Chapter 11

Countermeasures for Wastewater Pollution in the Metal Works Sub-sector

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11.1 Present Condition of Industrial Wastewater and Productivity in the Metal Works Sub-sector

11.1.1 Enterprises Studied

Table 11.1 shows a list of companies visited. The main products of the companies visited vary and include such things as hand tools, machine tools, pressure vessels, fans, mechanical tools, transformers, diesel engines, engine parts, mining machine tools, pumps, grindstones, process machines, textile machine parts, motors, agricultural tools, wire, plating goods, cars, tractors, badges, bolts and nuts etc. Some of the companies visited have no industrial wastewater, but surveying them was useful to understand the total make-up of the Metal Works Sub-sector.

Table 11.1 Companies Visited

No.	Ownership	Main Products	Establishment	Employees	Waste Water Volume m^3/day	Plating
M-01	SOE	Spare Parts for the Textile Industry	1986	140	40	Yes
M-02	PC	Plating Parts	1999	70	20	Yes
M-03	SOE	Tractors	1960	700	700	Yes
M-04	SOE	Bolts and Nuts	1963	413	200	Yes
M-05	SOE	Hand Held Tools	1960	630	260	Yes
M-06	SOE	Machine Tools	1958	150	200	No
M-07	SOE	Pressure Vessels	1962	230	20	No
M-08	SOE	Fans	1967	400	20	No
M-09	SOE	Cutting Tools	1968	450	15	Yes
M-10	JV	Transformers	1994	263	-	No
M-11	SOE	Engines	1980	1400	680	Yes
M-12	SOE	Spare Parts for Engines	1968	700	400	Yes
M-13	SOE	Spare Parts for the Coal Industry	1930	480	20	No
M-14	SOE	Pumps	1960	850	-	No
M-15	SOE	Grindstones	1966	407	24	No
M-16	SOE	Chemical Equipment	1976	350	-	No
M-17	SOE	Transformers and Motors	1977	500	20	No
M-18	JV	Diesel Engines	1969	500	-	No
M-19	SOE	Wires and Cables	1972	145	20	No
M-20	JV	Automobiles	1995	140	160	No
M-21	SOE	Medals and Badges for Police	1981	120	3	Yes
M-22	PC	Small Plated Parts	1983	10	10	Yes

SOE: State Owned Enterprise / JV: Joint Venture / PC: Private Company

Of the 22 companies visited, only two companies were private enterprises and the rest were state-owned companies. This fact indicated that companies specializing in plating are not under the control of MOI, so to proceed further with our investigation of possible counter-measures for industrial pollution in plating works required cooperation between MOI and the local government.

Figure 11.1 and Figure 11.2 show the distribution data of the amount of waste water and the number of employees of the 22 companies visited.

These figures indicate that there are many companies who have a volume of wastewater that is less than 50 m^3/day and whose number of employees is less than 500 persons. Especially for companies specializing in plating, the size of the companies is small and the number of employees is less than 100 persons.

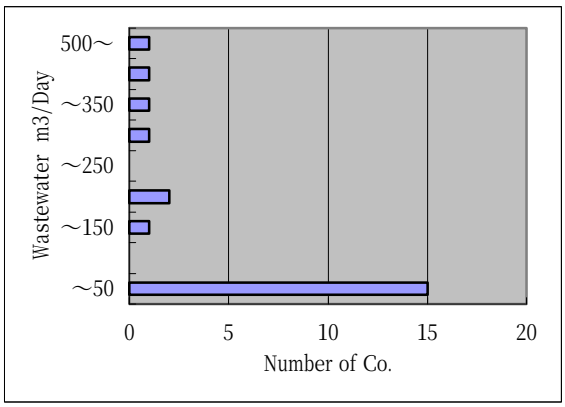

Figure 11.1 Volume of Wastewater

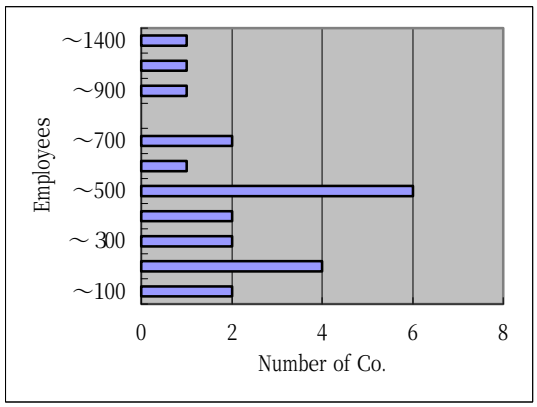

Figure 11.2 Number of Employees

From the 22 companies visited, the Study Team selected a few companies for a more detailed study that took place during the third field survey. The selection criteria was as follows:

1. Companies which have major water pollution problems, namely those that have plating shops.
2. Companies in which improvement can be expected.
3. Companies which have a sufficient technology level.
4. Companies which have enough of a financial base to bear the cost required for pollution prevention investment, desirably private companies.

Considering the above criteria, and through discussion with MOI, four companies, M-01~04 in Table 11.1, were selected for the detailed study.

11.1.2 Industrial Pollution Generated by the Metal Works Sub-sector

a. Present Status of Discharged Material from the Metal Works Sub-sector that Causes Industrial Pollution

The problems with industrial wastewater being discharged from the Metal Works Sub-sector are summarized below:

1. Wastewater discharged from the plating process contains hazardous material.
2. Wastewater discharged from the acid washing process, which occurs after the heat treatment and surface treatment processes, contains acid.
3. Wastewater discharged when floors and machines are cleaned contains oil and grease.

Wastewater can be analyzed in two groups. One group is wastewater discharged from plating shops, and the other is wastewater discharged from factories without plating shops. The results of wastewater ample analysisi in the companies visited is as follows :

(1) Wastewater Discharged from Plating Shops

Wastewater analysis results of the 10 companies which have plating shops are shown in Table 11.2. The volume of wastewater includes not only that discharged from plating shops, but also includes domestic use wastewater. According to operating conditions, wastewater quality may fluctuate. So, the following points are general in matter:

1. Many companies' pH values at final discharge points are within Viet Nam standards even though wastewater discharged from plating shops has high acidity.
2. In the case where BOD, COD, SS and OIL are high at the final discharge point, it is supposed that this result is caused from a mixture of domestic use wastewater and washing water from mechanical shops.
3. The major problem is that hazardous discharged materials such as CN, Cr^{6+} etc., exceed Viet Nam standards.
4. Water treatment units are necessary for water discharged from plating shops.

(2) Wastewater Discharged from Factories Without Plating Shops

The wastewater analysis results of seven companies is shown in Table 11.3. Wastewater discharged from mechanical shops is almost always mixed with other wastewater at the final discharge point. Much of this wastewater is standing water which means there was no water flow at the time of sampling. So, according to the operating conditions, wastewater quality may fluctuate. The following points are general in matter:

1. In the case of low pH levels which are out of the standard, acid washing water after heat treatment may be discharged.
2. Oil content is out of the standards in many cases. Machine wash water, or other wash water may be discharged.
3. Sometimes domestic use wastewater causes high BOD and high COD levels.
4. There are no problems with hazardous materials such as heavy metals.
5. Regarding acid and oil, pretreatment like neutralization and/or oil separation is required.

Table 11.2 Water Analysis Results (factories with plating processes)

Company No.	Water Volume m^3/day	pH	Oil Content mg/l	BOD mg/l	COD mg/l	SS mg/l	CN mg/l	Cu mg/l	Fe mg/l	Zn mg/l	Cr^{+6} (T.Cr) mg/l	Ni mg/l
M-01	40	2.6~10.8	0~2	1~8	4~29		0.01~0.03	0.05~0.66	0.23~1.28	0.09~0.35	0.09~0.63	0.27~4.38
M-02	20	4.4~9.0	8~15	3~6	39~165		0.17~3.29	0.38~2.33		0.86~2.55	0.03~0.81	0.25~2.84
M-03	350	7.1~8.0	0.2~0.4	13~18	48~88		0	0.27~0.68		0.93~2.64	0.05~2.07	0.01~0.42
M-04	200	2.1~10.4	0~0.2	15~34	90~192		0.01~0.43		0.1~10.2	0.91~2.7	0.01~0.08	0.01~0.08
M-05	260	5.8~8.1	0	5~7	28~135	18~312	0.05~0.59	0.27~2.27	0.01~2.45	0.05~0.41	(0.4~2.6)	2.3~12.5
M-09	15	6.7~7.0	0.1~0/9	12~127	51~184	17~79	0.06~0.09	0.19~1.27	1~1.52			
M-11	680	7.4~9.3	0.4~1.6	82~125	113~174	12~75	0	0.16~0.45	0.4~3.2	0.4~0.7		
M-12	350	4.1~7.1	0~2.2	59~102	98~223	24~102	0~0.01	0.24~1.24	1.1~6.3	0.7~1.0		
M-21	3	1.6~3.4	0~0.2	1~9	5~46		0	0.02~6.65	0.2~4.2	0.03~0.41	0.01~0.61	0.03~0.30
M-22	10	3.0	0	72	126	180	0.32	2.76			0.095	
TCVN 5945		5.5~9	1 or 10	50	100	100	0.1	1	5	2	0.1 (1)	1

Table 11.3 Water Analysis Results (factories without plating processes)

Company No.	Water Volume m^3/day	pH	Oil Content mg/l	BOD mg/l	COD mg/l	SS mg/l	CN mg/l	Cu mg/l	Fe mg/l	Zn mg/l	Cr^{+6} (T.Cr) mg/l	Ni mg/l
M-06	200	6.8~7.6	0~0.05	5~138	7~181	46~126	0.05~0.29	0~0.03	0.6~9.4	0.09~0.81		
M-13	20	8.5~12.2	0~41	26~72	55~92	5~4900	0		0.8~19.6	0.17~3.55		
M-15	24	2.7~8.1	0~0.4	23~82	53~112	14~280						
M-17	20	1.9~5.1	11~156	1~43	3~471	0~0.1			13.2~18.6	0.01~0.53	0.01~0.02	0.07~0.08
M-18	-	7.1~7.2	6~228	2~37	24~339		0					
M-19	10	6.7	10.8	20	48		0.03	0.03	0.49			0.98
M-20	160	7 ~7.5	9~28	63~129	150~370		0.03~0.09			0.3~0.81	0.08~0.11	
TCVN 5945		5.5~9	1 or 10	50	100		0.1	1	5	2	0.1 (1)	1

b. The Influence of the Metal Works Sub-sector on Industrial Pollution in Viet Nam

To survey the influence of the Metal Works Sub-sector on industrial pollution, it is necessary to calculate the total discharged amount of material that is causing pollution. Our data obtained in the previous survey is not sufficient to calculate this. So a very rough calculation, based on some assumptions, was done to estimate the influence on industrial pollution of the Metal Works Sub-sector. Materials causing industrial pollution are CN, Cu, Ni, Cr^{6+} and Zn. For the calculation base, maximum analysis data was taken. Base data is shown in Table 11.4.

Table 11.4 Base Data

Material	CN	Cu	Ni	Cr^{6+}	Zn
Detected max. mg/l	3.29	6.65	12.5	2.67	2.7
Wastewater m^3/day	20	3	20	20	20
Company	M-17	M-20	M-1	M-19	M-1

The wastewater amount discharged from plating shops where only the total wastewater amount is known is estimated to be 20 m^3/day. The total number of companies which have plating shops was determined on the basis of Table 11.5, which contains information on the Mechanical Industry in Viet Nam.

Table 11.5 Number of Companies with Plating Shops in Viet Nam

Classification	No. of Company	% of Companies having plating	No. of Companies having plating
State-owned	457	10 %	46
JV Status	929	10 %	93
Private	40	10 %	4
Sub-total	1,426		143
Personal	30,000	5 %	1,500

Based on the above assumption, the calculated annual total discharge of pollution causing material is shown in Table 11.6.

Table 11.6 Total Discharge Amount of Pollution Causing Material (t/year)

Material Causing Pollution	CN	Cu	Ni	Cr^{6+}	Zn
State-owned + Private	4	1	13	2	3
Personal	18	6	68	11	15

However, the actual condition in personal workshops is unknown. The amount of wastewater discharged from personal workshops is estimated to be half that of other companies. The results of our calculation show that the annual total amount of pollution causing material discharged from the Metal Works Sub-sector is less than 100 Tons for each type of company, a figure which would seemingly have little influence on total pollution. In MOI's survey report (Report on Environmental Real State), it was reported that the influence of the mechanical industry on the surrounding environment is very small because of the small scale of production. It also states that solid waste and discharged gas from this industry is limited and slight, and the main pollution problem that must be corrected is dust from the casting, plating and painting processes. Especially, with regard to wastewater, the electro-plating process has the largest problems. However, in general, it's influence on total pollution is very small. Nevertheless, even though the total amount of industrial pollution causing material discharged is small, countermeasures for hazardous material are required.

c. History and Present Status of Industrial Pollution Generated by the Plating Industry in Japan

The plating industry developed as a city-type industry because of the use of many kinds of chemicals and the industry's support of other industries. From the reconstruction period after World War II, industries grew and developed into large size operations with the introduction of automation and mass-production. The plating industry also followed this trend and the number of companies increased, as shown in Figure 11.3. On the other hand, industrial pollution started to become a social problem around the end of the 1950s. Effluent trouble with cyanide contained wastewater discharged into rivers in the Tokyo area in the year 1963 and 1964 served to highlight wastewater pollution discharged from the plating industry. In this chapter, pollution problems generated by the plating industry and countermeasures for pollution prevention, which were established by the plating industry and the government, are outlined.

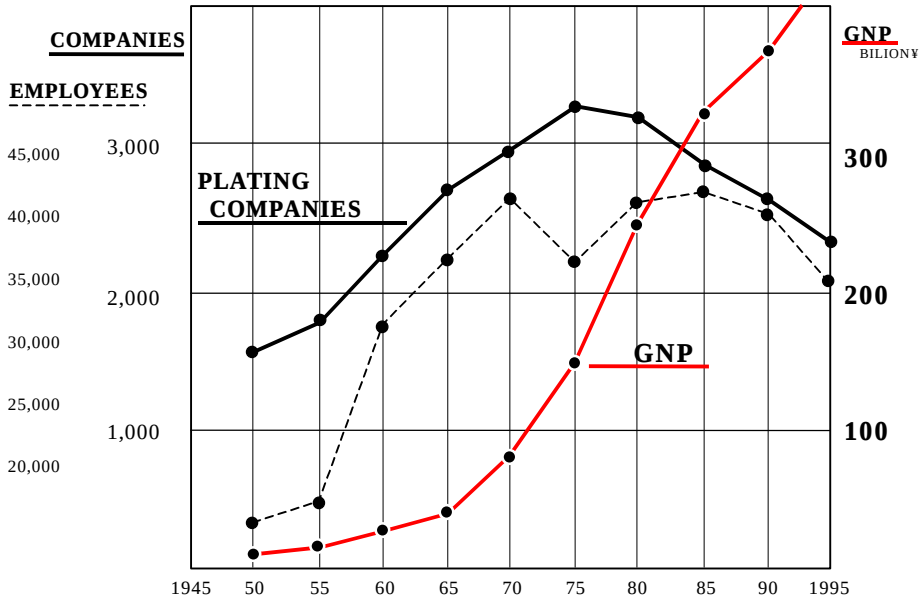

Figure 11.3 Development of the Plating Industry

(1) Pollution Problems

1) Cyanide Problem

1. A large amount of cyanide effluent was discharged into a branch of the Tama River which is a source of water supply in the south part of Tokyo. Because of a water intake stoppage at a water purification plant, water supply to a part of that area was shut off. This became a big social problem. The cause of the trouble was the breakdown of a Cu electrolyte filter.
2. Accidents which resulted in injury, supposedly caused by hydrogen cyanide gas in the Tokyo sewage, occurred twice (April and October) in 1969. It was decided that the cause must be condensed cyanide waste discharged from plating shops or the acidification of wastewater. In the same year, cyanide effluent troubles occurred at midstream and down stream points of the Tama River, and in the Hachioji and Kiso rivers which are located in the middle of Japan. It was concluded that this series of troubles was due to a lack of management awareness for hazardous material and lax wastewater management. Regarding these troubles, many serious studies were carried out by the government and the local citizens, which led to the establishment of new technologies and new treatment methods.

2) Cadmium Problem

"Ouch-ouch" sickness, which occurred in the basin of the Jintsu River in 1968, was determined by the government to be caused by Cadmium pollution. Accordingly, the government, including local governments, performed an actual status survey of the same problem. 49 plating shops were exposed as having some relation to this problem, and it became a serious social problem. At the time, there were 252 companies which were using cadmium, and 142 of them discharged cadmium in amounts in excess of the national standard. The union of the plating companies announced a stoppage in the use of cadmium. In foreign countries, there were no existing regulations and no treatment methods. It required more than one year to restart cadmium plating only for indispensable items.

3) Chromium (VI) Problem

In 1975, a social problem caused by chromium(VI) occurred and electro-plating companies were investigated and forced to reveal facts about their past operations. The problem was determined to have come from an elution of chromium(VI) from a disposal site that a chromic acid manufacturer in Tokyo had been using to bury waste for ten years. At that time, the tracking of carcinogen generating companies became very severe. This pursuit expanded to include checks of the working environment and diseases of plating shop workers. In the area where plating companies were systematically carrying out work, periodical health checks and measurements of the working environment were done thoroughly.

4) Chlorinated Organic Solvent Problem

For the purpose of the improvement of the pretreatment process and for severe degreasing, usage of chlorinated organic solvents, like tri-chloro-ethane for the plating process, expanded rapidly because of their effectiveness in improving quality and for use as an anti-grease effluent. However, as one of the countermeasures for ozone protection from destruction by fluorocarbons, a law limiting the usage of tri-chloro-ethane was established. The plating industry changed the solvent and is intending to use a non organic solvent. Figure 11.4 shows the relation between the time of the occurrence of pollution problems and the development of the plating industry.

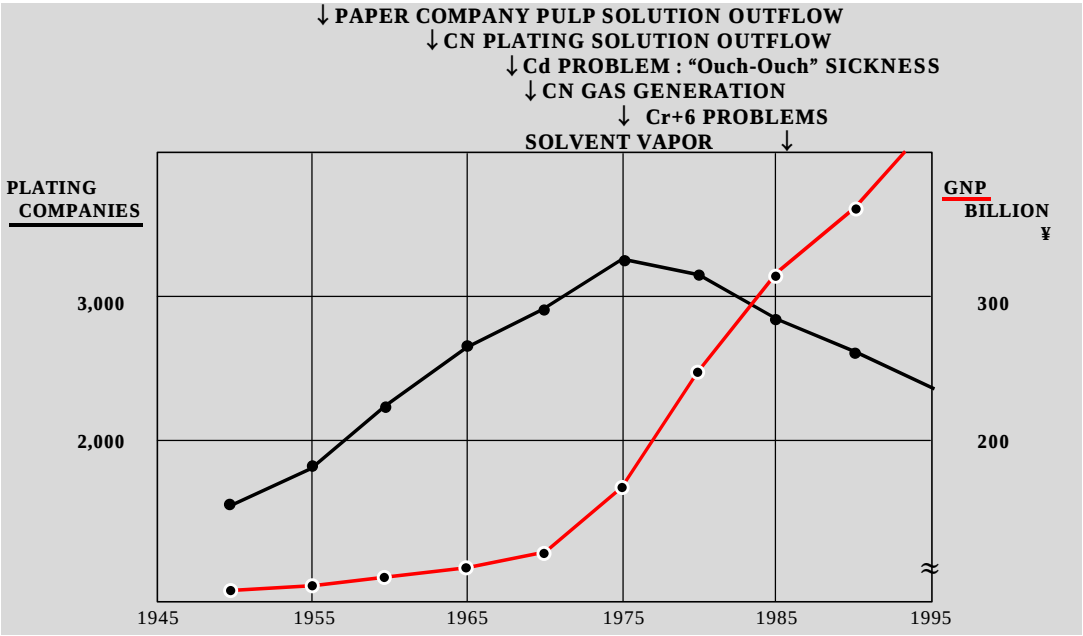

Figure 11.4 Environmental Problems

(2) Government and Citizens Tackle Pollution Protection

The electroplating industry grew up as a city-type industry and special attention was paid to the environment inside and outside of the factory. After the establishment of laws such as the "Law Related to the Limitation of Factory Waste water" in 1958, "Basic Law for Pollution Countermeasures" in 1967 and " Water Pollution Protection Law" in 1970, the electroplating industry could not continue business without complete wastewater treatment. At that time, it was very difficult for small companies to comply with the laws perfectly. In order to develop new technologies and/or invest in new facilities, technical cooperation with other companies and an introduction of public funds were required. The industry made their best effort and the power of their union grew for pollution protection. The government's instructions were carried out through the union. In 1970, 89% of 3900 plating companies had joined the union.

1) Cooperative Pollution Countermeasures --- Plating Industrial Zone

To rationalize a city-type industry consisting of many small companies, it was thought that it would be very useful to be able to carry-out cooperative business activities, so a system for consolidation and a cooperative were considered. Especially, it was thought that it would be very useful if cooperative pollution countermeasures and facility management could be applied, so they started to

tackle the consolidation issue in the early stages. With a positive plan and the help of the local government, a plan for creating plating industrial zones proceeded and was completed. This movement expanded in all areas of Japan, in spite of the long depression which set in after the 1973 oil shock. From the view point of pollution protection technology, many epoch-making measures, such as the resource recycle system for each metal, complete closed systems etc. were undertaken and realized.

2) Pollution Protection by the Government

In 1971, the Mine and Coal Bureau of MITI included in their budget traveling instructions for plating companies to make complete countermeasures for waste water. They made "Instruction Standard for Wastewater Treatment of Electro-plating" as a text book for INSTRUCTION. Based on this common standard, actual instruction was performed by instructors who belonged to local public institutes. Other than the items above, a technical seminar which related to wastewater treatment technology and plating technology was also held periodically in six areas. Accompanied with the regulation of laws, the above mentioned INSTRUCTIONs were carried out by MITI.

(3) Future Subjects for Environmental Preservation

The whole industry will not achieve continuous development without positively tackling environmental preservation on a global scale. Japanese plating companies have overcome pollution problems up to now, but the search for new advanced technologies to help preserve the environment shall continue. Items that need to be investigated are as follows :

1. Risk management --- corresponding method to an accident and a disaster
2. Protection against underground penetration of hazardous materials and soil pollution
3. COD countermeasures for facilities discharging water in areas close to the sea
4. Recovery and material recycling
5. Countermeasures for organic solvents
6. Vaporization countermeasures for non-electrolyte Ni plating liquid

(4) Subjects in Viet Nam referring to Japanese Pollution History

In Japan, pollution problems, including personal injuries from were generated during the rapid economical growth period the reconstruction period after World

War II until 1960.

In Viet Nam, they are in the rapid economical growth period from the year of 1991, following the introduction of the “doi moi” policy which has been applied from the year of 1987 after the war ended at the year of 1975.

Now, it is a very dangerous period regarding pollution problems, they need to start the investigation for the industrial wastewater pollution countermeasures. Referring to Japanese examples, the following items need to be tackled:

1. Recognize that the causes of pollution problems are insufficient of management of hazardous material and careless waste water management.
2. The Government with the cooperation of citizens needs to investigate pollution problems through the assistance of the plating union.
3. Investigate the consolidation of the electro-plating industry and promote the construction of plating industrial zones with the help of local governments.
4. The government needs to carry out industrial pollution prevention countermeasures, such as giving re-locating orders to plating companies etc., accompanied with the regulation of laws.

11.1.3 Summary of the Present Condition of Wastewater and Productivity in the Metal Works Sub-sector

The present conditions of wastewater and productivity, focusing on the plating processes, are as follows:

1. There are no plating companies which do not have water treatment units in Japan. However, in Viet Nam, plating companies must start waste water treatment from here forth.
2. There is no statistical data on plating productivity in Viet Nam, but the operating load and productivity of some of the private plating companies are similar to those of Japanese plating companies. On the other hand, the operating load and productivity of some of the plating shops of the state-owned companies are much different.
3. The entire picture of the plating industry in Viet Nam is not clear yet. There are no plating companies unions in Viet Nam, so enterprises do not have an opportunity for information exchange and also, can not compare their production technologies with other enterprises.

11.2 Analysis of Present Conditions in the Metal Works Sub-sector

11.2.1 Present Status and Problems of Production Technology in the Metal Works Sub-sector

a Present Status of Applied Technology and Technological Trends in the Metal Works Sub-sector

Of the 22 companies visited, 12 companies have no plating shops and 10 companies, including companies specializing in plating, have plating shops. The companies visited are classified into these two groups.

Final products of the companies which have no plating shops include various items like mechanical parts, tools, machine tools, diesel engines, fans, pumps, cars, transformers, motors, grindstones, wire etc. and the basic process of their production is shown in Figure 11.5.

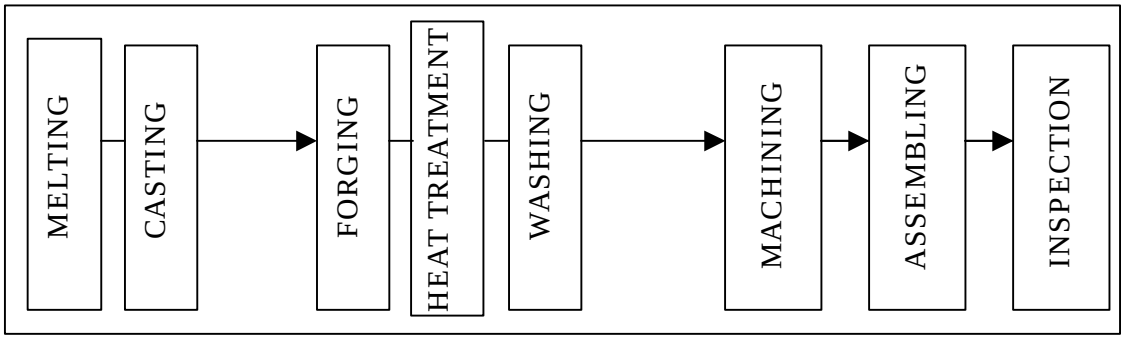

Figure 11.5 Basic Production Process in Companies Without Plating

The process, as shown in Figure 11.5, may differ depending on the enterprise at the parts manufacturing stage, but machining and assembling are part of every production process. Generally, applied technologies and facilities are very old and there is almost no advanced technology in use, except in joint venture companies with foreign enterprises which have first class technology.

In the case of most machining and assembling factories, there are industrial pollution problems with waste gas, dust, and noise, but almost no problems with wastewater.

So, from the view point of our investigation on industrial wastewater, technological trends in plating shops will be focused on.

(1) Plating Process

The Ni-Cr plating process is shown in Figure 11.6. The Zn electroplating process is shown in Figure 11.7. The Zn hot-dipping process is shown in Figure

11.8. The plating processes used in the 10 companies visited depend on the shape of the base material, but are almost the same as in Figure 11.6, Figure 11.7 and Figure 11.8.

(2) Present Condition and Future Trends of Production Technology

Generally, plating facilities and technology utilized are old and operated manually. The actual technology being used presently includes:

1. Preparation work that is required before plating is attached to the base material on a jig manually. In the plating process, much work has to be done manually because of space limitations, which is one of the reasons for the low automation level in plating production.
2. Many plating shops are using cyanide. It is well known that cyanide has high toxicity. Enterprises should consider changing electrolytes to types that contain no cyanide. However, actually only one plating company has changed over to this cyanide free-type and others have no plans to change over at all.
3. In the case of small parts (washers, springs etc.) plating, all companies are using barrel type equipment (rotary type).
4. From the view point of general production technology, the method where electrolytes are swished-off and the treatment where liquid is dropped during the transportation of plating materials require some technical consideration. This is one of the principles of Cleaner Production, so these methods should be investigated further.
5. A fume vacuum duct is installed on a Cr plating bath in one company, but it's effectiveness has not been confirmed.
6. Zn hot dipping is applied for the plating of bolts and nuts, and the technology level of this process is considered to be average level.
7. In a specialized factory for decorative plating, plating is applied onto plastic used for badges and buttons of uniforms and the technology level in this process is good. Of course, Au plating, which is characteristic of decorative plating, is also applied.
8. In the plating shop of mechanical manufacturers, there seems to be no chance to apply new technology because plating is only done on their own products.
9. On the other hand, in one specialized plating factory, it's technology level is increasing day by day because they are applying a new technology which is required to respond to new orders from outside customers.

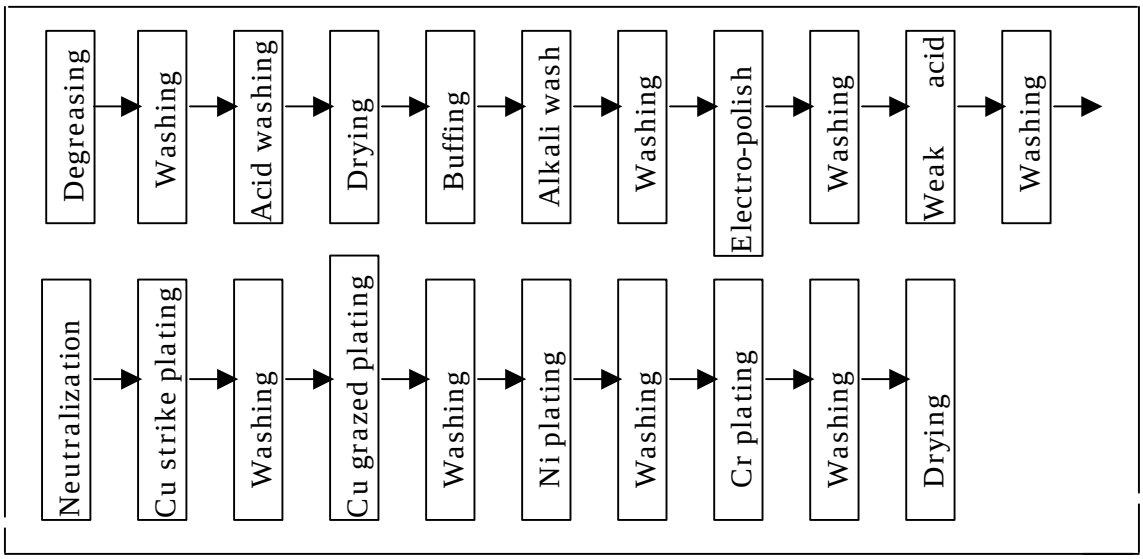

Figure 11.6 Ni-Cr Plating Process

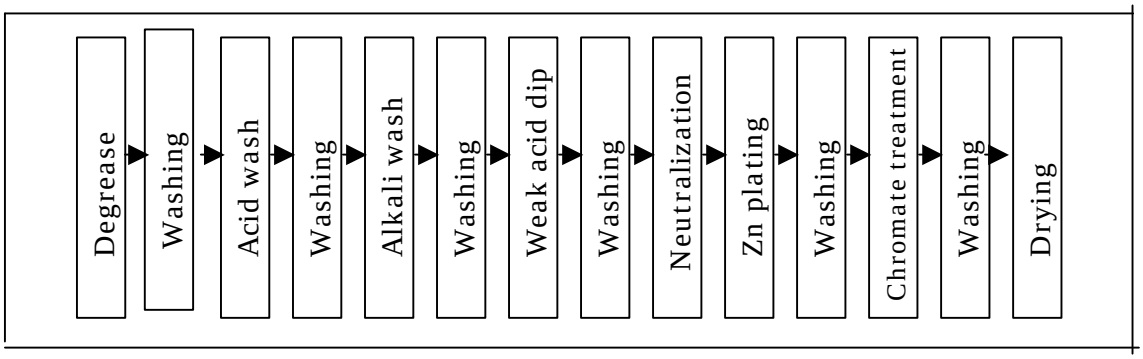

Figure 11.7 Zn Electro-plating Process

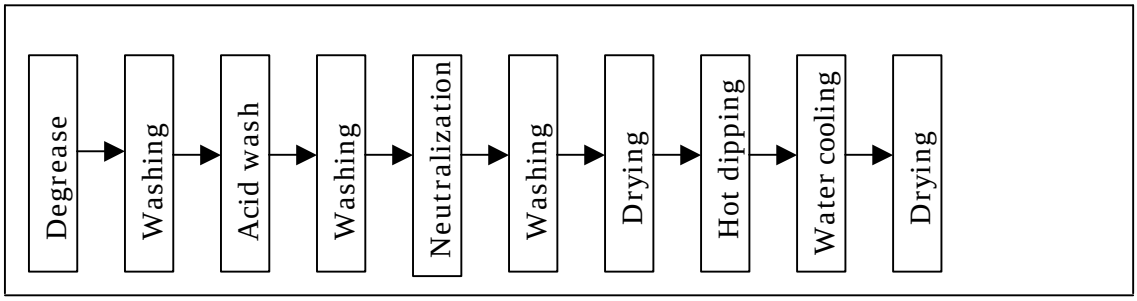

Figure 11.8 The Zn Hot-Dipping Process

b. Problems in Production Technology

Of the 22 companies visited, three are specialized plating companies, seven have plating shops and 12 have no plating shops at all. The general problem facing this industry is that JV companies and companies which have good relationships with foreign enterprises posses advanced technology, while on the other hand, purely domestic companies have old facilities and old technologies which means

they can't compete internationally. A complete level up of the industry could be possible if information exchange meetings took place between state-owned companies.

Concrete problems in the plating process are as follows:

(1) Few Applications of the Counter Flow Method for Water Washing

The washing operation in the plating process has the same importance as quality improvement for plating. Most of the washing processes in companies visited use a process where plated goods are only dipped in stored water even when there are two water tanks in place. Usually a counter flow method, shown in Figure 11.9, is applied in Japan for this operation.

This method is applied in one company which has introduced Japanese plating technology. Information exchange regarding this method should be carried out.

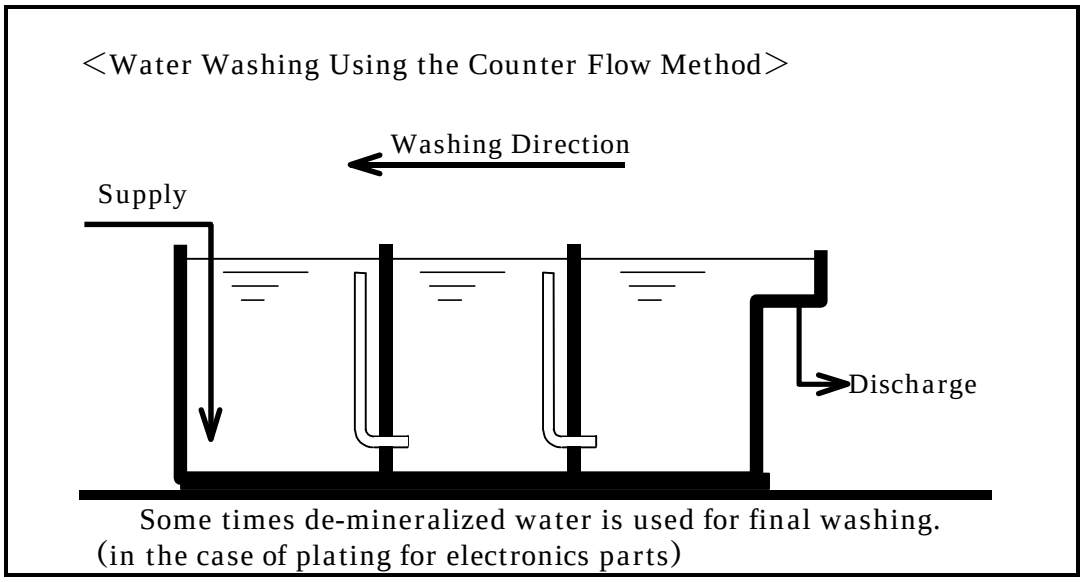

Figure 11.9 Water Washing Using the Counter Flow Method

(2) Insufficient Swish-off of Electrolytes and Dropping Liquid Management

One of the most important principles of cleaner production technology is to swish-off electrolytes to an acceptable level. Also, it is important to separate dropping water in each plating process. If dropping liquid is mixed in a pit or with sewage, it is difficult to treat and treatment costs becomes high. Figure 11.10 shows wastewater systems, one with a separate discharge and one with a mixed discharge system.

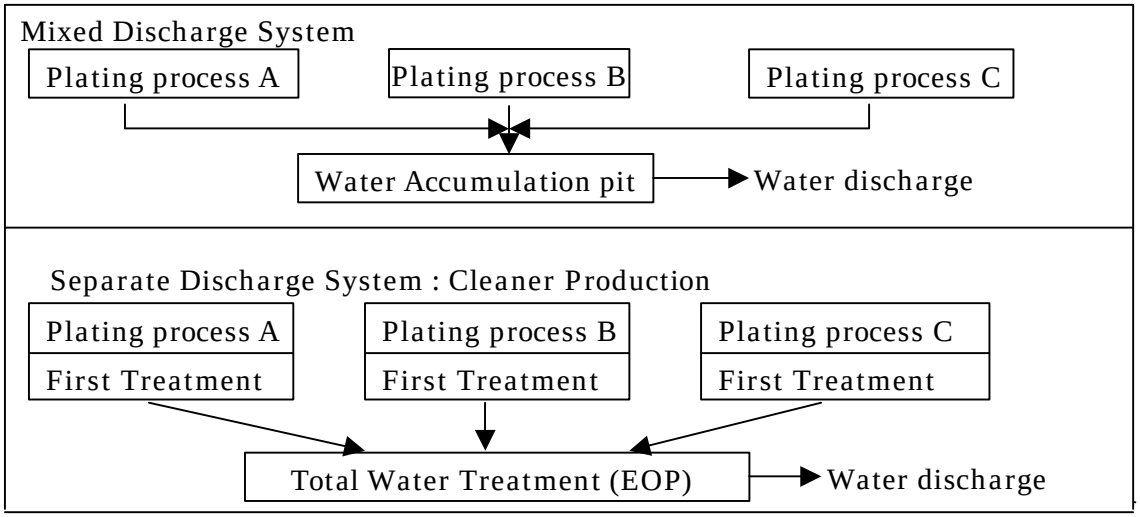

Figure 11.10 Wastewater System Comparison

11.2.2 Present Status and Problems of Production Management Technology in the Metal Works Sub-sector

a. Present Status of the Management Level of Companies in the Sub-sector

Management data was not studied in detail for the 22 companies visited, so the precise level of management is not known. However the general management level could be evaluated by visiting these factories. The general management level of these companies is as follows :

1. In JV companies, production management, quality control and job site management are at a very high level and some of these companies have obtained ISO9000 certification.
2. In some of the state-owned companies, TQC activities and 5S activities are carried out through the instruction of foreign consultants. The production management level is very high at these companies.
3. Many of the state-owned companies indicated that they are busy with manufacturing and that they have no extra money to spend for improving the management level. Without improving management, they will not realize higher production, better quality, better international competitiveness and a higher operation rate.

b. Problems in Production Management Technology

Problems with the above mentioned present status of management are as follows.

1. The management level differs widely between companies.
2. Companies which are exporting their products need to acquire ISO9000 certification and work to improve their management level. On the other hand, companies which have no relations with foreign enterprises are not taking steps to improve their management level.
3. There seems to be few opportunities for information exchange, so companies do not know their own situation compared with others.

Summarizing these problems, steps to improve the management level, the most important step in Cleaner Production, are not being sufficiently carried out. Cleaner Production activities such as quality up-grading, energy saving and material saving, should be emphasized and carried out by these companies.

11.2.3 Summary of Present Status Analysis

The present status of the plating industry in Viet Nam is as follows:

1. The priority for wastewater treatment in the enterprises is very low, so the necessity of wastewater treatment is not yet recognized.
2. The necessity of data gathering and information exchanges for the plating process has not been recognized, because the plating shop is only a minor part of each enterprise.
3. The plating shops in the state-owned companies are only plating on their own products. There are no opportunities to plate on other companies' products, so there is no necessity to improve technology and facilities.

11.3 Technological Improvement in the Metal Works Sub-sector

11.3.1 Present Problems in Metal Works Sub-sector

Present problems studied up to now are summarized as follows:

1. Old facilities and little technical progress.
   (1) JV companies have advanced technologies, but state-owned companies have old facilities and technologies.
   (2) In the plating process, facilities and technologies are also very old.
      ① There are few applications of the counter flow washing method.
      ② Insufficient management of the swishing-off and dropping liquid processes.
2. Insufficient improvement activities in many companies
   (1) Inadequate arrangement and cleaning of work shops.
   (2) There are big differences in management level among companies. The

management level of state-owned companies, especially, is not good.

(3) There are few opportunity for information exchange, so companies can not grasp their overall level through comparison.

3. Many companies are directly discharging hazardous waste.

Wastewater from one plating shop is discharged directly without treatment.

11.3.2 Items for Improvement that Apply Cleaner Production Technology in the Metal Works Sub-sector

a. Improvement Items for Production Technology:

(1) Reduction of CN Plating Baths

On one hand, the plating technology of CN plating baths has some good points. However, in small plating companies, the installation of water treatment units is currently very difficult because of a lack of finances. Considering the toxicity of CN, plating baths that do not contain CN should be installed. For Cu plating, copper sulfate baths without CN are one possible direction for the industry to consider.

(2) Separate Discharge of Dropping Liquid

In the plating process, it is indispensable that dropping liquid be used between processes. However, it is urged that a system that is able to discharge dropping liquid separately be considered. In the case of sewer systems, where dropping liquid from each process is mixed on the work floor, simple water treatment technology can not be applied. For the a-fore mentioned plating company which can not install a water treatment unit, an effective water treatment unit could be installed to reduce the water amount by applying a separate discharge system.

(3) Directions for Improvement in the Plating Process

Directions for Cleaner Production in the plating process are as follows:

1. Perform inspection upon receipt of goods and reject inferior goods before input
2. Perform preventive facilities maintenance, including bath components, and also minimize operating hours.
3. Select plating processes, plating material and pre/after-treatment for easy recycling.
4. For plating, use only required parts at their required thickness.
5. Eliminate useless transportation inside and outside of the company.
6. Keep tools in good condition.

7. Make the plating process simple, as much as possible, except for quality requirements.
8. Perform density control on electrolytes and keep it to a minimum.
9. Keep the appropriate agitation in baths and maintain uniform current distribution to prevent useless plating.
10. Prevent aging of electrolytes to achieve energy saving and material saving.
11. Perform water saving and recovery to reduce the water treatment load.
12. Perform heat, current and water control to achieve energy savings.
13. Make clear the material balance of the plating process and water treatment process to prevent chemical waste.
14. Store condensed waste liquid and metal sludge appropriately for making recycled resources.
15. Perform recycling of raw materials, facilities and instruments to reduce waste.

b. Promote Improvement Activities

(1) Improve the working environment through good organization and cleaning

Nothing should be placed directly on the floor. The various tanks, which are placed on the floor, should be put on movable carts so as to be able to construct the layout according to the job flow. Unnecessary material in the shop should be taken out. Walkways should be clearly painted. Making work easy promotes high productivity and high quality which helps to increase business opportunity.

(2) Utilize Break Even Point Charts to Ascertain Improvement

Figure 11.11 shows an example of a Break Even Point Chart. The chart can be made easily by inputting the correlation between production and sales amounts, and fixed costs and variable costs. By making a chart for the entire company it will help each department know the direction of profit improvement. Methods for improving profit are ① increasing production, ② increasing the unit selling price, ③ reducing variable costs and ④ reducing fixed costs.

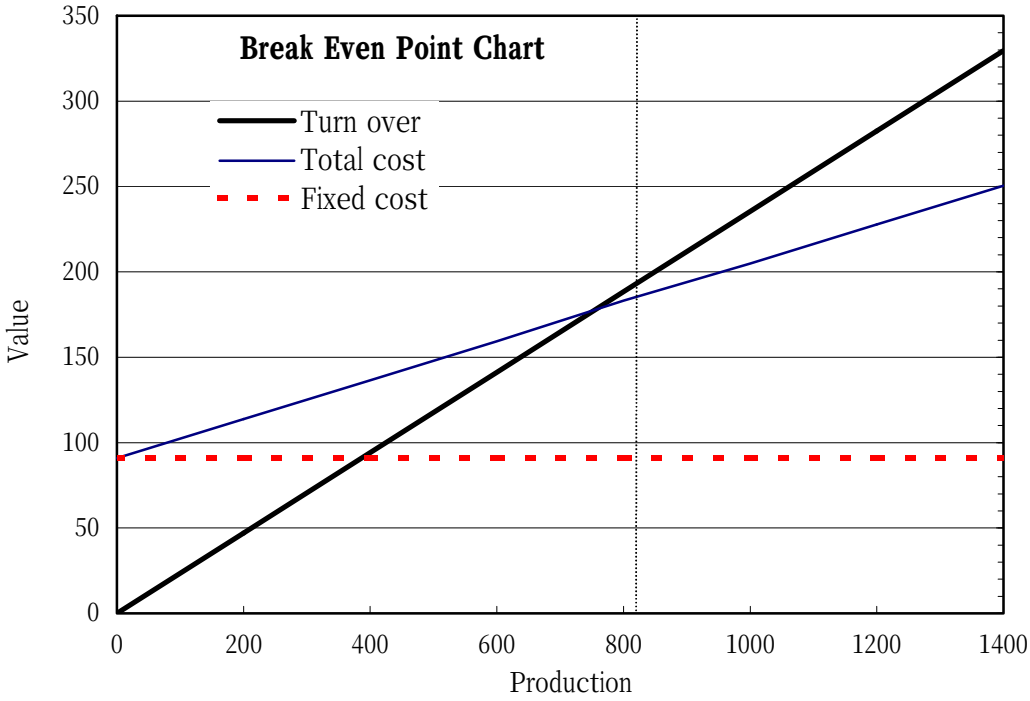

Figure 11.11 Example of A Break Even Point Chart

It is possible to concentrate on the most effective items when using the chart. In this way, the effect of water treatment unit investment on company profits can be known.

(3) Promotion of Cleaner Production Activities

Figure 11.12 shows an example of a proposal for a Cleaner Production activity. Figure 11.13 shows an example of an “Improvement Proposal Sheet”. It is very important to collect and gather ideas from workers, because they know well what is necessary to do. An application of such ideas can improve profits. It is also necessary to support workers who have good ideas, but are not good at writing reports.

Cleaner Production Activity

Purpose:
The purpose of the activity is to increase work performance and to make a better company by utilizing employees ideas.

Method:
Submit an "Improvement Proposal Sheet." There is no limitation on the numbers of sheets that can be submitted per person.

Contents:
Improvement items can be concerned with the following:
1. Energy saving : reduce utilities(electricity, fuel, water etc.)
2. Material saving : reduce raw materials(agent, consumers etc.)
3. Quality : reduction in specification rates
4. Productivity : increase production
5. Working Environment : make a safer and more organized factory

Bonus
A bonus will be given to employees who submitted proposals as follows:
1.For every submitter. : ??? VND/sheet
2.For an idea that was actually applied. : ??? VND/idea
3.For an idea which has a big effect. : ??? VND/idea

Figure 11.12 Example of an Improvement Activity Proposal

Improvement Proposal Sheet	
Name	
Date	
Title	
Before Improvement	
After Improvement	
Effect	

Figure 11.13 Example of an "Improvement Proposal Sheet"

11.3.3 Improvement Items that use End of Pipe Technology in the Metal Works Sub-sector

a. Improvement Plan for Installing Water Treatment Units in All Companies

It is important for management to have a philosophy that water treatment units are indispensable for plating shops. For this purpose, countermeasures to be carried out in the mid and long term are as follows:

1. Companies which have no available space for water treatment units, or are located in the center of cities, should consider relocating to an industrial zone and using a cooperative water treatment unit.
2. Plating shops with mechanical processes which have water treatment units should be independent from other processes and should handle other companies' plating works as well. This means that plating shops without water treatment units should stop their plating works, and request outside plating shops, which have water treatment units, to do their plating work.
3. The government and local government should put effort into instruction. This means that plating companies without water treatment units should be regulated and water treatment costs should be recognized as plating costs.

b. Concrete Example of a Water Treatment Unit

In the plating process, the treatment of toxic material like CN and Cr^{6+} is required. A wastewater treatment process which includes cyanide is shown in Figure 11.14. In alkali liquid, cyanide is oxidized by hypochlorous acid. The oxidation of cyanide requires a first and a second reaction. In the first reaction, cyanide is decomposed into cyanic acid, and in the second reaction, cyanic acid is decomposed into nitrogen and carbon dioxide. Lean Cr^{6+} ion can be eliminated by an ion exchange resin, but in the method usually used, Cr^{6+} in wastewater is deoxidized into Cr^{3+} by means of sodium bisulfite and then chromium hydroxide is settled by adding alkali. (Figure 11.15)

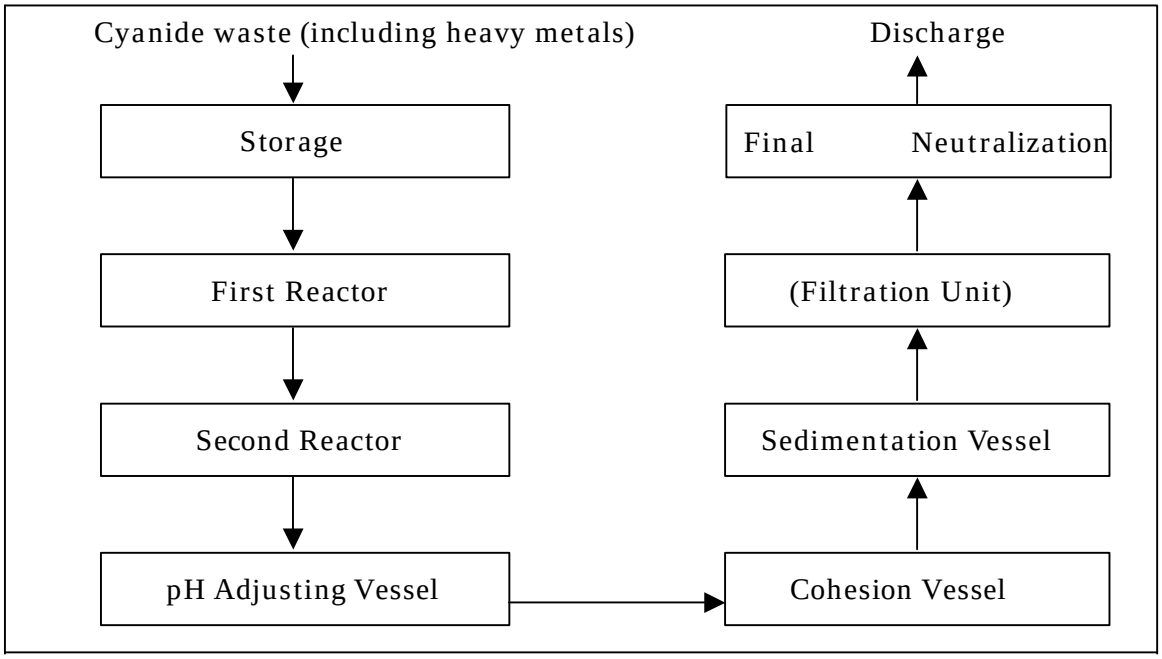

Figure 11.14 Cyanide Wastewater Treatment through the Alkali Chloride Method

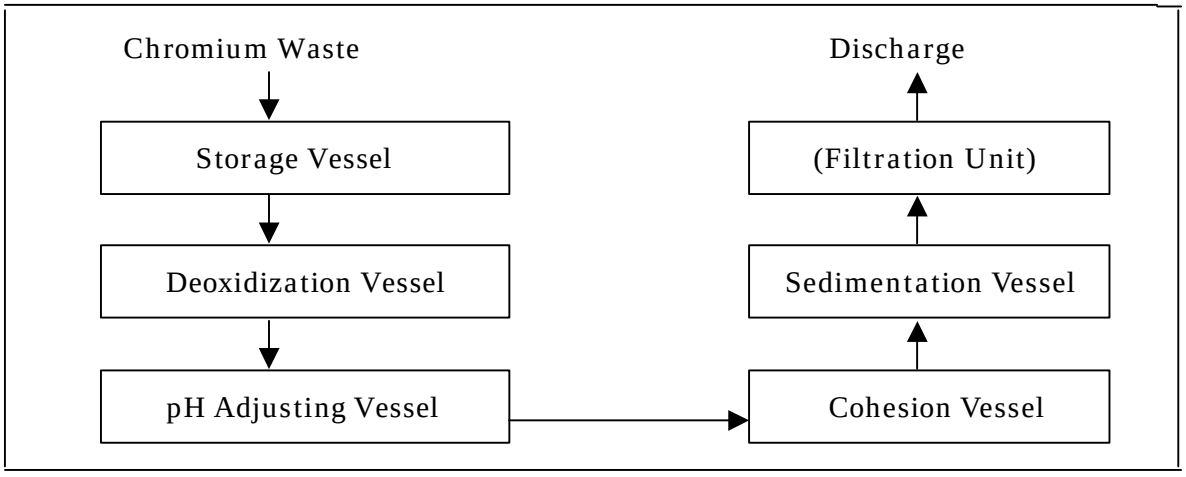

Figure 11.15 Chromium Wastewater Treatment through the Deoxidization Method

The standard plating wastewater treatment process is shown in a simplified block flow diagram (Figure 11.16). This is the most popular treatment method for cyanide contained wastewater, chromium contained wastewater and acid & alkali contained wastewater. They are all treated separately and then finally discharged after readjustment of pH. In the actual plant, further separate treatment for high condensed water and low condensed water in each system is effective.

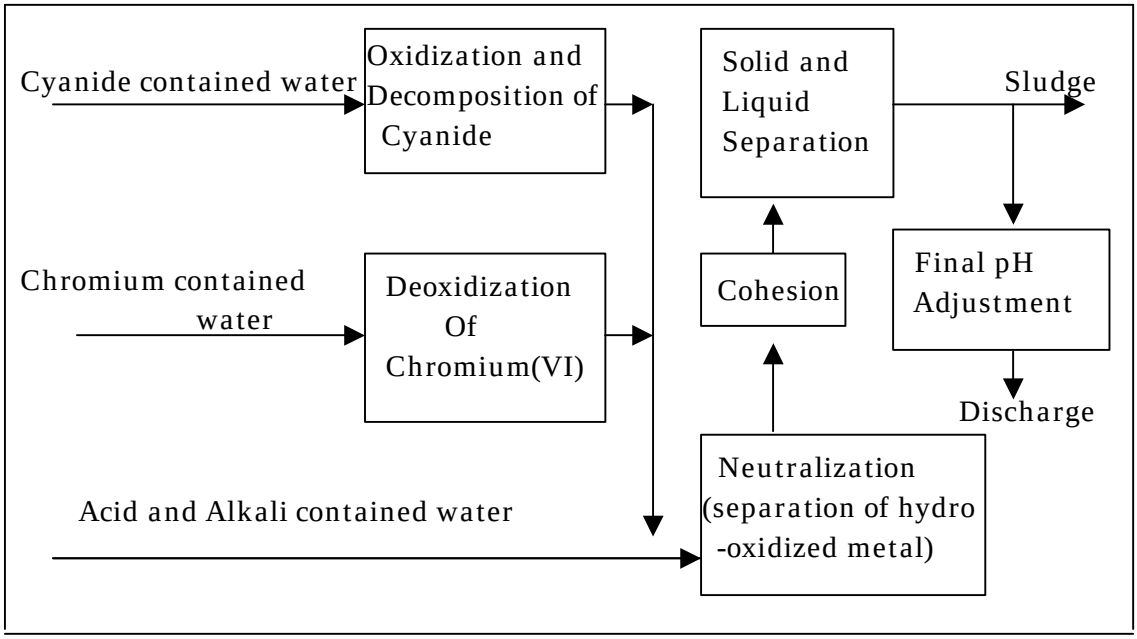

Figure 11.16 Standard Plating Wastewater Treatment Process

In the case where a continuous treatment process is applied, as shown in Figure 11.16, actual plant costs become very high because it requires many vessels (30~50 vessels) for chemicals such as acids, alkali, cohesive agents etc. Therefore, it is difficult to apply a continuous process in the plating industry because the industry consists of many small companies. For small plating companies whose wastewater amount is less than $5m^3$/day, the application of a batch wise treatment system, shown in Figure 11.17, is suitable because of the small scale of the unit. However, in this batch wise process, a storage vessel and a sludge treatment unit are also required.

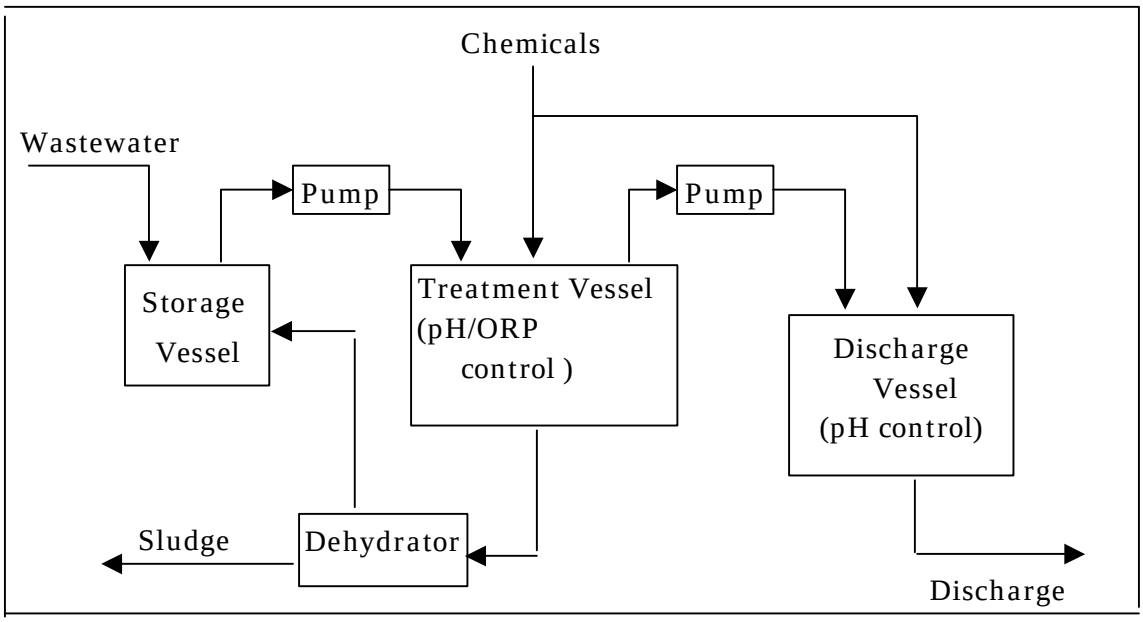

Figure 11.17 Example of a Batch Wise Plating Wastewater Treatment System

11.3.4 Evaluation of Technology Improvement Plans

The evaluation of technology improvement plans are as follows:

1. Process improvement and improvement activities do not required a large amount of money, but can reduce pollution in the plating industry and increase company profits. Even though these methods can't reduce the pollution level up to the regulation, it should be implemented urgently at the intermediate stage.
2. Implementation of a water treatment unit requires a large investment cost. However, it is indispensable to implement a water treatment unit as a final stage.

11.4 Conclusion and Recommendations for Industrial Wastewater Pollution Prevention in the Metal Works Sub-sector

11.4.1 Recommendations for Industrial Wastewater Pollution Prevention in the Metal Works Sub-sector

a. Proposals for SOEs with Plating Shops

The items proposed to be carried out by SOEs are summarized in Figure 11.18.

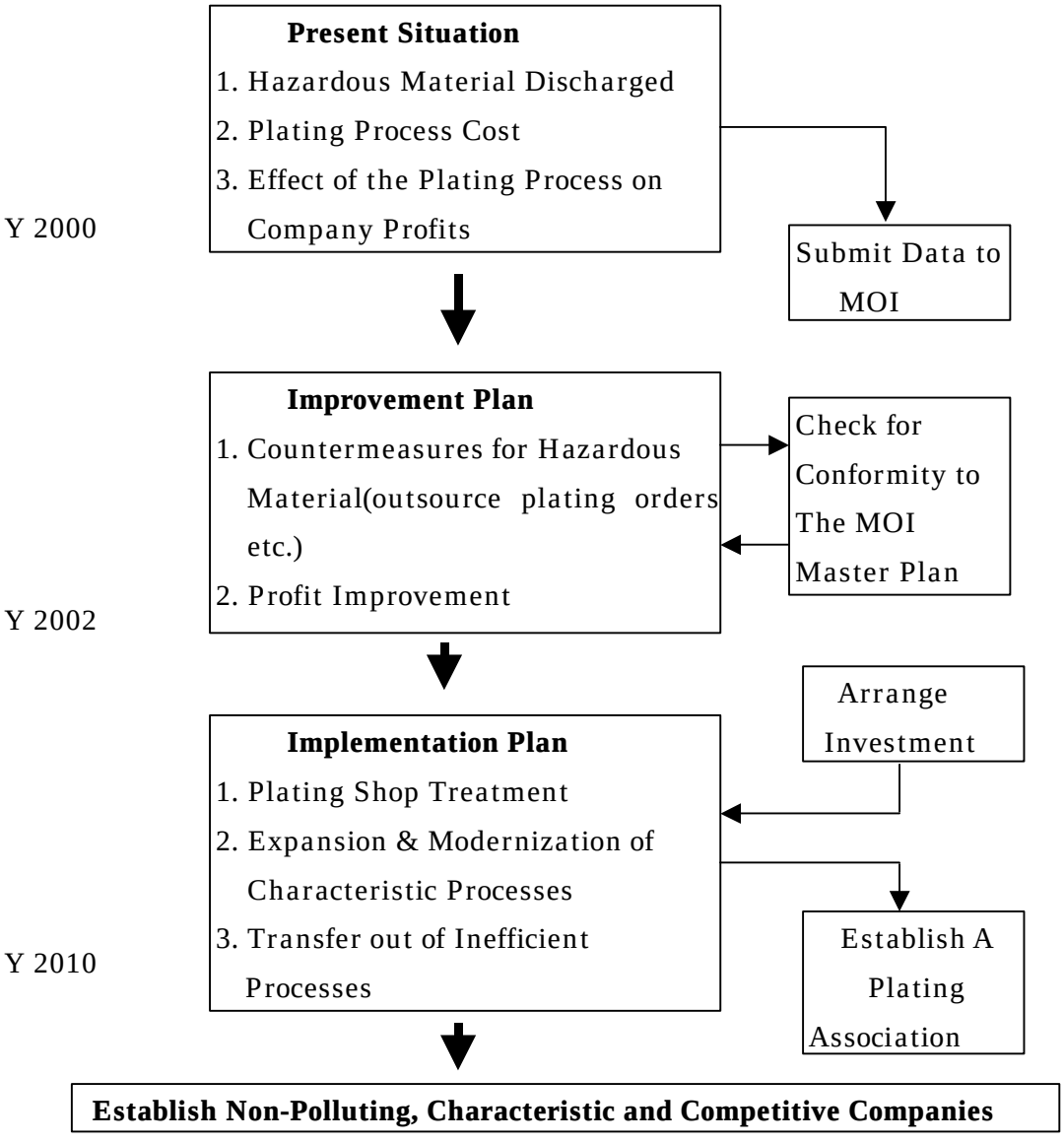

Figure 11.18 Proposed Items to be carried out by SOEs

b. Proposals for Private Plating Companies

The proposed items to be carried out by private plating companies are summarized in Figure 11.19.

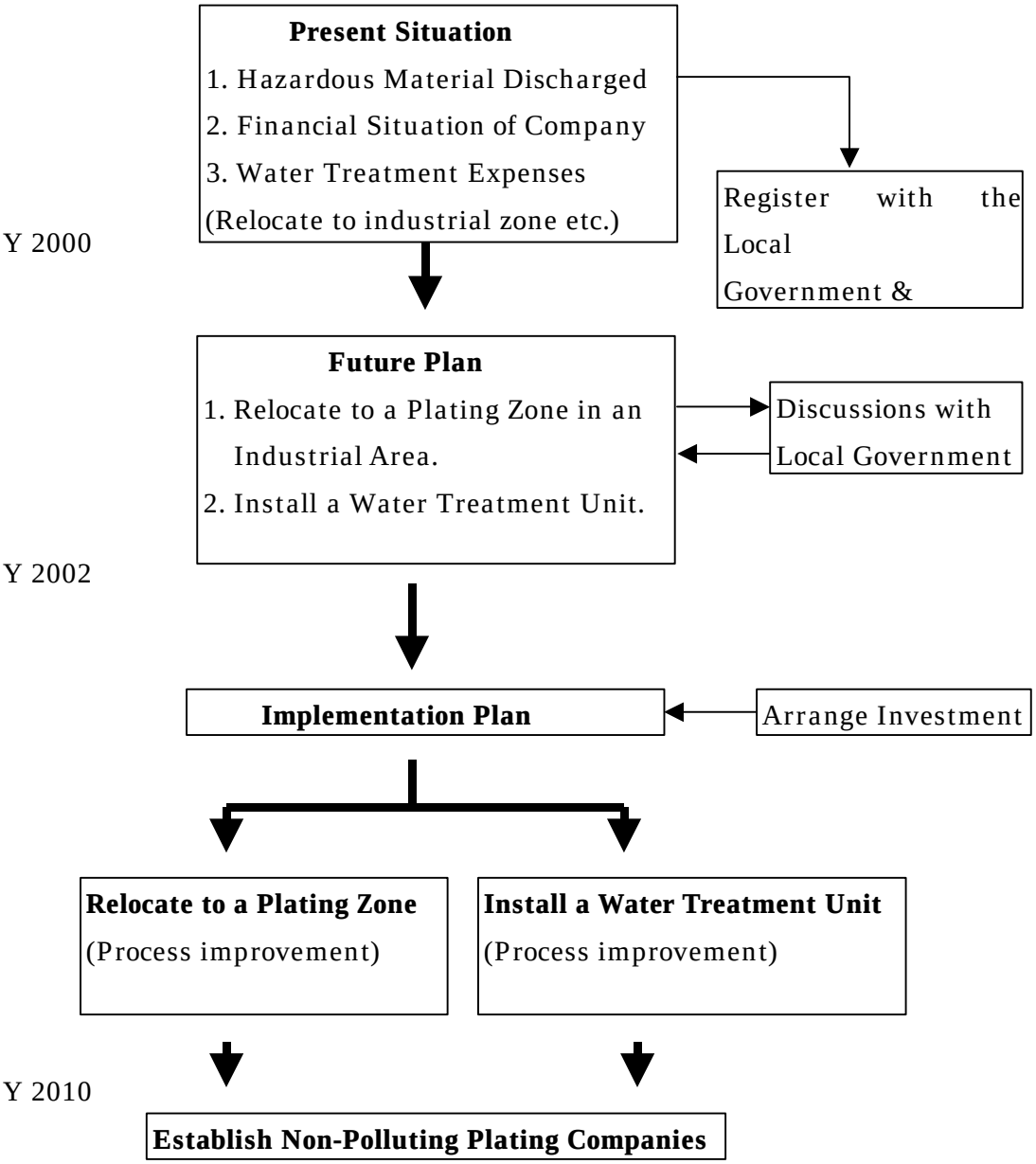

Figure 11.19 Proposed Items to be carried out by Private Plating Companies

11.4.2 Proposed Countermeasures for the Government to Carry Out

Our proposals to MOI (Proposal for the Master Plan) are summarized in Figure 11.20.

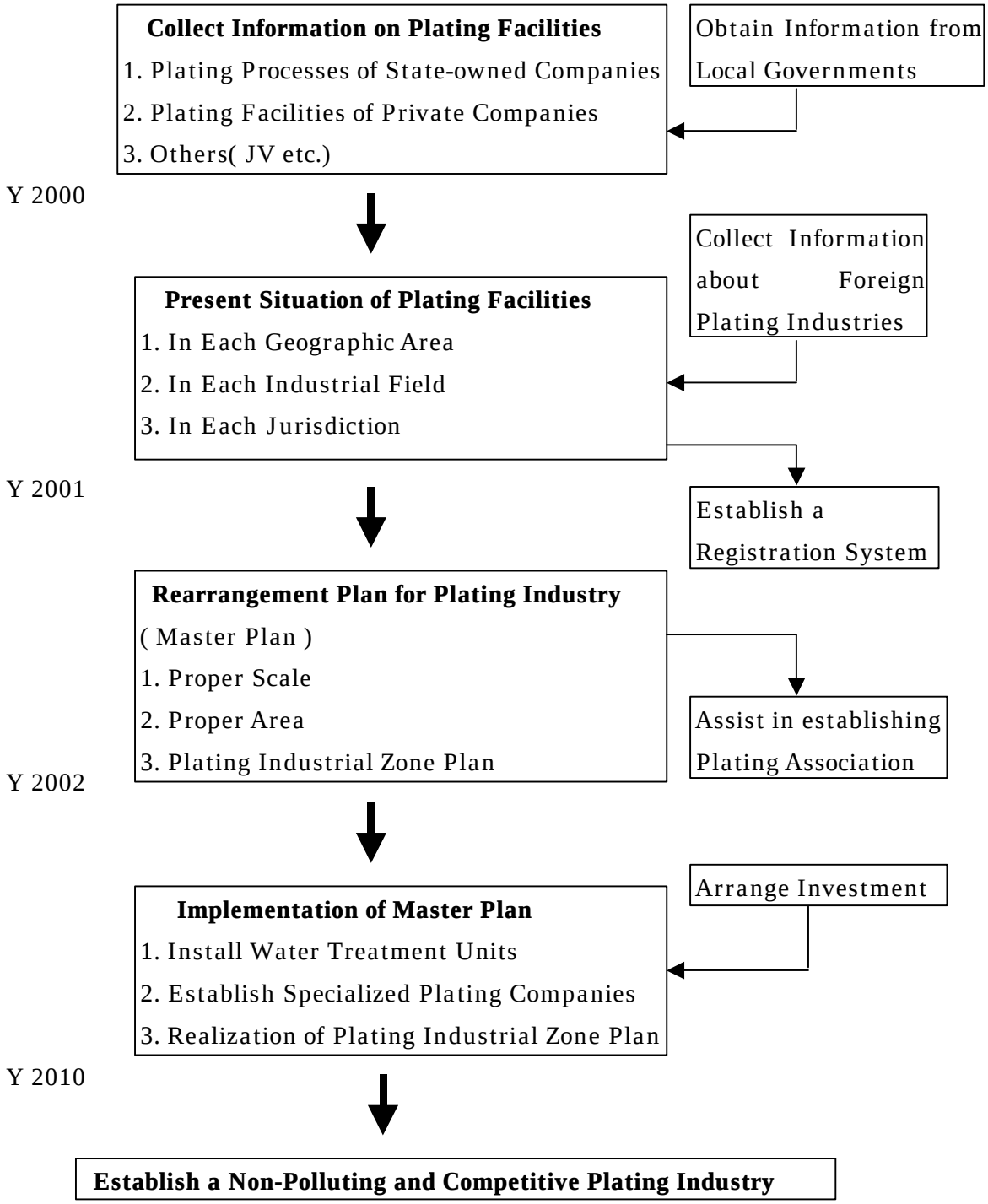

Figure 11.20 Proposal to MOI (Proposal for Master Plan)

11.4.3 Investment Demand for Industrial Wastewater Pollution Prevention in the Metal Works Sub-sector

Table 11.7 shows the calculation results of investment demand for industrial wastewater pollution prevention in the 22 companies studied. Total investment demand for the 22 companies is about 9.2 billion VND (77 million Japanese Yen).

Table 11.7 Estimated Investment Demand for Pollution Prevention Facilities

Unit: million VND

Ownership	Area	Company No.	Name of Equipment	No. Req'd	Investment Demand
SOE	HCMC	M-01	Water treatment unit	1 set	700
Private	HCMC	M-02	Water treatment unit	1 set	500
SOE	Hanoi	M-03	Water treatment unit	1 set	370
SOE	Hanoi	M-04	Water treatment unit	1 set	550
SOE	Hanoi	M-05	Not required		
SOE	Hanoi	M-06	Not required		
SOE	Hanoi	M-07	Not required		
SOE	Hanoi	M-08	Not required		
SOE	Hanoi	M-09	Water treatment unit	1 set	410
JV	Hanoi	M-10	Not required		
SOE	Hanoi	M-11	Water treatment unit	1 set	2,900
SOE	Hanoi	M-12	Water treatment unit	1 set	2,000
SOE	Hanoi	M-13	Water treatment unit	1 set	160
SOE	Hanoi	M-14	Not required		
SOE	Hanoi	M-15	Water treatment unit	1 set	400
SOE	HCMC	M-16	Not required		
SOE	HCMC	M-17	Water treatment unit	1 set	400
JV	HCMC	M-18	Not required		
SOE	HCMC	M-19	Not required		
JV	HCMC	M-20	Not required		
SOE	Hanoi	M-21	Water treatment unit	1 set	400
Private	Hanoi	M-22	Water treatment unit	1 set	460
Total					9,250

* HCMC: Ho Chi Minh City

This calculation assumes that there are 1,426 metal works companies in Viet Nam, the same as is shown in Table 11.5. The total investment demand in Viet Nam in the Metal Works Sub-sector will be 600 billion VND (5 billion Japanese Yen). However, actually, because water treatment units will be consolidated and the situation of private plating companies is not known, this total investment demand figure should only be used for reference.

Reference Materials

1. Report on survey, evaluation of the existing environment pollution caused by Mechanical Engineering of Viet Nam. (MOI 1997)
2. Report on environmental real state. (MOI 1999)
3. Study on electroplating market in Hanoi & surrounding. (MOI 1998)
4. Practical Plating (III) (Japan Plating Association)
5. Guide for Electroplating (Union of Japan Plating Industry)
6. History of Plating Union (Union of Japan Plating Industry)

Appendix 11

Metal Works Sub-sector

1. An Overview of the Metal Works Sub-sector

(1) Enterprises Categorized in the Metal Works Sub-sector

The metal works sub-sector is wide in scope and includes many different kinds of companies. In this sub-sector, plating work has the most influence on industrial wastewater pollution. According to the grouping of the Ministry of Industry of Viet Nam, plating work is classified as work performed by mechanical manufacturing companies. For this reason, our Study necessarily has to follow this classification.

Table 11.A.1 shows the numbers and distribution of mechanical manufacturing companies in Viet Nam in 1996.

Table 11.A.1 Number of Mechanical Manufacturing Companies in Viet Nam

Ministry	Number of Companies						
	Total	Ha Noi	HoChi Minh	Hai Phong	Bac Thai	Hai Hung	Others
Industry (MOI)	56	19	14	1	5	3	14
Transport	46	16	7	8			15
Agriculture	29	9	6			1	13
Construction	12	8	1	1			2
Sea production	4		1	2			1
Commerce	3	2	1				
Culture	2	2					
Invalid	1						1
Education	1		1				
Medicine	2	1			1		
Port	2	2					
Bank	2	1	1				
Defense	41	8	7	1	6		19
Internal affairs	2	1	1				
Sub-Total	203	69	40	13	12	4	65
Provincial	254	34	35	24	2	7	152
Total	457	103	75	37	14	11	217

The 457 companies shown in Table 11.A.1 are all SOEs. On the other hand, there are 929 joint venture companies and 40 private companies. Moreover, there are nearly 30,000 personal-private workshops in this field.

According to Table 11.A.1, there are many mechanical manufacturing companies around Ha Noi and Ho Chi Minh City, so it was decided that the second field survey would be performed in the areas around Ha Noi and Ho Chi Minh City. Among these companies, our main issue of concern was to determine how many companies have plating shops which affect industrial wastewater pollution in the metal works sub-sector. However, because there is no accurate data concerning this issue, through our survey findings we estimated that between 5 to 10% of them may have plating shops. In addition, some of the companies that have plating shops have stopped plating works, and for this study we are required to survey the actual plating conditions. Moreover, no data exists on the actual condition of plating in private companies. In the case of plating, there are a great number of small companies which are required to have appropriate countermeasures in place.

Table 11.A.2 shows the water usage break-down of one machine manufacturer in Thuong Dinh, one of the industrial zones around Ha Noi. This factory is using water at the rate of 120~160 m^3/day.

Table 11.A.2 Water Use Distribution

Name of the Shop	Amount of Water Usage
Plating	70-100 m^3/day
Air Compressor	10 m^3/day
Machining	10-15 m^3/day
Living	10-20 m^3/day
Others	10-15 m^3/day

For machine manufacturers, according to Table 11.A.2, water usage in plating shops accounts for 60~70% of total water usage.

So, to proceed with the investigation of industrial pollution (wastewater), it was decided that plating shops should be the focus of our Study.

(2) Past Transition and Future Forecast

The mechanical manufacturing industry in Viet Nam was established more than 40 years ago and has been developing since then. A wide range of products such as mechanical tools, ships, traffic vehicles, small tractors, process equipment, pumps, engines, small machine tools etc are manufactured in the mechanical manufacturing industry. This industry has been characterized by

"self-completion" from it's beginning. "Self-completion" means that a company manufactures everything from billets to final products. Because of this characteristic, this industry is distributed throughout almost all provinces in Viet Nam. According to statistical data in 1996, there were 50,000 machine tools in Viet Nam, of these which 10,000 machine tools were out of order and 7,000 machine tools were either medium or large size machine tools. Most of these machine tools were manufactured between the end of the 19th century and the beginning of the 20th century. Some of them are multi function types manufactured in the 1940s and 1950s. The operation ratio of small machine tools is about 40% and there are a few forging machines which have a high accuracy. According to the data, the total number of employees in the mechanical manufacturing industry is about 200,000, of which 104,000 are in state-owned companies and 93,000 are employed in private companies. Around 1990, foreign enterprises started investing in Viet Nam and by 1994, a total of 54 foreign enterprises had invested in Viet Nam. Most of these enterprises invested in the automobile, motor-bike and home electronic field. Only a few of them invested in the mechanical manufacturing industry because of low profits and a long investment recovery period.

From now on, it is forecasted that the demand for plating parts in the automobile, motor-bike and home electronics fields will increase more and more.

According to our field survey of the mechanical manufacturing industry, it became very clear that plating works should be the focus for studying countermeasures for industrial wastewater pollution in the Metal Works Sub-sector. Therefore, we decided to concentrate our Study mainly on plating works.

2. Technology Trends in Japan and Other Countries

Plating technology is advancing, along with the development of the industry. One advance in the field is the expansion of applications, and another is the expansion of plating base material. From the view point of these two types of expansion, the applications and plating base material, examples of plating technologically in advanced countries are described as follows:

(1) Application for Electronics

As typical examples, Cu plating, Au plating and Ag plating are outlined. Also, other metal plating like Rh, Pt, Pd etc. is applied for electronics.

1) Cu Plating

For industrial use, Cu plating that is aimed at a high performance level is playing a very important part in this industrial field. The typical example is "Through Hole" plating which is indispensable technology for multi-layer printed circuit boards. Without Cu "Through Hole" plating, the development of microelectronics up to this point would have been very difficult.

Industrial Cu plating is classified by the kinds of plating baths shown in Table 11.A.3. Properties of deposited plating film are different for each plating bath. So, it is very important to select an appropriate plating bath which fits the required properties of use.

Table 11.A.3 Types of Cu Plating Baths vs. Properties of Film and Users

Type of Plating Bath		Properties of Deposited Film	Main Users
Acid Bath	Copper Sulfate Bath	Good in gloss & smoothness. Soft film & improved additives makes good quality.	Thru-hole plating, Electroforming, Printing roll, etc.
	Copper Boro-fluoride Bath	High speed plating and a Min. film elongation rate.	Electroforming, Printing roll
Alkali Bath	Copper Cyanide Bath	Direct plating on Fe, Zn and die casting. Good appearance and smoothness.	Strike plating, Under plating, Non-blazed plating.
	Copper Pyrophosphate Bath	Uniform adhesion and low electric transmission loss.	Thru-hole plating, Wave transfer tubes
	Copper Electrolysis	Plating on non-conductor and uniform thickness	Thru-hole plating, Under plating for plastics.

Requirements for Cu plating in "through-hole" plating are as follows:

1. Good uniform adhesion.
2. High elongation rate and tensile strength.
3. Long shelf life.
4. Good soldering performance.
5. Good anti-scratching performance.

Regarding electric conductivity, the most important point is to have a small contact resistance. Cu plating film has the characteristic of a good heat transfer coefficient (94% of silver). Utilizing this characteristic, bottom parts of stainless cooking pans are sometimes plated with thick copper to improve the heat transfer coefficient .

2) Au Plating

Industrial Au plating plays a very important role for electric semiconductor parts. Table 11.A.4 shows industrial users and purposes of Au plating.

Table 11.A.4 Industrial Users and Purposes of Au Plating

Users	Application Parts	Purposes of Use
Electronics, Semiconductor	Contacts, Terminals, Connectors, Pins, Rotary switches, Lead flames, IC headers, Transistor systems etc.	Conductivity, Low contact resistance, Anti-corrosion, Anti-friction
Micro-wave circuit	Wave transfer tubes	Smoothness
Photocopier	Reflecting mirror	Reflection rate of light

Generally, Au plating is used as alloy metal plating which consists of a small amount of other metals. Some times pure gold (more than 99.7%) is used for IC header, stem, lead flame etc., but usually hardness and abrasion resistance are required, so hard gold which consists of 0.1~8% of Ni and/or Ag and/or In and/or Co, is used for plating. Compared to pure gold plating, it is said that hard gold plating has two times the hardness and three times the abrasion resistance. For contacts, terminals etc. for electronics parts, plating film thickness is less than 2μm. Nowadays thin film specifications like 1μm and 0.5μm are increasing.

3) Ag Plating

Like Au plating, Ag plating plays a very important technological role in the electronics industry. Ag is cheaper than Au and has the highest electric conductivity, so Ag plating is used in very wide applications. Table 11.A.5 shows industrial users and the purposes of Ag plating.

Ag plating is used in the following two ways.

1. As glazed plating for connectors, terminals, switches etc. (HV100~150 hard silver).
2. As high purity, non-glazed (half glazed) plating for transistors and IC lead flame (soft silver).

The latter one is a substitution for Au plating, so severe performance is required.

Sulfate discoloration occurs easily in Ag plating, so after plating, anti-discoloration treatment is applied. In the case of electric contacts, some times it is better to apply an oil-coating treatment rather than to apply chromate treatment for anti-coloration.

Table 11.A.5 Industrial Users and Purposes of Ag Plating

Users	Application Parts	Purposes of Use
Heavy electric	Disconnect switch(40~80μm), Movable switch parts(15~25μm), Terminals, Bus bars, Contact parts of switches (1~10μm) etc.	Electric conductivity, low contact resistance, soldering performance
Light electric	Switches, Contacts, Terminals, Connectors (5~10μm), Lead flame and Stem	Same as above
Air Plane	Bearings, Engagement parts, High temperature use bolts & nuts	Anti-friction and Anti-seizure
Micro-wave Circuits	Wave transfer tube (millimeter wave)	Smoothness

(2) Expansion of Plating Base Material

1) Plating on Plastic Surfaces

Technology for plating on plastic surfaces has progressed along with other plating technology. Especially, the appearance of ABS resin and the establishment of etching technology makes it perfect for industrialization. One merit of electro-plating on plastics is that it improves performance of plastics. However, the main reason it is widely used is because it adds value to the metallic appearance and it economical. Recently, industrial research has progressed and now it is has become possible to plate on high performance engineering plastics like polycarbonate, polyacetal, polyamide etc.

2) Plating on High Performance Glass

Because it doesn't damage the high performance of quartz glass, borosilicate glass, or soda lime glass, direct non-electrolysis Ni plating technology makes it possible to joint with other metals and/or ceramics and make circuits or electrodes on glass surfaces. In the past, dry plating like vacuum evaporation was the plating method used on glass surfaces. Spattering was applied, but there were many weak points in the method like lack of adhesion, high cost etc. Also, this method could not be applied on three dimensional surfaces like "through-hole", pipe interiors etc. This new technology employs chemical joint technology to get uniform adhesion between glass and plating film without causing surface roughing like mechanical joint technology does. This technology is applied to Ni-Au plating on the outside and inside of borosilicate glass tubes and non-electrolysis Ni plating is applied on the outer surface of quartz optical fibers.

3) Plating on Textiles

Development of the plating process for special materials is actively carried out by enterprises and public research institutes for advanced technologies, and because of this, plating on textiles such as polyester fibers, acrylic fibers, carbon fibers, and cotton was made possible. Ni plated textiles can be energized and heated with a low voltage battery and are applied for medical use, electric carpets, winter clothes etc. For special use development, there is an anti- electromagnetic wave apron, which can protect OA machine operators from electromagnetic waves and it is said that they can be reduced to between one thousandth and one ten thousandth.

4) Plating on Fine Powder

This kind of plating is direct wet plating on fine powder like alumina-ceramic, tungsten, carbon etc. and is applied to metallic powder for screen printing, sintering metal, IC packages etc. Ag, Cu and Ni plating are also possible.

5) Ceramic Plating

Technologies exist for forming in ceramic film on metal surfaces, such as plasma melt injection, PVD etc., but this kind of ceramic plating forms ceramic film through electro-crystallization and is sintered under wet conditions. The principle of this technology, forming ceramic film on metal, like anodes in an electrified solvent, is like that of electro-plating. Therefore, it is called ceramic plating. The main points of this technology are the use of metals, like aluminum, which form a passive film under electrification, as an anode and silicate as a solvent. Through electrolysis, anode surfaces become passive states and electric and plasma discharges occur. During these operations, silicate is drawn to the anode and it changes to ceramic through sintering. The adhesion of crystallized film is very good and coloring is also possible. It also has good processability, so it can be applied for decorative uses like high grade wall materials, kitchen goods etc. Possible film thickness is said to be up to 50μm.

Reference Materials

1. Report on the Survey, and Evaluation of Existing Environment Pollution

Caused by Mechanical Engineering in Viet Nam (MOI 1997)
2. Report on the Real State of the Environmental (MOI 1999)
3. Study on Electroplating Market in Hanoi & Surrounding Areas (MOI 1998)
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5. Guide for Electroplating (Union of Japan Plating Industry)
6. History of the Plating Union (Union of Japan Plating Industry)

References

Chapter 12

Current Industrial Policies

Chapter 12 Current Industrial Policies

12.1 Industrial Growth by Enterprise Ownership

Industrial growth of each sector of enterprise ownership is shown in Figure 12.1. Gross output of industry by the foreign invested sector is enlarging more rapidly than other sectors. From 1995 till 1998, the foreign invested sector showed a 22.73% growth rate per year, and the portion of this sector in total industrial output enlarged from 25.09% in 1995 to 31.82% in 1998. The portion of the foreign invested sector surpassed that of the central state owned sector in 1998. In opposition to this tendency, the portion of total industrial output of the state owned sector, collective owned sector and households sector has been continuously decreasing. The share of the households sector decreased from 17.6% in 1995 to 13.56% in 1998. The growth rate per year in the households sector was 3.94%, and was the lowest among all sectors. Private owned enterprises showed a rather fair growth rate of 15.71%. However the portion of private owned enterprises enlarged little, from 2.20% in 1995 to 2.33% in 1998, and remains a very small sector.

Table 12.1 Growth Rate by Ownership

sector	growth ratio
Central State owned	0.1039
Local State owned	0.0992
Collective owned	0.0839
Private owned	0.1571
Households	0.0394
Mixed	0.2489
foreign invested	0.2273

Source: Socio-Economic Statistical Data of 61 Provinces and cities 76 P

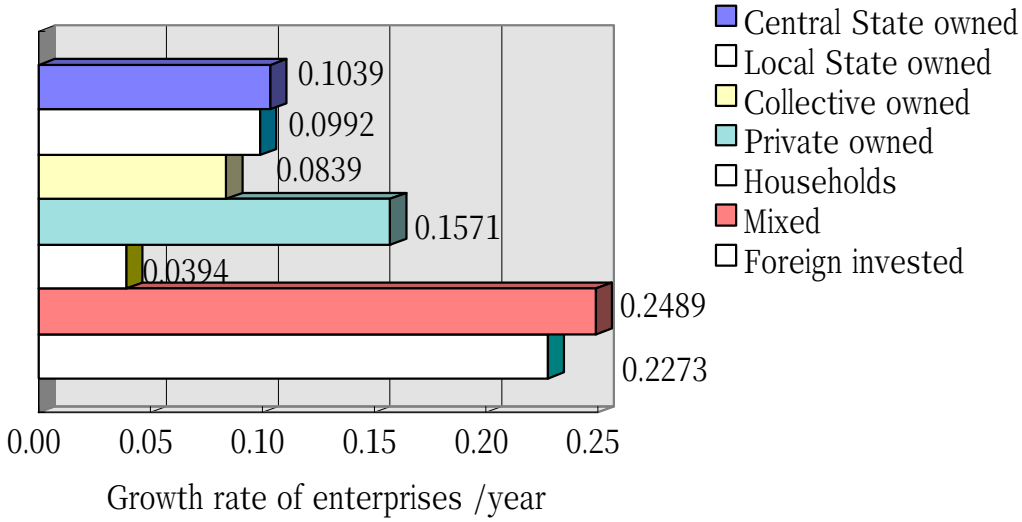
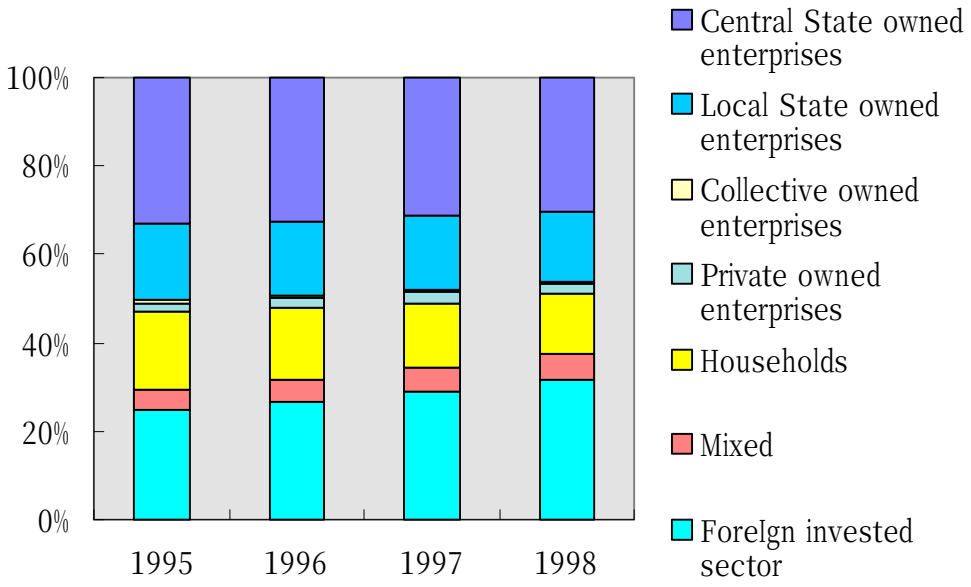


Figure 12.1 Growth Rate by Enterprise Ownership

Table 12.2 Gross Output of Industry by Enterprise Ownership

	1995	1996	1997	1998
Central State owned enterprises	32.81	32.52	31.41	30.26
Local State owned enterprises	17.48	16.73	16.56	15.92
Collective owned enterprises	0.63	0.58	0.56	0.55
Private owned enterprises	2.20	2.36	2.40	2.33
Households	17.60	16.07	14.66	13.56
Mixed	4.19	5.01	5.50	5.55
Foreign invested sector	25.09	26.73	28.92	31.82
	100.00	100.00	100.00	100.00

Source: Socio-Economic Statistical Data of 61 Provinces and cities 76P



Source: Socio-Economic Statistical Data of 61 Provinces and cities

Figure 12.2 Gross Output of Industry by Enterprise Ownership

12.2 Growth of GDP in Viet Nam

While other ASEAN countries suffered because of the recent economical crisis and there GDP growth rate decreased, even to a minus growth rate in some countries, the GDP growth rate in Viet Nam remained higher than that of other ASEAN countries during the period of the economical crisis.

Table 12.3 GDP Growth Rate

year	Viet Nam	ASEAN4 and South Korea	Japan
1991-97	8.36	7.0	1.6
1997	8.15	4.5	0.8
1998	5.80	-8.0	-2.5
1999	4.75	0.1	-0.2
2000	4.75	3.2	1.4

Source: Japan's GDP figures are from IMF, World Economic Outlook.
ASEAN figures are from WB,1998,Global Economic Prospects.
Viet Nam figures are from Socio Economic Statistical Data 22P
Figures after 1999 are from Viet Nam Socio-Economy The Period 1996-1998 50P

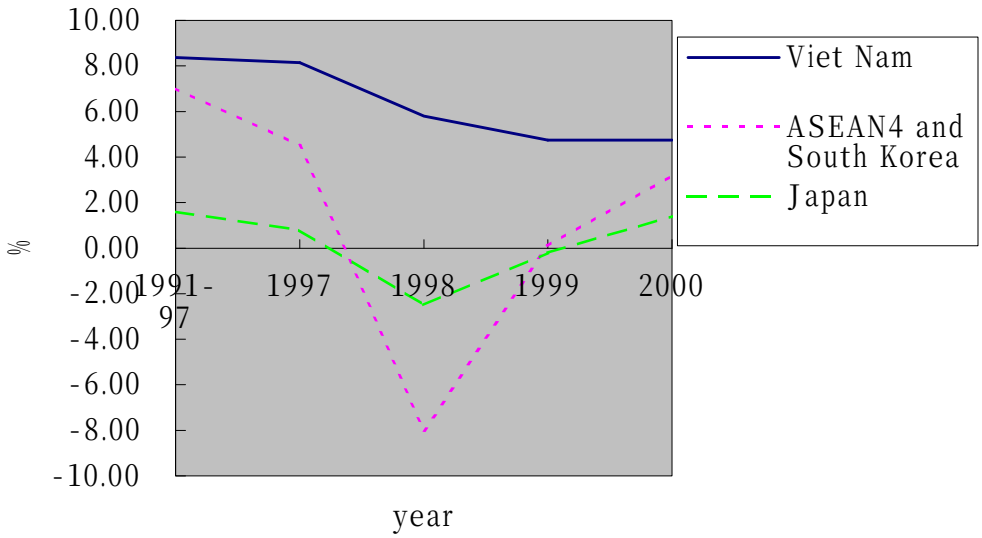


Figure 12.3 GDP Growth Rate

12.3 GDP Growth by Enterprise Ownership

From the view point of GDP, similar changes were seen. The foreign invested sector maintained a high growth rate 18.33% from 1995—1998 and the portion of GDP of this sector expanded. However, for the GDP base, the foreign invested sector still has only at 9.82% share of total GDP base. The state sector (40.17%) and the household sector (34.00%) hold a large portion of total GDP base. So, especially in the industrial field, it is estimated that investment from abroad is changing the structure of this sector dramatically.

Table 12.4 Structure of GDP by Enterprise Ownership

Year	1995	1996	1997	1998
State	40.18	39.93	40.47	40.17
Collective	10.06	10.02	8.92	8.95
Private	3.12	3.35	3.38	3.38
Household	36.02	35.25	34.33	34.00
Mixed	4.32	4.05	3.84	3.68
Foreign invested sector	6.30	7.40	9.06	9.82
Total	100.00	100.00	100.00	100.00

Source: Viet Nam Socio Economy The Period 1996-1998 218P

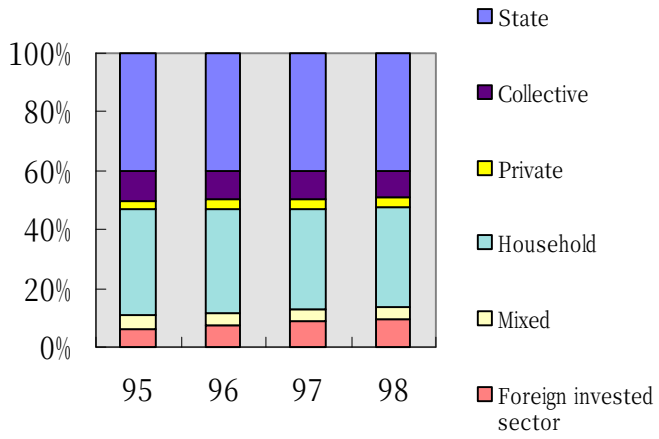


Figure12.4 Structure of GDP by Ownership

12.4 Outline of Industries Related to the Survey

The structures of individual industries which are related to this survey are shown in Tables 12.5 to 12.9. In all industries, state sectors are the main ones and occupy a big portion, in the highest case 68.4% (chemicals), in the lowest case 47.6% (food and beverage), of total gross output. The foreign invested sector has shown a tendency to increase its share and occupies, in the highest case 30.1% (metal works) and in the lowest case 14.9% (paper and paper products) of total gross output. The share of the households sector has shown a tendency to decrease and occupies, in the highest case 20.9% (textile products and garments), and in the lowest case 3.4% (chemicals) of total gross output.

The private owned enterprise sector is now expanding rapidly and has a high growth rate of around 96.4%per year (paper and paper products), 41.6%

（chemicals), 31.7%(textile products and garments), but still holds a small portion of gross output. In the highest case it has only a 5.1% share（food and beverage）, and in the lowest case a negligible 0.4%,（metal works）share of gross output.

Table 12.5 Industrial Production Amount(in 1994 Bill.dong)

Textile • Garment	Industrial Production Amount					Component ratio (%)			
	1995	1996	1997	1998	growth ratio %	1995	1996	1997	1998
central state industry	3082.4	3453.1	3779.8	4170.6	10.6	33.8	35.3	32.6	34.0
local state industry	1451.8	1455.2	1732.8	1829.3	8.3	15.9	14.9	15.0	14.9
collective owned enterprises	120.2	114.0	115.4	-	-2.0	1.3	1.2	1.0	-
private owned enterprises	141.5	206.4	242.4	-	31.7	1.6	2.1	2.1	-
mixed ownership	339.8	652.0	954.7	-	69.2	3.7	6.7	8.2	-
households	2384.1	2350.5	2418.9	-	0.8	26.1	24.0	20.9	-
foreign invested sector	1606.2	1542.7	2342.6	2535.7	18.7	17.6	15.8	20.2	20.6
total	9126.0	9773.9	11586.6	12281.9	10.5	100.0	100.0	100.0	100.0
(state sectors)	4534.2	4908.3	5512.6	5999.9	9.8	49.7	50.2	47.6	48.9
(private sectors except foreign)	2985.6	3322.9	3731.4	3746.3	8.0	32.7	34.0	32.2	30.5

Source: STATISTICAL YEARBOOK170-206P

Table 12.6 Industrial Production Amount(In1994 Bill.dong)

Chemical	Industrial Production Amount					Component Ratio (%)			
	1995	1996	1997	1998	growth ratio %	1995	1996	1997	1998
central state industry	2271.7	2537.3	3145.1	3433.1	14.9	44.7	40.4	43.5	44.0
local state industry	1586.0	1729.1	1888.4	1902.0	6.3	31.2	27.5	26.1	24.4
collective owned enterprises	8.0	12.8	11.3	-	24.1	0.2	0.2	0.2	-
private owned enterprises	31.8	47.5	63.6	-	41.6	0.6	0.8	0.9	-
mixed ownership	226.9	334.8	385.4	-	31.3	4.5	5.3	5.3	-
households	219.5	227.0	247.7	-	6.3	4.3	3.6	3.4	-
foreign invested sector	741.7	1394.6	1481.2	1678.5	35.9	14.6	22.2	20.5	21.5
total	5085.6	6283.1	7222.5	7799.5	15.5	100.0	100.0	100.0	100.0
(state sectors)	3857.7	4266.4	5033.5	5335.1	11.5	75.9	67.9	69.7	68.4
(private sectors except foreign)	486.2	622.1	707.8	785.9	17.6	9.6	9.9	9.8	10.1

Source: STATISTICAL YEARBOOK170-206P

Table 12.7 industrial Production Amount(In 1994 Bill.dong)

Paper •Pulp	Industrial Production Amount					Component Ratio (%)			
	1995	1996	1997	1998	growth ratio %	1995	1996	1997	1998
central state industry	775.1	909.8	1028.0	1161.8	14.5	39.8	39.7	38.9	39.2
local state industry	404.8	436.4	472.3	526.0	9.1	20.8	19.0	17.9	17.8
collective owned enterprises	67.3	73.5	92.9	-	17.8	3.5	3.2	3.5	-
private owned enterprises	19.6	41.2	75.2	-	96.4	1.0	1.8	2.8	-
mixed ownership	169.8	203.1	278.3	-	28.3	8.7	8.9	10.5	-
households	211.9	280.6	306.6	-	20.8	10.9	12.2	11.6	-
foreign invested sector	298.3	349.0	390.5	442.1	14.0	15.3	15.2	14.8	14.9
total	1946.8	2293.6	2643.8	2961.0	15.0	100.0	100.0	100.0	100.0
(state sectors)	1179.9	1346.2	1500.3	1687.8	12.7	60.6	58.7	56.7	57.0
(private sectors except foreign)	468.6	598.4	753.0	831.1	21.3	24.1	26.1	28.5	28.1

Source: STATISTICAL YEARBOOK170-206P

Table 12.8 Industrial Production Amount(in1994 Bill.dong)

Food Processing	Industrial Production Amount					Component Ratio (%)			
	1995	1996	1997	1998	growth ratio %	1995	1996	1997	1998
central state industry	5894.8	6592.4	7235.2	7875.6	10.1	21.8	21.3	21.3	21.3
local state industry	6982.4	7956.7	8925.8	9706.4	11.6	25.9	25.8	26.2	26.3
collective owned enterprises	21.7	41.9	43.3	-	48.2	0.1	0.1	0.1	-
private owned enterprises	1265.2	1528.1	1735.2	-	17.2	4.7	4.9	5.1	-
mixed ownership	1472.0	2097.0	2116.1	-	21.7	5.5	6.8	6.2	-
households	6214.2	6482.8	6826.6	-	4.8	23.0	21.0	20.1	-
foreign invested sector	5157.9	6187.8	7132.9	7902.9	15.3	19.1	20.0	21.0	21.4
total	27008.2	30886.7	34015.2	36932.4	11.0	100.0	100.0	100.0	100.0
(state sectors)	12877.2	14549.1	16161.0	17582.0	11.0	47.7	47.1	47.5	47.6
(private sectors except foreign)	8973.1	10149.8	10721.3	11447.5	8.5	33.2	32.9	31.5	31.0

Source: STATISTICAL YEARBOOK170-206P

Table 12.9 Industrial Production Amount(In 1994 Bill.dong)

Metal Works	Industrial Production Amount					Component Ratio (%)			
	1995	1996	1997	1998	growth ratio %	1995	1996	1997	1998
central state industry	1895.6	2311.1	2211.6	2465.2	9.7	55.3	56.6	55.3	58.1
local state industry	184.6	166.3	154.9	167.8	-2.8	5.4	4.1	3.9	4.0
collective owned enterprises	8.5	12.8	12.3	-	23.3	0.2	0.3	0.3	-
private owned enterprises	15.7	16.9	16.7	-	3.2	0.5	0.4	0.4	-
mixed ownership	91.0	41.7	55.9	-	-10.1	2.7	1.0	1.4	-
households	218.7	234.4	251.5	-	7.2	6.4	5.7	6.3	-
foreign invested sector	1013.9	1302.7	1296.8	1275.4	8.8	29.6	31.9	32.4	30.1
total	3428.0	4085.9	3999.8	4239.8	7.7	100.0	100.0	100.0	100.0
(state sectors)	2080.2	2477.4	2366.5	2633.0	8.6	60.7	60.6	59.2	62.1
(private sectors except foreign)	333.9	305.8	336.5	331.4	0.0	9.7	7.5	8.4	7.8

Source: STATISTICAL YEARBOOK170-206P

12.5 The Present State of Industrial Policy

Many policies can be created in order to help problematic industrial sturucture change into more desirable ones. For example:

① Make tax system adjustments, such as heavy duty or favorable taxation

② Financing (offer long term low interest rate loans)

③ Establish budgetary subsidies

④ Establish obstacles for importation

⑤ Modify conditions of economical competitiveness, such as the protection of a production cartel.

12.6 Tax System Now in Use

(1) Current tax system and tax rate

① Enterprise Income Tax

Table 12.10 Enterprises Income Tax

Tax Rate	Industries
32%	Domestic business enterprises, foreign organizations and individual that do business in Viet Nam that are not subject to the Law on Foreign Investment in Viet Nam (Production, construction, transportation are currently subject to profit tax of 25%)
57%	High profit enterprises which have objective superiority (Government indicates how to classify "high profits")
25% 20% 15%	Enterprises that have new investment projects in an industrial field or location that investment incentives are applied to.
	①20% after 10 years Enterprises that satisfy the following conditions: Export at least 50% of their products, employee at least 500 people, have agriculture related activities, use advance technology and invest in development research; use material available in Viet Nam
	② 15% after 12 years Enterprises that satisfy the following conditions: Export up to 80% of their products, invest in metal refinery, metal work, substantial chemicals, oil refinery, fertilizer, electronics, car and motorbike spare parts, invest in infrastructure, invest in poor areas, transfer businesses to the government after a certain period of time or meet two conditions in the 10% condition list
	③ 10% after 15 years Enterprises that satisfy the following conditions: Development of infrastructure in poor areas; invest in mountainous areas, island, remote areas, plant forests, or belong to other special incentive investment project lists
	④If it is Industrial Zone, Export Zone, or High tech Zone infrastructure development then the level of income tax will be 20%,15%, and 10% respectively, through the period the project is implemented.

Tax Rate	Industries
50%	Oil Development
32-50%	Other mineral exploration

Source: data Institute of Industrial Chemistry, MOI

② A Value Added Tax

The VAT rate is shown in Table 12.11. The tax rate shown in Table 12.12 will be used for some limited explanation.

The VAT rate could be considered as a method for emphasizing policies that encourage and reduce loads for ① agriculture and forestry products and their raw materials, and agriculture related materials such as fertilizer, pesticides, and insecticides② scientific technology and education.

On the other hand, it can also be used to plan for controlling the consumption of luxuries, such as jewels.

Table 12.11 VAT

Tax Rate	
0%	Products for exportation
5%	①tap water ② fertilizer and raw materials for fertilizer, insecticides, pesticides ③ medical tools and equipment, medicine④ educational tools ⑤ toys and books ⑥ agriculture products halfway processed fishery products, forestry products, cotton, animal food ⑦ science technology services
10%	① crude oil, coal, minerals ② electricity for commercial use③ electronic, electric, and machine products ④ chemical products⑤ textile products ⑥ paper and paper products ⑦ ceramics, porcelain, rubber, plastic, wood products and products for construction ⑧ construction and installation
20%	① noble metals and jewels ②hotel , travel, and restaurant services ③ lottery

Table 12.12 VAT (temporally)

Exemption	Airplanes, boat, crude oil developing equipment, printing and publishing newspaper and textbooks
5%	General agriculture products, insurance
3%	Special agriculture and forestry products, raw materials produced from wastes
4%	Products which burden the special tax rate
1/2 tax rate	① refined metal, basic chemical products, certain sized tires for automobile, machine parts, calculators ② coal ③ medicine ④ construction and installation⑤ hotel services, travel services, and restaurant services

Source: data Institute of Industrial Chemistry, MOI

③ Tariffs

The following cases receive favorable tariff treatment. However, there is no favorable treatment for importing equipment for pollution prevention.

- The importation of equipment, transportation equipment, and raw materials for licensed projects
- The importation of materials for use as equipment in enterprises which receive favorable tariff treatment.
- Tariffs paid for raw materials and parts for export products will be refunded at the ratio they were when the products were actually exported.

Table12.13 Tariff Rate for Main Products (%) Dec.11 1998 Source: THE TARIF AND LIST OF THE IMPORTS and EXPORTS

Tariff Rate	Textile・Garments	Chemicals	Paper・paper products	Food	Metal Works
0%	Sheep wool, cotton, nylon and polyester	Fertilizes Sulfur Iron Oxide・Sodium・Lead・ Aluminum Carbonate Ethylene Propylene Methanol Phenol Diethyl ether Aldehyde Ketone Carboxylic acid Vitamin・hormone Diazo compound、X-ray film Polyethylene Polypropylene Natural hide Glass for industrial machinery	Wood pulp Dictionaries Textbooks Newspapers Science and technology related magazines and journals Children's books	Animals , Greens Wheat	Steel and non-ferrous ore Steel ignot Thick and thin rods made of steel or non-ferrous ore Stainless steel parts Rails Bronze ignot, poles and wire Nickle ignot, poles and tubes Chainsaw Cutting machines for agriculture and forestry use Engines for airplanes Medical and pharmaceutic use large refrigerators Sorting and washing machines for agricultural products Milk processing machines Beer production machines (over 5,000 kiloliters a year) Paper and pulp manufacturing machines Textile machines Dyeing machines Rubber forming machines Metalworks machines
1%	Nylon, Polymide tire cord	Benzene Toluene Naphthalene Activated carbon	Mechanical pulp		Gold Silver Platinum Non-ferrous ignot Machine-use chains
3%		Clay Kaolin Mica Hydrochloric acid Natural or sinthetic Rubber	Plywood Chemical pulp Cement bags		Springs Aluminum sheeting, poles, rods and pipes Duplicating machines Musical instruments (pianos, flutes, organs etc.)
5%	Silk wastes and rough silk	Coal Sulfuric acid Vinyl chloride Catalyst Polystyrene Tires for airplanes Composite leather	Wood chips Raw material for carbon paper	yeast	High pressure, large cylinders Engines for large ships Calculators Knock down use small tractors Medium sized boats
10%	Artificial textile threads	Salt Limestone Gasoline Phosphoric acid Ammonia Liquid caustic soda Benzylyne and other pharmaceutics Paint for ships Waste plastic Pharmaceutic use anburu	Raw material for wall paper Filters	rice bean mollases cocoa	Belts for use on steel machinery Knock down automobile engines Medium sized motors and power generators Various kinds of boats Tricycles and dolls

Tariff Rate	Textileand Garment	Chemical	Paper and Pulp	Food Processing	Metal Works
15%	Silk thread	Salt Crude oil Solid caustic soda Glutamic acid		Raw materials for beverages	Knock down use cameras
20%	Wool thread Twisted cotton fiber Shoe parts Helmets	Clinker Detergent Black and white film Plastic pipes and sheets Industrial use leather goods Glass vessels VTR tapes Floppy Disks	Newspaper	Milk and cream Wheat flour Rice flour Starch Coffee beans artificial sweetner	Gold parts for doors High pressure small cylinders Stel fencing Bronze nails Aluminum doors and window frames Tools Cutting utensils for cooking and the food processing industry Engines for tractors and automobiles that have a seating capacity of ten or more Small tractors Small motors and power generators
25%					Refrigerator(knock down use)
30%	Cotton fiber Dynthetic fiber thread Tents Sails Umbrellas and cane parts	Basic paints Polisher color film Plastic vessels Automobile use tires Glass tubes	Cigarette rolling paper Towels Sanitary napkins Wood boxes・casks・shelfs	Cheese Processed milk goods Various kinds of vegetables Various kinds of fish Tobacco leaves	Rivets Bolts Nails Wax Oven Steel and Bronze high heat cookware Knifes Small engines for ships
40%	Silk fabrics Wool fabrics Cotton fabrics Syntetic fabrics and artificial fabrics Carpets and rug Races Embroidered product Knitted cloths Umbrellas Canes	White cement Plastic floor sheeting and construction materials Leather products (bags etc.) Bricks Plate glass	Wood frames and tables Printing paper Wallpaper Envelope Note Account books	Refined vegetable oil Refined sugar	Jewly L・H・T type steel Stainless bathtubs and sinks Bronze and aluminum toilet parts Engines for automobiles with a seating capacity of 9 or less Clocks Various kinds of furniture (chairs, beds, etc.)
50%	Clothes Leather clothes Rag Shoes・Sandals・Boots Hats and caps	Cosmetics Perfume Soap Plastic bath tubs・sinks and tables Tires for motorcycles and bicycles Tile Glass tableware		Tea Meat and fish products Chewing gum Roasted coffee Cocoa by-products Biscuits Cake Vegetable by-products Sauce Beverages Alcohal	Bicycle and motor cycle chanes Motorcycle engines Air conditionor Refrigerator for houseuse Washing machines Video games
60%		Diesel oil Naphtha			
100%	Used clothes			Beer Wine Whisky Tobacco products	

By looking at the tariff system, it becomes clear that Viet Nam is adopting the following industrial policies:

- The Government will admit low priced, imported raw materials. However, for final products, those which are produced in domestic industries are protected by high tariff rates .e.g.)

  raw cotton(0%), ethylene (0%), polyethylene(0%), mechanical chips (1%), wheat (0%), and iron ingot (0%), There is almost no tariff on theses materials. However, the following materials have high tariff rate.

  cotton thread (20%), cotton fabrics (40%), plastic building materials (40%), furniture (50%), printing paper (40%), beer(100%), and automobile(60%).
- Intermediate products, such as parts, also have high tariff rates in order to protect domestic industries e.g.)

  tires (30%), paint (30%), white cement (40%), sugar before refining (30%), bicycle chains and engines for bicycles and motor cycles (50%), iron nails and bolts (30%), steel rods and die (40%)
- Concerning goods for industrial use, the tariff rate will be lower than the tariff rate on goods for consumption, so that industrial activities will be supported. e.g.)

  fertilizer (0%), tire cords(1%), tires for air crafts (5%), cement bags (3%), raw material paper for carbon paper (5%), yeast (5%), machine chains (1%)
- The tariff on final products for such things as industrial use machines, which are not produced domestically, have low tariff rate in order to promote industries.e.g.)

  looms, dyeing machines, rubber forming machines, paper and pulp producing machines, sorting and washing machines for agriculture, metal processing equipment (all of them have a 0% rate)
- In technology development, health and medical, cultural and children's products have low tariff rates.

Technology development use examples (0%):

Ceramics products for laboratory use, scientific technology magazines and documents

Health and medical use examples (0%):

X-ray film, vitamin and hormone drugs, large size refrigerators for medical use

Cultural and children's use examples:

Dictionary, textbooks, newspaper and children's books (0%)

Instruments like pianos, organs, and flutes (3%)

Toys such as tricycles and dolls (10%)

The present fixed tariff rates are considered to be rational because ①domestic industries are protected ② there is a lower tariff rate on industrial use goods compared to consumer use goods ③ technology, health and medical use goods, and culture are promoted.

However, the following issues still remain:

• Processed products such as textiles, clothing, plastic products, printing paper, refined vegetable oil, refined sugar, biscuits, beer, furniture, appliances such as refrigerators, and automobiles are protected by a 40 to 50% tariff rate. However, this protective action by high tariff rates will decrease because Viet Nam is promoting free trade with ASEAN countries. Moreover, if enterprises don't increase international competitiveness as soon as possible, they will lose the market to stronger international competition.

• Protective action that uses high tariff rates protects only the industries which make the particular product under the tariff. The burden of downstream industries which use the products produced by the protected industries increases and their competitive power becomes weaker. Thus, the Viet Nam government must consider the side effects of keeping the high tariff rate policy in place and protective action like this should be lessened and reconsidered as well.

Example

• The tariff rate for textiles made of silk, wool, cotton and synthetic fibers increased to 40%, and surely these textile industries are protected from competition by imports. However, the material cost for the sewing industry will increase because imported materials have a lower price out side of Viet Nam. If the sewing industry uses domestic materials which are relatively expensive in the international market, it will be difficult to export the products.

• At present, the tariff rate for naphtha is 60% which is very high. Once the oil refinery and oil chemical industry start operating, they will have some other difficulties in the international market besides naphtha because ethylene, propylene, polyethylene, and polypropylene have a 0% tariff rate. However, if they raise the tariff rate too high for polyethylene and the like, their competitiveness will drop in the plastic products market.

• The relatively high 15% tariff rate for solid caustic soda, serves to protect the Caustic soda industry. However, competitive power of the pulp industry, which mainly uses caustic soda as raw material, will decrease.

④ Export Tax

Table 12.14 shows export tax conditions at present. Export taxes raise the price of export products and lower competitiveness. Naturally, export taxes have a controlling effect on exports.

Looking at the export tax system, it becomes clear that the following policies are being adopted:

- Controlling exports of low form, value added natural resources such as timber, iron ore, and tin in order to bring up the processing level inside the country .
- Controlling the export of low price scrap in order to bring up the level of processing domestically.

Table 12.14 Export Duty (10% or more)

	Timber	Mineral	Leather
10%	Rattan Roots from natural trees Boxes and black boards made from natural trees	Iron ore	Animal leather
15%	Wooden pillars Boards and floor boards made from artificial trees Shelves and prefabricated house parts made from natural trees		
20%	Aromatic trees Raw timber Board and floorboard made from natural trees	Tin stone	
35%		Scrap from iron products	
45%		Scrap from copper, nickel, aluminum lead, tin	

Source: from Institute of Industrial Chemistry, MOI

⑤ Import Approval System

The following articles are under the import approval system. (Decision 253/1998)

- Crude oil, liquid soda (NaOH), fertilizers, plastic packages, facing and floor bricks of ceramics and granite, glass, consumer goods made of glass, ceramics, clinkers, cement, packing and printing paper, refined vegetable oils, refined and crude sugar, wine, steel, all kinds of steel tubes (20mm-113mm), bicycles, engines and frames of

motorbikes and three-wheelers of all kinds, not uniform, motorbikes and motored three-wheelers, and their parts, passenger/cargo cars with 15 seats or less, passenger cars with 15 - 50 seats, lorries under 5 tons, ambulances, and electric fans.

In addition to this, there is a system where the enterprises that import consumer goods must pay their import costs in foreign currency to maintain foreign currency balance.

The purpose of these tariff barriers is to protect existing domestic industries and maintain a good currency balance.

(2) Targeted Sections for Favorable Taxation

a. Targeted Sections

According to Decree7 made effective in 1998, the following items have been designated for favorable taxation.

① Investment in the following industries:

- Agriculture, forestry and fishery products processing
- Export products, or production of substitute import products
- Industries listed in the Development Priority List (1995-2000)

Consumer Products (textiles, leather, rubber, high quality plastics, clothing, paper, and stationery)
Metalworking
Electric information technology (production, assembly, machine repairs, and production equipment)
Food processing
Shipbuilding
Trains
Electronic products for exportation
Software
Raw materials and fuel production (oil refining and coal development, iron and nonferrous metals, cement, other building materials, fertilizer, and main chemical products)
Traditional Industries (lacquer, bamboo ware, rattan work, chinaware, porcelain, and silk)

- Industries in Industrial zones, exportation processing areas, and high

technology industrial zones (infrastructure investment and services for these areas)

② Investment in industries which use the following technologies:

- High technology and technology which supports the equipment of other industries
- Technology that produces higher quality products using domestic raw materials
- Cleaner technology, and technology that utilizes solid, liquid, and gas waste

③ Production projects which require that many employees (projects that employ at least 100 people yearly on average in the following areas) be hired

- Enterprises located in predominately minority ethnic areas, tribal mountain areas, islands, and in other poverty stricken areas

④ Investment in industries located in minority areas, tribal mountains areas, and on tribal islands far away from the main land (designated areas)

⑥ Investment in industries in poverty stricken areas and remote areas far away from cities (designated areas)

⑦ Investment in enterprises in industrial zones, export processing areas, and high technology industrial zones

These kinds of favorable tax treatment show that the Viet Nam Government now has the following policies in order to help industries:

- Acquisition of foreign exchange
- Ensure employment and improve the income level of people in local areas
- Promote high technology
- Promote the domestic consumer industry
- Promote the basic raw materials industry
- Encourage investment in industrial zones, export processing districts, and high technology industries
- Promote cleaner technology and resource recovery technology for waste

However, there are no favorable merits for general pollution prevention and pollution prevention equipment.

b. Details of favorable tax treatment in targeted industries

Enterprise income tax and personal income tax

① Investment made by a new enterprise under the previously stated conditions:
…A two year tax exemption starting from the time the company incurs taxes,

and then a tax deduction of half of the regular tax rate after the tax exemption ends.

② Investment made in new enterprises which meets both previously stated conditions and makes inroads into ethic minority areas or tribal mountain areas.

…A four year tax exemption starting from the time the company incurs taxes, and then a tax deduction of half of the regular tax rate for five to seven years after this tax exemption ends. If two or more of the previously stated conditions are met, then the number of years for the 50% tax exemption will increase from seven to nine years.

③ Investment in enterprises which meet both the conditions stated above and make inroads into poverty stricken areas

… A Three year tax exemption starting from the time the enterprise incurs taxes, and then a tax deduction of half of the regular tax rate for five years after this tax exemption ends.

④ In the case that existing enterprises expand their businesses:

… A one year tax exemption starting from the time the enterprise incurs taxes.

Revenues that are used for reinvestment are not considered as being subject to taxation.

⑤ In the case that corporations or individuals buy stocks or invest money in enterprises, a three year tax exemption from the enterprise income tax, or income tax, including additional taxes for high income earners, will be granted.

Value Added Tax (VAT)

① Investment made by a new enterprise that meets the conditions stated before:

…A one year tax deduction of half of the regular tax rate starting from the time the company incurs taxes.

② Investment made in new enterprises which meets both conditions stated before and makes inroads into ethic minority areas or tribal mountain areas.

…A three to four year tax deduction of half the regular tax rate starting from the time the company incurs taxes.

③ Investment in enterprises which meet both the conditions stated above and makes inroads into poverty stricken areas.

… A two year tax deduction of half the rate of the regular tax rate starting

from the time the enterprise incurs taxes.

Deduction in the Land Tax

① Enterprises which meet both the conditions stated above and are involved in agriculture, fishery, forestry or salt production.

… In the case the land was granted by the government, enterprises are exempted from taxation. In the case the land was leased from the government, a five year tax exemption will be granted, and then after the tax exemption ends, a tax deduction of 50% of the regular tax rate will be applied.

② Enterprises which invest in infrastructure in industrial zones, export processing zones, and high technology industrial zones.

… A five year deduction of the land tax to 50% of the tax rate.

③ Enterprises which invest in project areas stated previously in industrial zones, export processing zones, and high technology industrial zones.

… 50% of the land tax will be deducted.

12.7 Budgetary Measures

The Viet Nam Government is increasing the budget mainly for①agriculture and rural development, ②fisheries and③transportation. From 1997 to 1999, the budget of these Ministries increased respectively 49.1%,134.3%, and 41.7%,while total State expenditures increased only 5.6%.

Table 12.15 Central Government Budget by Ministries

Mill.dongs	1997	1999
Ministry of Justice	271238	232305
Ministry of Construction	148668	114450
Ministry of Agriculture and Rural Development	1934557	2884745
Ministry of Fishery	84497	197940
Ministry of Transport	3720791	5274064
Ministry of Trade	62267	49250
Ministry of Industry	362355	261854
Ministry of Foreign Affairs	431255	311910
Ministry of Culture and information	391123	339486
Ministry of Education and Training	862281	927179
Ministry of Health	975865	1001756
Ministry of Labour,Invalid and Social Affairs	95325	102890
Ministry of Finance	87238	52020
Mill.dongs	1997	1999
Ministry of Science,Technology & Environment	117060	108360
Ministry of Planning & Investment	36335	19230

Source: Socio-Economic Statistical Data of 61Provinces and Cities 34P

In spite of governmental policies of equalization of income and abolishment of poverty, industrialization in Viet Nam brought big benefits to a relatively small related group and differences in income between people increased over the last few years (Figure 12.5).

In all of Viet Nam, the highest income producing group received an income 6.5 times as much as that of the lowest group in 1994, but in 1996, this ratio increased 7.3 times. This ratio is the highest in the Central highlands, and it was 12.8 times that of the lowest group in 1996.

Table 12.16 Income Disparity

	1994	1995	1996
The Country	**6.5**	**7.0**	**7.3**
Urban	7.0	7.7	8.8
Rural	5.4	5.8	6.1
By regions	**1994**	**1995**	**1996**
North mountain and Midland	5.2	5.7	6.1
Red river delta	5.6	6.1	6.6
North central coast	5.2	5.7	5.9
South central coast	4.9	5.5	5.7
Central highlands	10.1	12.7	12.8
North east coast	7.4	7.6	7.9
Mekong river delta	6.1	6.4	6.4

By dividing households into 5 groups, each group accounted for 20%
Source: Viet Nam Socio Economy the Period1996-1998 47P

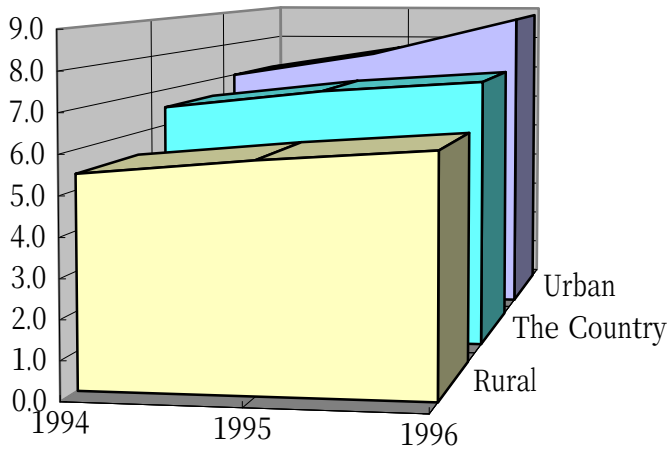


Figure 12.5 Income Disparity

In order to solve this problem and increase social stability, most of the budget is used mainly for ①Agriculture and local development② Fisheries ③ and transportation systems.

12.8 Policies to Attract FDI (Foreign Direct Investment)

The driving force of rapid industrialization in Viet Nam is apparently the foreign invested sectors. Contents of foreign investment are shown in Table 12.17. From 1988 till 1998 a total of 2468 projects were approved and total registered capital reached 35,495 Mill. USD, of which 16,172 Mill. USD was actually invested in Viet Nam.

The ratio of FDI to GDP was 13.88% on average from 1988 to 1998. The number of FDI projects peaked out in 1995. Total registered capital in 1996, and legal capital in 1995 respectively, recorded their highest levels. The ratio of FDI to GDP decreased from 16.94% in 1995 to 6.49% in 1998, and this surely caused the growth rate of GDP and Industry in 1998 -1999 to be lower than in the past.

The Law on Foreign Investment was passed in 1987 and revised in 1996 to attract more foreign investors. This revised new Law put priority on① export promotion,② manufacturing of agricultural, forestry, and fishery products,③ high technology,④ development of socio -economic infrastructure, and⑤remote areas.

Products which have a higher rate of exported products like metallurgy, chemical products, petroleum products, fertilizer, manufacture of mechanics, electronic products, auto, and motorbikes can receive an income tax exemption. For special products, 10% of income tax will be exempted for 8 years. Also, 25% of the land tax will be reduced.

Import taxes on imported machinery, and transportation equipment will be exempted, if the equipment is considered to be a fixed asset.

Table 12.17 Foreign Direct Investment

year	Number of projects	Total registered capital (Mill.USD)	Of which Legal capital (Mill.USD)	GDP at current prices (Bill.Dong)	FDI/GDP%
1988	37	371.8	288.4	15420	24.29
1989	68	582.5	311.5	28093	14.40
1990	108	839.0	407.5	41955	12.61
1991	151	1322.3	663.6	76707	11.23
1992	197	2165.0	1418.0	110535	16.66
1993	269	2900.0	1468.5	136571	13.96
1994	343	3765.6	1729.9	170258	13.19
1995	370	6530.8	2986.6	228892	16.94
1996	325	8497.3	2940.8	272036	14.04
1997	340	4462.5	2148.8	313623	8.90
1998	260	4058.6	1807.9	361468	6.49
1999	230	7451.6			
Total	2698	42947.0	16171.5		

Source: FDI from Viet Nam Socio Economy The Period 1996-1998 361P
GDP from Socio Economic Statistical Data of 61provinces and cities
Exchange rate is 12985Dong/US$(1998.12 official rate)

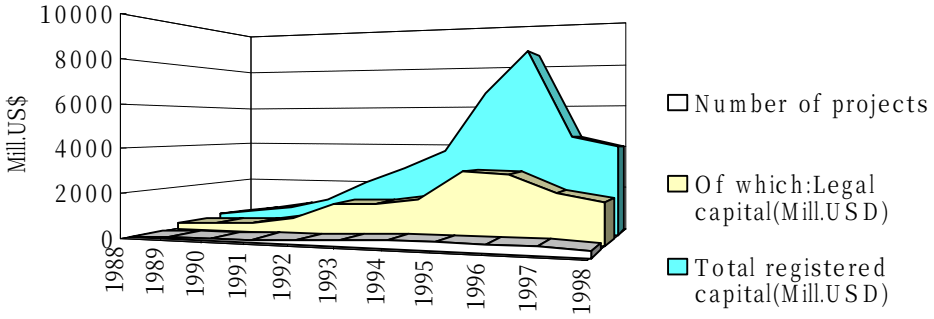


Figure 12.6 Foreign Direct Investment

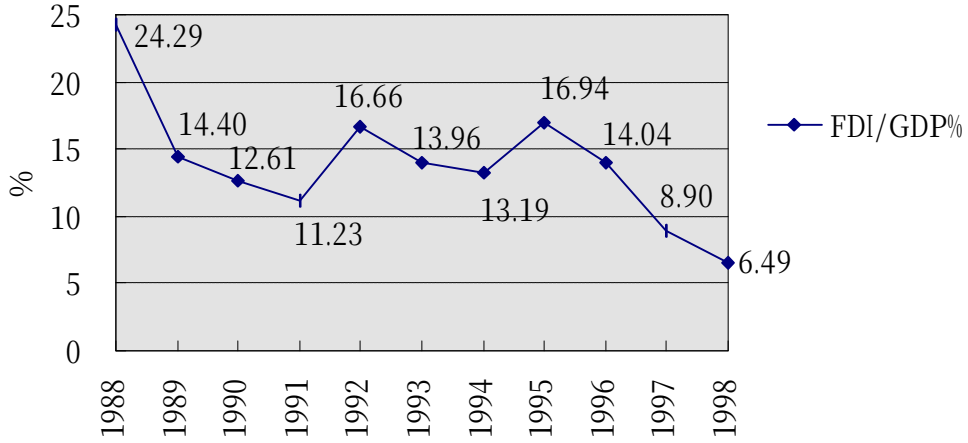


Figure 12.7 FDI／GDP

12.9 Promotion of Industrial Zones (IZ)

Most of the IZs have been established since 1995 in conformity with the Industrial Zone Status promulgated by the Government at the end of 1994. The Tan Thuan and Linh Trung IZs were established earliest. After the success of Tan Thuan and Linh Trung IZs, many IZ projects were promoted in other local areas. To attract investors, tax incentives were put in place, like exemption or reduction of import taxes on machinery, equipment, raw materials, taxes on finished goods for export, turnover taxes and land taxes.

In September of 1999 there were 62 IZs, 3 export processing districts, and one high technology zone in Viet Nam. Among the 59 IZs, 20 are modern Industrial Zones and 34 were established based on former state industry enterprises.

At the end of 1998, 609 industrial enterprises operated in IZs with a total investment capital of about 5.8 billion USD, (implementation capital 3.8 billion USD) and 120,000 laborers. Each type of capital accounted for 24.6%, and 38.4% respectively, of total FDI in the period 1995-1998.

Promotion of IZs contributed much to industrialization and modernization in Viet Nam. However, all IZs did not fully succeed because 77% of the total area is still waiting for investors and 17 of the 59 IZs had no projects at the end of 1998. Promotion of remote areas is now one of the important governmental policies.

Recently constructed IZs, including those under development, are shown in Table 12.18.

Table 12.18 Industrial Zones in Viet Nam

Hanoi	Arc (ha) May,1998
North East Hanoi	430
South Thang Long	200
North Thang Long	350
Soc Son	100
Da Phuc	900
Dong Anh	80
total	2060
HA TAY	
Hoa lac1(Hightech)	1600
Hoa lac 2	600
Xuan Mai	500
total	2700
18 th Road	
Pha lai	500
Chi Linh	1000
Dong Trieu	800
Mao Khe	400
Uong Bi-Doc Do	500
Chap Khe (Uong Bi)	350
total	3550
Quang Ninh	
Dong Dang	150
Cai Lan	90
Hoann Bo	170
Total	410
Hai phong	
Do Son	1000
Nomura	153
Dinh Vu	1000
Min Duc	1200
total	3353
Northern area	**12073**
Quang Nam	
Da Nang EPZ	63
Dien Ngoc	145
Lien Chieu-Hoa khanh	120
Total	328
Quang NgaI	
Tinh Phong	142
Dung Quat	14000
Total	14142

Ho Chi Min City	Arc (ha) May,1998
Tan Thuan EPZ	300
Linh Trung EPZ	60
Hiep Phuoc	2000
Hitech Ho Chi Min	300
Cai Lai	800
Linh Xuan	500
Tan Binh	250
Phu My-Nha Be	400
Tay Bac Cu Chi	150
Tan Quy Cu Chi	150
Tan Thoi Hiep	400
An Ha	200
Tan Tao	200
Vinh Loc A	200
Binh Chieu	30
Total	5940
Song Nai	
Bien Hoa I	382
Bien Hoa II	376
Ho Nai	300
Song May	700
Long Binh	1060
Tuy Ha	2500
Tam Phuoc	1500
An Ph-ic	1794
Long khanh	250
Xuan Loc	200
Dinh Quan	100
Tan Phu	100
Tri An	300
Amata	700
total	10262
Ba Ria-Vung Tau	
My Xuan Phu My	2500
Long Huong	400
Long Son	400
Phuoc Thang	130
Dong Xuyen	160
Ben Dinh	120
total	3710

Song Be	Arc (ha) May,1998
Song Than	185
Binh Duong	36
Binh Hoa	1000
Thuan Giao	100
An Phu	500
Tan Dinh	150
Bau Beo	350
Truong Bong	500
Phu Hoa	200
Go Dau-Phu Tho	200
Tan Uyen	500
My Phuoc	300
La Uyen	500
Nam Chon Thanh	500
Nam Dong Phu	1000
total	6021
Southern area	**25933**

Hanoi	Arc (ha) May,1998	Ho Chi Min City	Arc (ha) May,1998	Song Be	Arc (ha) May,1998
Khanh Hoa					
Khanh Hoa	152				
Total	152				
Middle Viet Nam	**14622**				

Source: Viet Nam2000 180 P **and**
Municipal and Industrial solid waste management strategy to the year 2000

12.10 Present Problems in Industry

① Small Scale Enterprises in Equipment Intensive Industry

Reactors, furnaces, tanks etc., are said to increase in proportion to, not production capacity, but by production capacity to the 0.6 power .

Simply written, the cost of machinery per production is as follows:

The cost of machinery per product unit＝The cost of machinery／ production capacity （production capacity）$^{0.6}$／ production capacity＝**1**／（production capacity）$^{0.4}$

This type of industry is called an equipment intensive industry and also has the characteristic that the number of laborers, in many cases, will not increase greatly if the production capacity increases.

When plant costs follow the economic rule of production capacity to the 0.6 power, there is a change in unit production cost and that change is shown in Table 12.19.

Table 12.19 Effects of Large Scale Production

Production ability	1.00	1.50	2.00	2.50	3.00	3.50	4.00	5.00	5.64	10.0	20.0	30.0
Investment in plant	1.00	1.28	1.52	1.73	1.93	2.12	2.30	2.63	2.82	3.98	6.03	7.70
Unit cost	1.00	0.85	0.76	0.69	0.64	0.61	0.58	0.53	0.50	0.40	0.30	0.26

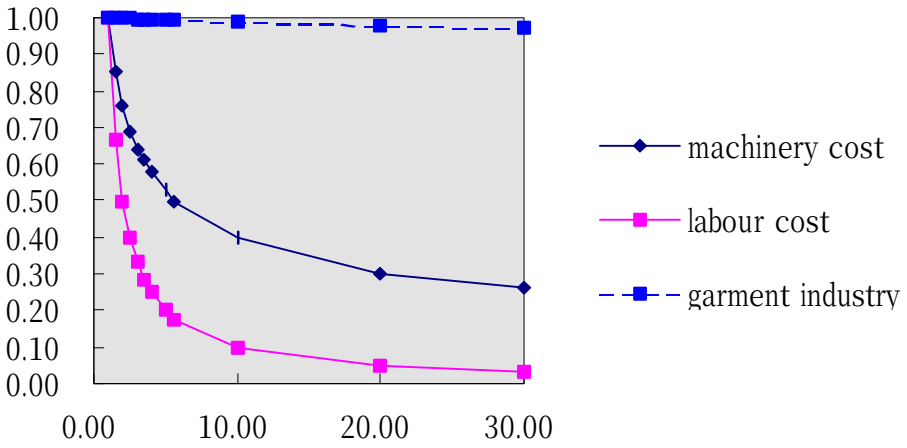


Figure 12.8 Production Ability Effects of Increases in Scale

In the paper and pulp industry, Japanese companies on average produce 80,000TON per year. The statistical data is not the same, but in Viet Nam, the average production of SOEs is about 4,000TON per year, so simply considered, the ratio is 20 to 1, and the cost of machinery is estimated to be 0.3 to 1.

In the chemical industry, if we compare production of caustic soda, the annual production amount per factory per year is 100,000TON (Japan) to 5,000 TON (Viet Nam). The ratio is similar to that of the paper and pulp industry.

In the food industry, several kinds of food items are produced. Compared to beer production, which has the characteristic of being an equipment intensive industry, the average production ability per factory per year in Japan is 173,000 kl and in Viet Nam total production is 440 kl. The ratio of production amount between factories in Japan and Vietnam is thought to be about 400 to 1.

In the garment industry, scale is not important as it is in equipment intensive industries, and the average production amount per company is different as well. However, Viet Nam has strong international competitiveness in this industry. However, the dyeing industry has the same characteristics as the chemical industry, so enterprise concentration would have an advantage for reduction of production costs.

The plating industry is characterized by low levels of production of many kinds of products and is called a small and medium size industry. It would not realize an advantage through enterprise concentration. However, for the treatment of waste water there are still merits for building cooperative treatment facilities.

Table 12.20 Production Per Unit (1996)

	Number	production TON	Production TON/company	
Paper and paper products				
State companies in Viet Nam	42	176000	4190	
Non-State	1453	40000	28	
Foreign investment	13	4000	308	
total	1508	220000	146	
Japanese paper and pulp companies	375	30012000	80032	not including paper products
Caustic Soda		production TON	production TON/company or factory	
State companies in Viet Nam	2	9099	4550	
Japanese caustic soda companies	29	4061854	140064	
Same (number of factories)	40	4061854	101546	
Garments		Thous. pieces	Thous. pieces/companies	
State companies in Viet Nam	90	70877	787.5	
Non-State	78617	114366	1.5	
Foreign investment	75	21716	289.5	
total	78782	206959	2.6	
Japanese clothes and textile products companies	30753	832000	27.1	
Beer		Mill.litres	Mill.litres/factories	
State companies in Viet Nam		365		
Non-State		28		
Foreign investment		140		
total	1200	533	0.44	
Japanese beer factories	40	6934	173	

Source: Socio Economic Statistical Data, Chemical Products handbook, Knowledge of paper and pulp, Japanese Statistics, Food Industry Statistics

12.11 Industrial Development According to Comparative Advantage Conditions

Vietnam, mutually together with other ASEAN countries, is lowering customs taxes and aiming to enter into a free trade system. Under this system, individual countries are promoting the most profitable industries in terms of cost, and are trading products within the region. It is expected through this exchange that citizens of these countries will be able to enjoy the least expensive products.

In reality, where the production conditions of individual countries are disadvantaged, even if industrial promotion is carried out, in order to make comparative advantage equal to that of other foreign countries, it is necessary to invest a large sum of money. To make this happen is not easy.

An abundant, high-quality work force, and endowed mineral, agricultural and marine resources are areas in which Vietnam Industry enjoys a comparative advantage. From the point of view of conditions like these, the textile industry (making the most of the advantaged work force), food processing industry (making the most of marine and agricultural resources), and the mineral industry (making the most of mineral resources) can be said to be “comparative advantage industries.”

On the other hand, because the comparative advantage conditions of industries can even be developed according to industrial policy, depending on the planning for technological promotion, etc., the basis of Government policy, conditions of comparative advantage can be developed. Under this policy, in order to promote the advanced technology field, domestic use commodity industries, and the basic materials industry, the adoption of preferential tax measures by the Vietnam Government and other methods, such as protection measures that utilize high customs taxes, are already being executed.

On a different subject, as for the policy goals of securing employment and income in the regions, acquiring foreign currency and promotion of cleaner technology and hazardous waste utilization technology, an improvement in international competitiveness and the promotion of comparative advantage industries can be planned and developed from a different point of view.

Concerning the securing of internationally comparatively advantaged industries, at present, through high custom taxes and import quotas, domestic protection measures are effectively in place. However, improvement in competitiveness that coincides with the lowering of custom taxes under the free trade system of the future, is necessary.

As far as the promotion of regional industry goes, it is necessary to adopt industrial promotion policies that take into account the special characteristics of the various regions, and at the same time, maintain high-standard roads and the like where it is imperative to lower transportation costs. Vietnam is a long, thin country that stretches from the north to south, and the entire eastern side of the country faces the coastline. In addition, there are many large-sized rivers like the Red, Mekong, etc. Following this, on the eastern side, there are many transportation merits for shipping to the interior. On the other hand, for the western part of the country, once the road, presently under construction, that cuts vertically across the country is completed, a comparative advantage will be born in transportation costs and will make possible the development of new industry.

Chapter 13

Industrial Wastewater Data and Status of Other Kinds of Pollution

Chapter 13 Industrial Wastewater Data and Status of Other Kinds of Pollution

13.1 Water Quality in Public Water Areas

The following figures show the environmental pollution conditions of each of Vietnam's main rivers. Measurements were taken from Dec.1999 to January 2000.

SAI GON RIVER SAMPLING POINTS OUTLINE

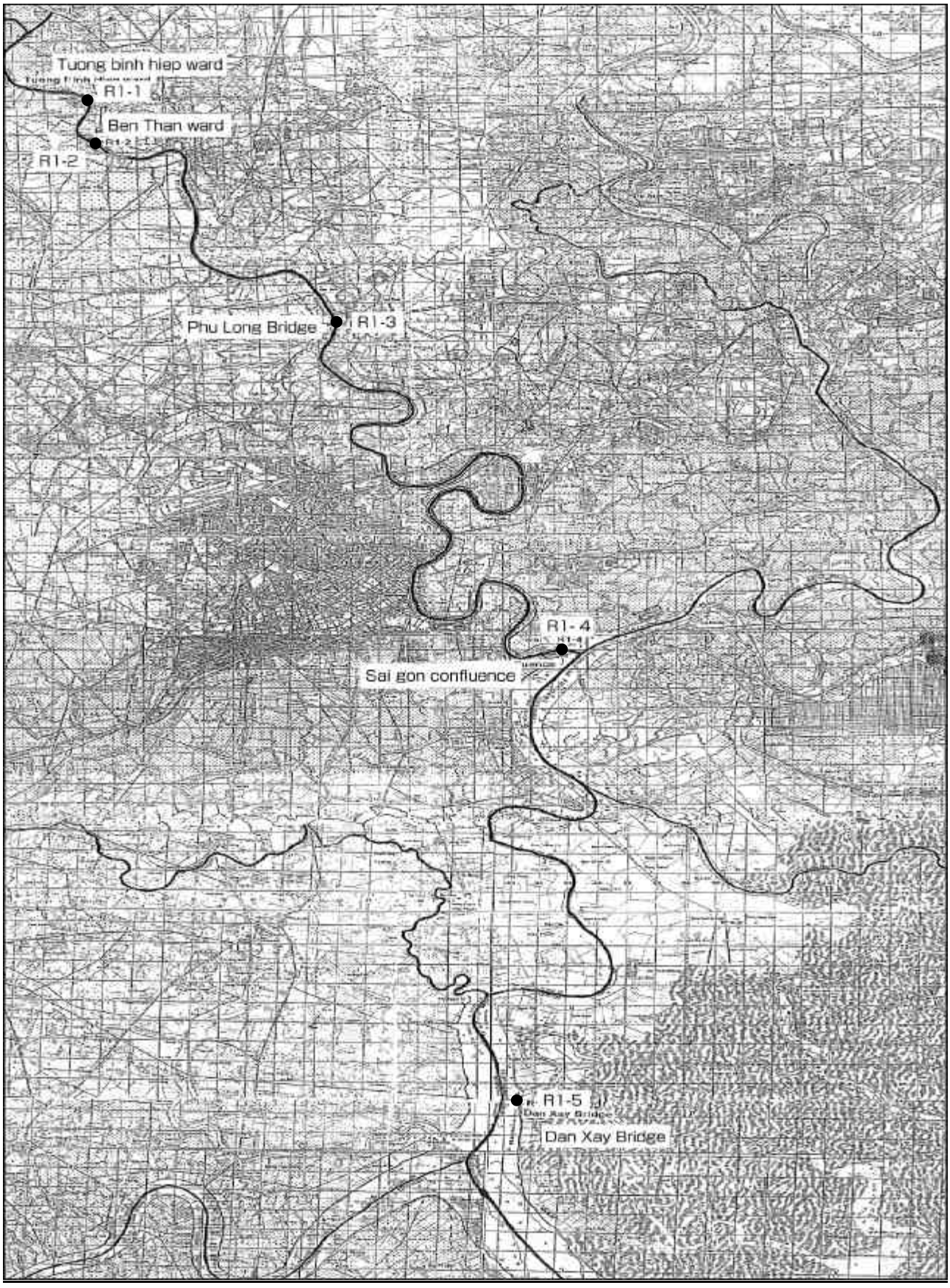


Table 13.1 The Results of River Water Quality Measurement

River name： The Sai gon river
Date samples were taken： Dec.11.1999

N⁰	Items	Unit	Sampling Points				
			R1-1	R1-2	R1-3	R1-4	R1-5
1	Water temperature	℃	26.3	26.5	27.1	27.9	28
2	pH		7.20	7.01	7.05	7.10	7.00
3	Conductivity	mS/cm	0.03	0.02	0.03	0.39	0.364
4	Turbidity	NTU	26	21	25	23	13
5	Oil contents	mg/l	0.13	0.13	0.12	0.12	0.15
6	BOD_5	mg/l	5.9	5.6	5.8	17	29
7	COD	mg/l	12.8	11.2	9.6	30.8	40.8
8	DO	mg/l	6.8	6.7	6.8	6.3	6.6
9	SS	mg/l	46	24	32	35	72
10	Total Nytrogen	mg/l	5.3	4.8	4.2	7.5	5.2
11	Cyanide	mg/l	$5x10^{-3}$	$3x10^{-3}$	$4x10^{-3}$	$3x10^{-3}$	$8x10^{-3}$
12	Phenol	mg/l	$1x10^{-3}$	$1x10^{-3}$	$<1x10^{-3}$	$<1x10^{-3}$	$1x10^{-3}$
13	Residual Oxygen	mg/l	0.03	0.19	0.15	0.18	0.17
14	Hexavalentchromium	mg/l	0.02	0.01	0.02	0.01	0.01
15	Copper	mg/l	0.16	0.11	0.14	0.10	2.01
16	Iron	mg/l	0.80	0.79	1.04	0.62	0.12
17	Manganese	mg/l	0.3	0.3	0.4	0.6	0.3
18	Zinc	mg/l	0.27	0.29	0.26	0.35	0.28
19	Mercury	mg/l	$6.5x10^{-4}$	$8.4x10^{-4}$	$7.1x10^{-4}$	$7.9x10^{-4}$	$8x10^{-4}$
20	Arsenic	mg/l	$1.1x10^{-3}$	2.05x10	$1.98x10^{-3}$	$1.92x10^{-3}$	$2.02x10^{-3}$
21	Barium	mg/l	0.03	0.022	0.026	0.023	0.026
22	Cadmium	mg/l	$6x10^{-4}$	$4x10^{-4}$	$5x10^{-4}$	$6x10^{-4}$	$6x10^{-4}$
23	Lead	mg/l	$5.6x10^{-3}$	$5x10^{-3}$	$5.7x10^{-3}$	$6.4x10^{-3}$	$6.1x10^{-3}$
24	Nickel	mg/l	0.012	<0.01	0.01	0.012	0.013
25	Tin	mg/l	$1.44x10^{-3}$	$1.9x.10^{-3}$	$2.02x10^{-3}$	$2.15x10^{-3}$	$1.91x10^{-3}$
26	Nitric acid ion	mg/l	1.5	1.7	2.0	2.6	2.0
27	Nitrit ion	mg/l	$7x10^{-3}$	$9x10^{-3}$	0.016	0.208	0.013
28	Ammonia nitrogen	mg/l	0.28	0.32	0.33	1.04	1.85

Note：R1—1 is the furthest upper stream sampling point and the other points follow in succession down steam. Other sampling points are presented in the same way.

THI VAI RIVER SAMPLING POINTS OUTLINE

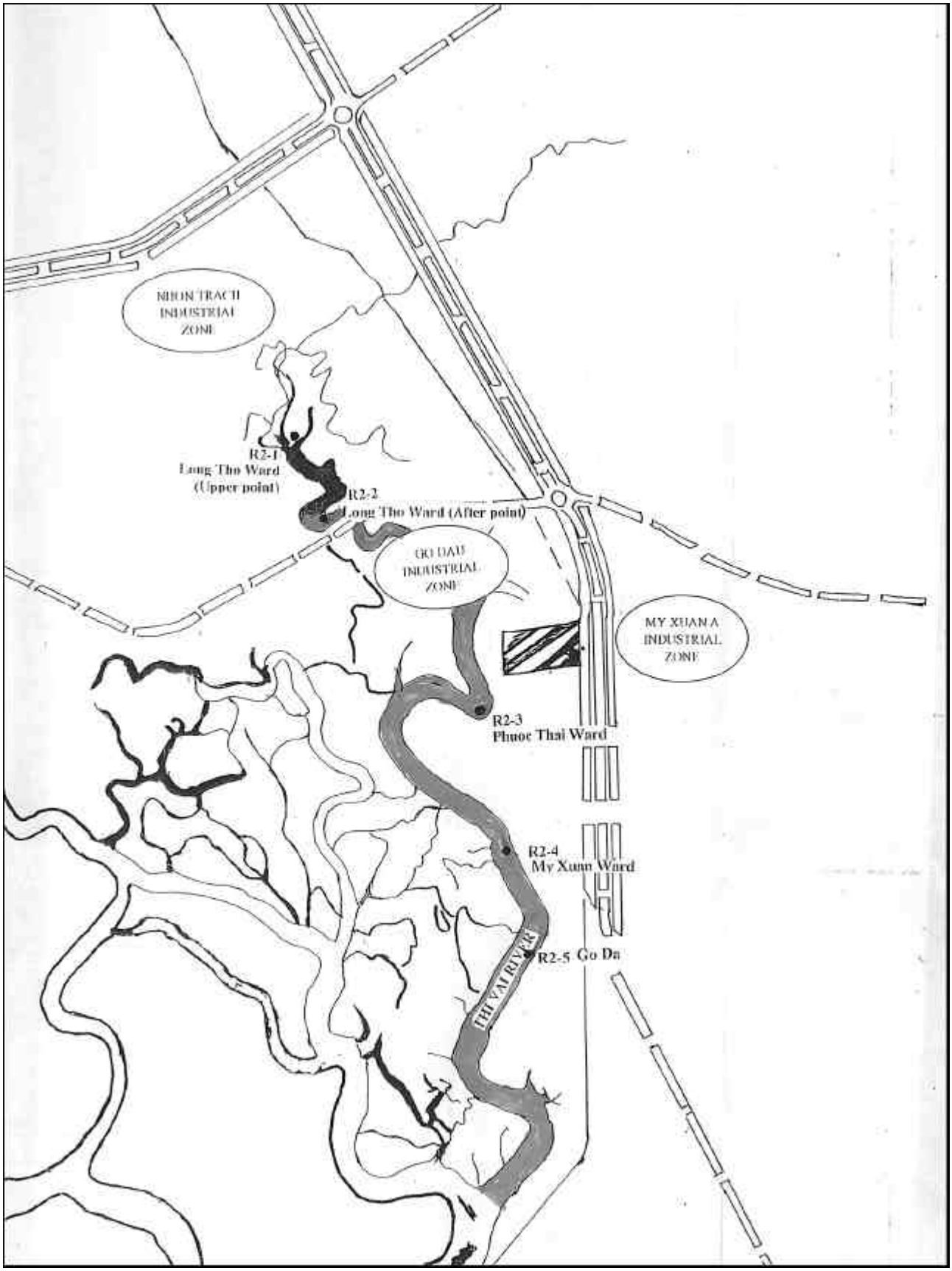


Table 13.2 The Results of River Water Quality Measurement

River name： the Thi Vai river
Sampling Date： Dec. 13.1999

N⁰	Items	Unit	Sampling points				
			R2-1	R2-2	R2-3	R2-4	R2-5
1	Water temperature	℃	29.1	28.9	28.9	28.8	28.8
2	pH		6.9	6.84	7.04	6.93	6.87
3	Conductivity	mS/cm	0.26	0.33	0.31	0.54	0.58
4	Turbidity	NTU	18	18	14	14	8
5	Oil contents	mg/l	0.12	0.12	0.1	0.12	0.14
6	BOD_5	mg/l	37	48	9	45	97
7	COD	mg/l	102.4	100.8	28.8	120	496
8	DO	mg/l	4.6	4.5	4.6	4.1	3.8
9	SS	mg/l	35	19	17	38	19
10	Total Nytrogen	mg/l	6.2	6.0	6.5	7.5	7.3
11	Cyanide	mg/l	$8x10^{-3}$	$12x10^{-3}$	$2x10^{-3}$	$54x10^{-3}$	$23x10^{-3}$
12	Phenol	mg/l	$<1x10^{-3}$	$<1x10^{-3}$	$1x10^{-3}$	$<1x10^{-3}$	$1x10^{-3}$
13	Residual Oxygen	mg/l	0.06	0.08	0.08	0.11	0.17
14	Hexavalentchromium	mg/l	0.01	0.01	0.01	<0.01	<0.01
15	Copper	mg/l	0.76	1.39	1.22	1.87	1.20
16	Iron	mg/l	0.26	0.26	0.14	0.15	0.14
17	Manganese	mg/l	0.5	0.4	0.2	0.3	0.2
18	Zinc	mg/l	0.27	0.25	0.29	0.28	0.29
19	Mercury	mg/l	$1.7x10^{-3}$	$1.3x10^{-3}$	$5.5x10^{-4}$	$6.2x10^{-4}$	$6.9x10^{-4}$
20	Arsenic	mg/l	$1.35x10^{-3}$	$1.27x10^{-3}$	$1.43x10^{-3}$	$2.1x10^{-3}$	$1.36x10^{-3}$
21	Barium	mg/l	$91x10^{-3}$	$84x10^{-3}$	$71x10^{-3}$	$86x10^{-3}$	$79x10^{-3}$
22	Cadmium	mg/l	$5x10^{-4}$	$4x10^{-4}$	$4x10^{-4}$	$5x10^{-4}$	$5x10^{-4}$
23	Lead	mg/l	$2x10^{-3}$	$2x10^{-3}$	$4.7x10^{-3}$	$3x10^{-3}$	$3.5x10^{-3}$
24	Nickel	mg/l	<0.01	<0.01	$18x10^{-3}$	$10x10^{-3}$	$10x10^{-3}$
25	Tin	mg/l	$1.62x10^{-3}$	$1.58x10^{-3}$	$1.58x10^{-3}$	$1.72x10^{-3}$	$1.63x10^{-3}$
26	Nitric acid ion	mg/l	1.8	2.2	1.7	1.9	3.2
27	Nitrit ion	mg/l	0.051	0.074	0.019	0.04	0.161
28	Ammonia nitrogen	mg/l	1.86	2.69	2.75	2.8	5.46

HAN RIVER SAMPLING POINTS OUTLINE

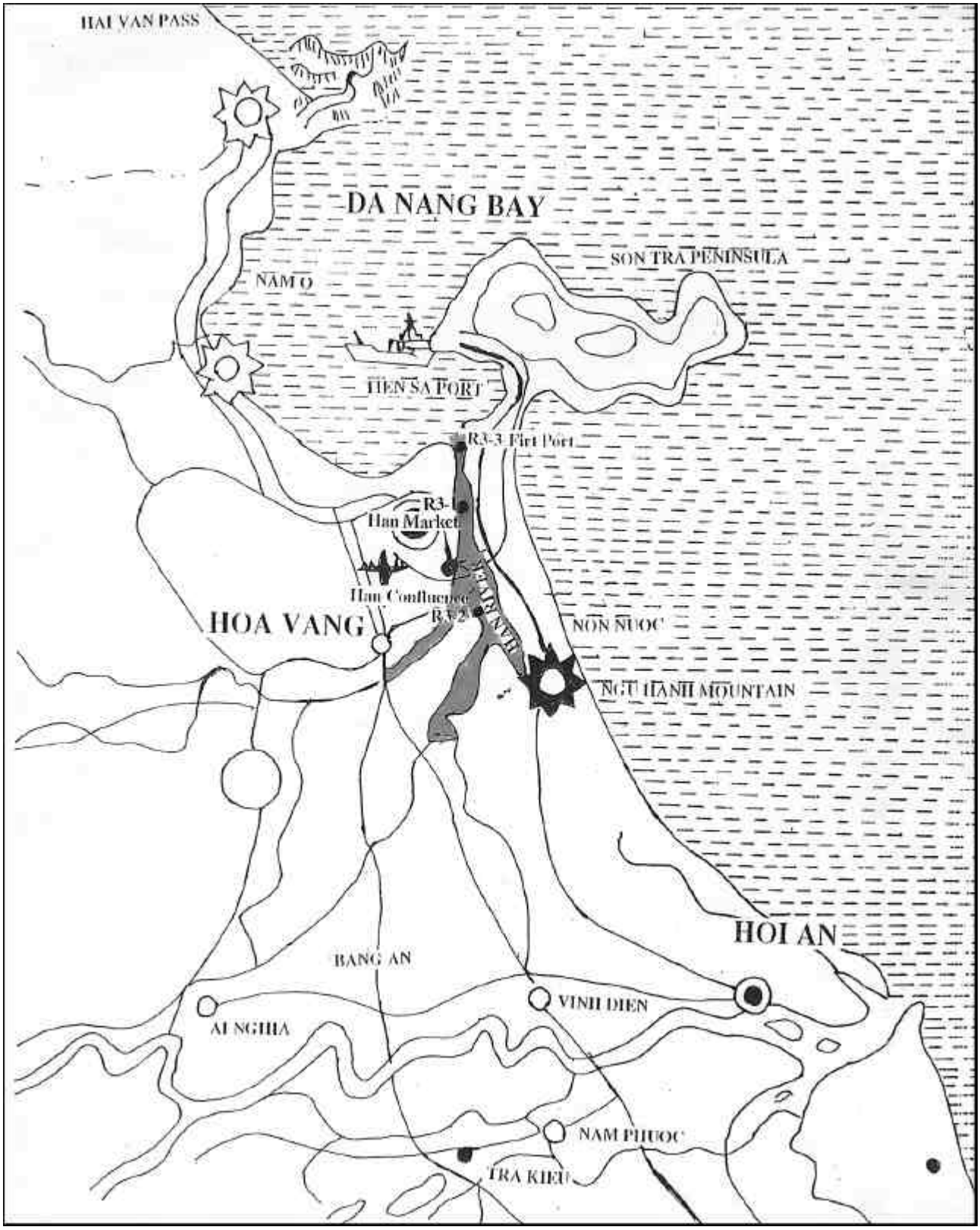


Table 13.3 The Results of River Water Quality Measurement

River name： the Han River
Sampling Date： Dec.17.1999

N⁰	Items	unit	Sampling Points		
			R3-1	R3-2	R3-3
1	Water temperature	℃	27.2	27.2	27.3
2	pH		7.30	7.40	7.33
3	Conductivity	mS/cm	0.32	0.35	0.34
4	Turbidity	NTU	27	29	31
5	Oil contents	mg/l	0.14	0.14	0.12
6	BOD_5	mg/l	4.8	5.6	6.4
7	COD	mg/l	6.5	8.4	9.2
8	DO	mg/l	6.3	6.5	6.5
9	SS	mg/l	45	44	49
10	Total Nytrogen	mg/l	10	2.8	4.0
11	Cyanide	mg/l	$5x10^{-3}$	$6x10^{-3}$	$4x10^{-3}$
12	Phenol	mg/l	$<1x10^{-3}$	$1x10^{-3}$	$<1x10^{-3}$
13	Residual Oxygen	mg/l	0.05	0.15	0.06
14	Hexavalentchromium	mg/l	0.01	<0.01	0.01
15	Copper	mg/l	0.01	0.01	0.01
16	Iron	mg/l	0.3	0.22	0.28
17	Manganese	mg/l	0.1	<0.1	0.1
18	Zinc	mg/l	0.27	0.23	0.25
19	Mercury	mg/l	$8.2x10^{-4}$	$8.6x10^{-4}$	$8.2x10^{-4}$
20	Arsenic	mg/l	$1.53x10^{-3}$	$1.57x10^{-3}$	$1.61x10^{-3}$
21	Barium	mg/l	$62x10^{-3}$	$67x10^{-3}$	$65x10^{-3}$
22	Cadmium	mg/l	$5x10^{-4}$	$5x10^{-4}$	$4x10^{-4}$
23	Lead	mg/l	$6x10^{-3}$	$6x10^{-3}$	$5x10^{-3}$
24	Nickel	mg/l	0.03	0.04	0.04
25	Tin	mg/l	$1.73x10^{-3}$	$1.71x10^{-3}$	$1.66x10^{-3}$
26	Nitric acid ion	mg/l	0.2	<0.1	0.3
27	Nitrit ion	mg/l	$13x10^{-3}$	$3x10^{-3}$	$19x10^{-3}$
28	Ammonia nitrogen	mg/l	0.22	0.08	0.38

Note：R3—2,R3—1,R3—3 are located in succession from up stream to down stream in this table

NHUE RIVER SAMPLING POINTS OUTLINE

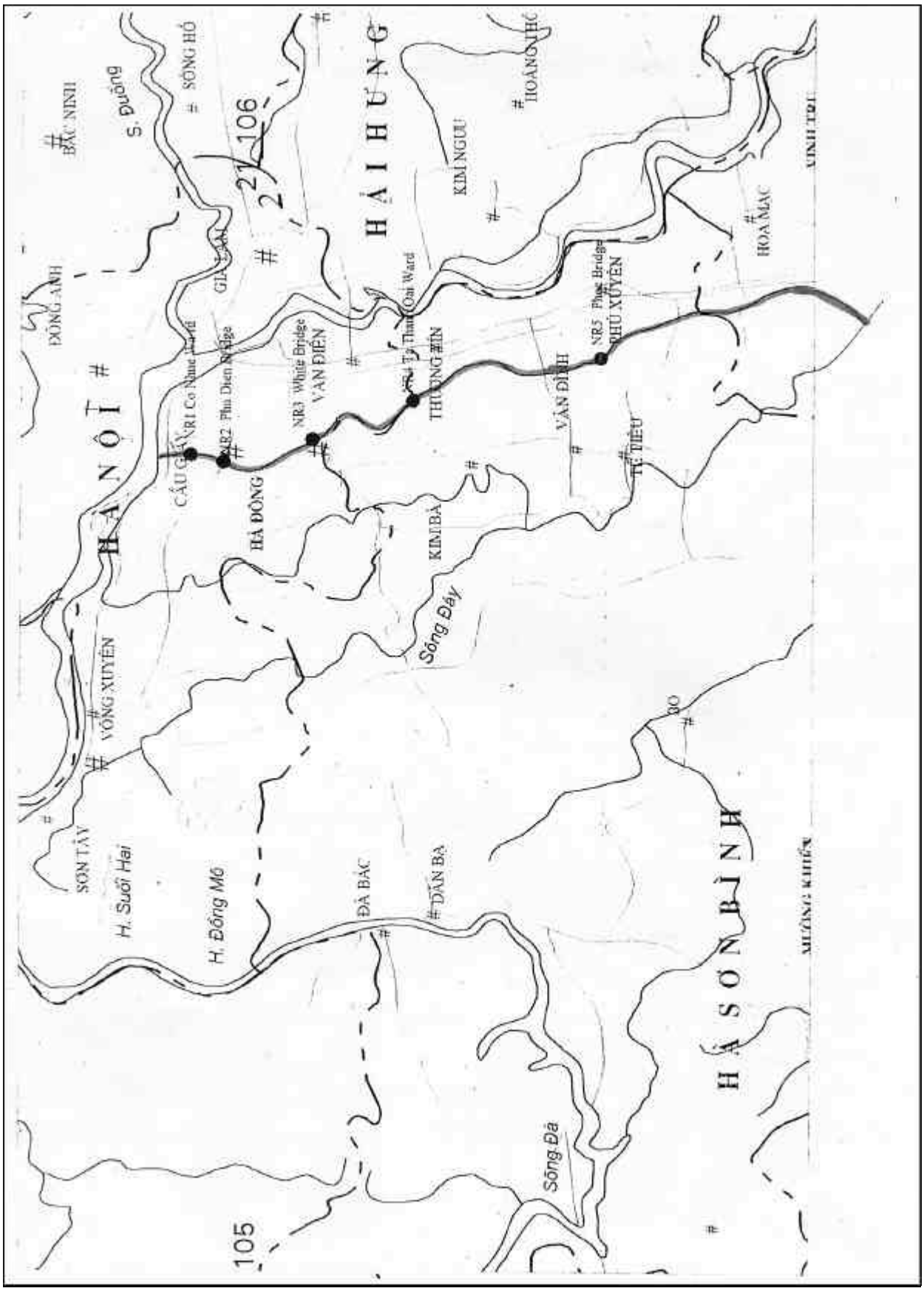


Table 13.4 The Results of River Water Quality Measurement

River name： The Nhue River
Sampling date： Dec.13.1999

N⁰	Items	Unit	Sampling Points				
			R4-1	R4-2	R4-3	R4-4	R4-5
1	Water temperature	℃	20.1	20	19.4	19.6	18.3
2	pH		6.98	7.12	7.1	7.17	7.15
3	Conductivity	mS/cm	0.198	0.199	0.214	0.284	0.245
4	Turbidity	NTU	52	53	59	60	55
5	Oil contents	mg/l	0.16	0.14	0.13	0.15	0.16
6	BOD_5	mg/l	2.2	3.9	5.7	7.3	6.5
7	COD	mg/l	5.6	6.8	8.6	10.4	9.6
8	DO	mg/l	6.3	6.4	6.2	6.5	6.3
9	SS	mg/l	57	55	6.1	6.2	6.8
10	Total Nytrogen	mg/l	6.2	6.2	6.5	6.8	6.3
11	Cyanide	mg/l	$4x10^{-3}$	$<1x10^{-3}$	0.001	0.001	<0.001
12	Phenol	mg/l	$1x10^{-3}$	$3x10^{-3}$	$1x10^{-3}$	$1x10^{-3}$	$3x10^{-3}$
13	Residual Oxygen	mg/l	0.34	0.33	0.36	0.35	0.34
14	Hexavalentchromium	mg/l	0.01	<0.01	0.01	<0.01	<0.01
15	Copper	mg/l	0.01	0.02	0.01	0.29	0.24
16	Iron	mg/l	0.36	0.44	0.42	0.47	0.48
17	Manganese	mg/l	0.3	0.1	0.3	0.2	0.3
18	Zinc	mg/l	0.9	0.13	0.1	0.15	0.17
19	Mercury	mg/l	$5.1x10^{-4}$	$7.5x10^{-4}$	$7.8x10^{-4}$	$8.6x10^{-4}$	$9.3x10^{-4}$
20	Arsenic	mg/l	$9.1x10^{-4}$	$1.73x10^{-3}$	$1.69x10^{-3}$	$1.4x10^{-3}$	$1.6x10^{-3}$
21	Barium	mg/l	0.1	0.105	0.103	0.112	0.105
22	Cadmium	mg/l	$6x10^{-4}$	$5x10^{-4}$	$5x10^{-4}$	$4x10^{-4}$	$1.5x10^{-3}$
23	Lead	mg/l	$3.9x10^{-3}$	$9x10^{-4}$	$8x10^{-4}$	$8x10^{-3}$	$5.2x10^{-3}$
24	Nickel	mg/l	0.135	0.138	0.135	0.07	0.05
25	Tin	mg/l	$1.35x10^{-3}$	$1.95x10^{-3}$	$1.87x10^{-3}$	$1.71x10^{-3}$	$2.23x10^{-3}$
26	Nitric acid ion	mg/l	1.9	1.8	3.6	3.1	2.9
27	Nitrit ion	mg/l	$4x10^{-3}$	$<1x10^{-3}$	$9x10^{-3}$	$12x10^{-3}$	$21x10^{-3}$
28	Ammonia nitrogen	mg/l	0.35	0.27	0.65	2.48	2.09

CAU RIVER SAMPLING POINTS OUTLINE

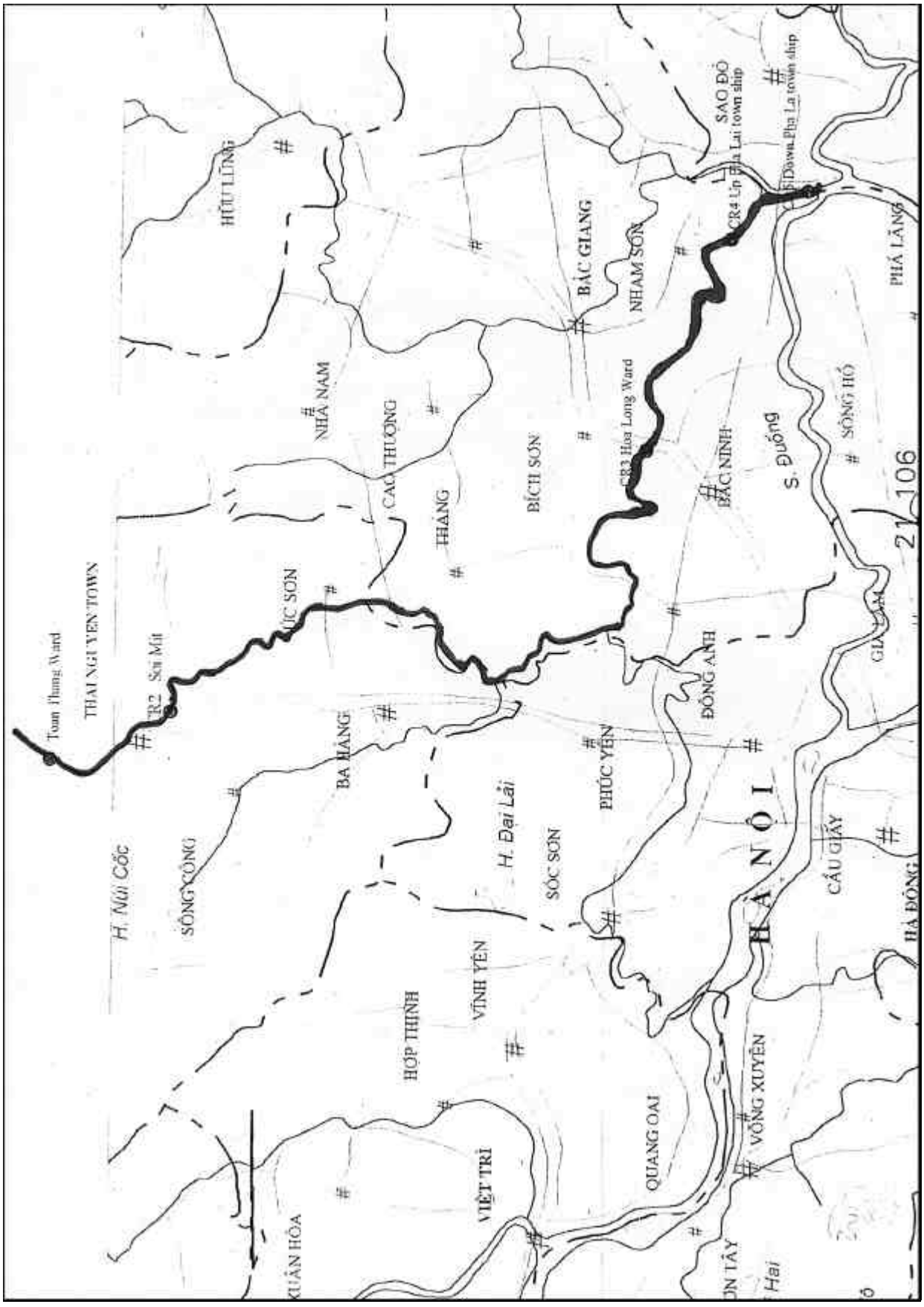


Table 13.5 The Results of River Water Quality Measurement

River Nama：The Cau River
Sampling Date : Dec.28.1999

N⁰	Items	Unit	Sampling Points				
			R5-1	R5-2	R5-3	R5-4	R5-5
1	Water temperature	℃	16.1	18.7	19.1	20.1	20.3
2	pH		6.9	7.2	7.2	7.1	7.0
3	Conductivity	mS/cm	0.18	0.3	0.204	0.199	0.201
4	Turbidity	NTU	4	19	31	26	27
5	Oil contents	mg/l	0.08	0.08	0.1	0.7	0.1
6	BOD_5	mg/l	4	5.2	5.3	5.6	6.3
7	COD	mg/l	7.3	8	7.2	7.5	8.6
8	DO	mg/l	6.8	6.5	6.3	6.9	6.9
9	SS	mg/l	7	26	41	33	37
10	Total Nytrogen	mg/l	3.6	4.2	4.1	3.8	3.6
11	Cyanide	mg/l	$2x10^{-3}$	$7x10^{-3}$	$8x10^{-3}$	$6x10^{-3}$	$9x10^{-3}$
12	Phenol	mg/l	$1x10^{-3}$	$8x10^{-3}$	$3x10^{-3}$	$5x10^{-3}$	$8x10^{-3}$
13	Residual Oxygen	mg/l	0.03	0.13	0.20	0.16	0.17
14	Hexavalentchromium	mg/l	0.01	0.03	0.04	0.03	0.03
15	Copper	mg/l	0.01	0.15	0.23	0.21	0.22
16	Iron	mg/l	0.12	0.21	0.54	0.42	0.38
17	Manganese	mg/l	0.1	0.3	1.0	0.4	0.7
18	Zinc	mg/l	0.2	0.22	0.24	0.25	0.21
19	Mercury	mg/l	$8.7x10^{-4}$	8.10^{-4}	$8x10^{-4}$	$3.3x10^{-4}$	$3.7x10^{-4}$
20	Arsenic	mg/l	$1.87x10^{-3}$	$1.31x10^{-3}$	$1.47x10^{-3}$	$1.26x10^{-3}$	$1.47x10^{-3}$
21	Barium	mg/l	$47x10^{-3}$	$42x10^{-3}$	$45x10^{-3}$	$71x10^{-3}$	$76x10^{-3}$
22	Cadmium	mg/l	$4x10^{-4}$	$4x10^{-4}$	$4x10^{-4}$	$4x10^{-4}$	$4x10^{-4}$
23	Lead	mg/l	$4.7x10^{-3}$	$7x10^{-4}$	$71x10^{-4}$	$5x10^{-4}$	$7x10^{-4}$
24	Nickel	mg/l	0.12	$25x10^{-3}$	$31x10^{-3}$	$118x10^{-3}$	$135x10^{-3}$
25	Tin	mg/l	$1.93x10^{-3}$	$1.85x10^{-3}$	$1.87x10^{-3}$	$1.59x10^{-3}$	$1.67x10^{-3}$
26	Nitric acid ion	mg/l	0.9	1.8	3.0	3.0	3.5
27	Nitrit ion	mg/l	$6x10^{-3}$	$14x10^{-3}$	0.02	0.017	0.018
28	Ammonia nitrogen	mg/l	0.12	0.34	0.42	0.42	0.44

TO LICH RIVER SAMPLING POINTS OUTLINE

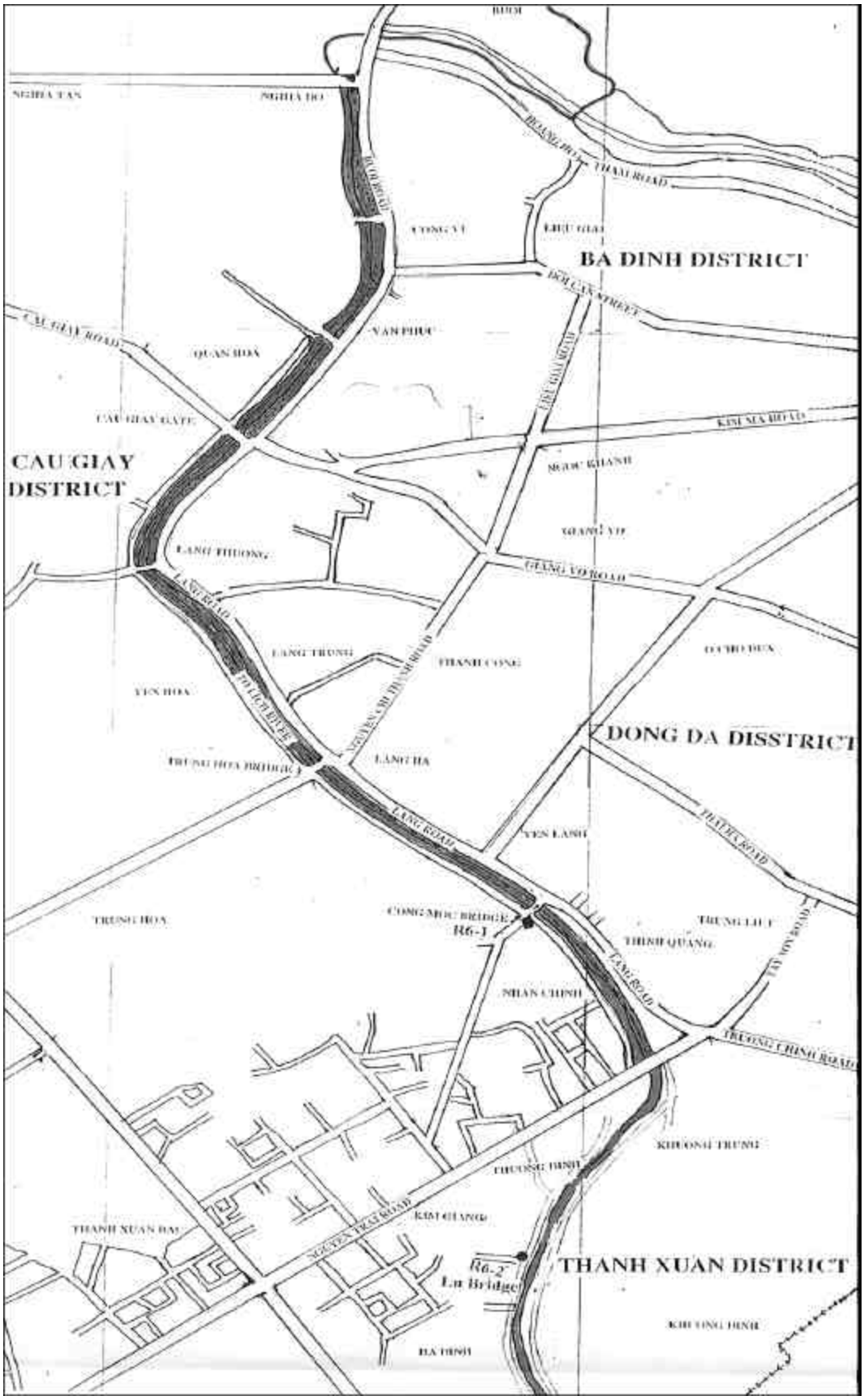


Table 13.6 The Results of River Water Quality Measurement

River Name: the To Lich river
Sampling Date: Jan.10.2000

N⁰	Items	Unit	Sampling Points	
			R6-1	R6-2
1	Water temperature	℃	24.1	24.2
2	pH		6.9	6.72
3	Conductivity	mS/cm	0.703	0.861
4	Turbidity	NTU	33	35
5	Oil contents	mg/l	0.15	0.15
6	BOD_5	mg/l	302	378
7	COD	mg/l	440	535
8	DO	mg/l	3.6	3.8
9	SS	mg/l	41	46
10	Total Nytrogen	mg/l	32	36
11	Cyanide	mg/l	$15x10^{-3}$	$18x10^{-3}$
12	Phenol	mg/l	$1x10^{-3}$	$8x10^{-3}$
13	Residual Oxygen	mg/l	0.34	0.22
14	Hexavalentchromium	mg/l	0.01	0.01
15	Copper	mg/l	0.66	0.63
16	Iron	mg/l	0.48	0.51
17	Manganese	mg/l	1.3	1.8
18	Zinc	mg/l	0.47	0.48
19	Mercury	mg/l	$1x10^{-3}$	$<1x10^{-3}$
20	Arsenic	mg/l	$4x10^{-3}$	$4x10^{-3}$
21	Barium	mg/l	$34x10^{-3}$	$42x10^{-3}$
22	Cadmium	mg/l	$3x10^{-3}$	<1.10
23	Lead	mg/l	$102x10^{-3}$	$125x10^{-3}$
24	Nickel	mg/l	$3x10^{-3}$	$13x10^{-3}$
25	Tin	mg/l	$11x10^{-3}$	$4x10^{-3}$
26	Nitric acid ion	mg/l	8.8	9.3
27	Nitrit ion	mg/l	$39x10^{-3}$	$54x10^{-3}$
28	Ammonia nitrogen	mg/l	29.375	30.65

KIM NGUU RIVER SAMPLING POINTS OUTLINE

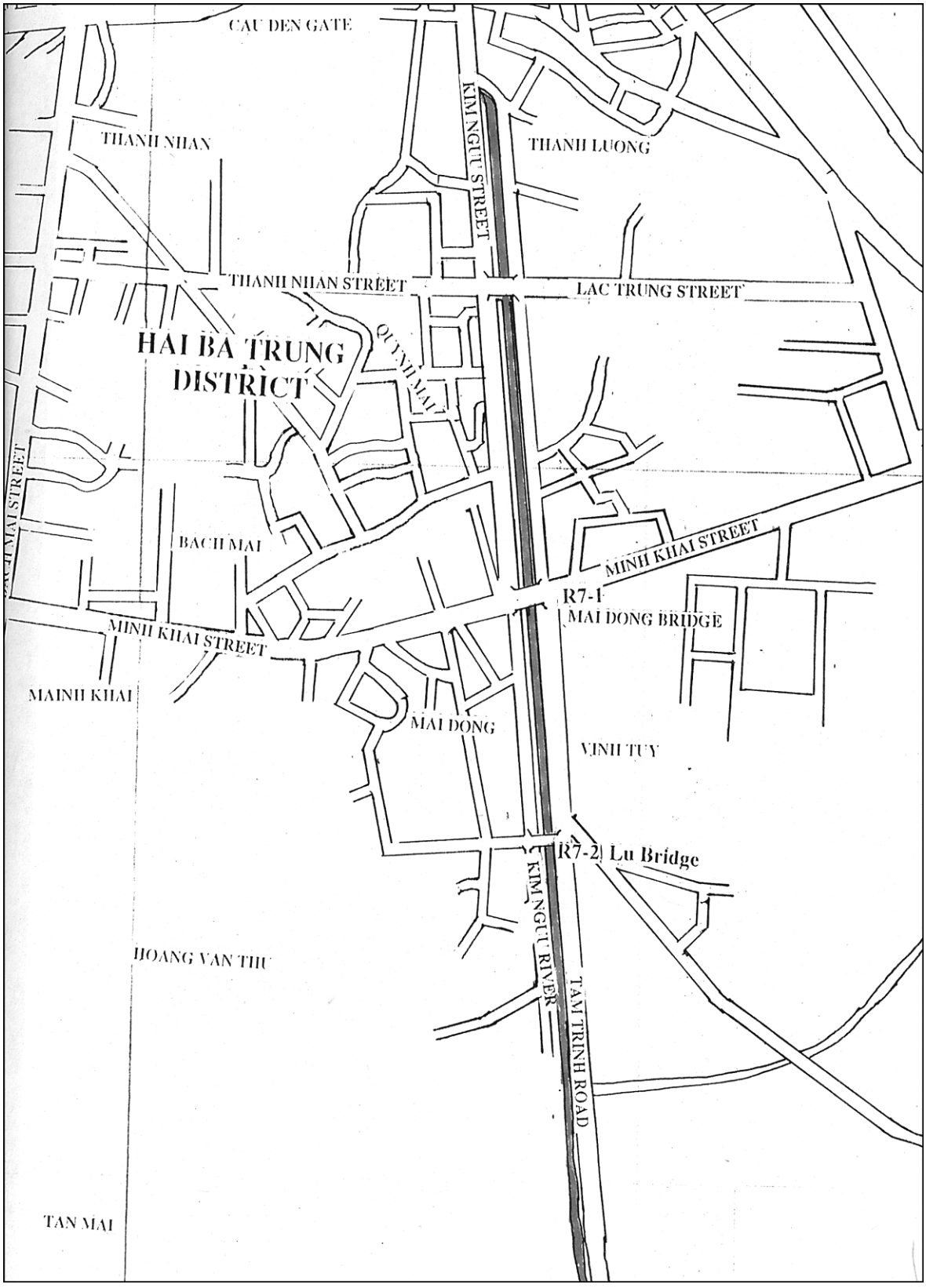


Table 13.7 The Results of River Water Quality Measurement

River name： the Kim Nguu River
Sampling Date：Jan.6.2000

N⁰	Items	unit	Sampling Points	
			R7-1	R7-2
1	Water temperature	℃	24.3	24.0
2	p H		6.79	6.69
3	Conductivity	mS/cm	0.832	0.694
4	Turbidity	NTU	37	42
5	Oil contents	mg/l	0.21	0.20
6	BOD_5	mg/l	115	136
7	COD	mg/l	160	200
8	DO	mg/l	3.8	4.2
9	SS	mg/l	46	53
10	Total Nytrogen	mg/l	25.17	28.2
11	Cyanide	mg/l	$8x10^{-3}$	$6x10^{-3}$
12	Phenol	mg/l	$25x10^{-3}$	$20x10^{-3}$
13	Residual Oxygen	mg/l	0.37	0.43
14	Hexavalentchromium	mg/l	0.03	0.01
15	Copper	mg/l	0.66	0.84
16	Iron	mg/l	0.45	0.49
17	Manganese	mg/l	2.3	2.6
18	Zinc	mg/l	0.38	0.54
19	Mercury	mg/l	$<1x10^{-3}$	$1x10^{-3}$
20	Arsenic	mg/l	$<1x10^{-3}$	$1x10^{-3}$
21	Barium	mg/l	<0.01	<0.01
22	Cadmium	mg/l	$4x10^{-3}$	$5x10^{-4}$
23	Lead	mg/l	$42x10^{-3}$	$855x10^{-3}$
24	Nickel	mg/l	$5x10^{-3}$	$11x10^{-3}$
25	Tin	mg/l	$<1x10^{-3}$	$8x10^{-3}$
26	Nitric acid ion	mg/l	9.2	9.1
27	Nitrit ion	mg/l	$47x10^{-3}$	$53x10^{-3}$
28	Ammonia nitrogen	mg/l	21.375	26.5

Table13.8 Maximum Allowable Concentration of Pollutants in Surface Water
(TCVN5942-1995)

No	Parameter and substance	Unit	Limitation value	
			A	B
1	pH value	-	6～8.5	5.5～9
2	BOD_5(20℃)	mg/l	＜4	＜25
3	COD	mg/l	＜10	＜35
4	Dissolved oxygen	mg/l	≧6	≧2
5	Suspended solids	mg/l	20	80
6	Arsen	mg/l	0.05	0.1
7	Barium	mg/l	1	4
8	Cadimium	mg/l	0.01	0.02
9	Lead	mg/l	0.05	0.1
10	Chromium, Hexavalent	mg/l	0.05	0.05
11	Chromium, Trivalent	mg/l	0.1	1
12	Copper	mg/l	0.1	1
13	Zinc	mg/l	1	2
14	Manganese	mg/l	0.1	0.8
15	Nickel	mg/l	0.1	1
16	Iron	mg/l	1	2
17	Mercury	mg/l	0.001	0.002
18	Tin	mg/l	1	2
19	Ammonia (as N)	mg/l	0.05	1
20	Fluoride	mg/l	1	1.5
21	Nitrate (as N)	mg/l	10	15
22	Nitrite (as N)	mg/l	0.01	0.05
23	Cyanide	mg/l	0.01	0.05
24	Phenol compounds	mg/l	0.001	0.02
25	Oil and grease	mg/l	not detect	0.3
26	Detergent	mg/l	0.5	0.5
27	Coliform	MPN/100ml	5000	10000
28	Total pesticides (except DDT)	mg/l	0.15	0.15
29	DDT	mg/l	0.01	0.01
30	Gross alpha activity	Bq/l	0.1	0.1
31	Gross beta activity	Bq/l	1.0	1.0

Note:

1 Values in column A are applied to the surface water using the source of domestic water supply with appropriate treatments.

2 Values in column B are applied to the surface water used for purposes other than the domestic water supply. Quality criteria of water for aquatic life are specified in a separate standard

Table13.9 Maximum Allowable Concentrations of Pollutants in Coastal Water
(TCVN5943-1995)

No	Parameter and substance	Unit	Limitation values		
			Bathing and recreation area	Aquatic cultivation area	Others
1	Temperature	℃	30	-	-
2	Odor		Unobjectionable	-	-
3	pH value		6.5～8.5	6.5～8.5	6.5～8.5
4	Disolved solid	mg/l	≧4	≧5	≧4
5	BOD_5 (20℃)	mg/l	＜20	＜10	＜20
6	Suspended solid	mg/l	25	50	200
7	Arsen	mg/l	0.05	0.01	0.05
8	Ammonia (as N)	mg/l	0.1	0.5	0.5
9	Cadmium	mg/l	0.005	0.005	0.01
10	Lead	mg/l	0.1	0.05	0.1
11	Chromium(Ⅵ)	mg/l	0.05	0.05	0.05
12	Chromium(Ⅲ)	mg/l	0.1	0.1	0.2
13	Chloride	mg/l	-	0.01	-
14	Copper	mg/l	0.02	0.01	0.02
15	Fluoride	mg/l	1.5	1.5	1.5
16	Zinc	mg/l	0.1	0.01	0.1
17	Manganese	mg/l	0.1	0.1	0.1
18	Iron	mg/l	0.1	0.1	0.3
19	Mercury	mg/l	0.005	0.005	0.01
20	Sulfide	mg/l	0.01	0.005	0.01
21	Cyanide	mg/l	0.01	0.01	0.02
22	Phenol compounds	mg/l	0.001	0.001	0.002
23	Oil and fat film	mg/l	none	none	0.3
24	Oil and fat suspension	mg/l	2	1	5
25	Total pesticides	mg/l	0.05	0.01	0.05
26	Coliform	MPN/100ml	1000	1000	1000

Table13.10 Maximum Allowable Concentrations of Pollutants in Ground Water
(TCVN5944-1995)

No	Parameter and pollutant	Unit	Limitation value
1	pH value		6.5～8.5
2	Colour	Pt-Co	5～50
3	Hardness (as $CaCo_3$)	mg/l	300～500
4	Total solids	mg/l	750～1500
5	Arsenic	mg/l	0.05
6	Cadmium	mg/l	0.01
7	Chloride	mg/l	200～600
8	Lead	mg/l	0.05
9	Chromium(VI)	mg/l	0.05
10	Cyanide	mg/l	0.01
11	Copper	mg/l	1.0
12	Fluoride	mg/l	1.0
13	Zinc	mg/l	5.0
14	Manganese	mg/l	0.1～0.5
15	Nitrate	mg/l	45
16	Phenol compound	mg/l	0.001
17	Iron	mg/l	1～5
18	Sulphate	mg/l	200～400
19	Mercury	mg/l	0.001
20	Selenium	mg/l	0.01
21	Fecal Coliform	MPN/100ml	Not detectable
22	Coliform	MPN/100ml	3

Table13.11 Maximum Allowable Concentration of Industrial Wastewater Pollutants

(TCVN5945-1995)

No	Parameters and substances	Unit	Limitation		
			A	B	C
1	Temperature	°C	40	40	45
2	pH value	-	6〜9	5.5〜9	5〜9
3	BOD_5 (20°C)	mg/l	20	50	100
4	COD	mg/l	50	100	400
5	Suspended solids	mg/l	50	100	200
6	Arsenic	mg/l	0.05	0.1	0.5
7	Cadmium	mg/l	0.01	0.02	0.5
8	Lead	mg/l	0.1	0.5	1
9	Residual Chlorine	mg/l	1	2	2
10	Chromium (VI)	mg/l	0.05	0.1	0.5
11	Chromium (III)	mg/l	0.2	1	2
12	Mineral oil and fat	mg/l	not detect	1	5
13	Animal-vegetable fat and oil	mg/l	5	10	30
14	Cooper	mg/l	0.2	1	5
15	Zinc	mg/l	1	2	5
16	Manganese	mg/l	0.2	1	5
17	Nickel	mg/l	0.2	1	2
18	Organic phosphorous	mg/l	0.2	0.5	1
19	Total phosphorous	mg/l	4	6	8
20	Iron	mg/l	1	5	10
21	Tetrachloroethylene	mg/l	0.02	0.1	0.1
22	Tin	mg/l	0.2	1	5
23	Mercury	mg/l	0.005	0.005	0.01
24	Total nitrogen	mg/l	30	60	60
25	Trichloroethylene	mg/l	0.05	0.3	0.3
26	Ammonia (as N)	mg/l	0.1	1	10
27	Fluoride	mg/l	1	2	5
28	Phenol	mg/l	0.001	0.05	1
29	Sulfide	mg/l	0.2	0.5	1
30	Cyanide	mg/l	0.05	0.1	0.2
31	Coliform	MPN/100ml	5,000	10,000	-
32	Gross alpha activity	Bq/l	0.1	0.1	-
33	Gross beta activity	Bq/l	1.0	1.0	-

a) A category is used for cases where wastewater is discharged into drinking water areas.

b) B category is used in cases where wastewater is discharged into non-drinking, public use water areas.

c) C category is adopted for public use water areas that do not belong to category A or B.

References
「Report On Environmental Status In Vietnam 1998」
「Vietnam Environmental Standard : TCVN-1995」

13.2 Other Pollution Conditions

(1) Air pollution

According to a monitoring survey carried out in 1997, air quality in Vietnam is seriously polluted by soot and dust. At most of the cities monitored, including Hanoi, Hai Phong, Ha Long, Hue, Da Nang, and Ho Chi Minh, SPM exceeds acceptable levels (Daily average: 0.2 mg/m^3 or below) by 1.5 to 3.0 times. In particular, the levels in areas adjacent to industrial zones exceed the acceptable levels by a factor of between two and four. The most polluted areas are those near cement plants in Hanoi and Hai Phong and brick kilns in Lao Cai.

The burning of fossil fuels, such as coal and petroleum, to power industrial activity and automobile transportation generates air pollutants such as sulfur dioxide, nitrogen oxides, and carbon monoxide. According to air monitoring surveys conducted in 16 provinces in Vietnam in 1997, the concentrations of these pollutants were below the maximum acceptable level in residential areas. However, high concentrations of these pollutants were identified in areas surrounding industrial zones and areas with heavy traffic. Measurements taken in 17 industrial zones demonstrate that cement plants in Hai Phong, brick plants in Lao Cai, the Thuong Dinh industrial zone in Hanoi, Tan Binh in Ho Chi Minh, and the Phuoc Long industrial zone show up to double the amount of the maximum acceptable level of sulfur dioxide (daily average: 0.3 mg/m^3 max). Other areas that were measured show concentrations to be below the maximum acceptable level, demonstrating low levels of pollution.

Vietnam has been measuring acid rain caused by sulfur dioxide and nitrogen oxides in the air since 1995 (only at one measuring post in the Lao Cai area at present). In 1996, 11 out of 260 samples detected acid rain with a pH of below 5.5. In 1997, 130 out of 435 samples showed a pH of below 5.5, which is about a 7-fold increase compared to the previous year. This indicates that contamination by acid rain is worsening. However, the specific causes of acid rain in Vietnam have not yet been identified.

(2) Waste and sewerage

Waste disposal is increasingly becoming a serious problem in Vietnam as industrialization and urbanization continue to progress, and countermeasures need to be taken immediately. According to a 1997 survey, 11,700 tons of solid waste (out of which 2,500 tons are industrial waste) is generated daily. Half of this waste is generated from four centrally-administered cities, including Hanoi. A waste treatment plant with a daily capacity of 200 tons is under construction at Tran Dai in Bien Hoa City. A medical waste treatment plant with an annual treatment capacity of 16,000 m^3 is also under construction at Cau Dien in Ho Chi Minh City. At present, medical waste is incinerated in Ho Chi Minh City, and the installation of waste incinerators at many national and provincial general hospitals is being considered.

With regard to sewerage systems, treatment of sludge is a problem. However, no specific measures have yet been taken. Sewerage systems in urban areas and industrial zones have not improved much, with only an average of 50 to 60% of sewage being collected. In addition, the sewerage system is not separate, and thus all sorts of wastewater including storm water, excrement, household wastewater, and industrial wastewater, are discharged together into the sewerage system. Few cities and industrial zones have installed incinerators for toxic industrial waste in spite of the increasing volume of sewerage water and toxic substances, and this has led to water pollution and soil contamination. Improved sewerage systems are also urgently required for health and sanitation reasons.

(3) Noise pollution

According to a traffic noise measurement survey conducted at 23 national highways and 21 urban roads in the three years between 1995 and 1997, the average daily noise level along roads was 70 dB. Noise levels in cities measured are trending upwards. Trunk roads in Hanoi, Hai Phong, Da Nang, and Ho Chi Minh City demonstrated the highest noise level, a level which exceeded 90 dB. The chief causes of this noise level are thought to be the prevalence of older motorized vehicles, and the frequent speed adjustment and use of horns due to the inappropriate design of roads.

Chapter 14

Current Trends Related to the Environment

Chapter 14 Current Trends Related to the Environment

14.1 Laws and Regulations on Environmental Protection

14.1.1 Laws Related to Environmental Protection

The Environmental Protection Law that was enacted in Dec 1993 states the importance of preserving and managing the environment, and calls for human rights protection and improvement of the national environmental management ability, and so on as follows:

「The environment is of special importance to the life of humans and other living creatures, as well as to the economic, cultural and social development of the country, the nation and mankind as a whole.

This law is established in order to raise the effectiveness of state management and the responsibilities of the administration at all levels of state agencies, economic and social organizations, units of the People's Armed Forces and all individuals with respect to Environmental protection, with the vision of protecting the health of the people. It ensures the right of everyone to live in a healthy environment and serve the course of sustainable development of the country, thus contributing to the protection of the regional and global environment.

Pursuant to Article 29 and Article 84 of the 1992 Constitution of the Socialist Republic of Vietnam.」

This law provides for the protection of the environment.

Chapter I

General Provisions

Article 1

The environment comprises closely interrelated national factors and man made material factors that surround human beings and affect life, production, and the existence and development of man and nature.

Environmental protection, as stipulated in this law, includes activities aimed at preserving a healthy, clean and beautiful environment, improving the environment, ensuring ecological balance, preserving and overcoming the adverse impact of man and nature on the environment, making a rational and economical exploitation and utilization of natural resources.

Article 2

For this law the below cited terms shall have the following meanings.

1. "Components of the environment" mean factors that constitute the environment, air, water, soil, sound, light, the earth's interior, mountains, forests, rivers, lakes, sea, living organisms, ecosystems, population areas, production centers, nature reserves, natural landscapes, famed beauty spots,

historical vestiges, and other physical forms.

2. "Wastes" mean substances discharged from dairy life, production processes or other activities. "Wastes" may take a solid, gaseous, liquid, or other forms.
3. "Pollutants" mean factors that render the environment noxious.
4. "Environmental pollution" means alternation in the properties of the environment, violating environmental standards.
5. "Environmental degradation" means qualitative and quantitative alternation in the component of the environment, adversely affecting man's life and nature.
6. "Environmental incidents" mean events or mishaps occurring in the process of human activities, or abnormal changes of nature causing serious environmental degradation. Environmental incidents may be caused by;
    1) Storms, flood, drought, earth cracks, earthquakes, landslides, ground subsidence, volcanic eruptions acid rain, hail, climate changes and other natural calamities.
    2) Fires, forest fires, technical failures at production or business establishments, or in economic, scientific, technical, cultural, social, security or defense facilities, causing damage to the environment.
    3) Accidents in prospecting, exploration, exploitation or transportation of minerals or oil and gas, pit collapse, oil spouts, and spills, pipeline breaks, shipwrecks, accidents at oil refineries and other industrial establishments.
    4) Accidents in nuclear reactors, atomic power plants, nuclear fuel producing or re- processing plants or radioactive material storages. .
7. "Environmental standards" mean norms and permissible limits set to serve as a basis for the management of the environment.
8. "Clean technology" means a technological process or technical solution either causing no environmental pollution or generating pollutants at the lowest level.
9. "Ecosystem" means a system of groups of living organisms existing and developing together in a given environment, interacting with one another and with that environment.
10. "Biodiversity" means the abundance in gene pools, species and varieties of living organisms and ecosystem in nature.
11. "Environmental impact assessment" (EIA) means the process of analyzing, evaluating and forecasting the effect on the environment by socioeconomic development projects and plans, by production and business establishments, and economic, scientific, technical, medical, cultural, social, security, defense, or other facilities, and proposing appropriate solutions to protect the environment.

Article 3

The state shall exercise unified management of environmental protection through the country, draw up plans for environmental protection, build up capabilities for environmental protection activities at the central and local levels.

The state shall adopt investment policies to encourage organizations and individuals at home and abroad to invest, under different forms, in and apply scientific and technological advances to, environmental protection, and protect their lawful interest their in.

Article 4

The state shall be responsible for organizing the implementation of education, training, scientific and technological research activities and the dissemination of scientific and legal knowledge on environmental protection.

Organizations and individuals shall be liable for participating in the activities mentioned in this Article.

Article 5

The state shall protect national interests with regard to natural resources and the environment.

The state of Vietnam shall broaden cooperative relations with other countries in the world, with foreign organizations and individuals in the field of environmental protection.

Article 6

Environmental protection is the common cause of the entire population.

All organisms and individuals shall have the responsibility to protect the environment , observe the environmental protection legislation, have the right and obligation to detect and denounce any act in breach of the environmental legislation.

All foreign organizations and individuals operating on Vietnamese territory shall abide by Vietnam's environmental protection legislation.

Article 7

Organizations and individuals making use of components of the environment for production or business purpose shall, if necessary, contribute financially to environmental protection.

The government shall regulate the circumstances, levels and modalities for the financial contribution mentioned in this Article.

Any organizations or individuals whose activities cause damage to the environment shall make compensation therefore according to regulations by the law.

Article 8

The National Assembly, the People's Council, the Vietnam Father Front and its member organizations, within the scope of their tasks and powers, shall be

responsible for the control and supervision of the implementation of the environmental protection legislation.

The government and the People's Committees, at all levels, shall be responsible for organizing the implementation of the environmental protection legislation.

Article 9

All acts causing environmental degradation, environmental pollution or environmental incidents, are strictly prohibited.

Chapter II
Prevention and Combat Against Environmental Degradation Environmental Pollution and Environmental Incidents

Article 10

The state offices, within the scope of their functions and tasks, shall be responsible for organizing the investigation, study and evaluation of the existing condition of the environment, periodically reporting to the national Assembly on the current status of the environment for identifying areas of environmental pollution and notifying the public thereof and for drawing up plans for prevention and combat against environmental degradation, environmental pollution and environmental incidents. Organizations and individuals shall have the responsibility to engage in prevention and combat against environmental degradation, environmental pollution and environmental incidents.

Article 11

The state encourages and shall create favorable conditions for all organizations and individuals in the rational use and exploitation of components of the environment, the application of advanced technology and clean technology, the exhaustive use of wastes, the economic use of raw materials and the utilization of renewable energy and biological products in scientific research, production and consumption.

Article 12

Organizations and individuals shall have the responsibility to protect all varieties and species of wild plants and animals, maintain biodiversity and protect forests, seas and all ecosystems.

The exploitation of biological resources must observe their prescribed seasonal characteristics and areas, using proper methods and permitted tools and means in order to ensure their restoration in terms of density, varieties and species, thus preventing ecological imbalance.

The exploitation of forests must comply strictly with plans and specific stipulations of the Law on Forest Protection and Protection and Development. The

state shall adopt plans to involve organizations and individuals in aforestation of waste lands and denuded hills and mountains to quickly expand the forest cover and protect regions attached to water courses.

Article 13

The use and exploitation of nature reserves and natural landscapes must be subject to permission by the sectoral management authority concerned and the State management agency for environmental protection and must be registered with the local People's Committees entrusted with the administrative management of these construction sites.

Article 14

The exploitation of agricultural land, and land for aqua culture must comply with land use plans, land improvement plans and ensure ecological balance. The use of chemicals, chemical fertilizers, pesticides and other biological products must comply with stipulations by law.

In carrying out production and business activities or construction works, measures must be taken to restrict, prevent and combat soil erosion, land subsidence, landslides, soil salinity or sulfation, uncontrolled desalination, laterization and desertification of land, or its transformation into swamps.

Article 15

Organizations and individuals must protect water sources, water supply and drainage systems, vegetation, sanitation facilities and observe the regulations on public hygiene in cities, urban areas, countryside, population centers, tourism centers and production areas.

Article 16

In carrying out production, business and other activities, all organizations and individuals must implement measures for environmental sanitation and have appropriate waste treatment equipment to insure compliance with environmental standards and to prevent and combat environmental degradation, environmental pollution and environmental incidents.

The government shall stipulate the nomenclature of environmental standards and delegate the authority at different levels for promulgating and supervising the implementation of such standards.

Article 17

Organizations and individuals in charge of the management of economic, scientific, technical, health, cultural, social, security and defense establishments that have begun operations prior to the promulgation of this law must submit an E.I.A. report on their respective establishment for appraisal by the State management agency for environmental protection.

In case of failure to meet environmental standards, the organizations or individuals concerned must take remedial measures within a given period of time

as stipulated by the State management agency for environmental protection. Upon expiry of the stipulated time limit, if they still fail to meet the requirements of the State management agency for environmental protection, the latter shall report to the higher State authority at the next level to consider and decide on the suspension of operations or other penalizing measures.

Article 18

Organizations, individuals when constructing, renovating production areas, population centers or economic, scientific, technical, health, cultural, social, security and defense facilities, owners of foreign investment or joint venture projects must submit E.I.A reports to the State management agency for environmental protection for appraisal.

The result of the appraisal of E.I.A. reports shall constitute one of the basis' for competent authorities to approve the project or authorize their implementation.

The government shall stipulate in detail the format for the preparation and appraisal of E.I.A. reports and shall issue specific regulations with regard to special security and defense establishments mentioned in Article 17 and in this article.

The National Assembly shall consider and make decisions on projects with major environmental impact. A schedule of such types of projects shall be determined by the Standing Committee of the National Assembly.

Article 19

The importation and exportation of technologies, machinery, equipment, biological or chemical products, toxic substances, radioactive materials, various species of animals, plants, gene sources and microorganisms relating to the protection of the environment must be subject to approval by the sectoral management agency concerned and the State management agency for environmental protection.

The Government shall stipulate a schedule for each domain and each category referred to in this Article.

Article 20

While searching, exploring, exploiting, transporting, processing, storing minerals and mineral products, including underground water, organizations and individuals must apply appropriate technology and implement environmental protection measures to ensure that environmental standards are met.

Article 21

While searching, exploring, exploiting, transporting, processing, storing oil and gas, organizations and individuals must apply appropriate technology, implement environmental protection measures, develop preventive plans against oil leakage, oil spills, oil fires and explosions and dispose necessary facilities to respond timely to those incidents.

The use of toxic chemicals in the process of searching, exploration, exploitation and processing of oil and gas must be guaranteed by technical certificates and be subject to the control and supervision by the State management agency for environmental protection.

Article 22

Organizations, individuals operating means of water, air, road, rail transports must observe environmental standards and be subject to the supervision and periodic inspection for compliance with environmental standards by the relevant sectoral management agency and the State management agency for environmental protection. The operation of transport means failing to meet stipulated environmental standards shall not permitted.

Article 23

Organizations, individuals producing, transporting, trading, using, string, or disposing of toxic substances, must comply with regulations on safety for human and other living beings and must avoid causing environmental degradation, pollution or incidents.

The government shall stipulate a list of toxic, inflammable or explosive substances mentioned in this Article.

Article 24

The siting, design, construction and operation of plants in the nuclear industry, of nuclear reactors, facilities for nuclear research, for the production, transportation, utilization and storage of radioactive materials, for the disposal of radioactive wastes must comply with legal provisions on nuclear safety and radiation and with regulations by the State management agency for environmental protection.

Article 25

Organizations, individuals making use of machinery, equipments, materials with harmful electromagnetic radiation or ionizing radiation must comply with legal provisions on radiation safety and must carry out regular checks and environmental impact assessment of their facilities and report periodically to the State management agency for environmental protection.

Article 26

The choice of sites for collecting, dumping and treating refuse or pollutants and their transportation must comply with regulation by the State management agency for environmental protection and by the local authorities concerned.

Wastewater, refuse containing toxic substances, pathogenic agents, inflammable or explosive substances, non-degradable wastes, must be properly treated before discharge. The State management agency for environmental protection shall stipulate a schedule of wastewater and refuse mentioned in this Article and supervise their treatment process before discharge.

Article 27

The burial, lying in state, embalmment, interring cremation and transport of corpses or remains of the dead must utilize progressive methods and means and comply with provisions of the Law on Protection of Public Health to ensure environmental hygiene.

The Administration at all levels must plan for burial, cremation sites and guide people to gradually abandon backward practices.

Cemeteries, crematoria must be located far away from population areas and sources of water.

Article 28

Organizations, individuals, in the course of their activities must not cause noise and vibrations that exceed permissible limits, harming the health of surrounding people and adversely affecting their life.

The People's Committee at all levels shall be responsible for the implementation of noise control measures in areas of hospitals, schools, public offices and residential quarters.

The government shall promulgate regulations to restrict, and to proceed towards the strict prohibition of the production and firing of firecrackers

Article 29

The following activities are strictly prohibited;

1. Burning and destruction of forests, uncontrolled exploitation of minerals leading to environmental damage, destroying ecological balance.
2. Discharge of smoke, dust, noxious gas, bad odors causing harm to the atmosphere, emission of radiation, radioactivity exceeding permissible limits into the surrounding environment.
3. Discharge of grease or oil, toxic chemicals, radioactive substances exceeding permissible limits, wastes, dead animals or plants, harmful and infective bacteria and viruses into water sources.
4. Burial, discharge of toxic substances exceeding permissible limits into the soil.
5. Exploitation, trading in precious or rare species of plants and animals identified in the schedule stipulated by the Government.
6. Importation of technology and equipment not meeting environmental standards, importation, exportation of wastes.
7. Use of methods, means, instruments causing massive destruction in exploiting or harvesting animal and plant resources.

Chapter Ⅲ
Remedy of Environmental Degradation, Environmental Pollution, Environmental Incidents

Article 30

Organizations, individuals engaged in production, business and other activities that cause environmental degradation, environmental pollution, environmental incidents must implement remedial measures as specified by the local People's Committee and by the State management agency for environmental protection, and shall be liable for damages according to regulations by the law.

Article 31

Organizations, individuals allowing radioactivity, electromagnetic radiation, ionising radiation to exceed permissible limits must take immediate measures to control and remedy the consequences, make timely report to the relevant sectoral management agency and to the State management agency for environmental protection, as well as to the local People's Committee to solve the problem.

Article 32

The Remedy of an environmental incident includes ; eliminating the cause of the incident; rescuing people and property; assisting, stabilizing the life of the people; repairing damaged facilities; restoring production; sanitizing the environment, preventing and combating epidemics; investigating, collecting statistics on damages, monitoring changes to the environment; rehabilitating the environment of the affected area.

Article 33

Persons who detect signs of an environmental incident must immediately notify the People's Committee, the nearest agency or organization for timely action.

Organizations, individuals at the site of the environmental incident must take appropriate measures to timely remedy it and immediately report to a superior administrative authority, the nearest People's Committee and the State management agency for environmental protection.

Article 34

The chairman of the People's Committee of the locality where the environmental incident occurs is empowered to order an emergency mobilization of man power, materials and other means for remedial actions.

If the environmental incident occurs in an area covering several localities, the Chairman of the respective local People's Committee shall cooperate to take remedial actions.

In case the incident is beyond local remedy capability, the Minister of Science, Technology and Environment, in conjunction with the heads of the agencies concerned, shall determine the application of remedial measures and report to the

Prime Minister.

Article 35

In case the environmental incident is of special severity, the Prime Minister shall determine the application of urgent remedial measures.

When such incident has been brought under control, the Prime Minister shall determine the revocation of application of urgent remedial measures.

Article 36

The agencies which are empowered to mobilize manpower, materials and other means to remedy environmental incidents must reimburse the mobilized organizations and individuals for their expenses according to regulations by the law.

ChapterⅣ
State Management of Environmental Protection

Article 37

The scope of State management of environmental protection includes;

1. Promulgating and organizing the implementation of statutory instruments on environmental protection, promulgating systems of environmental standards.
2. Developing and guiding the implementation of strategies and policies of environmental protection, plans to prevent, control and remedy environmental degradation, environmental pollution, environmental incidents.
3. Establishing and managing environmental protection facilities and facilities relating to environmental protection.
4. Organizing, establishing and managing monitoring systems periodically assisting the current state of the environment forecasting environmental changes.
5. Appraising E.I.A. reports on projects and on production or business establishments.
6. Issuing, revoking of certificates of compliance with environmental standards.
7. Supervising, inspecting, checking the observance of environmental protection legislation; settling disputes, appeals or complaints concerning environmental protection; dealing with breaches of environmental protection legislation.
8. Training personnel in environmental science and management; education, propagandizing, disseminating knowledge and legislation.
9. Organizing research and development activities and application of scientific and technological advances in the field of environmental protection.
10. Developing international relations in the field of environmental protection.

Article 38

The Government shall, pursuant to its power and responsibility, exercise unified State management of environmental protection throughout the country.

The Ministry of Science, Technology and Environment shall be responsible to the government for exercising the function of State management of environmental protection.

All ministries, ministry-level agencies and other Government bodies shall, within the scope of their respective functions, powers and responsibilities, cooperate with the Ministry of Science, Technology and Environment in carrying out environmental protection within their sectors and inestablishments under their direct supervision.

The People's Committee of provinces and cities directly under the Central Government shall exercise their state management function for environmental protection at the local level.

The services of Science, Technology and Environment shall be responsible to the People's Committee of provinces and cities directly under the Central Government, for environmental protection in their localities.

Article 39

The system of organization, functions, responsibilities and powers of the State management agency for environmental protection shall be determined by the Government.

Article 40

The State management agency for environmental protection shall carry out its function of specialized inspection on environmental protection and be responsible to coordinate with specialized inspectors of the ministers and sectors concerned in the protection of the environment.

The organization, obligations, powers, activities and coordination of specialized inspectors in the protection of the environment shall be determined by the Government.

Article 41

During the inspection process, the Inspection Team or Inspector is empowered to;

1.Require the organizations, individuals concerned to provide documents and reply to questions on matters necessary for inspection.

2.Conduct technical control measures on site.

3.Decide to temporarily suspend, in case of emergency, activities which threaten to cause serious environmental incidents and be responsible for such decision before the law, and at the same time, immediately report the case to the competent State agency for decision or send a letter recommending that activities likely to cause environmental incidents be suspended.

4.Deal within their competence or recommend a competent State agency to deal with breaches of the law.

Article 42

Organizations, individuals must create favorable conditions for the Inspection Team or the Inspector to carry out their functions and must observe the decisions of the Inspection Team or the Inspector.

Article 43

Organizations, individuals are entitled to appeal to the Head of the agency which rules on the conclusions and decisions of the inspection adopted by the Inspection Team or the Inspector with regard to their establishments.

Organizations, individuals have the right to complain, or announce to the State management agency for environmental protection or other competent State agencies about activities in breach of environmental protection legislation.

Agencies receiving complaints or reports of breaches of the Environmental Protection Law shall be responsible for their examination and resolution in accordance with regulations covered by the law.

Article 44

In case there are several organizations, individuals operating within an area where environmental incidents, environmental pollution or environmental degradation occur, the power to determine the responsibility assigned to those organizations, individuals for remedial measures is defined as follows.

1. For environmental incidents, environmental pollution or environmental degradation occurring within a province or a city directly under the Central Government, the responsible parties shall be determined by the specialized environmental protection inspector of that province, city, or be proposed and reported through a letter to the Chairman of the People's Committee of that province or city for consideration and decision. If one or more parties disagree with that decision, they shall be entitled to appeal to the Minister of Science, Technology and Environment. The decision of the Minister of Science, Technology and Environment shall prevail.
2. For environmental incidents, environmental pollution or environmental degradation occurring in two or more provinces or cities directly under the Central Government, the responsible parties shall be determined by the specialized environmental protection inspector of the Minister of Science, Technology and Environment or be proposed and reported through a letter to the Minister of Science, Technology and Environment for consideration and decision. If one or more parties disagree with the decision of the Minister of Science, Technology and Environment, they shall be entitled to appeal to the Prime Minister for decision.

Chapter V

International Relations with respect to Environmental Protection

Article 45

The Government of Vietnam shall implement all international treaties and conventions relating to the environment which it has signed or participated in, honor all international treaties and conventions on environmental protection on the basis of mutual respect for each other's independence, sovereignty, territorial integrity and interests.

Article 46

The Government of Vietnam adopts priority policies towards countries, foreign organizations and individuals with respect to environmental manpower training, environmental scientific research, clean technology application, development and implementation of projects for environmental improvement, control of environmental incidents, environmental pollution, environmental degradation and projects for waste treatment in Vietnam.

Article 47

Organizations, individuals and owners of transportation means which, in transit through the Vietnamese territory, carry potential sources of environmental incidents or environmental pollution must apply for permission, declare and submit to the control and supervision of the State management agency for environmental protection of Vietnam. Any breach of Vietnamese environmental protection legislation shall, depending on the extent of the infringement, be dealt with according to Vietnamese law.

Article 48

Any dispute concerning environmental protection on the Vietnamese territory in which one or all parties are foreigners shall be settled according to Vietnamese law, taking into account international laws and practices.

Any dispute between Vietnam and other countries in the field of environmental protection shall be settled on the basis of negotiation, taking into account international laws and practices.

Chapter VI

Reward and Dealing With Breaches

Article 49

Organizations, individuals having good records in environmental protection activities, in the early detection and timely report of signs of environmental incidents, in the remedy of environmental incidents, environmental pollution, environmental degradation, in the preservation of acts which damage the environment, shall be rewarded. Those who suffer damage to their property, health

or life, while participating in the protection of the environment, in the remedy of environmental incidents, environmental pollution, environmental degradation and in the combat against activities violating environmental protection legislation, shall be compensated according to regulations by the law.

Article 50

Those who commit acts of destruction or cause damage to the environment, who disregard the order of mobilization by the competent State agency upon the occurrence of environmental incidents, who fail to implement regulations on environmental impact assessment, or infringe on other legal provisions for environmental protection shall be dealt with administratively or be criminally prosecuted, depending on the nature and extent of the infringement and the consequences.

Article 51

Those who take advantage of their positions and powers to infringe on environmental protection legislation, to protect persons who are infringing on environmental protection legislation, whose lack of responsibility allows environmental incidents or environmental pollution to occur, shall be disciplined or be criminally prosecuted, depending on the nature and extent of the infringement and consequences.

Article 52

Organizations, individuals that commit acts of violation against the environmental protection legislation , causing damage to the State, to other organizations or to individuals, shall, in addition to the penalties specified in Article 50 and 51 of this Law, make compensation for the damages and costs of remedying the consequences, according to regulations by the law.

ChapterⅦ
Implementation Provisions

Article 53

Domestic or foreign organizations, individuals that have caused serious damage to the environment prior to the promulgation of this Law, with long-term adverse impacts on the environment and the health of the people shall, depending on the extent of the consequences, be liable for the damages and the rehabilitation of the environment, according to regulations by the Government.

Article 54

This Law shall take effect from the date of its promulgation.

All previous stipulations which contradict this Law are revoked.

Article 55

The Government shall regulate in detail the implementation of this Law.

This Law was passed on 27 December 1993 by National Assembly of the Socialist Republic of Vietnam, 9th Legislature, at its 4th Session.

Chairman of National Assembly

14.1.2 Related government decrees and instructions

In line with the enactment and enforcement of the Law on Environmental Protection, government decrees and instructions related to this Law are promulgated to implement environmental policies. Major notices are described below.

1. Government Decree on guidelines for enforcement of the Law (Government Decree No. 175/CP)

   October 18, 1994

   This decree specifies the role and responsibility of the central and municipal governments in promoting environmental policies. In addition, it specifies environmental impact assessment, environmental standards, emissions standards, and regulation of imports and exports with regard to environmental concerns. It also strengthens the authority to impose inspections related to environmental issues, and advocates new environmental expenses and an environmental tax.

2. Instructions on guidelines for entrepreneurs on implementation of environmental impact assessment (Instruction No. 1420/MTg)

   December 26, 1994

3. Decision on promulgation of the environmental assessment committee organization, rules, and certificates (Decision No. 1806/QD-MTg)

   December 31, 1994

4. Decision on issue of promulgation of the environmental assessment committee organization, rules, and certificates (Decision No. 1807/QD-MTg)

   December 31, 1994

5. Government Decree on administrative regulations concerning violation of laws (Government Decree No. 26/CP)

   April 26, 1996

   The Decree intends to reinforce penal provisions for the violation of environmental laws as revealed by environmental impact assessment and inspection, damage to natural resources, the import and export of endangered species, illegal exploration, and underground mining.

6. Decision on issuance of sample documents related to surveys on illegal actions and administrative penalties (Decision No. 1118/QD)
May 28, 1996

7. Instruction on preparation and evaluation guidelines for environmental assessment reports related to investment projects (Instruction No. 1100/TT-Mtg)
August 20, 1997

8. Circular on examination of environmental assessment report related to investment projects (Circular No. 490/1998/TT18-BKHCNMT)
Revision of Instruction No. 1100
April 29, 1998

9. Decision on a taxation system for managing toxic solid waste (Decision No. 155/1999/QD-TTg)
July 25, 1999

10. Others: Instruction on prevention of illegal development of natural resources and trading, guidelines on environmental evaluation of development projects

Socialist Directive (Directive 36-CT/TW)
June 25.1998

A directive issued by the Socialist Party. It intends to reinforce environmental protection in response to increasing industrialization and modernization. It also sets out an action plan, and issues the following instructions to relevant organizations.

(1) National strategy on environmental protection, and sustainable development between 2001 and 2010.
(2) Establishment of an organization management system for environmental protection.
(3) Introduction of environmental education.
(4) Establishment of legal instructions on distribution of investment for environmental protection.
(5) Promotion of measures against serious environmental pollution such as by factories.

14.1.3 Laws related to environmental protection

The following laws related to environmental protection have been issued in Vietnam:

① Law on Foreign Investment; 1986
② Law on Protection of Human's Health; 1989
③ Law on Mineral Resources Exploitation; 1989
④ Maritime Law; 1990
⑤ Law on Forest Protection & Development; 1991
⑥ Petroleum Law; 1993
⑦ Law on Land; 1993
⑧ Mineral Law; 1996
⑨ Law on Water Resource; 1998
⑩ Law on Management of the Tourism Industry, etc.

14.2 Pollution Prevention Projects

The Vietnam-Canada Environment Project (VCEP), with support from the Canadian International Development Agency (CIDA), is advancing in central Vietnam and outlying areas (Hanoi, Hai Phong, and Da Nang cities, and Binh Duong Province). The aim of this project is to develop and train personnel in the various governmental bodies in charge of environment-related matters. One facet of VCEP is the model project called, "Environmental Management in Minh Khai - Vinh Tuy Industrial Area", which has been taking place in Hanoi over a three-year period, between 1997 and 1999. The aim of this project is to provide guidance to DOSTE in Hanoi, for the formulation of practical plans for preventing pollution, to improve the environment in industrial areas, and to train the personnel in charge, by having them learn about how to conduct environmental management in industrial zones. Another objective of the project is to provide an opportunity for the mutual exchange of information during the project's planning and implementation phases, via such means as receiving guidance from the central government's NEA and obtaining cooperation between the local DOI, other governmental bodies, and parties related to the plants and factories.

(1) Cau River Purification Project

The Cau River cuts through six provinces in Vietnam -- Bac, Can, Thai Nguen, Bac Ninh, Hai Duong, Bac Diang, and Vinh Phuc. The Cau River basin is home to 7.5 million people and a wide variety of industries, including chemical, foodstuff, and metal factories; coal, steel and other mining operations; and electrical power plants. This has caused the water in the Cau River basin to become very polluted. To resolve this problem, a project to improve water quality in the Cau River basin

has been implemented by the six provinces involved, MOI, DOSTE, and other central-government bodies.

This project entails a survey on the severity of the industrial pollution, the pinpointing of the main pollutants involved, a forecast of the effects on the environment caused by this pollution, and the formulation and implementation of technical measures to improve the environment.

(2) Cleaner Production support project

The following statements explain outlines related to main Cleaner Production projects.

(Ⅰ) Viet Nam National Cleaner Production Center Project

Funded: 2.52 million US$ (2.50 million US$ by Switzerland and 2 thousand million VD by Viet Nam)

Duration: Phase Ⅰ 1998-2000
Phase Ⅱ 2000-2003

International organization: UNIDO

Counterpart: INEST

Objectives: • To establish VMCPC to become a center of excellence in the field of cleaner production which will be able to play central coordinating and catalytic role in promoting cleaner production concept and to contribute to sustainable industrial development in Viet Nam.
• To train key people working in the field of promoting Cleaner Production in different levels.

Activities: • Training
• In plant demonstration projects
• Awareness raising and Cleaner Production information dissemination
• Policy advice

(Ⅱ) Ho Chi Minh City (HCMC) Environmental Management Project

Funded: 1.64 million US$ by UNDP, including 366 thousand US$ by UNIDO management

Duration: 1998 - 2000

International organization: UNIDO

Counterpart: HCMC DOSTE (Dept. of Science Technology and Environment)

Objectives: In order to develop the HCMC capacity for achieving the environmental sustainability in the face of rapid industrialization and urbanization.

Activities: • Training in country and overseas
• Network for environmental monitoring(Water and air quality)
• Propose mechanism for environmental management of river basins

Note: This project started in August 1998 in HCMC. A project office was set up, and a STA was signed to direct DOSTE. This project follows 2 other projects done in Viet Tri and Dong Nai provinces.

(III) Industrial Pollution Reduction in Viet Tri Province Project

Funded: 1.026 million US$ by UNDP

Duration: 1996-1998

International organization: UNIDO

Counterpart: Viet Tri province, DOSTE
(Dept. of Science Technology and Environment.)

Objectives:
- Reduce negative environmental impacts on region caused by industrial activities in Viet Tri and Dongnai
- Capacity building of environmental monitoring and management for the DOSTEs of these provinces, including laboratory equipment
- Waste auditing form selected industries

(IV) Industrial Pollution Reduction In Dong Nai Province Project

Funded: 974 thousand US$ by UNDP including 646 thousand US$ by UNIDO management

Duration: 1996-1998

International organization: UNIDO

Counterpart: Dong Nai province, Dept. of Science Technology and Environment. (DOSTE)

Objectives: Capacity building of environmental monitoring and management for the DOSTEs in order to improve industrial pollution situation

Activities:
1) List up pollutants and evaluate effects of pollutants
2) Set up countermeasures to decrease industrial pollution in order to fit the international standards for the time being and in the future
3) Conduct the average environment regulations activities
4) Implement plans to promote autonomous control of industrial pollution sources

Achievement:
- provided all the necessary equipment for pollution monitoring and number of staff member was increased from 5 to 8 in DOSTE.
- Conducted training for monitoring about water and air quality management, environmental level and industrial pollutants.
- 2 factories succeeded decreasing pollution by introducing Cleaner Production method.

This project was extended to June 1999, and World Bank is expected to follow up the industrial pollution prevention program after that .

(Ⅴ) Reduction of Industrial Pollution in Ho Chi Minh City Project
Funded: Three hundred thousand US$ by SIDA(Swedish International Development Cooperation Agency)
Duration:1997-1999
International organization: UNIDO
Counterpart: HCMC DOSTE
Objectives: Implement different measures for reducing pollutant generation in wastewater and to apply cleaner production in some industries of three important sectors of pulp and paper, textile, and dyeing and food processing in HCMC.

(Ⅵ) Wastewater Treatment Technology Transfer and CP Demonstration Project
Funded: 985000 AUD by Australia.
Duration: 1998-2000
International organization: Overseas projects corporation of Victoria Ltd., and EPA
Counterparts: NEA and Research Institute of Alcohol, Beer and Beverages of Ministry of Industry
Objectives: 1) To strengthen existing and develop new linkages for water and waste water management, including linkages between industry associations, research organizations and water authorities in Viet Nam.
2) To utilize existing and new treatment to demonstrate appropriate Australian technologies for some industries such as food processing, textile, and distilling , and also for industrial zones.
3) To train on total catchment management techniques and cleaner production, better water use and recycling within industry.
4) To assist with the technology that will allow local industries to develop their ability to produce tailor-made membranes at factory scale in food processing sector.

(Ⅶ) Industrial Pollution Prevention (IPP4) Project
Funded: 7 hundred thousand US$ by World Bank
Duration: 1995-1997(IPP1, IPP2, IPP3), IPP4 (planning)
International organization: UNIDO
Objectives: Implementing IPP in factory scales.
Planned Location: Dong Nai and Hai phong

(Ⅷ) Viet Nam Canada Environmental Project
Funded: by CIDA 7.32 million US$

Duration: 1997-2000(on –going)

Activities: In the second phase of the VCEP project, the number of provinces that will receive the fund will be higher and project focus will be on Cleaner Production implementation.

(IX) Pollution Prevention in the Textile Industry Project

Funded: CIDA (Canadian)

Duration:1995-1996

Counterpart: CEST of Hanoi University of Technology (VCPC)

Objectives: 1) Audit industrial wastewater in some selected textile industries in order to create appropriate suggestions for wastewater minimization.

2) Train environmental and production engineers on waste auditing for textile mills in Hanoi to promote cleaner production in textile sector.

(X) Pollution Prevention Training Course Project

Funded: 35 thousand US$ by SIDA (Sweden)

Duration: two weeks in 1995

Counterpart:MOI

Objectives: To provide basic knowledge of environmental management in industry, waste minimization and waste audit and economics of waste reduction.

(XI) Cleaner Production in Pulp and Paper Mills in Viet Nam Project

Funded: by UNEP

Duration: 1996-1997

Counterpart: Hanoi University of Technology and MOI

Objectives: Demonstrate Cleaner Production Assessment at selected paper mills and conduct training courses on Cleaner Production in this sector

Chapter 15

Hypothesized Effects of Countermeasures

Chapter 15 Logical Hypothesis on Countermeasure Effects

15.1 Evaluation of Regulation

15.1.1 Wastewater standard

In Vietnam, TCVN 5945-1995 was established in 1995, and is in effect as the effluent standard for controlling industrial wastewater. In comparison to Japan (refer to Table 15.1), as for the control of items that are hazardous to human health such as cyanide and cadmium, 24 substances are subject to such controls in Japan, while only 9 substances are subject to such controls in Vietnam. Control subjects are more limited in Vietnam. From now on, it may be necessary to review the items subject to control, including organochlorine compound, which may be generated as industrialization and modernization proceed. Comparing the standard concentrations of 9 substances being controlled in both Japan and Vietnam with each other, we find that the standards are arranged in classes A, B and C in Vietnam. In the most stringent class A, the standards for the 2 substances of lead and mercury are the same as those in Japan, but with regard to the standards concerning the other 7 substances, the standards in Vietnam are more stringent than those in Japan.

Table 15.1 Comparison of Wastewater Standards（Health Related Items）

Items	Japan	Viet Nam		
		A	B	C
Cadmium	0.1	0.01	0.02	0.5
Cyanoge	1	0.05	0.1	0.2
Organic Phosphorus	1	0.2	0.5	1
Lead	0.1	0.1	0.5	1
Hexavalent chromium	0.5	0.05	0.1	0.5
Arsenic	0.1	0.05	0.1	0.5
Mercury	0.005	0.005	0.005	0.01
Alkyl mercury	Not Detectable	—	—	—
PCB	0.03	—	—	—
Trichloroethylene	0.3	0.05	0.3	0.3
Tetrachloroethylene	0.1	0.02	0.1	0.1
Carbon Tetrachloride	0.02	—	—	—
Dichloromethane	0.2	—	—	—
1,2-Dichloroethane	0.04	—	—	—
1,1-Dichloroethylene	0.2	—	—	—
cis-1,2－Dichloroethylene	0.4	—	—	—
1,1,1-Trichloroethane	3	—	—	—

Items	Japan	Viet Nam		
		A	B	C
1,1,2-Trichloroethane	0.06	—	—	—
1,3-Dichloropropene	0.02	—	—	—
Thiuram	0.06	—	—	—
Simazine	0.03	—	—	—
Thiobencarb	0.2	—	—	—
Benzene	0.1	—	—	—
Selenium	0.1	—	—	—

（Note）Unit mg/l

In comparison to Japan (refer to Table 15.2), regarding items related to the living environment such as BOD, COD, etc., the number of control subjects is 16 in Japan and 22 in Vietnam. This means that control items are more extensively covered in Vietnam when comparing the standards in Japan with those of class C in Vietnam for the concentration of control subjects in almost all items (Except for pH and copper. However, as for BOD, COD, etc., the local effluent standards, which are more stringent than national standards in Japan, are excluded) the standards in Vietnam are equal to, or more stringent than those in Japan. Therefore, taking measures at the source, including at factories, to satisfy these standards is an important challenge.

Table 15.2 Wastewater Standards Comparison

Items	Japan	Viet Nam		
		A	B	C
pH	5.8～8.6	6～9	5.5～9	5～9
BOD	160mg/l	20	50	100
COD	160 〃	50	100	400
SS	200 〃	50	100	200
Oil Contents (Mineral oil)	5 〃	Not Detected	1	5
Oil Contents (Animal and vegitable oil)	30 〃	5	10	30
Phenol	5 〃	0.001	0.05	1
Copper	3 〃	0.2	1	5
Zinc	5 〃	1	2	5
Iron	10 〃	1	5	10
Manganese	10 〃	0.2	1	5
Chromium	2 〃	0.2(Trichromium)	1	2
Fluorine	15 〃	1	2	5

Items	Japan	Viet Nam		
		A	B	C
Coliform Bacilli	3,000/cm^3	5,000/100ml	10,000	—
Nitrogen	120mg/l	30	60	60
Phosphate	16 〃	4	6	8
Water Temp	—	40℃	40	45
Perchloric acid	—	1	2	2
Nickel	—	0.2	1	5
Tin	—	0.2	1	5
Ammonium	—	0.1	1	10
Sulfide	—	0.2	0.5	1

Now, with regard to the regulation of and guidance for pollutant generating sources, including factories, it may be necessary to enforce a thorough compliance to class C standards. As for factories in which class A and B standards apply, rather flexible measures are suggested, i.e. regulators should recommend compliance to class C standards at first, and then after some interval (granting a grace period), request the factories to make modifications, for example by introducing waste treatment facilities to improve environmental quality.

Also, for promoting the said measures at the sources, it may be necessary to take advantage of the financial and monetary support scheme that is stated in this report.

15.1.2 Environmental standards

As domestic standards correspond to the environmental standard, Vietnam is utilizing the water quality standard TCVN 5942-1995 for surface water like rivers, the water quality standard TCVN 5943 for offshore seawater and the water quality standard TCVN 5944 for ground water. Comparing the standards for surface water with Japanese environmental standards (refer to Table 15.3), as for human health related items such as cyanide and cadmium, the number of established standards in Vietnam is 9, far less than the 26 in Japan. Comparing the concentrations of the 7 substances being controlled in both Japan and Vietnam with each other, the standards of cadmium and hexavalent chromium (class A) are equal, but those for other items are more stringent in Japan. With regard to items related to the living environment, there are no big differences between the standard concentrations in Japan and in Vietnam, however, the number of items subject to control by standards is greater in Vietnam. As for future measures, it may be necessary for the items subject to control by standards which is already used in Vietnam and

assumed to be used more such as trichloroethylene for human health.

Table 15.3 Environment Standard Comparison（River Water）

Items	Japan	Viet Nam		Item	Japan	Viet Nam	
		A	B			A	B
Cadmium	0.01	0.01	0.02	pH	6～8.5	6～8.5	5.5～9
Cyanoge	Not Detected	0.01	0.05	BOD	1～10	4	25
Lead	0.01	0.05	0.1	※ COD	1～8	10	35
Hexavalent chromium	0.05	0.05	0.05	DO	2～7.5	6	2
Arsenic	0.01	0.05	0.1	SS	25～100	20	80
Total mercury	0.0005	0.001	0.002	coliform bacilli (MPN/100ml)	50～5000	5000	10000
Alkyl mercury	Not Detected	—	—	Trichrome	—	0.1	1
PCB	Not Detected	—	—	Ammonia	—	0.05	1
Dichloromethane	0.02	—	—	Barium	—	1	4
Carbon Tetrachloride	0.002	—	—	Copper	—	0.1	1
1,2-Dichloroethane	0.004	—	—	Zinc	—	1	2
1,1-Dichloroethylene	0.02	—	—	Nickel	—	0.1	1
cis-1,2 — Dichloroethylene	0.04	—	—	Manganese	—	0.1	0.8
1,1,1-Trichloroethane	1	—	—	Iron	—	1	2
1,1,2-Trichloroethane	0.006	—	—	Tin	—	1	2
Trichloroethylene	0.03	—	—	Nitrate	—	10	15
Tetrachloroethylene	0.01	—	—	Nitrous acid	—	0.01	0.05
1,3-Dichloropropene	0.002	—	—	Phenol	—	0.001	0.02
Cadmium	0.01	0.01	0.02	pH	6-8.5	6-8.5	5.5-9
Thiuram	0.006	—	—	Oil and Fats	—	Not Detected	0.3
Simazine	0.003	—	—	Detergent	—	0.5	0.5
Thiobencarb	0.02	—	—				
Benzene	0.01	—	—				
Selenium	0.01	—	—				
Nytrogyen	10	—	—				
Flourine	0.8	1	1.5				
Boron	1	—	—				
Insectcide	—	0.15	0.15				
DDT	—	0.01	0.01				

(note) Unit mg/l（Except pH value、Number of coliform bacilli

15.1.3 Relationship of environmental standards to effluent standards

Generally, in consideration of the dilution effect by the rivers, etc., the effluent standards are set at about 10 times higher than the environmental standards. The standards of typical substances in Japan are as follows.

	Effluent standards	Environmental standards
Cadmium	0.1 mg/l	0.01 mg/l
Lead	0.1 mg/l	0.01 mg/l
Hexavalent chromium	0.5 mg/l	0.05 mg/l
Arsenic	0.1 mg/l	0.01 mg/l

In Vietnam, assuming that the water quality standards TCVN correspond to the environmental standards in Japan, the effluent standards and the environmental standards of the following substances that fall into the human health related items category are set at the same, or almost the same concentrations. (Values are not set for the items related to the living environment.) This is because if the environmental standards are the desired values to be maintained for conserving the water quality of public water areas, it seems to be impractical to apply the same or almost the same values to the effluent standards for factories.

	Effluent standards (A, B)	Environmental standards (A, B)
Cadmium	0.01, 0.02 mg/l	0.01, 0.02 mg/l
Lead	0.1, 0.5 mg/l	0.05, 0.1 mg/l
Hexavalent chromium	0.05, 0.1 mg/l	0.05, 0.05 mg/l
Arsenic	0.05, 0.1 mg/l	0.05, 0.1 mg/ml

Therefore, these standard values need to be reviewed to accordingly reflect actual conditions.

15.1.4. Introduction of the Regional Pollutant Regulation

(1) Regional regulations

For controlling effluent coming from the source, facilities to be regulated should be identified, and the effluent discharged from factories to public water areas from such facilities should be the control subject. However, because of certain regional characteristics, such as the concentration of industries and the siting of local industries, it may not be the best solution to apply national uniform standards. However, it is necessary to take measures that give consideration to the

present conditions of pollution and the actual situation in local areas, such as the condition of the sources.

(2) Environmental Standards and Pollution Effect to Human Being

Monitoring and countermeasures should continue to be implemented because some river water exceeds regulations in terms of lead and cyanogen values, which are considered special toxic substances and dangerous to human health. Lead is suspected to come from waste batteries for cars, however, it is also suspected that it may come from wastewater discharged from a battery producing factory. Cyanogen is responsible for the slaughter of fish and seashells in the area. Lead that accumulates in the bodies of fish and seashells can cause terrible damage to human health if consumed. The concentration value of heavy metals, such as chrome, should continue to be monitored and checked. Because the concentration value of heavy metals does not exceed environmental regulations yet, there is no need to worry now about the effects. The environmental regulation values are generally set at values that should be safe for human health if material has accumulated in the bodies of fish and seashells and has been consumed over a long period of time. People in western countries do not eat as much of seafood as people in Asia. If the amount of seafood consumed in Vietnam is as large as Japan, it is reasonable to adjust environmental regulation values to Japanese values, and if the amount of seafood consumed is not as large, the concentration values should be adjusted to the western values. However, the Hg value exceeds Japanese standards that were set under the condition that a large amount of seafood is consumed, so monitoring should be continued to make sure that the value does not increase. Countermeasures for cyanogen do not need to be taken in a hurry because environmental pollution from plating industry products is not large, and according to the heavy metal concentration values, has not reached a dangerous level.

- Countermeasures for industrial pollution caused by everyday activities, such as BOD,COD, and SS values, are more urgent than countermeasures for toxic wastes, like heavy metals, for the present conditions in Viet Nam. Countermeasures have to be carried out at the same time for both domestic use and industrial use wastewater, or it will be difficult to generate any positive results. As was shown earlier, the BOD value varies greatly from the upstream to downstream of the Saigon River, and because domestic use wastewater is mixed in, countermeasures for both types of wastewater must be carried out

simultaneously.

- The measurements taken in Da Nang, mentioned earlier, were taken during the rainy season in Viet Nam. For this reason, it can be surmised that the toxic concentration values will probably rise steeply if measurements are taken in the dry season. Following this, in the least, it is necessary to set up a regular monitoring system during the rainy season. At the same time, the toxic concentration values that exceed regulations must be observed very closely during the rainy season because concentration values will rise. When the geographic areas and polluted substances that will be given high priority for countermeasure are chosen, it will be important to consider improved environmental regulations during the severe dry season.

(3)Set up local effluent standards

In the case that each enterprise implements pollution prevention countermeasures, and in turn most of the enterprises satisfy the concentration standards, but do not satisfy environmental standards, it would be reasonable to set up local effluent standards.

Below is an example of a local effluent standard in Japan that is more stringent than the national standards and is based on a Prefectural ordinance.

BOD 25 mg/l (160 mg/l is the national standard)

This standard being applied to specified factories, except for factories in the newly established livestock industry

120 mg/l (160 mg/l is the national standard)

This standard is being applied to the factories related to the existing wool spinning industry

(4) Conclusion

Local effluent standards should be introduced when regular concentration standards have difficulty bringing about the conditions that clear the environmental criteria. It is crucial to take precedence, enforcing enterprises to adhere to the concentration standards, when standards presently in use are not followed, as in Viet Nam. If regional regulation is adopted in Vietnam, it will be possible to take practical countermeasures that maintain environmental conditions and only require a small budget. An outline of this method is as follows:

There are big differences in the pollution situation depending on the place and river in Vietnam. Needless to say, when wastewater flows into a big river that has a big stream, there is a small effect on the environment because toxic substances are diluted by a large amount of water. However, when the river water flow is small, or is a closed body of water, the environmental standard value is easily exceeded.

Thus, zones which have a high toxic concentration should receive a higher priority for implementing countermeasures, and for the opposite case, a low priority should be given for countermeasures, even if the wastewater drained into the river is contaminated very badly and exceeds the standard value. This is because the effect from the wastewater to the whole body of water is not easily identified. (Theoretically, it is expected that there will be no damage if water values are within the environmental standard, even if wastewater exceeds the wastewater standard value.)

That is to say, under the circumstances that there are many factories which can not comply with the concentration regulations, areas should be specified which do not satisfy the environmental standards and pollutants. Priority should be given for countermeasures in this area so that compliance with environmental regulations and avoidance of environmental damage can be accomplished with low costs in an early stage.

To put it concretely, factories that discharge toxic hazardous waste, of which the value exceeds environmental regulations, should conduct countermeasures and wait for countermeasures to be taken for other pollutants from factories that are satisfying environmental regulations, even if their concentration value for the other pollutants exceed wastewater regulations.

15.1.5 Introduction of Total Pollutant Load Control Method

(1)Total Pollution Load

In Vietnam, pollution containing organic substances is serious due to household effluent and/or the wastewater from industrial complexes in big cities like Hanoi City and HCM City, and also because of the high volume and concentrations of pollutants related to the living environment, such as COD and BOD. As a measure for preventing pollution containing organic substances, the concentrations in industrial effluent are being controlled at present, but considering that industrialization and urbanization will further develop from now on, this type of pollution may become more serious in the future.

Under these circumstances, it is necessary to introduce the total pollutant load control method in addition to concentration control of pollutants in wastewater from the factories that can not bring concentration levels to within the standards. In addition, the total pollutant loads in closed water areas where it is hard to meet the environmental standards needs to be reduced. The total pollutant load control is a method used to regulate for a targeted water area, where the total volume of pollutants being discharged from factories is controlled.

In Japan, water areas among wide, closed bodies of water are designated by the Water Pollution Control Law, and the total pollutant load control is being utilized for reducing the total pollutant load to those targeted water areas, which are Tokyo bay, Ise bay and the Seto Inland Sea at present. The control subject is COD. The 21 related prefectures to the control water areas have set up a target value of reduction (to be reviewed every 5 years) and regulate it by allotting a COD load to each regional factory subject to control based on a total load reduction plan.

(2) Merits of the total pollutant load control method for Vietnam

In general, the total pollutant control is usually used only in the case there are difficulties with concentration standards. Under the following circumstances in Viet Nam, introducing the total pollutant control method would be the best way to maintain the environment at the lowest cost, and can be said to be one method for dealing with this problem in the early stages.

Presently, most enterprises are violating wastewater regulations in Viet Nam. Implementing wastewater countermeasures for all enterprises at the same time is not realistic and is absurd from the point of view of enterprises that have low profit levels because it requires an enormous investment in finance, manpower, and technology.

For example, the survey team investigated 21 enterprises in the paper and pulp industry. The organic substance load amount to the environment is not proportional to the concentration values, and we estimated the total load using the following equation for calculation purposes:

Total contamination load = Concentration value (COD) X amount of wastewater.

The results of this estimation are shown in Table 15.4, and five enterprises from the top of the list produce 96.9% of the entire total pollution load. Therefore, if the total load control is carried out at these five enterprises only, then the pollution load will be reduced to 1/32 of the present amount. It can be said that it would be more effective to conduct countermeasures intensively only at large

enterprises that produce a large amount of pollution, instead of taking countermeasures at the same time at all the enterprises that are exceeding wastewater standards. Suppose that we pick up the top 5 enterprises that are discharging high concentrations of wastewater from the list, and implement countermeasures at these enterprises. The ensuring result would become a 92.7% decrease in the pollution load and the total pollution amount will be only 1/14 of the present amount. Concentration of pollutants in wastewater is not proportional to the pollutant load. Therefore, it is more effective to conduct countermeasures at the enterprises which have a large pollution load than to conduct them at the enterprises that have a small pollution load.

In order to implement the total load control, it is crucial to grasp the average pollutant concentration values and total discharged amount of wastewater. Therefore, it is impossible to grasp these changing values only by having the regulating agency monitor pollutant values at regular intervals. Therefore, it is essential that enterprises themselves take daily measurements of the wastewater amount and concentration of pollutants.

Table 15.4 COD Value in the Paper and Pulp Industry

	amount of wastewater 1000m3/y	COD mg/l	Total COD ton/y	paper production ton/y	COD ton/production ton	wastewater ton/ paper ton	**Total COD Accumulation**
A	17000	9340	158780	60000	2.6463	283	0.8666
B	10237	669	6849	23823	0.2875	430	0.9039
C	576	8990	5178	4000	1.2946	144	0.9322
D	950	5320	5054	3802	1.3293	250	0.9598
E	4449	360	1602	60619	0.0264	73	0.9685
F	1800	525	945	7285	0.1297	247	0.9737
G	301	2680	807	15000	0.0538	20	0.9781
H	90	8320	749	1800	0.4160	50	0.9822
I	244	2893	706	483	1.4615	505	0.9860
J	1200	420	504	1667	0.3023	720	0.9888
K	396	1200	475	8827	0.0538	45	0.9914
L	840	345	290	3310	0.0876	254	0.9930
M	668	430	287	3800	0.0756	176	0.9945
N	864	259	224	4275	0.0523	202	0.9957
O	1650	128	211	4660	0.0453	354	0.9969
P	420	392	165	1238	0.1330	339	0.9978
Q	159	922	147	1750	0.0838	91	0.9986
R	23	5120	118	1000	0.1178	23	0.9992

	amount of wastewater 1000m3/y	COD mg/l	Total COD ton/y	paper production ton/y	COD ton/production ton	wastewater ton/ paper ton	**Total COD Accumulation**
S	40	2230	89	2000	0.0446	20	0.9997
T	655	71	47	1194	0.0389	549	1.0000
U	60	61	4	2000	0.0018	30	1.0000
Total	42622		183228	212533	0.8621	201	

15.1.6 Steps for Introducing the Total Pollutant Control Method

In Figure 15.1, we let the vertical axis be the concentration of pollutants in rivers (e.g. BOD) and the horizontal axis be the total amount of discharge (the product of concentration of pollutants in wastewater from an enterprise and the amount of wastewater), then if we want to show the condition of all enterprises, it becomes a kind of graph. Enterprises that belong to A and B categories do not satisfy the environmental standards, and enterprises in the C and D categories do satisfy the standard.

Countermeasures for pollution should be taken at enterprises belonging to the A category first of all, and then next at enterprises in the B category. Enterprises belonging to the C category actually satisfy environmental standards, and because there is no fear that pollution will cause any damage to human health for the time being, it would be reasonable to keep monitoring the situation and conduct countermeasures if time and budget allow. Enterprises belong to the D category satisfy the environmental standards, and because they discharge a low quantity of pollutants, they should receive the least priority for conducting countermeasures.

← Total pollution load amount discharged from the enterprise is small	Total pollution load amount discharged from enterprise is large →	
B Factories need to implement countermeasures(the pollutant concentration values exceed the environmental standards and possible bad effects on human health area concern. However, implementing countermeasures would be inefficient)	**A** Factories have the highest priority to implement countermeasures(the concentration values exceed the environmental standards and there is concern for bad effects on human health. Implementing countermeasures can be implemented efficiently)	↑ Concentration of pollutants is high in the Environment
D There is no hurry to implement countermeasures in these factories (the pollutant concentration values meet the environmental standards and there is no fear of causing bad influence on human health. Also, implementing countermeasures would be inefficient)	**C** Factories should implement countermeasures (the pollutant concentration values meet the environmental standards and there is no fear of causing bad influence on human health. However, the effects by reducing pollutants will be big)	25ppm （non drinking water）
• • • • • • • • • • • • • • • • • •	• • • • • • • • • • • • • • • •	4ppm (Drinking Water) Concentration of pollutants is low ↓

Figure 15.1 Relationship Between Pollutant Concentration in the Environment and Total Pollution Load Discharged from the Factory (BOD)

By implementing countermeasures at factories belonging to category A(Figure 15.1), environmental quality improvement can be promoted at a low cost.

The following steps should be taken for implementing this method.

① Select water areas and pollutants which need environmental improvement, and pick up the main factories in that water area which discharge wastewater that contains the selected pollutants.

② Make enterprises submit data on their respective factory's average concentration value of selected pollutants and annual wastewater amount.
(In the case the amount of river water and industrial activity changes depending on the seasons, pick a period where the concentration values are the most out of standards)

③ Regulate an average subject pollutant concentration, (n ppm) and an annual

total volume of wastewater,(V m^3) that is desirable to be complied with at point E.

④ Set desirable environmental concentration values(k ppm) for the average concentration value(n ppm) Generally, it is common to use the environmental standard value. For example, if the pollutant is BOD then for non-drinking water areas it will be 25 ppm.

⑤ For the total amount of the polluted substance that must be reduced, R TON can be expressed:

$$R = (n - k) \times V \times 10^{-6} \text{ TON}$$

⑥ On the other hand, the total amount of pollutants discharged from the factory, Q TON, (Q = sum of each factory's value of pollutant concentration multiplied by the total amount of wastewater) can be used as follows:

Thus R÷Q describes the reduction rate for pollutants discharged from a factory. When the value of R÷Q exceeds 100%, it proves that the environmental standard is not accomplishing anything, only preventing pollution at subject factories.

For this particular case:

a. The amount of discharge from small and medium-size factories that is not targeted for countermeasure implementation is large.
b. The amount of pollutants contained in the discharged domestic wastewater is too large, therefore by only implementing industrial pollution countermeasures water quality will not be brought up to the environmental standards. In this case, it is necessary to establish environmental pollution prevention countermeasures for domestic wastewater, too.
c. Either the measurement data, or the data submitted from the company is not correct.

⑦ The total reduction amount of pollutants should be equal to R.

⑧There are many points of view on allocating reduction amounts to each factory.

a. Allocate evenly using the ratio R÷ Q when factory scales and the like are similar.
b. When there is a big gap in factory scale, leave small scale factories as they are at present and have large scale factories reduce the small scale factories portion as well.

c. Q－R is considered to be the upper limit of the pollutant amount that can be discharged from concerned factories. Therefore, the value of Q－**R** should be allocated proportionally by calculating the production amount of each factory, added value or number of labors. This allotment amount depends on industrial policy. Each factory has to reduce the amount that is exceeding the value that is allocated.

For enterprises which have conditions that make it difficult to reduce the allocated amount, they should be allowed to transfer that amount to other enterprises which discharge wastewater to the same river system under the condition that compensation is paid and there is no local pollution problem. (Transferring and trading allocated reduction amount)

The cost will increase not so much for large scale companies because a treatment facility has to be installed in the company's factory by regulation and only a little amount of effort will be needed to improve wastewater capacity. Therefore, the total cost to the industry for implementing the total pollutant control method will be lower, and even some effects of implementing concentration standards will be realized. For example, there are large scale factories and small and mid scale factories and wastewater treatment facilities have to be installed in small and mid scale factories. If wastewater treatment facilities are installed, because their production level is small, costs rise. It will be reasonable to install pollution prevention equipment in the future when factories expand their scale. For the time being, small and medium-size enterprises can request large scaled enterprises to treat the wastewater from their factories.

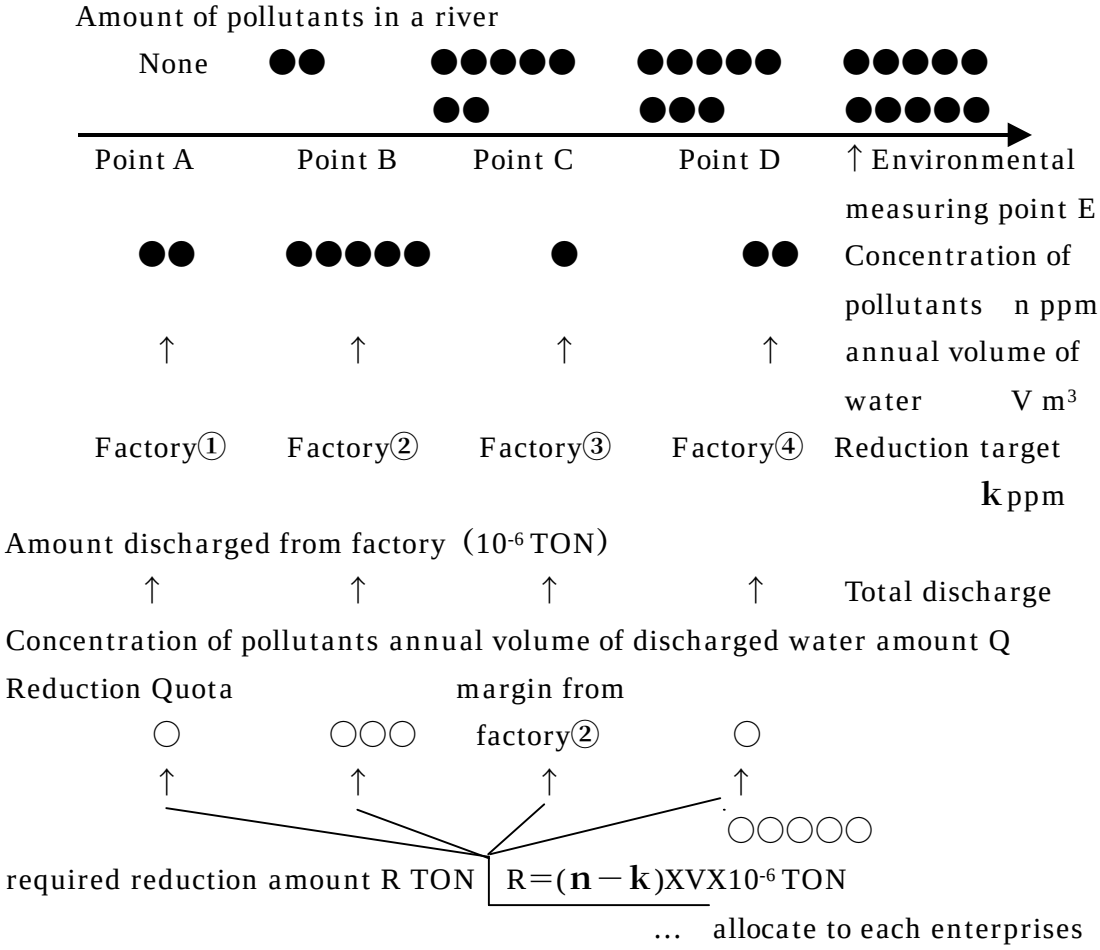


Figure 15.2 Introducing the Total Pollutant Control Method

This method is considered to be fair and rational because, instead of forcing the same concentration standards on every factory, it allows the environmental standard to be met in the early stages at a low cost. Also under condition, which allows factories the right to transfer their allocated reduction amount, the pollutant load is more economical and is in line with the respective production amounts of the factories. It is a matter of course that each factory should put more effort into satisfying concentration standards after the environmental standard has been satisfied. This method is realistic and takes place in stages.

Generally, the total pollutant control method is used only in the case that environmental standards are not satisfied, even though the concentration standards have been satisfied. Thus, this proposal deals with the case when concentration standards are not satisfied, and is not what is normally called “total pollutant control”. However, under conditions such as limited capital and the like in developing countries, improvement in environmental quality, at a low cost and

in early stages can be planned for, damage and harm to human beings can be prevented, and for accomplishing environmental standards, this new proposal is extremely rational at this time. There are many actual examples where the total pollutant control method has been used, and results of implementing this method for preventing pollution have been very successful. There are no examples that reveal problems with carrying out this method.

15.1.7 Introduction of a pollution control manager system

In Vietnam, industrial pollution control is becoming more strict, but the systems for preventing pollution on the factory side are not well established and few factories have autonomous organizations for pollution control. For promoting measures for industrial pollution, it is essential to construct an in-house organizational system in charge of pollution control. Therefore, referring to the pollution control manager systems which have played an important role in Japan in the prevention of industrial pollution and the improvement of environmental quality, we suggest that such systems should be introduced in Vietnam as well.

In accordance with the “Law Concerning the Improvement of Pollution Prevention Systems in Specific Factories”, the factories which discharge environmental pollutants at a certain set volume or more are obligated to have a pollution control manager who must be licensed by national examination.

In Japan, apart from the pollution control manager stipulated under the said Law, some municipal governments impose the duty of establishment of pollution control manager systems based on a municipal ordinance for small and medium scale factories which may generate pollutants. (A case of Tokyo Metropolis)

Table 15.5 Pollution control manager systems based on the Tokyo Metropolis Ordinance for Pollution Control

Pollution control manager	For small and medium scale enterprises which may generate pollutants
License	Persons who have acquired grades 1-3 of the license of pollution control manager provided by the Tokyo Metropolis Ordinance for Pollution Control according to the type of factory and the number of employees (At a factory in which the number of employees is less than 10, the grade 3 license is required).
Tasks of the pollution control manager	• To recommend the enterprises to conform to the provisions of the ordinance • To supervise the technical issues such as working practices, maintenance of facilities, etc. for preventing pollution • To communicate with the local public to make them aware of the current measures for pollution control

In Viet Nam's case, it is very important to assign a manager to be responsible for dealing with pollution prevention at individual factories. From the point of view of pollutant load management ability and total amount of discharged pollutants, since enterprises vary widely in scale, large scale enterprises should be at the center of this movement.

If an enterprise has more than 300 employees it ought to assign a manager. About 35% of the enterprises in the paper and pulp industry have assigned managers, and 95.1% of the total pollutant load will be covered.

As for the pollution control manager's duties, first of all, they must grasp the concentration of pollutants discharged and the entire amount of discharged wastewater. It is possible to observe concentration values through the use of outside monitoring at regular intervals. However, for the total discharged amount of wastewater, it is very difficult to calculate by outside inspection without having a continuous wastewater flow meter in place.

In order to understand the actual situation, it is necessary for a pollution control manager to make a balance sheet for materials and figure out the total wastewater amount by using the sheet. Also, in the circumstance that highly concentrated wastewater is discharged at random because of batch system production, it is very important to figure out the total pollutant load in the wastewater by collecting data on pollutant concentration and the total amount of discharged water during both regular and highly concentrated periods.

Moreover, because grasping the amount of pollutants and the amount they have been reduced has a strong relationship with production itself, it is reasonable that the pollution control manager should also be put in charge of all production tasks (However, there is no obligation to force them to carry out production management tasks because this measure has no direct relationship to the public benefit, unlike the discharge of pollutants).

By grasping the consumption amount of raw materials, products and utilities and making a record of them, the pollution control manager can calculate the load and perform general tasks such as the reduction of polluted substances and production rate improvement. In this case, the manager should also be dealing with tasks related to production and utility management.

Establishing this kind of supervisor not only reduces the monitoring burden of the government, but also, because they are autonomously managing production, continuous improvement of the environment is expected. The government's monitoring function has indirect control through checks on wastewater data submitted from enterprises, and inspections on overall, general environmental quality.

15.1.8 Cleaner Production and Regulations

In general, enterprises tend to avoid tasks which require additional money because they decrease profits. Naturally, it is hard to imagine that they would voluntarily promote such activities. In the case as in Area B that pollution prevention costs are reduced, measures are easy to promote. However, contrary to this, in the case of enterprises categorized in Area C, it is difficult to expect that they will take any action autonomously in order to improve the environment, such as introducing wastewater treatment equipment, because it will lead to increased costs. End of Pipe technology should be used for factories in this category.

Because of this, in order to implement pollution prevention, it is necessary to establish regulations and force enterprises to comply with them.

Category A is an unfavorable category which invites a lot of pollution that requires large costs. It is hard to imagine that the enterprises belonging to this category would implement countermeasures voluntarily. However, there are examples where, both cost wise and environmental wise, deterioration occurred because of increases in the consumption unit of raw materials and insufficient maintenance due to low level management.

Regarding this, enterprises that are categorized in Area D are preferable

because they can implement countermeasures at a low cost and with high efficiency. There are many ways in which countermeasures that utilize Cleaner Production technologies can be introduced. However, enterprises will not implement any countermeasures autonomously unless there are reductions in cost. Thus, it can be said that reducing costs is an essential factor for enterprises to implement countermeasures.

It is not necessary for enterprises categorized in Area D to implement countermeasures by using the regulations. 5S activities, which don't require a lot of capital, can be used as a measure for enlightening and diffusing Cleaner Production methods. In addition, for measures that require a large budget, financial support is a possible countermeasure. Cleaner Production is applicable as a countermeasure in the textile and food processing industries only in small area. Like these industries, there are still many industries where End of Pipe technology is necessarily appropriate as the main countermeasure. For each industry, the promotion of Cleaner Production technology, and activities giving priority to enterprises in Area C should be promoted. In addition, it is rational to implement countermeasures for enterprises in Area B, by enforcing regulations in order to obtain compliance with environmental standards.

← Decreasing Cost	Increasing Cost →	
B Production preference No countermeasures executed • Wastewater discharged without treatment	**A Abandonment of production management and environmental management** • Increase in unit consumption of raw materials and pollutants due to insufficient maintenance	↑ Pollution increase
D Cleaner Production Technology • 5S activity • Switching to new technology requires a smaller unit consumption rate. • More efficient production by enlarging business scale • Energy and resource preservation	**C General pollution prevention (EOP technology)** • Installation and operation of wastewater treatment equipment	Pollution decrease ↓

Figure15.3 Regulations and Costs

15.2 Encouragement

15.2.1 Japanese Financial and monetary measures

In Vietnam, a financial and monetary support scheme to improve the environment is not in operation. For refurbishing production equipment, modifying processes, introducing treatment facilities and so on, the government provides due financing for the enterprises, but no special preference is given to enterprises who takes measures for the environment. For environmental improvement on the enterprise side, it is essential for the enterprises to introduce treatment facilities. In order to promote the introduction of such facilities a preference for special financing is definitely necessary as an incentive. For purchasing pollution prevention facilities, a tax preference i.e. a reduction of or exemption from taxes is desired. Also, for small and medium scale enterprises for which the operational burden is too heavy, other conditional preferences are needed.

The following outlines the case of financing for small and medium scale enterprises in local municipalities in Japan.

Table 15.6 Financing system for small and medium scale enterprises (1999)

Local municipalities	Tokyo Metropolis	Mie Prefecture	Yokkaichi City
Funds for modifying facilities	¥30 million • Installation and modification of pollution prevention facilities • Modification of facilities to environmental load reduction type	¥50 million • Installation and modification of pollution prevention facilities	¥20 million • Installation and modification of pollution prevention facilities
Funds for Relocation	¥80 million Relocation of factories	¥50 million Relocation off factories	¥20 million Relocation of factories
Interest (annual rate)	1% - long term prime rate (Max. 3%)	Basic rate 1.2% (Floor rate 2.0%)	Set at the long term prime rate 1.5% (Floor rate 1.2%)

(Note) The conditions of financing are subject to change year by year.

The maturity and the fees for credit guarantee are provided separately.

15.2.2 Environmental Fund and Examples of TSL in Another Countries

(1) Environmental Fund

VINACOAL established environmental funds in order to support pollution prevention in petrochemical industry. This is the first case of environmental fund in Vietnam.

(2) Examples of TSL

A typical TSL program via a yen loan and points for consideration at each stage of the program are illustrated below in two cases following Figure 15.4; one is a December 1996 project to support Indonesia to control pollution, and the other is a March 1996 financial project to support the Philippines to control industrial pollution.

First, a fund acceptance contract (L/A) is concluded between ① and ②.Conditions are the same for the two countries with payback period of 30 years (including the deferred period of 10 years), interest rate of about 2.5% and consultant margin of about 2.1%.

The borrowers of these projects were the national governments. The implementing agencies were the Department of Finance, the Central Bank, and the Department of Environmental Management for the Indonesian project, and for the Philippines, the implementing agency was a national bank, Development Bank of Philippines (DBP), which works in collaboration with the Department of Natural Resources (DNR).

Each implementing agency/ central bank is responsible for selecting executing banks ④⑤ which will directly be involved in investment to purchase and install pollution control equipment, etc. 20 banks were selected in the Indonesian project and about 30 banks were chosen for the Filipino project. Each bank was selected by meeting a number of criteria, including sound operating standards developed in each country, capital adequacy ratio, bad loan ratio, asset content, and operational status. Some local consideration was also taken into account. With the case of the Philippines, banks were selected by meeting the standard of sound operation set by the implementing agency, namely the Development Bank of Philippines.

Terms of lending by central banks to other financial institutions include; the interest rate of the official discount rate minus 5%, a payback period of 3 to 10 years (including a deferment period of 0 to 5 years). Terms of lending by

executing banks to end users, by and large, aim to use the same rate as the central bank's official discount rate and a payback period of 3 to 10 years (including the deferment period of 10 years) (with the resultant interest rate to end users of about 35%), and the banks lent 100% of the required fund.

In the case of the Philippines, the interest rate to end users was set at money market rate minus 2 - 3 %. Since the money market rate was 13%, the interest rate to end users turned out to be about 11%. The interest rate can be reviewed every six months, following the trends in money market rates. The banks provided 80% of the required fund in the Filipino project, whose terms of lending are a little different from other countries.

In this project, the entire five billion yen in the first phase was disbursed and subsequently, a TSL for the second phase of 20 billion yen was signed in December 1999.

The interest rate for the second phase was calculated as follows;
Donor (0.75%) + recipient government guarantee (1%) + DBP administration cost (2%) + tax (0.5%) = approximately 4.5% Central Bank's exchange risk of about 4.25% (normally 3% before the currency crisis) and the end banks' spread of about 3% were added, which resulted in the lending interest rate of about 12%. At the point of signing L/A, the money market rate was 13%. Officials at JBIC highly evaluated DBP's high proficiency of paper processing.

It is said that borrowers highly value long-term financing at a fixed rate. Furthermore, for both projects, consultants were hired and their TOR covers technical guidance and training on pollution control, reinforcement of the organization, and monitoring of financial status of financiers and borrowers, management of revolving funds, ranging from technical to financial consultancy.

Furthermore, in the case of Japan's yen loan, incentives have been offered to cases which fall into special environmental measures including pollution control since 1997. They include an interest rate of 0.75% and a payback period of 40 years (10-year deferment period included), which are better conditions than ordinary yen loans.

In the Philippines' case, the first phase was completed with about a 5 billion yen loan provided out of the required 15 billion yen, and the second phase, which requires about 20 billion yen, has already begun.

As for the project in Indonesia, the provision of the loan is currently under way and heading toward the target of 20 billion yen.

In terms of TSL alone, for one project in Vietnam, 4 billion yen has been provided as a fund for the development of small and medium size enterprise. For this project, the borrower is the Ministry of Finance and the implementing agency is the Central Bank (SBV), and two executing banks are expected to be chosen to provide loans out of the four major state-run commercial banks due to their superior operating performance. The interest rate spread between the national bank to loan banks is 5%, whereas the interest rate that loans banks charge end users should not exceed the market prime rate. The interest rate is expected to largely settle around the neighborhood of 12% to 15%. However, a mountain of issues remain to be solved before the executing banks can actually implement the planned loan, including clearing the bad loans that those banks carry, checking their operational management status, and determining collateral measures.

Another issue that is yet to be solved is how to share exchange rate risks since currencies of developing countries are weaker and more susceptible to fluctuations than those of donor countries.

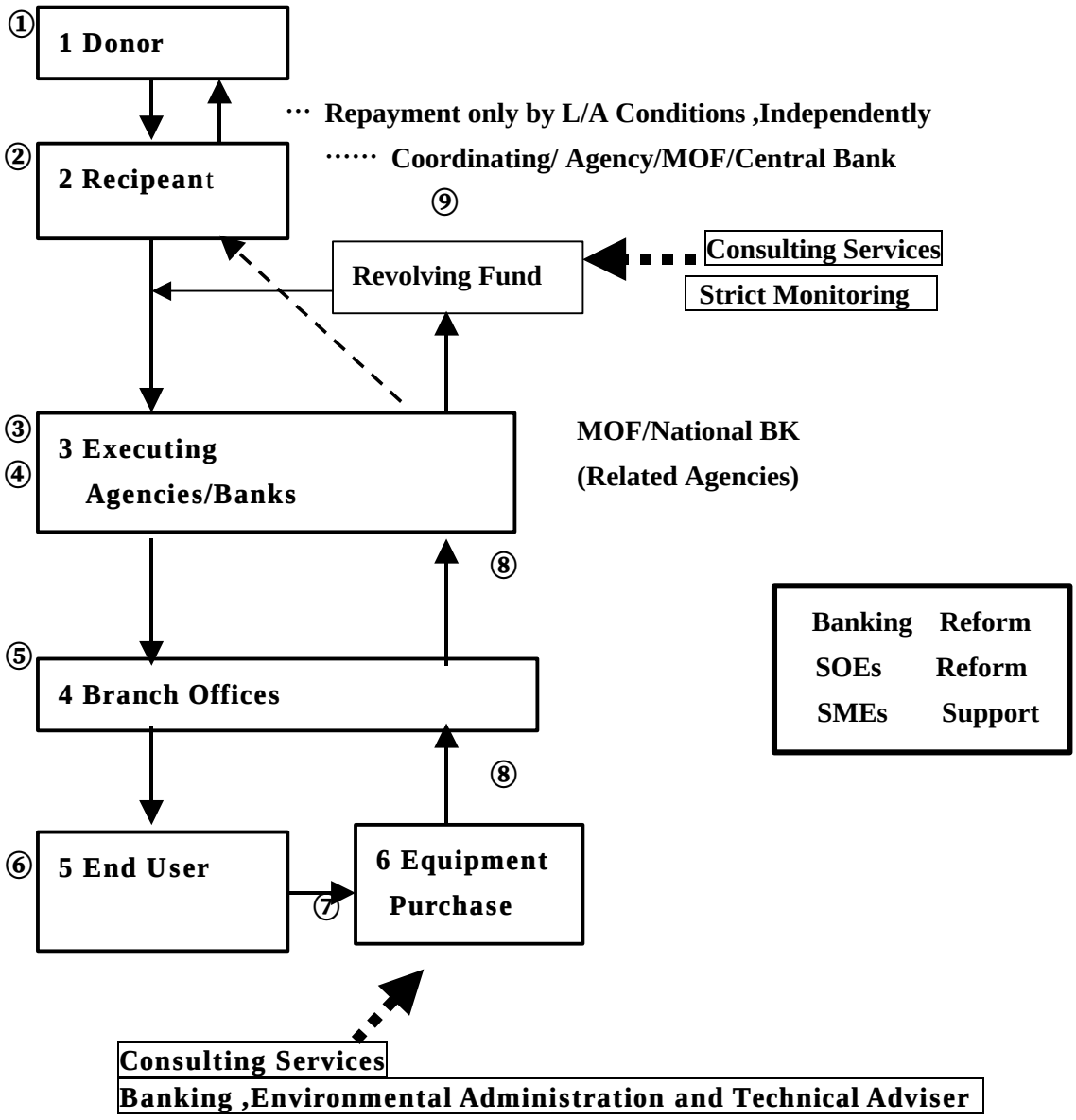


Figure 15.4 Outline of Two Step Loan System

15.3 Human Resource Development of Administrative Officials in Charge of the Environment (implementation of environmental training)

In order to respond to the new development in environmental policies and promote environmental measures effectively, it is important to place an emphasis on the programs to be developed and to improve the capabilities and skills of national and local environmental administrative officials. In Japan, the Environmental Training Center of the National Institute for Environmental

Studies has been providing training on environmental policies / administration, environmental pollutant analysis techniques, etc. to national and local officials. The total number of officials who completed the training from 1973 through the end of March 1998 is 27,213 (breakdown: 22,246 for the administrative related training, 4,967 for analysis related training).

Vietnam also has a training center in MOSTE and has been providing training on the environment to environmental administrative officials. However, in the future, opportunities for overseas training should be expanded for administrative officials. For resolving environmental problems, joint efforts by governments and people are needed to link industrial policies, including energy, and promote the development and introduction of environmental conservation technologies, which will enable the improvement of environmental quality, as well as economic development.

15.4 Environment Management Systems

Activities to establish in-house environment management systems and measures for improving the environment, like acquisition of certification of the International Standard Environmental Management System "ISO 14000", have been introduced and positively carried out. These activities are aimed at reducing the environmental load and improving environmental quality, and thus the organizations/enterprises which have acquired the certificate of ISO 14000 can prove internationally that they have environmentally sound businesses.

Enterprises in developed countries are fully aware of the importance of acquiring the certified environmental management systems. However, in developing countries, the awareness of such management systems is not high, except in some foreign capitalized or international companies. In Japan, many enterprises have already acquired the ISO certificate, and have applied and been registered for review of the acquisition. National governments, as well as local municipalities are also encouraged to acquire the certificate. With regard to the number of enterprises that have acquired ISO 14000 in developing countries in Asia, Thailand has 190 cases, India has 117 cases, Malaysia has 115 cases, China has 85 cases, the Philippines has 50 cases and Vietnam has as few as 2 cases (source: ISO World, ISO 14000 registration figures as of the end of 1999).

Therefore, in Vietnam, in order to make enterprises aware of environment management systems and to encourage factories to introduce such systems, it is necessary to select some enterprises as model cases and assist them in acquiring the ISO 14000 certificate. The next desirable step may be to establish complete support systems for acquisition.

Chapter 16

Enterprise Investment Demand for Industrial Pollution Countermeasures

- Enterprise List -

Chapter16　Investment Demand for Industrial Pollution Countermeasures
－Enterprise List－

The investment demand of the enterprises subject to the survey (including both the simplified survey and the detailed survey) is shown from Table 16.1 to Table 16.5.

Table 16.1 Enterprise List Investment Demand for Industrial Pollution Countermeasures in the Textile Sub-sector

Enterprise	Cleaner Production		EOP
	Category	Demand (Y/N)	
Phong Phu Textile Company	Cooling Water Recycle	Y	
	Waste Heat Recovery	Y	Y
Dong Phuong Knitting Company	Cooling Water Recycle	Y	
	Waste Heat Recovery	Y	Y
Da Nang Textile Company			Y
Nam Dinh Textile Company	Waste Heat Recovery	Y	Y
Nam Dinh Silk Company	Cooling Water Recycle	Y	
	Waste Heat Recovery	Y	Y
Dong Xuang Knitting Company			Y
Phuc Long Textile Garment Company			Y
Thang Cong Textile Company			Y
Thanh Loi Textile Company			Y
Hue Textile Company			Y
Duc Giang Garment Export and Import Company			Y
Thang Long Garment Company			Y
Ha Dong Woolen Enterprise			Y

Table 16.2 Enterprise List Investment Demand for Industrial Pollution Countermeasures in the Chemical Sub-sector

Enterprise	Cleaner Production		EOP
	Category	Demand	
Vietnam Pesticide Company	Leakage Prevention	Y	Y
	Granulation Process Improvement	Y	
The Southern Fertilizer Company	Equipment Improvement	Y	Y
	Process Renewal	Y	
Lam Thao Superphosphate and Chemical Company	Equipment Improvement	Y	Y
	Process Renewal	Y	
Vinh Phu Battery & Cell Company	Equipment Improvement	Y	Y
	Process Renewal	Y	
Ha Bac Nitrogenous Fertilizer and Chemical Company			Y
Viet Tri Chemical Company			Y
Sao Vang Rubber Company			Y
Van Dien Fused Magnesium Phosphate Fertilizer Company			Y
Hai Phong Tia Sang Battery Company			Y
Ha Noi Battery Company			Y
Southern Rubber Industry Company			Y
Southern Basic Chemical Company / TAN BINH Chemical Factory			Y
Southern Basic Chemical Company / BIEN HOA Chemical Factory			Y
Industrial Gas and Welding Electrode Company			Y
Tay Ninh Rubber Company			Y
Da Nang Rubber Company			Y

Table 16.3 Enterprise List Investment Demand for Industrial Pollution Countermeasures in the Paper and Pulp Sub-sector

Enterprise	Cleaner Production		EOP
	Category	Demand Y/N	
Hoang Van Thu Paper Factory	Valuable Material Recovery	Y	
	Process Improvement	Y	Y
Van Diem Paper Factory	Process Improvement	Y	Y
Hoa Binh Paper Factory	Process Improvement	Y	Y
Bai Bang Company	Process Improvement	Y	Y
Viet Tri Paper Factory	Process Improvement	Y	Y
Thuan Thanh Paper Factory	Process Improvement	Y	Y
Tan Mai Paper Company	Process Improvement	Y	Y
Dong Nai Paper Company	Chip Size Improvement	Y	Y
	Washing Process Improvement	Y	
	Evaporator Efficiency Improvement, etc.	Y	
Binh An Paper Company	Process Improvement	Y	Y
Vien Dong Paper Company	Process Improvement	Y	Y
Linh Xuan Paper Company	Process Improvement	Y	Y
Hanh Linh Paper Company	Process Improvement	Y	Y
Hoa Phuong I C T Ltd. Company	Process Improvement	Y	
An Binh Paper Company	Valuable Material Recovery, etc.	Y	
	Dust Removal Improvement	Y	
Mai Lan Paper Enterprise	Process Improvement	Y	
Xuan Duc Paper Company	Process Improvement	Y	
Viet Dai Private Enterprise	Process Improvement	Y	Y
Bac Giang Exporting Paper Company	Valuable Material Recovery, etc.	Y	Y
Hai Phong Joint Stock Paper Company	Chip Size Improvement	Y	Y
	White Liquor Recovery	Y	
	Dust Removal Improvement	Y	
Thanh Long Paper Factory	Process Improvement	Y	
Muc Son Paper Factory	Process Improvement	Y	Y

Table 16.4 Enterprise List Investment Demand for Industrial Pollution Countermeasures in the Food Processing Sub-sector

Enterprise	Cleaner Production		EOP
	Category	Demand Y/N	
Ha Noi Liquor Company	Cooling Water Recycle	Y	Y
	Distiller Bottom Recovery	Y	
Hai Ha Confectionary Company	Waste Heat Recovery	Y	Y
	Cooling Water Recycle	Y	
Cau Tre Export Goods Processing Enterprise	Wastewater Separation	Y	Y
Tan Binh Vegetable Oil Factory	Wastewater Separation	Y	Y
Da Nang Beer Company	Waste Heat Recovery		Y
	Process Improvement		
Ha Noi Milk Factory			Y
Tam Hiep Sugar Paper Alcohol Enterprise			Y
Ha Tay Food Processing Company			Y
Viet Tri Food Processing Company			Y
Viet Tri Sugar- Beer-Alcohol Company			Y
Sai Gon Beer Company			Y
Dielac Milk Powder Enterprise			Y
Thien Huong Food Company			Y
Sai Gon Foodstuff Company			Y
Tuong An Oil Company			Y
Chuong Duong Beverage Company			Y
Saigon Cigarette Factory			Y
Thuan Phuoc Seafood and Trading Company			Y

Table 16.5 Enterprise List Investment Demand for Industrial Pollution Countermeasures in the Metal Works Sub-sector

Enterprise	Cleaner Production		EOP
	Category	Demand	
Cutting & Measuring Tools Company			Y
Song Cong Engine Company			Y
Spare Parts Company Number One			Y
Hon Gai Mechanical Company			Y
Hai Duong Grindstone Company			Y
Thu Duc Textile Garment Engineering Company			Y
Electronic Equipment Company			Y
Agricultural Machine and Tractor Company			Y
Mechanics & Weapon Center			Y
Tu Son Standard Parts Factory			Y
Thanh Luan Manufacturing and Trading Co. Ltd.			Y
Thanh Binh Corporation			Y