STUDY ON APPROPRIATE ENVIRONMENTAL PROTECTION MEASURES FOR DEVELOPING COUNTRIES

– State of Industrial Water Pollution in Indonesia
and Experiences of Kitakyushu City –

March, 1993

Institute for International Cooperation
Japan International Cooperation Agency

Foreword

This report on "Environmental Protection Measures for Developing Countries" provides the results of the study conducted by Kitakyushu International Techno-cooperative Association (KITA), entrusted by Japan International Cooperation Agency (JICA). The Jakarta metropolitan area in Indonesia was selected for the study concerning the state of industrial water pollution. The report focuses on how the experience and the pollution-combatting technology gained by a local entity in Japan, in this case, Kitakyushu City, can be applied in the major cities in developing countries. The primary aim of this report is to summarize the existing problems in this area and to provide sources for the discussion on how the situation can be improved.

The problems of industrial water pollution caused by effluent and other pollutants in developing countries have become increasingly evident in the process of industrialization. However, these developing countries lack the funds, technology and experience necessary for coping with such problems. On the other hand, some of the local governments in Japan, especially the ones that acted in the forefront for solving such pollution problems, possess various types of technologies and administrative skills and knowledge gained through their efforts in fighting pollution.

This study suggests that the experience and technologies for the abatement of pollution and conservation of the environment that Japan has accumulated over the years can be utilized for confronting the problems originating in rapid industrialization and urbanization which developing countries are facing today.

This study was made in the specific area of countermeasures for industrial water pollution in Indonesia. However, the contents can be fully applied for cases in other ASEAN countries as well as other developing countries. We hope, in the future, that this report will be of some assistance in solving the environmental problems in developing countries and be of use to the people involved in the improvement of environmental situations.

I would like to express my sincere appreciation to the Government of Indonesia, to the Indonesian firms and to the Japanese authorities concerned for their advice and collaboration.

March, 1993

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Chapter 1. Background and Purpose of the Study

1-1 Background

There is evident similarity between current environmental pollution problems in developing countries, above all, ASEAN, and those which Japan was faced with in the 1950's and 1960's. It is thus believed that the Japanese experience in achieving economic growth while coping with environmental problems and the pollution control technologies accumulated during this period will be of great help for solving pollution problems in developing countries.

However, the pollution control technologies currently practiced in Japan tend to necessitate a large budget and a high level of administration. In the situation where there is a lack of sufficient funds and a low level of engineering expertise, as is often the case in developing countries, expensive methods and high technology cannot be easily applied.

There are also differences in the level of development among these nations. Differences in the natural environment around the cities and social conditions lead to differences in the quality and severity of environmental problems.

Consequently, for successful pollution control in developing countries, it is of great importance to determine the effectiveness of the control measures in the target area through investigating not only technological and economic aspects but also the social and cultural aspects of the area. However, there is currently a lack of such information.

1-2 Purpose

The purpose of this study is to investigate what types of pollution control technologies accumulated in Japan are applicable for dealing with the environmental problems which developing countries are currently facing and examine the possibility of modification of such technologies to suit the situations in these countries while paying considerable attention to their technological, economic, social and cultural aspects. In this, we make use of both the knowledge and information gained by local entities in Japan which have considerable experience in the field of environmental conservation.

1-3 Scope

In recent years, development and industrialization have accelerated for more rapid economic growth in South East Asia. In the mean time, population growth has also been remarkable with increasing numbers of people flooding into major cities in each country. As a result, environmental pollution problems such as air and water pollution have become serious. The rivers running through urban and industrial areas, in particular, have seen an alarming rate of deterioration of their water quality.

In this study, DKI Jakarta, the Republic of Indonesia, is selected as a model area. Investigation was made focusing on water pollution of the Ciliwung River, the main river in Jakarta, to identify pollution control technology applicable for developing countries and to examine the possibility of modifying Japanese technology to suit the local circumstances based on the experiences of Kitakyushu City.

1-4 Procedure

The study was conducted with the following procedure:

(1) Preparatory arrangements in Japan

a) Selection of a model area to implement the study

DKI Jakarta in the Republic of Indonesia was selected.

b) Collection of information on environment-related matters in Jakarta area

The following information was collected in Japan.

* The state of water pollution
* The factors causing water pollution
* Legislation related to water quality control
* Organizations and systems related to water quality control
* Water pollution control measures

c) Reviewing the situation of water quality control technologies in Kitakyushu City

Investigation was conducted on water quality control technologies accumulated in corporations, universities and the local administration in and around Kitakyushu City.

d) Research prior to the actual survey

Hearing sessions with the local staff were organized for the purpose of understanding the current situations in the model area.

(2) Field survey

Based on the results of the preparatory arrangement noted above, the current state of water pollution, environmental administration, the state of implementation of pollution control measures, technological levels, natural and social conditions and the requirements in the model area were understood through the field survey and interviews with the persons concerned.

(3) Analysis in Japan

a) Analysis of the current environmental state in the model area

Based on the information collected through the preparatory arrangements in Japan and the study conducted in the model area as mentioned above, the current state of the water quality was analyzed and problems were pointed out.

b) Comparison of environmental conservation technologies

The results of the analysis of the current environmental state of the model area were compared with those of the review of Kitakyushu City's experience in environmental pollution control.

c) Clarifying future issues

Measures necessary for improvement of water quality in the model area were investigated and problems were clarified and discussed for the efficient and effective use of pollution control technologies.

1-5 Framework of the Report

This report consists of three chapters as follows:
In Chapter 1, the purpose, background, scope and procedure of the survey are summarized.
In Chapter 2, by comparing DKI Jakarta, the model area, with Kitakyushu City, one of the municipalities in Japan where various pollution-control measures have been implemented, the water pollution problems and their

characteristics in Jakarta are made clear from five viewpoints:(1) the state of water pollution, (2) legislation, (3) organizations and systems, (4) industrial effluent control and (5) other measures against environmental pollution.

In Chapter 3, problems related to water quality control in Jakarta are further reviewed and solution measures are clarified. While investigating such measures, technologies applicable for developing countries are examined as well as technical tasks for modifying the technologies to suit the situations in such countries.

Chapter 2. Comparative Analysis of Water Quality Control Measures

2-1 Current State of Water Pollution

2-1-1 River pollution

(1) Analysis of the characteristics of water pollution

In general, a rough understanding of the water quality characteristics in rivers can be gained by taking the ratio of COD to BOD value (BOD/COD) which are water pollution indexes. That is, when the value of BOD/COD of a sampling point is large, it is estimated that the river water may be highly affected by domestic wastewater containing a large amount of highly decomposable organic pollutants among microorganisms, in other words biologically unstable organic pollutants. On the other hand, when the value is small, it is considered that there may be an influence of industrial effluent containing biologically stable organic pollutants and/or an influence of treated effluent which has been biologically stabilized.

When the value of BOD/COD (bichromate method) is 0.5 to 1, it is generally said that the water has the quality of urban sewage which is affected largely by domestic waste water. When the value is about 0.5 or below, the inflow of industrial effluent is considered.

By making use of this method, analysis was performed on the water quality characteristics of major rivers in DKI Jakarta. The data on concentration of pollutants in the Ciliwung River, one of the main rivers in DKI Jakarta, shows that the values of BOD and COD change from the upper stream to the middle stream of the river. The values of the ratio (BOD/COD), however, range from 0.52 to 0.54, which indicates its change is small with almost the same value of 0.5 or above. (Refer to Table 2-1-1)

We can presume from these findings that domestic waste water has a great influence on the upper stream and the middle stream of the Ciliwung River and that the composition of the effluent does not change much though there is a minor difference in quantity.
Analyzing the distribution of pollutant sources in the river basin, we can learn that the densely populated area is widely spread out. As for factories and plants, there are almost no large-scale pollution sources to be the subject of

the First Project of PROKASIH in the upper river basin. About ten factories are distributed close to the middle river basin. At Pejompongan, located in the lower part of the middle river basin, BOD/COD has a somewhat smaller value of 0.45, and the river water of this area is presumed to have been affected by industrial effluent containing biologically stable organic pollutants. (Refer to Table 2-1-1.)

In the Cipinang River, all values of BOD/COD are as high as 0.56 to 0.62, which indicates that the influence of domestic wastewater is great. It can also be found, however, that the influence of domestic wastewater becomes relatively weak at Pondok Gede in the middle river basin compared with the upper- and lower -stream sections. It is considered that this area has been affected by the effluent discharged from the factories located in the upper river basin of Pondok Gede. In this area, particularly, there is a concentration of more than 20 factories that are large-scale pollution sources to which PROKASIH is applied. This condition is considered to be the reason for smaller BOD/COD values.

In the Mokerbaat River which runs through the west of DKI Jakarta, all the BOD/COD values at the three sampling points are 0.5 or below. It is clear that the river water has been largely influenced by industrial effluent containing organic pollutants which are biologically stable. In the Mokerbaat River Basin, more than 40 factories to which PROKASIH is applied are concentrated. Therefore, it is presumed that a large quantity of industrial effluent is being discharged into it.

Table 2-1-1 BOD/COD in the Major Rivers in DKI Jakarta

(The Ciliwung River)

Measuring points		BOD (mg/ ℓ)	COD (mg/ ℓ)	BOD/COD
Upper stream	1. Condet Public Water Supply	14.40	26.60	0.54
⇩	2. Manggarai Watergate	20.10	37.50	0.54
	3. KH Mas Mansyur	15.20	28.95	0.52
Lower stream	4. PLN Pejompongan	22.00	48.70	0.45

Table 2-1-1 BOD/COD in the Major Rivers in DKI Jakarta (Continued)

(The Cipinang River)

Measuring points		BOD (mg/ ℓ)	COD (mg/ ℓ)	BOD/COD
Upper stream	1. Cibubur	16.00	27.98	0.57
⇩	2. Pasar Rebo Ring Road	35.60	55.37	0.64
	3. Pondok Gede Street	28.00	49.78	0.56
Lower stream	4. Muara Sunter	33.80	54.81	0.62

(The Mokerbaat River)

Measuring points		BOD (mg/ ℓ)	COD (mg/ ℓ)	BOD/COD
Upper stream	1. Serpong	9.15	24.75	0.37
⇩	2. Public Water Supply Intake	12.16	26.01	0.47
Lower stream	3. Mauk	13.15	41.95	0.31

Note: The above listed values are the averages taken from the data in the period from December 1989 to June 1990 for the Ciliwung River; from December 1989 to June 1991 for the Cipinang River; and from February 1990 to February 1991 for the Mokerbaat River.

(2) Comparison of water pollution levels

Fig. 2-1-1 shows the comparison of the state of water pollution in the Ciliwung River and Cipinang River which are two major rivers of DKI Jakarta and the Murasaki River which runs from south to north in Kitakyushu City.

Comparing the BOD values, one can find that the lower stream of the Cipinang River is in the same state as the Murasaki River was in about 20 years ago. Also, the lower stream of the Ciliwung River is in the same state as the Murasaki River was in about 10 years ago.

Water quality of the Murasaki River had been drastically improved by about 10 years ago. Therefore, it is expected the water quality of the rivers in DKI Jakarta will also be improved within the period of 10 years if appropriate measures are taken to treat the effluent which causes pollution.

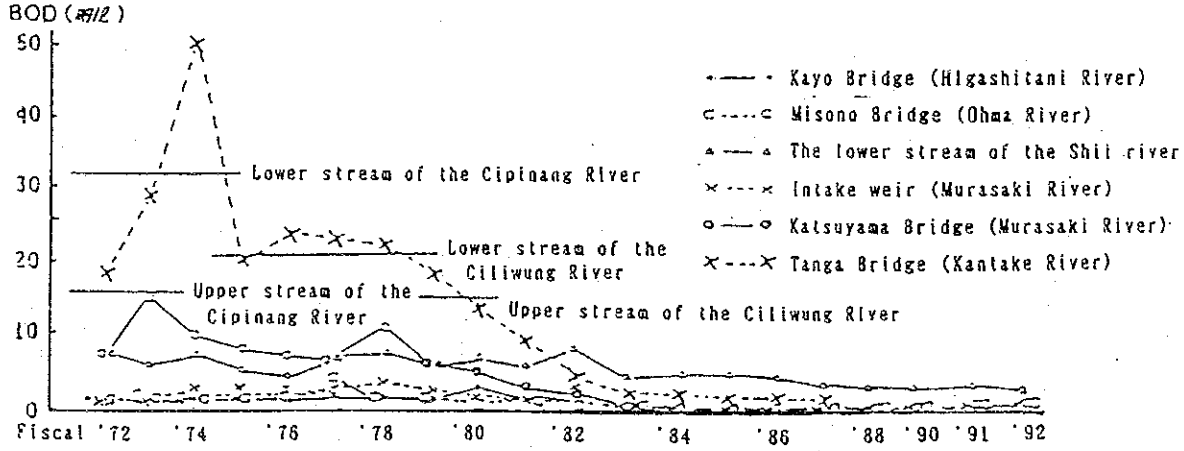

Fig. 2-1-1 Comparison of BOD Concentration between the Murasaki River in Kitakyushu City and the Rivers in DKI Jakarta

2-1-2 Marine pollution

Table 2-1-2 shows the data on water quality around Java Island and in Jakarta Bay. For the purpose of making a comparison, data on the same items of Dokai Bay in Kitakyushu City along with that of neighboring waters to the Japanese Islands are presented.

From the results of the survey, organic pollution in the coastal waters around Java Island seems apparent. However, the dissolved oxygen concentration ranges from 5.8 to 6.6 mg/ ℓ. Saturation of oxygen can be calculated, from the oxygen saturation volume of 6.40 mg obtained at a water temperature of 28.0 ℃ and chlorinity of 20‰, to be in the range from 91 to 103%. From this, we can judge that the condition of coastal water around Java Island is almost favorable as far as the state of dissolved oxygen is concerned.

Although BOD was measured around Java Island in the survey, BOD is, properly speaking, an index of pollution with the aim at studying (a) the degree of microbiologically unstable substances among organic matter in industrial effluent and river water; (b) the possibility of decomposition of such organic matter by microorganisms; and (c) the possibility of self-purification. It is very rare that BOD is applied to the study of marine pollution.

It was reported that there were cases of the maximum COD values exceeding 1,000 mg/ ℓ. However, even the maximum historical value in Dokai Bay, which was once seriously polluted, was approximately 35 mg/ ℓ (in 1969). There may thus be some problems in sampling methods, measuring methods and/or measuring procedures. As for problems concerning the measuring method and procedure, there is the possibility that consumption of oxidizing agent by chlorine was measured as COD owing to the incomplete masking of chlorine. In the future, it will be necessary to re-examine the measurement items and also to check and standardize the measuring methods, procedures and data arrangement & analysis methods as quickly as possible.

Further, measured values are, as a rule, shown in three figures. However, the data on waters around Java Island are shown in four significant figures (some data in five figures). It is incorrect from the viewpoint of analytical chemistry to show data with such figures; besides, it may lower the reliability of data greatly.

Data on sedimentary heavy metals in Jakarta Bay are shown in Table 2-1-3. Together with these, data on the bed of Dokai Bay collected before and after the dredging of polluted sediment and data on Japan's coastal sections of the

Pacific Ocean and the Sea of Japan are shown.

As shown in the Table, fewer kinds of heavy metals are seen in Jakarta Bay compared with the seas around Japan. As for copper and lead, Jakarta Bay indicates the same level as Dokai Bay (before dredging) or even lower. It is, however, found that the existing concentration of mercury is extremely high in Jakarta Bay.

However, in the studies made in the past, sediment monitoring points tended to be limited to the coastal areas. Further, data concerning tidal currents inside the Jakarta Bay and the characteristics of sediment (e.g. geological types, particle size distribution, ignition loss, sulfide content, etc.) have not been clear. For the future, it will be desirable to conduct an overall monitoring of the sediment pollution in Jakarta Bay in further detail.

Furthermore, comprehensive and continuous study on environmental pollution including an investigation on biological species inhabiting the Jakarta Bay and study on harmful substances by biological samples, so called Biological Monitoring, should be conducted.

Table 2-1-2 Comparison of Water Quality in Sea Areas in Indonesia and Japan

Investigation point	Water temp. ℃	Dissolved oxygen mg/ℓ	BOD mg/ℓ	COD mg/ℓ	Cu μg/ℓ	Cd μg/ℓ	Cr μg/ℓ	Pb μg/ℓ	Hg μg/ℓ	Zn μg/ℓ	As μg/ℓ
· Around Java Island											
1 Banten	29.1 - 29.6	6.1 - 6.1	27.0 - 27.0	267.5 - 755.9	10 - 20	ND	ND	ND			
2 Pamanukan	29.1 - 29.6	6.3 - 6.5	30.0 - 65.0	244.0 - 880.8							
3 Cirebon	28.8 - 29.2	6.4 - 6.5	27.0 - 27.0	122.0 - 582.4	10	ND	ND	ND			
4 Tegal/Pekalongan	29.0 - 29.3	6.0 - 6.5	30.0 - 51.0	105.9 - 352.6							
5 Semarang	28.3 - 28.7	6.1 - 6.6	33.0 - 45.0	91.2 - 782.7	10	ND	ND	ND			
6 Tuban	27.8 - 28.3	6.3 - 6.3	39.0 - 51.0	147.2 - 261.8	10	ND	ND	ND			
7 Surabaya	27.8 - 29.9	5.8 - 6.4	42.0 - 63.0	49.1 -1154.7	10 - 20	ND	ND	ND			
· Jakarta Bay						175-200		28.0-633	1.2-35.4	51-497	
· Surface water of Dokai Bay(1969)	1.1 - 4.5			10.1 - 35.8	ND - 14	ND					10 -119
· Surface water of Dokai Bay(1989)	5.4 - 7.2		1.9 - 5.1		ND	ND	ND	ND			ND
· Surface water of the Pacific(average)	25.62	4.76		0.68	0.029		1.089	0.065			1.30
· Surface water of the Japan Sea (average)	18.29	5.43									1.36

Note: ND indicates "Not Detectable".

Table 2-1-3 Comparison of Heavy Metal Concentration in Sediments in Sea Areas in Indonesia and Japan

Investigation point	Hg mg/kg	Cu mg/kg	Mn mg/kg	Zn mg/kg	Fe (%)	Pb mg/kg	Ni mg/kg	Co mg/kg	Cr mg/kg	Cd mg/kg	As mg/kg
* Jakarta Bay	0.05-4,000	10-80	900-1,900	60-140	3-7	5-400	4-16	10-25	4-33		
* Sediment in Dokai Bay(1971)	0.3-551	182-562				5-1,870			1-1,620	1.5-603	0.3-395
* Sediment in Dokai Bay(1981)	1.1-5.6					80-152				1.7-13.4	16.3-22.3
* Sediment in the Pacific	0.068					8.9			16.8	0.039	2.35
* Sediment in the Japan Sea	0.026					6.4			20.8	0.048	4.08

2-2 Legislation Related to Water Quality Control

2-2-1 Water quality standards

(1) Comparison of water quality standards

The water quality standards applied to the rivers in DKI Jakarta are applied exclusively for the area. They are established by the Governor's decree and are different from the national standards. In Japan, on the other hand, uniform standards are applied nationwide for the control of water quality. Accordingly, in this report, the water quality standards in DKI Jakarta will be analyzed by comparison with those of Japan.

An apparent difference between DKI Jakarta's water quality standards and those of Japan is, as shown in Table 2-2-1, the difference in the number of control items. The number of items in the case of Jakarta is 47 while that in Japan is 14 altogether. Out of the 14, 9 items are related to the protection of human health and the remaining 5 items are related to the protection of our living environment.

The number of items in Jakarta's standards is about 3.4 times as many as that of Japan. Markedly, there is a large number of items related to the physical properties and chemical properties of heavy metals. Most of these items correspond to the 26 items in the water quality standards for tap water in Japan.

There are many Type A items in Jakarta's standards because these are aimed at water sources supplied without any treatment. As for Types B to D, these items are applied without any variation.

Table 2-2-2 shows the comparison in standard-value levels of the environmental quality standards between Jakarta and Japan. The Type A standard-value level in Jakarta's standards is almost the same as that of Japan's environmental standards and water quality standards for tap water.

In Japan, standard values are uniform in the items related to the protection of human health in both environmental standards and tap water quality standards. However, items related to the living environment in the environmental standards are divided into six types. The standard values of these types are established with large differences in levels. On the other hand, although Jakarta's standard values are established for four types, there are not large differences in levels. Measuring and analyzing all the 47 items of Jakarta's water quality standards will require a great deal of work and financial resources. Further

higher technology will be required for the measurement of some of the items.

For these reasons, in DKI Jakarta, measurement and monitoring activities are actually focused on such basic items as BOD, COD, SS, pH, etc. It seems that the reason why items other than these are not found in the data on river water quality is based on the same reasons even though they have been announced officially.

Table 2-2-1 Comparison of the Number of Items in Water Quality Standards for River Water and Tap Water

Item	Jakarta Environmental standard for river water quality	Japan		
		Environmental standards for river water quality		Water quality for tap-water
		Items related to health	Items related to living environment	
Physical property	5	-	-	5
Chemical property	26	6	1	15
Organic matter	8	3	-	4
Special substance (COD, etc.)	6	-	3	-
Microorganisms	2	-	1	2
Total	47	9	5	26
		14		
		40		

(2) Revision of the items

Basically, it is enough, as far as monitoring of river water quality is concerned, to measure items especially harmful to human health, e.g., mercury, arsenic, cadmium, etc., and items which can be used as typical indexes of water quality, e.g., BOD, COD, SS, DO, pH, etc. However, any items which are regarded as especially important, judging from the characteristics of pollution sources in the area, must be added at any time.

Among the items provided in the environmental standards for river water quality of DKI Jakarta, items which can be deleted are shown below.

① Conductivity: Although the total quantity of ionic substances can be obtained, the value as a water pollution index is low.
② Ammoniacal nitrogen: Contamination from night soil can be found. However, such contamination can be detected by examining microorganisms. Further, from the viewpoint of the complicated nature of the analyzing work, it is worth considering deleting this item.
③ Barium: Toxicity is low.
④ Iron: No toxicity.
⑤ Manganese: No toxicity.
⑥ Hydrogen sulfide: If hydrogen sulfide which is a reducing material exists, DO will show a very low value. The measurement of DO will provide enough information about water quality.
⑦ Chloride ion: This item is necessary for drinking water. As an item for environmental monitoring, however, its necessity is low. Especially, the established value of 20ppm in Type B is too low for attaining the standard.
⑧ Selenium: Selenium is a special metal though it has toxicity. When there are no selenium-related mines in the basin, it is possible to delete this item.
⑨ Chloroform extract: This is a method for measuring the total quantity of organic substances having hydrophobic properties in water. This is useful for finding the quality of drinking water. However, in the case of general environmental water quality, values obtained by measuring BOD and COD can substitute for this item. It is not necessary to measure chloroform extract.
⑩ Methylene blue activated substance (MBAS): MBAS is contained in the surface active agent and does not require measurement specifically. There is no problem in deleting this item.
⑪ Others: It is necessary to investigate whether or not to adopt such items as fat and oil, organic chlorinated compound, absorption rate of sodium and sodium (%).

For the future environmental water quality standards which will be applied to

rivers in DKI Jakarta, it may be advisable to reconsider the items, classification, standard-value levels and time for achievement so that they can be more appropriate by taking account of the state of land use, the state of river water use, and the state of improvements in measurement and analysis systems.

Table 2-2-2 Comparison of Standard Values in the Environmental Water Quality Standards for River Water

Item	Unit	Jakarta Environmental water quality standards for river water (4 types)	Japan	
			Environmental water quality standards for river water	Water quality standards for tap-water
I (Physical property)				
Turbidity	NTU	100 to 150		2 or below
Color	TCU	100		5
Dissolved substances	mg/ ℓ	500		500
Others		Conductivity, temp.		Taste, odor
II (Chemical property)				
1 Hg	mg/ ℓ	0.001 to 0.005	0.0005	N.D.
2 As	mg/ ℓ	0.05	0.05	0.05
3 Fe	mg/ ℓ	2		0.3
4 F	mg/ ℓ	0.5 to 1.5		0.8
5 Cd	mg/ ℓ	0.01	0.01	0.01
6 Cl^-	mg/ ℓ	20 to 100		200
7 Cr	mg/ ℓ	0.02 to 0.05	0.05(VI)	0.05(VI)
8 Ca	mg/ ℓ	25 to 40		300(Mg included)
9 Mn	mg/ ℓ	0.5 to 1.0		0.3
10 Nitrate	mg/ ℓ	10		
11 Nitrous acid	mg/ ℓ	1 to 2		10
12 pH		6.0 to 8.5	6.0 to 8.5	5.8 to 8.6
13 Zn	mg/ ℓ	0.2 to 1.0		1.0
14 Cu	mg/ ℓ	0.02 to 0.1		1
15 Pb	mg/ ℓ	0.03 to 0.1	0.1	0.1
16 Others		Note 1)		
III (Organic matter)				
1 CN	mg/ ℓ	0.01 to 0.2	N.D.	N.D.
2 Phenol	mg/ ℓ	0.02 to 0.2		0.005
3 Organic phosphorus	mg/ ℓ	N.D.		N.D.
4 Surface active agent	mg/ ℓ	0.2 to 0.5		0.5
5 PCB	mg/ ℓ	N.D.	N.D.	
6 Others		Note 2)		
IV (Special substance)				
1 BOD	mg/ ℓ	10 to 30	1 to 10	
2 DO	mg/ ℓ	3	2 to 7.5	
3 SS	mg/ ℓ	100 to 200	25 to 100	
4 Others		Note 3)		
V (Microorganisms)				
1 Total number of coliform groups	MPN/ 100 mℓ	10,000 to 20,000	50 to 5,000	N.D.
2 Number of excremental coliform groups	MPN/ 100 mℓ	2,000 to 4,000		
3 Others				General bacteria

Note1) Ammoniacal nitrogen, Ba, B, H_2S, $CaCO_3$, Ni, Ag, phosphoric acid, Se, Co, sulfuric acid ion.
2) Chloroform extract, methylene blue activated substance (MBAS), fat and oil.
3) COD, absorption rate of sodium, sodium (%).
4) NTU : nephelometric turbidity units.
5) TCU : true colour units.

2-2-2 Effluent standards

(1) Comparison of effluent standards

The effluent standards applied to factories in DKI Jakarta are analyzed as follows by comparison with those of Japan.

Table 2-2-3 shows a comparison between Jakarta and Japan of the number of items of the effluent standards. The numbers of items in Indonesia's national uniform standards and in Jakarta's standards are 1.2 to 1.3 times as many as those in Japan's uniformity standards. Its features are that the number of items related to organic matters is small and that related to chemical properties is large. The more stringent standards applied to Kitakyushu City are established for specific factories and plants from which a large quantity of effluent is discharged. This is in the nature of the areawide total pollutant load control. The number of these items in the Japanese standards is about 20 percent of that of Jakarta. However, we can find through the comparison between the two, that the number is almost the same as the actual number of items applied to each type of industry in the national standards classified by industry types.

The levels of effluent standards are shown in Table 2-2-4. Jakarta's standards are strict ones and their levels are almost half of those of Japan's national standards. They are almost the same as the levels of Kitakyushu City's own standards which are more stringent. The effluent standards classified by type of industry are almost equivalent to the national standards in Japan.

Table 2-2-3 Comparison of the Number of Items in the Effluent Standards

Item	Indonesia		DKI Jakarta	Japan	
	National standard	standards for industry		National standards	Kitakyushu City's own standards
Physical property	3	1	5	1	1
Chemical property	23	13	23	14	2
Organic matter, etc.	8	4	9	13	4
Total	34	18	37	28	7

(2) Revision of items

Among the effluent standards of DKI Jakarta, it may be difficult to conform some items to the standard due to the inappropriate level of effluent treatment technology, such may be chemically illogical or of little importance for the regulation of pollutants. Some items having the possibility of being deleted are listed below.

① SO_4 (Sulfate ion)

If the waste liquid of sulfuric acid is only treated by neutralization using alkali, sulfate ion will not be removed at all. It is almost impossible to treat it by an ordinary waste water treatment method. This means that in reality it is impossible to handle sulfuric acid in a factory as long as sulfate is subject to regulation. This item should be deleted.

② Cl^- (Chloride ion)

Cl^- is produced when waste hydrochloric acid is treated by neutralization. This is an inappropriate item for the same reason as in the case of sulfuric acid. Cl^- is contained in sea water at the rate of approximately 1.8%. If sea water is used in a factory as coolant water, Cl^- will not be allowed to be discharged under the Cl^- regulation. As a result, sea water cannot be used at all.

In this connection, the Cl^- concentration of the water quality standard for tap water in Japan is 200mg/ ℓ. The Cl^- concentration in DKI Jakarta's effluent standards is 100 mg/ ℓ and it is a problem that such a stringent value, more strict than that for drinking water, has been established as a standard for industrial effluent.

③ Hardness ($CaCO_3$)

The standard for hardness of 100mg/ ℓ is extremely strict compared with the tap water quality standard in Japan which is 300 mg/ ℓ of $CaCO_3$. Such a strict standard is not meaningful in terms of controlling industrial effluent. Therefore, this item should be deleted.

④ Cl_2

This item does not require attention except in specific factories where a large quantity of chlorine gas is used. In reality, such factories seldom exist. Even if Cl_2 is contained in waste liquid, it can be treated very easily by reduction. Accordingly this is not worthwhile as an item of the standards.

⑤ KM_nO_4 consumption

This item is generally used for obtaining the concentration of organic matter in drinking water. COD is used as an indicator for almost the same details. KM_nO_4 consumption can be substituted by COD value, and therefore, this item is unnecessary.

Table 2-2-4 Comparison of the Standard Values of Effluent Standards

Item	Unit	Indonesia, nationwide		DKI Jakarta	Japan	
		Uniform standard (4 types)	Standard for Industry		National uniform standard	Kitakyushu City standard
I Physical property						
1 Water temp.	℃	35 to 45		38		
2 Soluble substance	mg/ℓ	1,500 to 5,000		500		
3 SS	mg/ℓ	100 to 500	50 to 300	100	200	25 to 100
4 Others				Turbidity Color		
II Chemical property						
1 pH		5 to 9	6 to 9	6 to 9	5 to 9	
2 Fe	mg/ℓ	1 to 20		5.0	10	
3 Mn	mg/ℓ	0.5 to 10			10	
4 Cu	mg/ℓ	1 to 5	3	1	3	
5 Zn	mg/ℓ	2 to 15	2	2	5	
6 Cr (VI)	mg/ℓ	0.05 to 1	0.3 to 0.5	0.5	0.5	
7 Cr	mg/ℓ	0.1 to 2	2	1.0	2	
8 Cd	mg/ℓ	0.01 to 0.5	0.05	0.05	0.1	
9 Hg	mg/ℓ	0.001 to 0.01	0.005	0.002	0.005	
10 Pb	mg/ℓ	0.03 to 2	0.3	0.1	1	
11 As	mg/ℓ	0.05 to 1		0.1	0.5	0.1 to 0.3
12 Ni	mg/ℓ	0.1 to 1	5	0.1		
13 CN	mg/ℓ	0.02 to 1	0.5	0.05	1	0.5
14 H_2S	mg/ℓ	0.01 to 1	1	0.05		
15 F	mg/ℓ	0.5 to 5		2	15	
16 Cl_2	mg/ℓ	0.5 to 5		1		
17 NH_4-N	mg/ℓ	0.02 to 20	10 to 50	5		
18 NO_3-N	mg/ℓ	10 to 50		10		
19 NO_2-N	mg/ℓ	0.06 to 5		1.0		
20 Others		Be, Sn, Se, Co	Metals	B, PO_4-P Cl^-, Hardness SO_4	Alkyl mercury	
III Organic matter						
1 BOD	mg/ℓ	20 to 300	50 to 250	75	160	
2 COD	mg/ℓ	40 to 600	150 to 500	100	160	15 to 80
3 MBAS	mg/ℓ	0.5 to 15		1		
4 Phenol	mg/ℓ	0.01 to 2	1	0.5	5	1
5 Oil and fat (Organic)	mg/ℓ	1 to 20	} 5 to 30	} 5.0	30	2 to 10
6 Oil and fat (Inorganic)	mg/ℓ	1 to 100			5	2
7 PCB	mg/ℓ	N.D.			N.D.	
8 Others		Radioactive substance		$KMn O_4$ Consumption value Precipitable matter, Agricultural chemicals, Radioactive substance	Organic phosphorus Alkyl mercury, Trichloroethylene Tetrachloroethylene, Number of coliform groups, N.P	
Total		34	18	37	28	7

2-3 Organization and Systems for Water Quality Control

2-3-1 Systems for monitoring and measuring the water quality

(1) Comparative analysis of the measuring system

Concerning the environmental pollution in the Jakarta area, KPPL in DKI Jakarta and the Institute of Hydraulic Engineering in Bandung have played a leading role in studying the river water quality by use of GEMS (Global Environmental Monitoring System). Also, the Institute of Energy & Atomic Power as well as the National Institute of Oceanology have studied Jakarta Bay.

KPPL implements measurements four to six times a year at 54 places in the city in order to monitor the water quality of the city's rivers. Although environmental standards concerning water pollution are established for 47 items, measurements have been carried out by focusing on general items such as COD (bichromate method), BOD, SS, DO and pH owing to the limited number of personnel and the facilities specified for measurement and analysis. Assuming that all the items are measured at all the measuring points five times a year, the total number of measurements is approximately 13,000 (Table 2-3-1). In case measurements are limited to the main five items only, the number of measurements is about 1,400, approximately 10% of the above total.

In Kitakyushu City, for monitoring river water quality, measurements are conducted in 23 rivers at a total of 36 points. 22 items are established in the environmental standards. The number of items measured and measuring points vary depending on the characteristics of the item as shown in Table 2-3-2. That is, the basic items related to the living environment (pH, DO, BOD, SS, the number of coliform bacteria) are measured 12 times or 4 times a year. The ten health-related items are measured once or twice a year while 7 items including COD are measured 4 times a year. The items related to the living environment, the basic items including COD and trichloroethylene, which have been subject to considerable public attention, are measured at most of the points. However, other items are measured at limited points such as the lowest point down stream of rivers. The number of such points is about half of all the measuring points.

In Kitakyushu City, the total number of times measurements are taken is about 2,500 a year. In the case of DKI Jakarta, almost 5 times as many measurements as Kitakyushu City are required under the maximum estimation. However, in reality the number of measurements carried out in Jakarta is only half of that of Kitakyushu City. In response to this, a careful study on appropriate measurement systems in compliance with the characteristics of measurement items and points

will be necessary.

Table 2-3-1 Total Number of Times of Monitoring River Water Quality In DKI Jakarta

Item		Number of measuring points*	Total number of measuring times
General items	pH, DO, BOD, COD, SS	54	1,350
Other items	42 items including heavy metals and organic matter	54	11,340
Total	47 items	-	12,690

* Note: Measurement was carried out 4 to 6 times a year at each measuring point.

Table 2-3-2 Total Number of Times of Monitoring River Water Quality in Kitakyushu City

Item		Number of measuring points				Total number of measuring times	
		12 times a year	4 times a year	2 times a year	1 time a year		
Items related to the living environment	pH, DO, BOD, SS, number of coliform groups	18	18			1,440	
Items related to health	7 items including heavy metals			15		210	266
	PCB				15	15	
	Tetrachloro-ethylene Trichloro-ethylene				31	31	
Others	COD		36			144	768
	6 items including total phosphorus		26			624	
Total	22 items	———				2,478	

(2) Problems of measuring system

Problems of the monitoring system for water quality control in DKI Jakarta are summarized as follows.

① Environmental monitoring is carried out by a number of organizations individually. Contact among these organizations is insufficient and this is leading to duplication or lack of data. There is confusion among these organizations.

② Owing to the lack of advanced planning for environmental monitoring, data are not utilized effectively.

③ Due to insufficient and personnel facilities for analysis, the subjects of monitoring are restricted to general items only. Therefore, such harmful substances as heavy metals and agricultural chemicals have not been investigated sufficiently.

④ Due to the lack of standardization of methods (time, place, method of sampling, etc.) for environmental monitoring, there is much difficulty in analyzing and comparing the results.

⑤ Since the analysis methods are not standardized, comparison of results is not possible.

⑥ Owing to inappropriate methods and procedures of measurement and analysis, some items lack accuracy.

2-3-2 Monitoring of pollutant sources and guidance

(1) Present situation of Jakarta area

In general, monitoring for checking whether or not effluent from a factory is in conformity with the effluent standards is conducted through sampling and analysis of the effluent during site inspections in the factory and further, by inspecting how waste-water generating facilities and effluent treatment facilities are operated and managed.

Factories which discharge effluent are obliged to take samples of effluent and have them analyzed at KPPL once every 3 to 4 months. Such samples are examined to check whether they conform to the effluent standards or not. If the result of

the examination if dissatisfactory, a warning is given to the factory through the Ministry of Industry, which has authority in giving permits to factories. The factory is then obliged to take the necessary measures to improve the situation and to report on the measures taken. If no report is submitted, or if the details of the report are judged to be inappropriate, a site inspection is carried out and effluent is sampled to be brought into KPPL for analysis. Depending on the result of the examination and analysis, necessary steps are taken, e.g., issuing of order and suspension of factory operation.

When issues on environmental pollution are published through the media, or people's complaints or petitions on such matters are made, BAPEDAL gives a warning through the Ministry of Industry to the relevant factory causing pollution and demands that the factory take necessary measures and submit a report. In case such a warning is given repeatedly, as many as three times, a site inspection will be carried out in the same process as introduced above.

A site inspection of a factory is generally conducted by organizing a team of four or five persons, such as BAPEDAL staff in charge of site inspection, a local administrator, an analytical engineer and a police officer, etc. Presently, two or three site inspections are conducted every month. At the moment, the budget and the number of staff are insufficient and these should be expanded for the future.

In order to monitor sources of pollution and provide guidance more properly and promptly, it is necessary to transfer the authority for relevant activities to local entities. In Indonesia, at present, investigation into establishing the local version of BAPEDAL, BAPEDALDA, is now proceeding. Various authorities for constant monitoring of the environment and control of water-pollution sources and giving guidance are desired to be transferred to BAPEDALDA, in the same way as is seen in prefectural and municipal governments in Japan.

In addition, for more effective monitoring and guidance, it is necessary to obtain in advance detailed information on effluent in the source of pollution. At the same time, actual conditions of the source should be known in detail. In Indonesia, various information concerning such pollution sources is submitted to the Ministry of Industry which superintends plants and factories. Sufficient information is not submitted directly to BAPEDAL. Therefore, BAPEDAL collects information during site inspections. It will be necessary in the future to improve the collection of detailed data on effluent generating facilities such as the structure, usage, method of treatment and quality and quantity of discharged water. It will also be necessary to accumulate this information on an on-line data base system so that it can be used jointly by BAPEDAL and each

local organization.

(2) Present state of Kitakyushu City

In Kitakyushu City, so as to make plants and factories observe the effluent standards, designated staff carry out the regulation, guidance and site inspections. In site inspections, various items are inspected as follows: a) the state of observance of the effluent standards, b) the state of maintenance of effluent-generating facilities and/or their treatment facilities, c) the state of management of the records of pollutant load and measuring equipment and devices of pollutant load, and d) sampling of effluent, etc.

Sampled effluent is immediately analyzed at the Municipal Institute of Environmental Health Science and conformity with the effluent standard is checked. In 1991, site inspections were conducted in a total of 365 plants and factories : 138 for the purpose of checking conformity ; 154 for effluent inspection ; and 73 for inspection of total pollutant load control. As a result, it was found that five factories were violating the standards. Each of them was given a warning to improve its maintenance of effluent treatment facilities.

In the 1970's, Kitakyushu City gave about 20 orders for improvement and warnings to relevant factories and firms in a year. Long-term implementation of the monitoring and guidance given to factories has proved to be highly successful. Few factories now violate the effluent standards and the concentration of pollutants in the environment has fallen. In the time when the water pollution was serious, lack of understanding of environmental conservation and the low level of effluent treatment techniques at factories were the main causes of water pollution. On the other hand, some factories evaded the effluent standards with some form of ruse or discharged untreated effluent secretly into the public water areas. For reference purposes only, examples of ruses used by factories in Kitakyushu City are presented below.

① Owing to the fact that almost all the pollutants are regulated by their emission concentration, thick effluent was diluted with a large amount of sea water, river water and ground water to be discharged into the environment as effluent below standard.
② Treatment facilities with insufficient treatment functions were installed and operated only during site inspection.
③ Discharge of effluent which meets the standard from a drain registered at the Municipal Office while secretly discharging effluent with a higher level of pollutants than the standard from an unregistered drain.
④ Keep the effluent in a tank during the day and discharge it during the night

in darkness.

⑤ Drain away untreated effluent together with rain.

⑥ Collect untreated effluent to bury on the factory site or dispose of by permeation underground.

Regarding the problems presented above, the following countermeasures were taken in Kitakyushu City by strengthening the systems for monitoring and guidance for control of the pollution sources.

① Treatment by dilution was made impossible by combining the pollutant concentration regulation and the areawide total pollutant load control.

② Examine the effluent and inspect the functions of treatment facilities on a periodic basis.

③ Understand fully the production processes while obtaining information on quality and quantity of discharged waste water so that contradictions in relation to the final effluent can be made clear.

④ Collect samples of effluent from the drain 24 hours a day and analyze its properties.

⑤ Conduct competence inspections also on rainy days and collect effluent for analysis.

⑥ Much time may pass before the influence of water pollution appears in the environment outside the factories. Give environmental education to factory managers so that an awareness of environmental conservation can be gained.

For more efficient monitoring of pollution sources and implementation of guidance in DKI Jakarta, it is necessary to recruit and train personnel, and to compilate manuals on the monitoring and guidance.

Chapter 3. Issues for Future Improvement of Water Quality in the Jakarta Area

3-1 Problems Concerning Water Quality Control

Concerning problems of water quality control in the surrounding areas of Jakarta, Indonesia, the situation can be analyzed from five points of view which are the present state of water pollution, legislation, organization and/or system, countermeasures for industrial effluent and other measures as follows.

3-1-1 Problems related to status quo of water pollution

① While river pollution in the area has reached an alarming level, pollution sources and its mechanism are yet to be clarified because comprehensive and systematic investigation of pollution has never been conducted.

② There is a high level of pollution caused by heavy metals accumulated in Jakarta Bay. Fish and shellfish inhabitants along the coastlines and in the rivers flowing into the bay are highly contaminated by the harmful substances. Nevertheless, the actual pollution level of waters in the bay can hardly be clarified because the investigations conducted so far on waters and seabeds are limited to the coastlines and no analytical data of the living species in the bay is available.

3-1-2 Problems related to water quality control legislation

① There are too many items regulated in the environmental standards while there is lack of competent engineers, funds and techniques which result in deficient monitoring and measurement of every required standard.

② Certain items of the environmental standards are seen as not legitimate in themselves or as having their standard values set at inappropriate levels. Reconsideration is needed.

③ The authorities include in their effluent standards two concepts of water quality standards: one for the general environment and the other for the public water supply. For the time being, it is considered appropriate to address these standards separately and to plan individual countermeasures.

④ The authorities include in their effluent standards items whose set values are difficult to meet using effluent treatment techniques available today. Some are chemically irrational and/or not worth regulating.

⑤ For effective implementation of water pollution prevention measures, the authorities should compile individual laws regulating the items involved.

⑥ The Indonesian government has prepared a package of laws and regulations for the prevention of water pollution and is preparing additional provisions. However, the actual enforcement has yet to be realized.

3-1-3 Problems related to organizations and systems for water quality control

(1) Environmental monitoring

① The monitoring or measuring systems are not enough to meet the requirements by the Environmental Standards enforced in Jakarta.

② Environmental institutes are not furnished with adequate analytical equipment and personnel, limiting their work to commonplace monitoring work only and leaving investigation of harmful substances like heavy metals and agricultural chemicals undone.

③ Environmental monitoring work is not coordinated among institutes, preventing them from accessing mutually available environmental data.

④ There are cases where sampling and analytical methods are not standardized among institutes and that makes it difficult to compare environmental data produced by them.

⑤ There are cases where measuring and analytical methods or procedures are not appropriate, or analytical equipment are not calibrated correctly producing occasional inaccurate results.

⑥ Environmental engineers are not well trained in measurement and analysis and are not capable of analyzing or evaluating measured data.

⑦ There are a number of governmental agencies involved in environmental monitoring work. They are, however, not in close communication with each other and this lack of consistency among them results in different agencies working on an identical subject at the same time or important subjects being ignored by all of them.

⑧ Environment research centers do not have facilities and human resources to conduct sufficient physical and chemical studies.

(2) Regulation and monitoring of pollution sources

① With shortages in both personnel and budget for the site inspections of factories, the Jakarta authorities are not conducting sufficient monitoring of effluent from factories nor giving guidance to those causing pollution for the improvement of the situation.

② The authorities do not have complete data on facilities causing pollution in terms of structure, operation method, treatment method of effluent originating in the relevant facilities, quantity of effluent, level of pollution, etc., without which the authorities are unable to regulate, monitor and give guidance to those factories properly and effectively.

3-1-4 Problems related to industrial effluent control measures

(1) Pollution sources

① The Jakarta authorities center their water pollution control measures on effluent from factories. However, they lack in their overall plan control of effluent from business offices, households, stockyards, agricultural fields and garbage dumps.

② PROKASIH is applied to a limited number of large-scale factories but not to medium- and small-scale factories that constitute a large part of the industry in Jakarta.

③ Discharges of COD and BOD from factories under PROKASIH at large have undergone remarkable reduction while the environmental poilution concentration has seen little improvement.

④ Water pollutants against which countermeasures are taken include those related to protection of the living environment such as COD and BOD alone but not others related to the protection of health such as heavy metals and harmful chemical substances.

(2) Effluent control measures inside factories

① The awareness of companies concerning the importance of effluent control in their own factories is low.

② Many of those companies are reluctant to introduce effluent treatment measures on the assumption that it may increase production costs and the

price of their product and lower their profits, therefore hurting their business.

③ Some factories are discharging effluent into rivers without treatment or have installed unsuitable treatment facilities or methods for their purposes.

④ In many cases, effluent treatment facilities are used for the treatment of waste water after the final stage of the production process and little attention is paid to controlling wastewater within the production process which is more effective and cost-saving.

⑤ There are cases where effluent treatment facilities are not operated or maintained properly, discharging effluent containing pollutants exceeding effluent standards.

⑥ Up-to-date improvement is not always made of effluent treatment facilities in pace with advancing treatment technologies.

⑦ Sufficient numbers of consultant or engineering companies with effluent treatment expertise or experience are not available to back up the effluent control efforts of all factories.

(3) Monitoring of industrial effluent quality

① Some factories are sampling effluent at inappropriate points for quality measurement as a part of effluent control or have selected irrational measurement items in view of their types of business.

② Without their own analytical capability, some factories subcontract a professional firm to analyze the quality of their effluent and suffer a heavy financial burden from this. Furthermore, little effort is made to establish a system with which data gained after measurement and analysis are fed back promptly to the production line or the effluent treatment lines for improvement of overall effluent control.

③ Technical standards of private firms and consultants who are engaged in the measurement and analysis of environmental data are at an embryonic level.

3-1-5 Problems related to other measures of control

① To further advance the purification of water in rivers and seas for the future, it is necessary to conduct dredging of sludge and contaminated sediment to remove them from the river and sea beds.

② It is necessary to prepare sites for the disposal of the dredged sludge.

③ Many citizens of Jakarta are suffering heavily from contaminated water from flooded rivers which severely affect their health and living environment.

3-2 Measures for Solving Problems Concerning Water Quality Control (Proposal)

The following are measures which we propose to solve problems concerning water quality control in the model area as cited in the preceding Item 3-1.

Because river and marine pollution in Jakarta comes from a variety of sources and the impacts it exerts are multifarious, a comprehensive approach to the problem is essential, i.e., to identify individual problems and to implement appropriate measures to suit each problem. Of the various measures we propose, this report discusses mainly those on the legislation, organization and systems related to water quality control and measures for industrial effluent. (Table 3-2-1)

Table 3-2-1 Measures for Water Quality Control

Items	Measures
1. Present condition of water pollution	① Comprehensive investigation on condition of water pollution ② Investigation on present situation regarding discharges of water pollutants ③ Clarification of water pollution mechanism
2. Legislation for water quality control	① Revision of environmental standards ② Preparation of a set of individual laws for water quality control ③ Revision of effluent standards ④ Organization of an advisory council on pollution control measures ⑤ Comprehensive water environment administration
3. Organization and system for water quality control (1) Environmental monitoring	① Preparation of environmental monitoring program ② Establishment of measurement and analysis system ③ Formulation of standard method of measurement and analysis of water quality ④ Training of personnel assigned to water quality measurement work ⑤ Establishment of environmental monitoring system
(2) Regulation and monitoring of pollution sources	① Improvement of organization for regulation and monitoring of pollution sources ② Compilation of manuals for monitoring of pollution sources and guidance ③ Collection and preparation of data on pollution sources
(3) Other measures	① Expansion of functions of the Environmental Research Center ② Promotion of environmental education ③ Establishment of environmental information system

Items	Measures
4. Measures for industrial effluent control (1) General measures for pollution source control	① Expansion of PROKASIH coverage ② Compilation of water quality control plan
(2) Effluent control measures inside factories	① Training sessions on treatment techniques of industrial effluent ② Implementation of guidance for technical diagnosis on measures for industrial effluent control ③ Introduction of pollution control engineer qualification system ④ Introduction of financing programs for promotion of industrial effluent control ⑤ Industrial effluent control measures for medium and small companies ⑥ Technical guidance on the design, installation, and maintenance of effluent treatment facilities ⑦ Organization of environmental management system in the factories
(3) Monitoring of the of industrial effluent	① Improvement of the skill of measurement and analysis engineers ② Organization of measurement and analysis system inside factories
5. Other measures	① Dredging of sludge on seabeds, etc.

3-2-1 Measures for problems related to the status quo of water pollution

(1) Comprehensive investigation on the state of water pollution

Prior to proceeding with any water pollution control program, it is necessary, as a first step, to clarify precisely the state of existing pollution.

In order to understand the overall pollution conditions of the rivers in the Jakarta area as well as the water in Jakarta Bay, a systematic investigation and measurement must be carried out.

The study should include measurement of major water pollution indexes such as BOD, COD and heavy metals and investigation of the condition of the sediment, river inflows into the bay and current in the bay. Furthermore, it is necessary to clarify how water pollution affects the ecology in Jakarta Bay through investigating the lives of fish, shellfish and other aquatic organisms and conducting a biological monitoring and investigation of harmful substances using biological specimens.

It is desirable that a joint study is formed between experts from Japan and local counterparts (engineers and researchers from governmental or municipal agencies and universities). All of the analytical and measuring instruments and materials used in the study will be brought in from Japan. This form of joint study will also be an effective means of technology transfer.

As for the method of general investigation or measurement in the study, it is enough to use the basic and simplified standards used in Japan for the time being. However, development of specific techniques to suit the natural environment in Indonesia, in terms of species and habitats of organisms, will be necessary for the biological investigation or monitoring.

(2) Investigation on the present state of discharge of water pollutants

There are varieties of sources of pollutants which are causing deterioration of water quality in the rivers and sea in the Jakarta area. These include : effluent from factories, business offices, households, stockyards and farmlands and dumped garbage as well as sources of natural origin. For planning water-pollution control measures befitting the area, locations of these pollution sources must be known and the concentration and quantity in terms of BOD, COD, etc., emitted into the environment from each source must be figured out.

For expressing pollutant discharge, large-scale pollutant sources like large factories use the data from the actual measurement of the discharge of each pollutant. In the case of small pollution sources like small factories, business offices, etc., estimate the total discharge of pollutants from the discharge per work unit (unit discharge). In Jakarta, numbers of factories and offices have not introduced effluent treatment measures and many people use rivers for defecation and throw large amounts of garbage into them. In addition, heavy tropical rains wash a large amount of soil away into rivers. Therefore, the unit discharge of water pollutants adopted in Japan may not be applicable in Jakarta without certain modification. Thus, it is necessary to obtain samples from each pollution source type to determine the unit discharge applicable to the same type of pollution sources. Meanwhile, Japanese techniques may be applicable with out modification for the measurement of the amount of effluent and concentration of pollutants for the purpose of estimating discharges of water pollutants.

It is necessary to obtain information on the locations and workloads of pollution sources through available reports submitted by the relevant companies and studies compiled by research institutes as well as conducting site inspections and questionnaires.

(3) Clarification of water pollution mechanism

In order to clarify the water pollution mechanism and to estimate the damage caused by each pollution source, it is necessary to conduct a water pollution forecast simulation. For this, the data on concentration of pollutants in the water environment and the data concerning river inflows and basin [Paragraph(1)] as well as the data on locations of pollution sources and the pollutant discharge from each source [Paragraph (2)] are used. Based on the results, appropriate measures for water pollution control can be planned and at the same time, a management program can be established. [Item 3-2-4 (1)- ①]

In Japan, various models are used in pollution forecast simulations. A model should be selected to suit the situations in Jakarta based on the availability of information on pollution sources, the level of pollution in rivers and seas, topography, water flows and the availability of computers, and the accuracy of the desired output.

At the initial stage of forecast simulation, it is suggested to use two models - a simplified model that can be dealt with by personal computer and an accurate model that demands a large computer at the same time. Both results are then compared to determine the accuracy of the simplified model and to list up points to which consideration should be given in the use of the model. Afterwards, the

simplified model would be usable in the routine management of progress of pollution control measures.

It is also suggested that the initial forecast simulation using both simplified and accurate models be conducted in the form of a joint study between Indonesia and Japan as mentioned in Paragraph (1) and subsequently, the routine management using a simplified model be conducted by Indonesia alone.

3-2-2 Measures for problems related to the legislation concerning water quality control

(1) Revision of environmental standards

Since Indonesia has a long history of the people using rivers as providers of water for drinking and domestic purposes, it is desirable to have the water quality in the natural environment equivalent to that of tap water. However, for effective implementation of the existing water pollution control measures, it is advisable, for the time being, to have only general environmental water quality standards applied to rivers which are considered to be part of the natural environment and reserve applying the items related to tap water quality standards.

Further, as for the contents of general environmental water quality standards, reconsideration should be given to the items regulated in the standards as well as standard values presently enforced for selecting the minimum and most essential ones which will be monitored more effectively.

It should be noted, however, that pertinent water treatment at a water filteration plant is indispensable for the successful implementation of this option.

(2) Legislation of an individual water quality control law

In Indonesia, the water pollution control measures are taken and controlled by various government agencies and the functional mechanism of the measures is complicated. For the effective and comprehensive implementation of water pollution control measures, legislation of a set of individual laws integrating all water quality regulations is a must.

Japan's Water Pollution Control Law may give a basic idea about items to be included in Indonesia. However, the contents of each item should fully be considered in terms of responsibilities assigned to the relevant ministries and departments and the position or relationship of the new law to existing legal

system.

The items to be included in the new water pollution control law are as follows:

① General provisions:
Purpose, Definition, and others

② Industrial effluent control measures:
Effluent standards, Registration of special facilities, Directive for alteration of plan, Directive for improvement, Measurement of the level of pollution in effluent, Emergency actions, and others

③ Domestic waste water control measures:
Liabilities of central and local governments, Liabilities of the public, Compilation and promotion of a program for domestic wastewater control measures, and others

④ Water quality monitoring:
Continuous monitoring, Plans for measurement, Publication, Emergency actions, and others

⑤ Others:
Compensation for damage, Reporting, Inspection, Penalties, and others

(3) Revision of effluent standards

It is necessary to revise the items listed in the existing effluent standards, and to delete the ones which are difficult to achieve in view of currently available treatment technology, chemical irrationality or insignificance as regulated items.

(4) Organization of an advisory council on pollution control measures

It is necessary to organize an advisory council that coordinates and gives relevant advice on important deliberations in the process of formulating and enforcing water pollution control measures in the Jakarta area.

In Japan, the national government has an advisory panel called the "Central Council for Control of Environmental Pollution" and each local prefecture and city-level government has its own advisory panel called the "Regional Council for Control of Environmental Pollution". These councils have contributed in promoting pollution control measures in their respective areas. Similarly, in

Jakarta, it is recommended that an advisory council consisting of members from various fields is organized. Deliberating on an important environmental agenda, these members will deliver their candid and professional opinions from their own fields, thereby contributing to creation of substantial and practical pollution control measures.

Members for the advisory council shall be those who speak for various departments and strata of society including pundits and scholars such as university professors and representatives of citizens and industries. Also, representatives of the Environmental Research Center and NGOs should be include since the influence of these organizations upon environmental conservation activities in Jakarta is not negligible.

(5) Comprehensive measures of water environment management

Rivers and seas around Jakarta are multifunctional, providing people with water for agricultural, industrial and domestic uses-drinking, laundering, dish-washing, as well as with places to pursue pastimes - playing, yachting, rowing, etc. They are also home for aquatic organisms and stages of fisheries.

For successful implementation of measures to conserve the environment and to expand the utilitarian functions as well as possibilities for development of those rivers and seas, it is important to conduct a comprehensive and quantitative analysis and assessment of their individual functions and to seek latent capabilities they may have to predict future demand for them. Based on these scientific findings, it is necessary to establish the overall administrative measures for effective conservation of water environment.

In Japan, the Environmental Agency's National Institute for Environmental Studies and local governments including Kitakyushu City developed methods and techniques for comprehensive environmental assessment in the 1980's. These methods and techniques and their underlying concepts will be helpful in conducting the above-mentioned environmental analysis or assessment in Jakarta.

Furthermore, prior to the comprehensive environmental assessment of rivers and seas in Jakarta in reference to environmental indicators, it is necessary to clarify the roles and functions they play in the local communities, to set principles on the way of preserving and utilizing the water environment and to investigate what types of information are available.

3-2-3 Measures for problems related to the organizations and systems for water quality control

(1) Environmental monitoring

1) Preparation of environmental monitoring programs

In order to monitor the overall state of water pollution and to continuously assess the effectiveness of the regulations, an overall program for environmental monitoring which is followed by its systematic implementation needs to be established.

In preparing the environmental monitoring program in Jakarta, it is possible to apply the ideas and techniques as adopted in the program in Japan. However, specific items such as the locations, time and frequency of measurement should be determined after thorough and detailed investigation to reflect the local conditions : geographical conditions, climate, changes of water flow, the level of pollution in rivers, etc.
Such environmental monitoring program should cover the items as listed below :

① Locations of monitoring points of environmental standards :
(Representative locations should be selected after examining the conditions of river water flow and pollution, the conditions of tidal currents and pollution in Jakarta Bay, etc., in both the dry and rainy seasons.)

② Measurement items :
(Basically, these should be environmental standard items.)

③ Time and frequency of measurement :
(these should be determined for each item depending upon characteristics of each item. It may be once every month at the most, but should be at least two times a year since water quantity in rivers varies widely with seasonal changes of the dry and rainy seasons.)

④ Sampling methods :
(Basically, the sampling methods used in Japan are applicable.)

⑤ Measurement methods :
(Basically, the methods should not require high technology and inexpensive instruments should be employed.)

⑥ Responsibilities of organizations involved :
(Responsibilities of national and local government and universities involved and means of maintaining close communication between them should be stated clearly.)

⑦ Publication methods :
(Reports on investigation results, Environmental White Paper, etc.)

⑧ Others

2) Upgrading of measurement and analysis system

Jakarta should prepare for a continuous and comprehensive monitoring of its water environment including rivers, seas, lakes, ponds and ground water. Farther, thorough analysis of effluent and waste water should be expanded to include factories and other pollution sources.

In Jakarta, there are few university research laboratories and governmental research centers which have expert knowledge and experience in the measurement and analysis of water quality. In addition, few private consultants and businesses seem to be capable of expert water-quality analysis.

Today, environmental investigation and research institutes in Japan, whether run by municipal governments like Kitakyushu City and those operated by the national government and universities are equipped with sophisticated measurement and analysis techniques and instruments. It should be noted, however, that they began their initial phase of work using simple and less expensive instruments and have updated their skills and devices step by step in pace with the advancement of such techniques and instruments to reach today's standard. It is advisable for Jakarta also to follow the same path as Japan has taken. At the present stage, it is not advisable for Jakarta to employ the equipment as used in Japan today because few competent operators are available and there would be significant amount of investment involved. Rather, the Jakarta government should start with simple instruments for urgent matters. For the time being, it should put emphasis on recruiting and fostering competent personnel, and subsequently, increase its capacity with sophisticated and expensive instruments.

To be specific, the Environmental Management Center should be first of all set up with a measurement and analysis system which will form a core for the measurement and analysis activities in the Jakarta area. At the same time,

the plan for establishing local environmental offices (BAPEDALDA) should be implemented as soon as possible and they should be furnished with the sufficient measuring and analytical equipment. In parallel with the improvement and expansion of the facilities in public environmental institutes, private consultants and businesses in the field of the environment should also be encouraged to make steady and long-term efforts to improve their measuring and analytical capabilities.

3) Establishment of standard water-quality measurement and analysis methods

It is urgent to institutionalize water quality measurement and analysis methods including those of sampling, storage of samples, analysis, maintaining measurement accuracy, etc., thereby making it possible to secure accuracy in measurement and analysis results and to compare data produced by different environmental institutes.

4) Technical training on water-quality measurement tasks

Staff of BAPEDALDA offices and municipal offices assigned to water-quality measurement as well as engineers who are responsible for effluent treatment in private companies should be provided with training in water-quality measurement techniques that are necessary for monitoring water pollution, supervising industrial effluent sources and giving guidance to relevant engineers or companies.

Following the example of the environmental training program offered in Japan, the program in Jakarta should constitute three progressive phases with different technical levels and according to the priority as follows :

Phase I : Sampling method and analytical technique for primary water quality parameter

Phase II : Trace analysis technique for heavy metals and harmful substances

Phase III : Sophisticated analytical technique for chemical substances including agricultural chemicals

It is advisable to program Phase I & II of the training following the steps as mentioned in the example below and to hold the training sessions at the Environmental Management Center to be constructed in Jakarta Special Metropolis.

Step I Participants : Researchers and analytical engineers from the

Environmental Management Center
Lecturers : Experts to be dispatched from Japan
Textbooks : To be written in English

Step Ⅱ Participants : Researchers and analytical engineers to play central roles in local environmental programs
Lecturers : Analytical experts from the Environmental Management Center and experts to be dispatched from Japan
Textbooks : To be written in Indonesian and English

Step Ⅲ Participants : Leading local engineers
Lecturers : Analytical experts from the Environmental Management Center
Textbooks : To be written in Indonesian

It is advisable to organize Phase Ⅲ (Chemical Substances) training sessions for analytical experts from the Environmental Management Center and leading local researchers and hold it at such facilities as JICA's Training Centers or other locations in Japan.

5) Establishment of environmental monitoring system

Same as Paragraph (1): Establishment of regulating and monitoring system of pollution sources of the following section (2): Regulation and monitoring of pollution sources.

(2) Regulation and monitoring of pollution sources

1) Establishment of regulating and monitoring system of pollution sources

Regional branches of the central government and municipal governments must make concerted efforts in enforcing regulations, guidance and monitoring of pollution sources as well as conducting environmental monitoring. The Indonesian government has been endeavoring to organize BAPEDALDA or local environmental conservation network across the country. It is advised that the government delegate to BAPEDALDA much of its authority for regulating and monitoring pollution sources and conducting environmental monitoring.

It is necessary that the Indonesian government recruit a sufficient number of officials and engineers to be assigned to BAPEDALDA offices, and at the

same time, set up consecutive training programs and seminars to update and improve their knowledge and abilities.

The training program JICA offers in Japan is aimed at engineers who are graduates from universities or have a similar academic qualification with a command of English. At each session lasting for nearly four months, and group of trainees are given lectures and exercises on general effluent treatment, measurement and analysis. The training program proposed in this section refers to that to be staged in Indonesia which is aimed at senior high school graduates in governmental or municipal offices. It is an intensive course of about one month and each session takes five to ten participants. The curriculum should be so designed that the trainees learn about the current state of water pollution and countermeasures taken in Indonesia, fundamental theories and practices of effluent treatment technology and measuring and analyzing methods, low-cost effluent treatment techniques, as well as capacity building for policy formulation, etc.

2) Preparation of manual for pollution source monitoring and guidance

BAPEDALDA and municipal offices are the core of monitoring, regulating and instructing factories and other pollution sources to secure enforcement of the effluent standards. Due to lack of experience, their officials need on-the-job training for improvement of their expertise.

As part of the effective and appropriate implementation of monitoring of pollution sources and providing guidance, it is necessary to prepare an instruction manual giving details of routine work.

Site inspection methods in factories used in Kitakyushu or other local governments in Japan may be adopted to Jakarta without modification. In Japan, also, a variety of reference books and magazines are published to be used by the people in charge of environmental management in governmental offices and companies for updating their knowledge by themselves. Since such publications are not fully available in Jakarta, it is necessary to compile an instruction book detailing typical cases of pollution sources in the region, general effluent treatment methods, outline of measuring equipment, etc.

An experienced Japanese environmental engineer may be assigned to various types of jobs whereas in Jakarta, a job might involve many less-skilled engineers. In response to this situation, ample consideration should be given in the manual to how to coordinate activities and exchange information

among persons involved. The following are essential subjects to be included in the manuals of monitoring and guidance.

① Organization of an inspection team and role of each member
② Items and checklist of site inspections at factories : operation and maintenance of effluent treatment facilities, operation of production facilities, sampling, measurement and analysis of effluent, etc.
③ Outline of water pollutant generating facilities
④ Outline of effluent treatment facilities
⑤ Handling and operational practice on measuring instruments
⑥ Maintenance methods on measuring instruments
⑦ Others

3) Collection and preparation of data on pollution sources

Without sufficient data on effluent discharged from factories in hand, effective implementation of regulation of, monitoring of and guidance to pollution sources is beyond expectation. Factories in Indonesia are presently obliged to submit their information on pollution to the Ministry of industry, and therefore, BAPEDAL does not have satisfactory environmental data in its records. Aiming to fill this deficiency, BAPEDAL has started to have its inspection teams collect the necessary information as it sends the teams to factories for site inspections.

In the future, it is advised that each company in Jakarta should submit its application and plants to construct a factory to BAPEDAL, stating in detail the structure and use of facilities which generate effluent, the effluent treatment method, the types and amount of discharged pollutants, etc. At the same time, companies should report the state of use of the facilities and the state of discharge of effluent promptly when requested by BAPEDAL. This will facilitate BAPEDAL in its process of collecting and filing necessary data on the environment. It is also advisable to store collected information in a database so that it may be used on an on-line basis jointly by BAPEDAL and the regional environmental offices.

As for methods of submission of data, items to be contained in the report and the formats and implementation of the report, those used in Kitakyushu City and other municipal governments in Japan will also be applicable for Jakarta. Personal computers may be adequate for the establishment of the database system considering the volume of information to be handled, application and the simplicity of maintenance. Software available in Japan may be used for the system as it is, or, for higher operability, a

specific system can be designed or developed after identifying the number of users, the way the system is used, the number of data items, the type of data output, etc.

3-2-4 Measures for problems related to the industrial effluent control measures

(1) General measures for pollution sources control

1) Expansion of PROKASIH coverage

The pollution sources PROKASIH centers its efforts on presently are large- and medium-scale businesses such as factories, hotels and hospitals. However, the sources of pollution of rivers in the Jakarta area are diverse in their origin and characteristics. In order to improve water quality, it is necessary, for the future, to take into account the following pollution sources and implement measures for pollution control.

① Effluent from small-scale factories
② Effluent from medium- and small-scale businesses
③ Domestic waste water
④ Effluent from stockyards
⑤ Effluent from agricultural activities
⑥ Other pollution sources

Control items PROKASIH presently specifies are organic pollution indicators such as BOD and COD. It should, in its list of control items, include heavy metals such as mercury and lead and harmful substances such as cyanogen and trichloroethylene in consideration of human health.

Target areas PROKASIH is engaged in presently are restricted to rivers. It should expand the target areas to include lakes, seas and ground water in the future.

2) Preparation of a water quality management plan

For effective promotion of water pollution control measures in the rivers and seas in the Jakarta area, preparation of a master plan specifying environmental measures for the future is a must. To be complete, the master plan must be based on the results of basic investigations including clarification of the rate of contribution of each source to the existing pollution, a forecast of future pollution, and a projection and quantitative evaluation of possible countermeasures.

Taking into account the characteristics of water pollution in Jakarta, the master plan should be based on integrated watershed management specifying

measures as listed below.

① Expansion and reinforcement of environmental monitoring system
② Measures for controlling effluent from factories and businesses (tightening of regulations, financial and technical support)
③ Measures for domestic wastewater
④ Measures for effluent from stockyards
⑤ Measures for effluent from agricultural activities
⑥ Environmental education for general public and industrialists
⑦ Measures for public hygiene including water supply.
⑧ Countermeasures for floods in urbanizing areas
⑨ Measures to prevent soil erosion
⑩ Waste disposal measures, including measures to prevent illegal garbage dumping
⑪ Development of new sources of water
⑫ Others

It is necessary to set up a council consisting of officials in charge at related departments of central and local governments, the members of the environmental research centers, researchers, experts and scholars in various fields, and representatives of pollution-causing industries. The council will deliberate, exchange opinions and coordinate in the process of formulating and implementing the environmental plans.

For the framework of the master plan and the evaluation methods of individual measures, techniques and knowledge developed in Japan may be used. However, its contents, descriptions and coordination method should be determined upon understanding the development of environmental measures in the past and the roles of related agencies in Jakarta.

(2) Effluent control measures inside factories

1) Implementation of training on industrial effluent treatment techniques

Training for managers or persons responsible for effluent treatment in factories should be given so as to improve their knowledge and techniques.

The training sessions offered by JICA in Japan are given to a group of several engineers with high educational backgrounds from various countries. The courses are usually conducted for a long enough period of time to cover all aspects of effluent treatment theories and techniques. On the other hand, the sessions suggested in this paper are to be conducted in Indonesia

and designed to give intensive training over a period of about one month. The group of trainees will consist of five to ten factory engineers with the educational background of senior high-school graduates or above.

The curriculum should include; the status quo of water pollution in Indonesia and pollution sources, fundamental theory of low-cost effluent treatment processes and their applications, operation, maintenance and modification of effluent treatment facilities, practice in measuring and use of analytical instruments and design and construction of effluent treatment facilities.

2) Implementation of technical diagnosis and instruction concerning industrial effluent control

In the 1960's, during which Kitakyushu was experiencing serious air and water pollution, not only small- and medium-scale factories but also large-scale ones did not have accurate data on the air and water pollutants they were discharging, let alone the engineering capability to work out pollution control measures on their own. As a breakthrough, several university researchers and experts were summoned by the city government as factory-diagnosis supervisors. They visited the factories which were suspected of causing pollution and which had been targets of citizen's complaints and diagnosed the operating conditions of their production facilities and the overall plant facilities. Based on the diagnosis results, the supervisors discussed appropriate and practical improvement measures for each case.

An important feature of this factory diagnosis system was that it encouraged the engineers of relevant factories to play a leading role in discussions with the supervisors and to provide them with appropriate advice. This system was helpful in fostering competent in-house environmental engineers. In the Jakarta area, environmental engineers in factories and private think tanks are not fully established or trained in pollution control measures. Therefore, it is strongly advisable for the authorities in the Jakarta area to introduce a similar system.

3) Introduction of pollution control engineer qualification system

PROKASIH requires each factory in Indonesia to nominate a pollution control manager who supervises the design and operation of the effluent treatment facilities. The Indonesian Government should introduce a national qualification system as a step to secure and foster competent environmental engineers. With this system, only qualified engineers may be allowed to

take the post of pollution control manager.

Kitakyushu and other municipal offices in Japan share the experience that factories made rapid strides in improving their pollution control systems and nurturing competent environmental engineers particularly after the central government had introduced the qualification system. Similarly, the Indonesian Government will find the qualification system helpful in furthering pollution control measures within factories.

Responsibilities of a pollution control manager may include:

① Examination of raw materials for production
② Inspection of pollution-generating facilities
③ Operation, inspection and maintenance of effluent treatment facilities
④ Measurement of the state of pollution and record keeping
⑤ Inspection and maintenance of measuring instruments
⑥ Countermeasures in times of emergency
⑦ Countermeasures in times of accidents

The qualification exam may include such subjects as those covered in Japan: general aspects of pollution problems, water pollution control laws and regulations, effluent treatment techniques and measurement techniques. However, actual examination questions should be made to reflect Indonesia's legislation, current pollution control and effluent treatment measures, water quality measurement and analysis standards, etc.

4) Introduction of credit system to promote industrial effluent control measures

One of major obstacles, other than lack of technical capability, in promoting industrial effluent control in Indonesia is that companies do not have sufficient funds for such investment. Japan in the 1950's was in the same situation. In view of the situation, the Japanese government established Japan Environment Cooperation to support companies in their efforts to introduce pollution control measures by granting low-interest loans. Also, local governments added to the central government's efforts by implementing their own credit system mainly aimed at medium and small companies planning to install effluent treatment facilities in their factories or, to relocate the factories to more suitable sites such as industrial estates. It is considered necessary for the Indonesian Government to set up a similar financial system to support private firms.

5) Industrial effluent control measures of medium and small companies

A medium or small company may face technical and financial difficulty when planning its own effluent control measures. There are cases in Japan where several medium and small companies in the same line of business cooperated in planning successful effluent control measures. The types of cooperation include : joint-operation of their business relocation to an industrial complex, and installation of common effluent treatment facilities and so on.

The above approaches will also be highly effective in Indonesia where many companies run medium- or small-scale businesses. The authorities in Indonesia are advised to prepare feasible plans after analyzing the sizes and types of work of the companies participating in the project, the method of financial support, the desirable form of cooperation, and environmental conditions of the industrial complex where they are supposed to be located.

6) Technical guidance on the design, installation and maintenance of effluent treatment facilities

The history of pollution control in Indonesia is still a short one and there is much room for progress in its technical level. For the appropriate and effective implementation of industrial effluent control measures, the engineers and private consultants are required to improve their techniques and knowledge on design, installation and maintenance of effluent treatment facilities.

Japanese engineers have much experience in the design and installation of effluent treatment facilities. Many trial-and-error experiences led them to develop and accumulate various kinds of know-how not mentioned in textbooks and references available in the market. Such engineering know-how will certainly be useful in designing and constructing effluent treatment facilities most suited to the characteristics of effluent, climate and regulations in Indonesia.

To prevent facilities from developing trouble and keep them running at full capacity, it is necessary to provide proper routine maintenance. The maintenance principles, methods and procedures developed in Japan will be applicable in Indonesia without much alteration.

Factory engineers and private consultants should be trained in the above-mentioned techniques and know-how on occasions like training sessions on effluent treatment techniques, instruction in technical diagnosis regarding

industrial effluent control and routine site inspections.

7) Establishment of environmental management system in factories

Without proper management, even though sophisticated effluent treatment facility would not work efficiently. As a result, it will fail to keep the treated effluent at a specified level of pollutants and will be vulnerable to frequent failures and at the same time, its service life will be shortened. There is also a case where the quality of treated effluent is worsened or the capacity of the treatment facility is lowered as the production plan changes on the production line. To avoid such situations, close communication must always be maintained between the effluent treatment line and the production line.

Factories located in regions like Kitakyushu, therefore, have established an exclusive environmental management unit so that pollution control activities can be conducted and managed effectively. Such units contributed to successful pollution control results. This will also be beneficial for the Jakarta area when it is implemented.

In Jakarta, in general, there is insufficient inter-departmental communication and operations and the technical standard of engineers is not satisfactory. Considering a such situation, an environmental management system should be established emphasizing the improvement of the inter-departmental communications and training of the engineers in factories.

To encourage organization of such a management system in factories, the Indonesian environmental authorities should consider steps to make the system mandatory or give administrative guidance to force its setting up.

(3) Monitoring of industrial effluent quality

1) Improvement of measuring and analytical skills of engineers

The Indonesian environmental authorities should provide a program for training of the engineers and private consultants engaged in the measurement and analysis of effluents to improve their level of techniques. The contents of the training program are the same as those in Paragraph (1)-4) of 3-2-3: Technical training on water quality measurement tasks.

2) Preparation of measurement and analysis system in factories

To operate and implement maintenance management of effluent treatment facilities in good condition, it is necessary to measure the concentration of specified items at specific points of the treatment line. The result should promptly be fed back to the line so that the operational mode can be altered as required.

Should the quality analysis be commissioned to an outside service, prompt feedback would not be possible, resulting in the unstable operation of the treatment line with occasional irregularities where the concentration of treated effluent exceeds the specified standard. In order to avoid such an incident, it is advisable for each factory to have its own capacity to measure and analyze effluent quality items of minimum necessity and to properly maintain equipment for the purpose.

For a factory in the process of completing its measurement and analysis system, it should be noted that it will begin with simple and inexpensive instruments to suffice for the minimum and urgent requirements and upgrade the system step by step as pointed out in Paragraph 3-2-3 (1) - 1): Establishment of measurement and analysis system.

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