that the water quality around the bay meet the Environmental Water Quality Standards even if the dredging work is carried out without the temporary cofferdam around the dredging area. If the alcove of the bay is isolated with a bulkhead, and if the highly contaminated soil is pumped into it, the dredging volume can be reduced by half and about 80% of the mercury can be trapped permanently in the alcove.

It is felt that the north entrance of the bay should be closed with a temporary breakwater to check the current within the bay during dredging in order to prevent turbidity from spreading. After various discussion, it was decided to employ a process, in which the bottom sediments would be disposed partly by dredging and partly by reclamation.

3. Implementation

The working area is isolated by a stationary fishing net. But a part of the net is open to navigation. A sonic fish-repelling device is equipped at the navigation area to minimize passage of contaminated marine life.

The north entrance of the bay is closed with a concrete caisson, and the high mercury content area in the alcove measuring some 580,000 m^2 will be enclosed by construction of a bulkhead to provide a dump for the bottom sediments. The bulkhead will be of the double-walled sheet pile type, and it will be sand - filter for high resistance to water penetration and also to the infiltration of mercury.

To prevent fresh water or effluents containing methyl groups, which can cause methylation of the mercury, from flowing into the dump site, existing drainage ditches will be relocated outside the dump site. Sludge with a T-Hg concentration of greater than 25 ppm will then be pumped into the dump site by cutterless suction dredgers. Prior to actual dredging, test dredging by an actual dredger will be conducted in order to examine dredging capacity, incidence of secondary pollution, diffusion, and control of wastewater, and so on. Depending on the test results, detailed implementation plans will be formulated.

The excess water in the dump site will be purified by flocculation, precipitation and filtration to satisfy the monitoring standards, and then it will be discharged into the working area. The dump site will be kept flooded with sea water during the operation to prevent inorganic mercury from being methylated by aerobic condition or by exposure to direct sunlight. Upon completion of dredging, the dump site will be covered with high-quality soil. Finally, the stationary fishing net and temporary breakwater will be removed. During the cleanup project, close monitoring and surveying will be conducted to ensure prevention of secondary pollution. The work plan is shown in Fig. 2. It is estimated that the cleanup project will take 10 years to complete. (As of March 1988, the dredge of Minamata bay completed, and the research to confirm about the success of dredging there was carried out and this research had no problems. In future, from April 1988 to March 1990, the surface treatment, the covering up seed with soil and so on will be planned.)

Figure 1. Sludge Disposal Plan for Minamata Bay

4. Monitoring

During the operation, water quality and marine life will be investigated periodically to avoid the secondary pollution. The monitoring system is subject to the direct control of the Kumamoto prefectural government.

Ensuring careful monitoring, a monitoring committee was formed as an advisory body to the Kumamoto prefectural government. The committee consists of experts, specialists, and scholars in the fields of medical science, chemistry, biology, fisheries, civil engineering, representatives of local communities, heads of local municipalities, members of municipal assemblies, and officials of relevant authorities including the Environment Agency and the Fisheries Agency.

Water quality monitoring stations are installed in and around the dredging area and at the boundary between the dredging water area and other public water. The excess water from the dump site and the underground water around the dump site will be monitored.

Marine life including fish cultured around the work site, catches within the dredging area, and catches in the other public waters are also monitored. The required mercury concentration values for the master monitoring stations are determined in accordance with the Environmental Water Quality Standards. Surveys are conducted once a day (three times a day for T-Hg and turbidity). At the auxiliary monitoring stations, turbidity is measured 5 times a day. The monitoring station and monitoring standard will be reviewed and corrected occasionally, according to working conditions.

The monitoring standard values for mercury from the excess water of the dump site will be determined in accordance with the effluent limitations standards, applicable to spillways, as stipulated under the provisions of the Law of the Prevention of Marine Pollution and Maritime Disasters. Monitoring will be carried out once everyday. (Turbidity will be measured continuously.)

In order to examine mercury concentration trends, surveys are conducted every 10 days on cultured fish, and every month for fish caught within the dredging area. The monitoring standard values for marine life are determined in accordance with "the Interim Mercury Control Standard for Seafood", and the catches from such waters are investigated every season. If the survey results exceed the monitoring standard values, the work and the discharge of excess water from the dump site will be suspended. The Monitoring Committee will be convened immediately to discuss the matter and to take pertinent action.