Japan International Cooperation Agency

Ministry of Industry

The Socialist Republic of Viet Nam

No.

Final Report on the Master Plan Study for Industrial Pollution Prevention in Viet Nam (Wastewater)

September 2000

International Center for Environmental Technology Transfer
Mitsubishi Chemical Engineering Corporation

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Preface

In response to a request from the Government of the Socialist Republic of Vietnam, the Government of Japan decided to conduct the “Master Plan Study for Industrial Pollution Prevention (Waste Water) in Vietnam” and entrusted the Study to the Japan International Cooperation Agency (JICA).

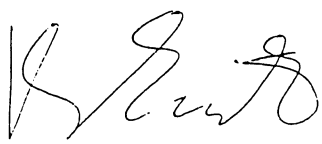
JICA sent a Study Team, headed by Mr. Goshin Kura of the International Center for Environmental Technology Transfer (ICETT) and constituted of members of ICETT and Mitsubishi Chemical Engineering Corporation, to Vietnam five times from October 1999 to August 2000.

The Team held discussions with the officials concerned of the Government of Vietnam and conducted related field surveys. After returning to Japan, the Team conducted further studies and compiled the final results in this report.

I do hope that this report will contribute to the reduction of Industrial Pollution in Vietnam and to the enhancement of amity between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Vietnam for their close cooperation throughout the Study.

September 2000



Kunihiko Saito
President
Japan International Cooperation Agency

September 2000

Mr. Kunihiko Saito
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit to you the final report of "the Master Plan Study for Industrial Pollution Prevention in Viet Nam (Wastewater)".

In this study we aimed at decreasing industrial pollution related to wastewater through two measures. One is to recommend productivity improvement based on the survey results of enterprises in five industrial sub-sectors: textile and garment, chemical, paper and pulp, food processing and metal works. The other is to create improvement policies for wastewater treatment technology.

According to the survey results, the environment pollution load caused by industrial wastewater is predicted to rise in line with the high growth rate of industrial sectors in Vietnam in the near future. However, most of the enterprises that need to make efforts to reduce the environmental load do not have a consciousness for environmental management. Therefore, the Study Team has proposed introducing Cleaner Production technology, which can improve the conversion rate of raw materials to products and reduce material loss in wastewater, to all the enterprises surveyed. If this technology is adopted, enterprises can improve productivity and increase profits as well as reduce environmental loads.

Moreover, in this Report, the Study Team has proposed to the Ministry of Industry, the Ministry of Science, Technology and Environment, and the Ministry of Planning and Investment a sustainable master plan for industrial pollution prevention,in which systems and methods for environmental management including Cleaner Production technology can be studied and easily adopted by all enterprises.

The Study Team expects that these proposals are put to their best use, and that in the near future, under the guidance of the Ministry of Industry, the environmental pollution load caused by industrial wastewater will be reduced. In addition, the Study Team hopes that these results will not only be limited to wastewater, but will be spread and help reduce industrial pollution caused in other fields by exhaust gas, waste, etc.

We would like to express our sincere appreciation to the Japan International Cooperation Agency, the Ministry of Foreign Affairs and the Ministry of International Trade and Industry for the support and assistance received while carrying out this project. We also would like to express our deepest gratitude to the Counterpart of this Study, the Ministry of Industry, as well as to the Ministry of Science,Technology and Environment, the Ministry of Planning and Investment, the General Corporations, and the management and staff of the factories we surveyed for their complete support and cooperation.

Yours respectfully,

Goshin Kura

Goshin Kura
Team Leader
Master Plan Study for Industrial Pollution Prevention In Vietnam (Wastewater)

Map


CHINA
Nanning
Hanoi
Zhan
Haiphong
Haik
LAOS
Gulf
Of
Tonkin
Hainan
Vientiane
Survey regions
Hue
Da Nang
on Sawan
VIETNAM
Nakhon Ratchasima
ngkok
CAMBODIA
Nha Trang
Phnom Penh
Ho Chi Minh City

Dyeing Factory／Dyeing Process

Textile Factory／Weaving Process

Detergent Factory／Raw Materials Mixing Process

Fertilizer Factory／Production Process(right left) and Raw Material Collection Process (Sedimentation Pond)

Pulp Factory／Raw Material Cooking Process

Pulp Factory／Chip Production Process

Soft Drink Factory／Filling and Shipment Process

Food Factory／Cooling Process for Recovered Cooling Water

Plating Process／Zinc Plating Tank

Plating Factory／Preparation Process for Parts

CONTENTS

Table of Contents

Figure of Contents

Abbreviation List

Organizations

ADB	Asian Development Bank
APEC	Asian Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
CECE	Center for Environmental and Chemical Engineering
CECO	Chemical Engineering Corporation
CECS	Center of Environmental Protection and Chemical Safety
CEETIA	Center for Environmental Engineering of Towns and Industrial Areas
CIDA	Canada International Development Agency
DOI	Department of Industry
DOSTE	Department of Science, Technology and Environment
DTPQ	Department of Technology and Product Quality
ENCO	Environmental Committee
EU	European Union
EPC	Environmental Protection Center
FIRI	Food Industries Research Institute
GEF	Global Environmental Facilities
GOV	Government of Viet Nam
IMF	International Monetary Fund
INEST	Institute of National Science and Technology
ISO	International Organization for Standardization
JBIC	Japan Bank of International Cooperation
JICA	Japan International Cooperation Agency
MOC	Ministry of Commerce
MOD	Ministry of Defence
MOF	Ministry of Finance
MOH	Ministry of Health
MOI	Ministry of Industry
MOSTE	Ministry of Science, Technology and Environment
MPI	Ministry of Planning and Investment
NEA	National Environmental Agency
OPEC	Organization of Petroleum Exporting Countries
SBV	State Bank of Vietnam
SIDA	Swedish International Development Authority
UNCRD	United Nations Centre for Regional Development
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
USA	United States of America
VCEP	Vietnam Canada Environmental Programme
VICB	Vietnam Industrial and Commercial Bank
VIDB	Vietnam Industry and Development Bank
VINABECO	Vietnam National Alcohol-Beer and Beverage Corporation
VINACHEM	Vietnam National Chemical Corporation
VINACOAL	Vietnam National Coal Corporation
VINAMILK	Vietnam National Milk Company
VINAPIMEX	Vietnam National Paper Corporation
VINATEX	Vietnam National Textile-Garment Corporation
VOCARIMEX	Vegetable Oil-Cosmetics-Aromas Company of Viet Nam
WB	World Bank
WHO	World Health Organization
WTO	World Trade Organization

Materials

ABS	Alkylbenzen Sulfonate
ABS	Acrylonitrile Butadiene Styrene copolymer
AOX	Adsorbable Organic bound Halogen
AP	Alkaline Pulp
BKP	Bleached Kraft Pulp
CGP	Chemi-Ground Pulp
CVC	Chief of Cotton
DIP	De-Inking Pulp
DDT	Dichloro-Diphenyl-Trichloro-ethane
DMDS	Dimethyl Disulfide
IC	Integrated Circuit
KP	Kraft Pulp
LAS	Linear Alkylbenzen Sulfonate
LPG	Liquefied Petroleum Gas
LSI	Large Scale Integrated circuit
MLSS	Mixed Liquor Suspended Solid
MM	Methyl Mercaptan
MS	Methyl Sulfide
MSG	Monosodium Glutamate
OCC	Old Corrugating Container
PCB	Polychlorinated Biphenyl

POY	Pre Oriented Yarn
PTY	Processing Textured Yarn
PVA	Polyvinyl Alcohol
PVC	Polyvinylchloride
SCP	Semi-Chemical Pulp
T/C	Mixture of Polyester and Cotton
TSPP	Sodium Pyrophosphate
UV	Ultra Violet
WP	Waste Paper

Special Terms

BOD	Biochemical Oxygen Demand
BOT	Build Operate Transfer
CCM	Computer Color Match
CCS	Computer Color Search
CIP	Cleaning in Place
COD	Chemical Oxygen Demand
CP	Cleaner Production
DF	Diffusion Factor
DTF	Official Discount Rate
E/S	Evaporation/Steam (ratio)
EFC	Effluent Chlorine Free
EIA	Environmental Impact Assessment
EOP	End of Pipe
EPZ	Export Processing Zone
FDI	Foreign Direct Investment
FOB	Free on Board
GAP	Green Aid Plan
GC	General Corporation
GDP	Gross Domestic Product
GMP	Good Manufacturing Practice
GNP	Gross National Product
HACCP	Hazard Analysis Critical Control Point
IQF	Individually Quick Freezing
IZ	Industrial Zone
JV	Joint Venture
KD	Knockdown
KN	Kappa Number
L/A	Loan Agreement

M/M	Minutes of Meeting
NIP	Nipper Pressure
OA	Office Automation
ODA	Official Development Assisteance
OJT	On the Job Training
ORP	Oxidation Reduction Potential
OWF	On the Weight of Fiber
PPP	Polluter Pays Principle
PR	Public Relations
PVD	Physical Vapor Deposition
QR	Quick Recommendations
RO	Reverse Osmosis
S/W	Scope of Work
SME	Small and Medium size Enterprise
SOE	State Owned Enterprise
SP	Solidification Point
SS	Suspended Solids
TCVN	Tieu Chuan Viet Nam (Vietnamese standard)
TOC	Total Organic Carbon
TPM	Total Productive Maintenance
TQC	Total Quality Control
TQM	Total Quality Management
TSL	Two Step Loan
TSS	Total Suspended Solids
ThOD	Theoretical Oxygen Demand
UHT	Ultra High Temperature
VA	Value Analysis
VAT	Value Added Tax
VCEP	Vietnam Canada Environmental Project
VSS	Volatile Suspended Solids

Units

g	Gram
ha	Hectare
kCal	Kilo Calorie
kg	Kilo gram
km	Kilo meter
kW	Kilo Watt
kWh	Kilo Watt Hour

l	Liter
m	Meter
m^2	Square meter
m^3	Cubic meter
mg/l	Milli-gram per liter
Mpa	Mega Pascal
MPN	Most Probable Number
mS/cm	Milli Siemens per centi-meter
NTU	Nephelometric Turbidity Unit
ppm	Part per million
rpm	Revolutions per minute
t	Ton
US$	United State Dollars
VND	Vietnamese Dong
μS/cm	Micro Siemens per centi-meter

Chapter 1

Background and Aim of the Study

Chapter 1 Background and Aim of the Study

1.1 Background of the Study

Since 1976, Viet Nam has industrialized as a socialist planned economy with an emphasis on heavy industry. Following the introduction of the *doi moi* (renewal) policies in 1986, the country has been stepping up its drive toward industrialization by following the principles of a market economy.

Even though the growth rate receded to –3.3% in 1989, industries in Viet Nam maintained a 10 % or higher growth rate from 1991 to 1999. A remarkable growth rate, 17.1%, was observed in 1992.

The primary factors for this industrial development can be explained as follows:

① Industrialization and modernization were effected by *doi moi* economic policies.

② Markets enlarged and economic conditions improved due to an increase in the purchasing power of citizens that was brought about by industrial promotion that utilized Vietnam's abundant labor force and rich natural resources.

③ A foreign investment promotion policy was adopted that opened markets and offered favorable treatment to foreign investors.

④ Vitality in the private sector that was generated by changing state-owned and small and medium-sized enterprises to equitized companies.

⑤ Countermeasures were implemented to support domestic investment by exempting taxes on raw materials and equipment, and a high tariff rate on imported items that compete with domestic products.

While industrial production in Viet Nam has been increasing, it has been pointed out that industrial pollution is worsening. The use of outdated production technology due to shortage of financing and lack of technological information on pollution prevention in small and medium-sized enterprises is considered to be the main cause of delay in implementing pollution prevention countermeasures.

An 8 % economic growth rate is expected over the next 10 years in Viet Nam, and in order to reach this figure, industries need to grow at the rate of 10 % or more per year. Thus, the pollution issue will become a very serious problem in Viet Nam if industry grows at the present rate without adopting pollution prevention measures.

The Vietnamese government has therefore been making every effort to formulate and implement various environmental policies, for example, by introducing an Environmental Protection Law in 1994. The first large-scale inspection was conducted through out the country starting in June, and running through November 1997. This investigation was conducted by the Ministry of Science, Technology, and Environment (MOSTE), and the Department of Science, Technology and Environment (DOSTE) of 61 provinces and cities with the related administrative bodies. They inspected factories, including those that did not submit an Environmental Impact Assessment (EIA) report, those that were not satisfying conditions that were established when the EIA report was established, those not making any effort to set up pollution prevention equipment, those causing severe environment pollution, and those that had been involved many times in law-suits concerning environmental issues. 47% of the 9,384 total factories inspected were either punished by fines, or received a warning about breaking environmental protection laws.

According to the results of the investigation, most of the factories that started operating before the Environmental Protection Law was formed, and some of the factories that started operations after the Law was formed, have no wastewater treatment equipment. As a matter of course, in most of these enterprises wastewater treatment is not carried out, or is conducted only through the use of primitive equipment, such as sedimentation tanks. MOSTE announced to the local government that 144 enterprises which were causing serious pollution problems had to shut down factories, and ordered other enterprises to set up pollution prevention equipment following the pollution prevention conditions that were established when the EIA report was established. In addition, enterprises were ordered to make an EIA report, if they hadn't already done so.

The investigation results revealed that the pollution prevention conditions at each factory were serious, and that State management for environmental protection needs to be strengthened. It also revealed that the legal system for environmental protection needs to be reconsidered and reinforced; investigation activities need to be strengthened by conducting inspections more often and at regular intervals; factories generating serious levels of pollution need to be shut down; the monitoring function needs be strengthened by improving the ability of factory employees through education and training; the number of employees working on pollution prevention needs to be increased; and regulations for implementing countermeasures, such as relocation of factories, need to be strengthened.

At the same time, the results of the investigation indicate that the enterprises need to consider adopting Cleaner Production technology and refurbish outdated equipment and technologies. In addition, it became evident that countermeasures for supporting enterprises are needed to improve their credit conditions, and tax incentive measures, investment in pollution prevention, and pollution prevention related loans are needed in order to improve the surrounding environment.

On the other hand, these type of cooperative programs have mostly been concentrated within MOSTE and the National Environmental Agency (NEA). Therefore, the approach taken by the Ministry of Industry (MOI), which is required to support and promote industrial pollution measures taken by private enterprises for environmental issues, lags in comparison with the establishment of environmental conservation systems. The MOI has just begun implementing and promoting industrial pollution prevention measures, and it now considers industrial pollution prevention to be one of the most important policies that needs to be adopted.

The first environmental impact appraisal was conducted in August 1998 through cooperation between MOI and Japan. In December 1998, MOI requested the Japanese government to conduct “the Study for an Environmental Pollution Prevention Plan for Industrial Wastewater Along the Cau River". In March 1999, the second environmental impact appraisal was conducted. During the discussions held thereafter, the MOI expressed a desire to extend cooperation by designing more comprehensive strategies for the entire country, rather than simply concentrating on local areas along the Cau River. This request was made in light of a comment that the MOI, which is on the side of providing support to enterprises for industrial pollution prevention, should have its own strategies for this area.

From these results, the Japanese government dispatched a preliminary Study team to Vietnam from JICA in August 1999. An agreement was reached in response to the request in the form of “the Master Plan Study for Industrial Pollution Prevention (Wastewater)”, and on August 11 the parties concerned signed the Scope of Work (S/W) for conducting this Study.

1.2 Objectives of the Study

The purpose of the Study is to create a synthetic master plan. In order to create this, reexamining regulations through investigations of pollutant concentration values of regulation standards and monitoring system should be carried out as well as establishing pollution prevention countermeasures for industries that cause pollution and countermeasures for the administrative side to implement for pollution prevention.

1.3 Study Schedule

The survey was conducted based on the operation of the following programs:

The first local survey in Vietnam was conducted for about one week from October 27-November 3, 1999. The survey included an investigation of industrial, environmental and financial policies in Vietnam.

The second local survey in Vietnam was conducted for 37 days from November 16-December 22, 1999. The survey included additional examinations of development plans, social and economic conditions, industrial structure and industrial pollution control policy in Vietnam; the circulation of questionnaires to the factories subject to the survey; water quality analysis; simple suggestions for improvement.

The third local survey was conducted from February 20 - March 20, 2000. The Study team surveyed detailed improvement proposals including estimates of costs for implementing countermeasures for the factories that were subject to the detailed inspection and selected for the second local survey and conducted water quality analysis. In addition, the Team announced industrial, environmental, and financial policies based on collected information as of the time related to industrial pollution prevention in Vietnam and countermeasures for five sub-sectors (the textile and garment, the chemical, the paper and pulp, the food processing and the metal works) in a joint seminar with the MOI in Ho Chi Minh City on February 24.

The fourth local survey was conducted over 10 days from June 1- June 10, 2000. The survey included four workshops (“ Industrial Policy”, “Environmental Policy”, “Environmental Management and Productivity Improvement” and “International Cooperation”), and discussions concerning pollution prevention policies with the Vietnam side. Also, discussions were held concerning the implementation and details of seminars in Hanoi and HCMC that were planned to be held on July 27, 28, and August 1, 2000.

The fifth local survey took place over 13 days from July 23 to August 4, 2000. In addition to an explanation and discussion on the draft of the Final Report, a Draft Final Report Seminar was held in Hanoi and HCMC.

1.4 Industrial Sectors Studied

The Scope of Work called for five different industries, that is the textile and garment, the chemical, the pulp and paper, the food processing, and the metal works, to be studied using the following standards:

① Industries that have the possibility or ability to become internationally competitive, or industries that can repay debt for foreign investment support in the future.

② Industries that have serious wastewater pollution.

③ Industries that mainly consist of small and medium-sized enterprises that are private, or are state- owned and have plans to privatize in the future.

The real purpose of this Study is not only to set up industrial pollution prevention plans for wastewater for these 5 subject industries, but also to prevent industrial pollution by providing and spreading the measures called for in these plans through all types of industries in Vietnam.

Chapter 2

Present Industrialization and Industrial Pollution Prevention Policy

Chapter 2 Present Industrialization and Industrial Pollution Prevention Policy

2.1 Present Industry in Viet Nam

2.1.1 Remarkable Industrial Progress in Viet Nam

Since renovation in 1986, Viet Nam has carried out the most important reforms in it's modern history, which have been termed *doi moi*, or "renewal." The contents of these reforms include ① a shift of the centrally planned economy to a market economy under the State's management, ② development and diversification of international economic relations, and ③ reform of the State Administration. After renovation began, industry in Viet Nam showed remarkable progress and the industrial growth rate kept rising continuously more than 10% from 1991 to 1999. The economy in Viet Nam suffered through a regional economic crisis in the late 1990's, the industrial growth rate is expected to drop below 10% in 2000. However, it is estimated that industrial growth will still remain stable compared to other ASEAN countries.

Table 2.1 Industrial Growth Rate

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Rate	-10.3	1.0	8.7	12.9	13.1	10.0	6.1	9.9	14.3	-3.3	3.1
Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
rate	10.4	17.1	12.7	13.7	14.5	14.2	13.8	10.3	10.4	9.5	

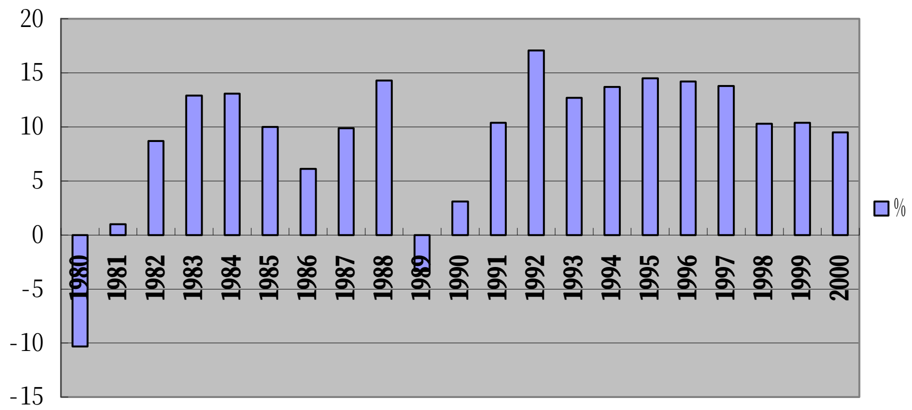


Figure 2.1 Industrial Growth Rate

Source: "Socio-economic Statistical Data of 61 Provinces and Cities" p.75

1999 figures are from the Annual Report by MOI

2000 figures are forecasted from "Viet Nam Socio-Economy the Period 1996-1998" p.50

The ratio of industry and construction in GDP became larger than that of agriculture, forestry and fishing in 1994. The ratio in 1999 reached 34.5% of GDP and is still foreseen to increase. The industrial sector is now the most important one for growth in Viet Nam.

Table 2.2 GDP Ratio by Sector

Year	(Agricultural, Forestry & Fishing)	(Services)	(Industry & Construction)
1985	40.17	32.48	27.35
1986	38.06	33.06	28.88
1987	40.56	31.08	28.36
1988	46.30	29.74	23.96
1989	42.07	34.99	22.94
1990	38.74	38.59	22.67
1991	40.49	35.72	23.79
1992	33.94	38.80	27.26
1993	29.87	41.23	28.90
1994	28.70	41.65	29.65
1995	27.18	44.06	28.76
1996	27.76	42.51	29.73
1997	25.77	42.15	32.08
1998	25.75	41.66	32.59
1999	25.4	40.1	34.5
2000	19.50	45.50	34.50

Source: Statistical publishing house P21
1999 figures are from the Annual Report by MOI
2000 figures are from "Viet Nam 2000" P34 (forecast)

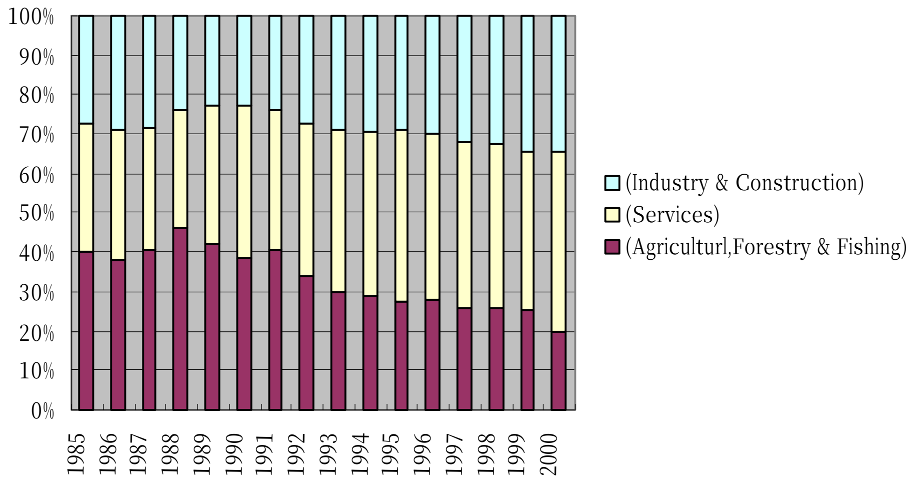


Figure 2.2 Industrialization in Viet Nam

2.1.2 Forecast of Industrial Production in Viet Nam

The forecast for production of main industrial products is shown in Table 2.3. From 1997 to 2000 many industrial products are estimated to increase several times, like steel and steel products (3.06 times), paper (2.06 times), caustic soda (6.00 times), vegetable oil (1.67 times), fabrics (3.57 times) etc. Production of these products is expected to increase more through 2010, and production of some products, like caustic soda, is predicted to expand 20 times. After the petrochemical industry begins operations, new chemical products like polyvinyl chloride, methanol, synthetic fiber, and polyethylene are expected to emerge.

This forecast made by MOI shows that industrialization in Viet Nam will continue at a high growth rate.

Table 2.3 Production Forecast

	unit	1997	2000	2010	Ratio2000 /1997	Ratio2010 /1997
Steel and steel products	1,000 tons	980	3000	8000	3.06	8.16
Urea fertilizer	1,000 tons	130	910	2000	7.00	15.38
Phosphate fertilizer	1,000 tons	834	1180	2700	1.41	3.24
Diesel engine	1unit	6300	44000	55000	6.98	8.73
Electric motor	1unit	39000	46000	55000	1.18	1.41
Transformer	1unit	6000	7700	15000	1.28	2.50
Machine tools	1unit	1030	600	1500	0.58	1.46
Industrial pump	1,000unit	650	1730	4000	2.66	6.15
Automobile tire and tube	1,000unit	24	700	2300	29.17	95.83
Fabrics	mil.meters	280	1,000	2000	3.57	7.14
Paper	1,000 tons	243	500	1200	2.06	4.94
Cigarette	mil.packets	2.1	2000	2460	952.38	1171.43
Beer	mil.liters	565	800	1500	1.42	2.65
Milk condensed	mil.cans	144	200	800	1.39	5.56
Vegetable oil	1,000 tons	60	100	300	1.67	5.00
Shoes	mil.pairs	33	220	380	6.67	11.52
Detergent	1,000 tons	202	140	250	0.69	1.24
Television	1,000 sets	114	950	2000	8.33	17.54
Apatite ore	1,000 tons	573	1000	1800	1.75	3.14
Caustic soda	1,000 tons	7.5	45	150	6.00	20.00
Soda ash	1,000 tons	0	0	150		
Polyvinyl chloride	1,000 tons	0	180	300		
Dioctyl phatalate	1,000 tons	0	60	120		
Methanol	1,000 tons	0	0	1300		
Synthetic fiber	1,000 tons	0	0	100		
Polyethylen, Polypropylene	1,000 tons	0	0	500		
Electricity	mil.Kwh	19000	33000	87800	1.74	4.62

Source: a guide to the Ministry of Industry 1996 p43-44

2.1.3 The Increasing Environmental Load

The industrial growth rate is increasing rapidly in Vietnam, and growth in the future is expected to be maintained at the same high rate. However, the environmental load has been increasing at the same rate as industrial growth.

Using the case of environmental load in the paper and pulp industry as an example, it is easy to make a comparison with Japan. The situation in both countries is explained as follows:

The total value of COD in Japan was 200,000 tons a year in 1989, (the COD value in Japan dramatically dropped over the last 10 years to a figure that is considered to be normal and not polluted, and thus, COD data has not been recorded recently), the total production of paper and cardboard was 26.81 million tons and the ratio of the COD load to production was 0.75%. On the other hand, the total production of paper and wrapping paper was 297,000 tons and the total COD load was 183,000 tons in Vietnam in 1998. From these figures, the ratio of COD load to production can be calculated as 61.6%.

The COD ratio to the production amount in Vietnam has reached about 82 times that of the Japanese figure, and the absolute values of COD are almost the same in Japan and Vietnam. The paper and pulp industry's expected production increase in the future will lead the environmental load volume in Vietnam to reach or surpass the Japanese level even though their production amount is not as large as Japan's.

<Reference>

In the Japanese case, before the implementation of environmental measures, the COD load from the paper and pulp industry was 2.2 million tons in 1970. Since then, subsequent promotion of pollution prevention measures over time brought a 91 % decrease in the total environmental load in spite of an increase in the production amount. The reason for this can be attributed to the effects gained by using Cleaner Production technology because production processes have been improved by changing production methods (58%), collecting black liquor (26%), and using End of Pipe technology (16 %).

2.1.4 Problem Points of Existing Industrial Policy

(1) Low Profitability Due to the Geographic Disbursement of Small Sized Enterprises in Equipment Intensive Industries

At present, industrial production in Vietnam is expanding rapidly. However, when production per factory is compared to international standards, it is revealed that production figures remain behind previous, smaller standards.

Because all industries possess distinct and special qualities, just because an industry's production scale is small does not mean that it will work at a disadvantage.

For cases like the textile industry, where the larger the production scale is the higher the costs of labor and textile machinery become, if labor and machinery are increased greatly, after expansion, the cost per unit produced will not decrease. Therefore, international competitiveness will not clearly become stronger. The textile industry is referred to as a “labor-intensive industry”.

On the other hand, for cases of the chemical and paper and pulp industries even if production capacity is increased greatly, the cost for various kinds of machinery will not increase proportionately to the increase in production capacity. In another way to say, basically, costs for additional reactors, furnaces, tanks, etc are proportionate to the production capacity to the 0.6 power, so the costs will increase gradually. (0.6 power rule)

Roughly speaking, the cost of machinery will decrease by 1/2 if production increases 5.64 times, and by 40% if production increases 10 times, and by 30% if production increases 20 times. In other words, if the same investment is concentrated on in one factory, production ability can grow 1.6 times compared to a plan that calls for constructing two factories.

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 much if the production ability increases.

In this situation, concentration and integration are effective for the reduction of cost for both equipment and labor.

Profits made by small sized and geographically dispersed factories will be low because facility, equipment and labor costs are relatively expensive in equipment intensive industries. This situation would put small sized and dispersed factories at a disadvantage because it is hard for them to carry out pollution prevention investment.

On the other hand, products that are only produced in small quantities, in many different varieties, and are not mass produced by large equipment are suitable for small and medium-size enterprises. Even though the pulp industry is an equipment intensive industry, changing over production equipment to large sized equipment for paper products such as special paper, or paper containers, will not have many merits for the industry producing special paper and paper containers.

MOI is promoting a type of local industrialization with the aim of maintaining a secure employment system and well-balanced industrial growth in Vietnam. It is expected that small and medium-size enterprises in industries such as food processing, furniture, and sundries that have favorable conditions, such as a secure supply of raw materials, or have some kind of distinguishing local quality, will grow rapidly in the future.

(2) Increasing Costs Due to Outdated Production Processes

There are many factories in Vietnam that are still using outdated production methods. In the pulp industry, the Kraft Pulp (KP) method is now the main method used for producing pulp**.** This method utilizes caustic soda (NaOH) and sulfate soda (Na_2S), and wastewater contains these chemicals and energy, which is called black liquor, is recollected. In Viet Nam this method is being adopted at a low rate. Among the 21 enterprises subject to the Study, only 2 enterprises are following the Kraft Pulp method and implementing the installment of black liquor collection equipment, accumulating and burning waste liquor, recollecting energy, and at the same time, recollecting caustic and sulfate soda. Furthermore, a collection rate of chemicals reaches to 80 % high in efficient case, and it will be possible to increase the rate up to 98% when production management is implemented efficiently.

Good quality pulp can be produced using the KP method. Wastewater is utilized as a source of energy, and there is little consumption of chemicals in this method due to recollection. By using this method, all wastewater can be converted to energy and pulp factories need not purchase any energy. Indeed, factories can get more than just energy for pulp production**.** The other, older methods in use for producing pulp have disadvantages in cost, quality, energy conservation and pollution prevention. With these methods it is basically necessary to convert the entire production process, but in small-scale factories it is difficult to install equipment for recollecting black liquor.

There are some companies that are producing caustic soda according to the diaphragm process, however, the ion exchange membrane method is more profitable, both in terms of general energy costs and quality. From now forth, especially because the amount of caustic soda used is expected to increase greatly, the accumulation cost will decrease, and because of the ease of handling, it is hypothesized that a large majority of caustic soda, in the form of 50% concentrated, will be circulated. In the case of liquid caustic soda, when the diaphragm method is utilized, 5% of the raw material salt remains in the product. This salt will make the occurrence of problems, like corrosion of machinery that utilized by salt, easier and for international competitiveness, this method is unprofitable in terms of cost and quality. However, in the ion exchange membrane method, if the refining of raw material salt water is not carried out sufficiently, the ion exchange membrane will be clogged. Therefore it is necessary for this method to raise the production management standards in order to prevent this kind of trouble.

In the dyeing process, continuous dyeing equipment has an advantage, but in Viet Nam there is very little continuous dyeing equipment in use. In addition, for these type of dyeing machines, it is possible to reduce the ratio of the liquid dye to cloth, therefore both cost and the pollution load can be validly decreased. In small-scale dyeing factories, for high production capacity, continuous dyeing machines, because the operation rate will decrease drastically, from here forth the general execution of scale increases and the introduction of new equipment are necessary.

It is necessary for companies to have profits in order for factories to invest in the environment. However, only through improvement in product yield by production management improvement there may be a limit to cost reduction and profit increases that can be gained. For these cases, in order to advance pollution prevention it will be necessary, at any rate, to adopt policies for changing the production method.

(3) Disadvantaged Factory Locations

a. Problems requiring long term consideration

External conditions and conditions that factories require for the location of their enterprises change over time. In the case that site conditions change drastically compared to the time a factory was constructed, and these conditions have a debilitating effect on profit conditions, reconsideration of factory location may be required.

In general, a location where raw materials can be obtained for little cost is suitable for industries that require a large amount of raw materials. A location that is close to consumer areas, which makes transportation costs low, is good for industries that produce heavy products such as the beer industry. Labor intensive industries will have a better advantage if they are located in an area with low labor costs.

Also, for areas where employment opportunities are scarce, sometimes social policy measures that promote the allocation of industries, even to areas that do not have the best criteria for a particular industry, are required.

Even though, in many cases, each industry demands different conditions in terms of their long term plans for introducing new equipment, factory locations that bring about improved profitability and meet the needs of economic and social change are one of the important elements for industrial development.

b. The following are some examples of problems that should be solved in the long term

In order to increase enterprise profits and make investment for pollution prevention easier, it is also important that problems relating to social stability, especially the promotion of industries in poverty areas, be solved in the long run.

Among the paper factories, some have changed over raw materials to imported pulp from domestic wood or bamboo. For mass-produced products like pulp, the portion of transportation costs out of the total cost is large and competitiveness can change just by re-location. So, those factories located inland, far from seaports, must consider changing their location and re-locating near seaports. Most of the paper factories are now using imported material and the use of imported material in the industry is foreseen to increase in the future**.**

At present, in central Vietnam, construction is being advanced in the petrochemical industry. In the case of the petrochemical industry, it is non-wasteful and economically valid to utilize heat energy and by-products that are generated. It will become important to physically tie together petrochemical plants using pipelines and locate them within a close vicinity to related production companies that inevitably utilize the raw material nafusa and lead products, propylene and ethylene.

For caustic soda, utilization of the ion exchange membrane method is the most effective way to increase competitiveness because of the low level of electricity consumption and high quality. This method requires the use of high quality salt. So, in order to obtain high quality salt from the sea, rather than using lower quality salt from mines, it is necessary to consider a factory location near a sea-port. In addition, in order to utilize a by-product chlorine efficiently in petrochemical industry, it is necessary the factory to locate near other petrochemical factories.

In the textile industry, especially in the sewing industry, because the percentage of labor cost included in the total manufacturing cost is high, there are no merits gained from increasing the production scale, and there is not much of a necessity to reduce transportation costs.

c. Direction of Considerations

It is profitable to consider generally, locating each industry depending on their respective special characteristics. Concerning remote areas, a plan for luring industries that are not really related and can't obtain merits through reduced transportation costs and scale increases to remote areas is thought to be adequate. Examples of such industries are traditional handicrafts, arts and crafts, industries using regional products and the tourism industry, which makes use of special natural conditions.

Oppositely, in fixed industries like the petrochemical industry, massive sized facilities, integration, including the integration of related industries, and a location where low cost transportation is possible, are required.

(4) Insufficient Production and Environmental Management

In all five industries surveyed it is necessary to improve the level of management. It is obvious there is a need to record wastewater statistics for environmental prevention, but on top of that, it is also necessary to raise competitiveness so companies can afford to invest in the environment.

To raise quality and reduce costs it is necessary for each factory to record daily operation data. From these records, data on consumption units and other necessary operation data concerned with materials, energy, chemicals and other substances should be calculated.

After collecting data for a period of time, operators will be able to detect a change in consumption units and other useful information. If unit consumption should become worse, then the operator will know whether there is something wrong with the equipment, whether material is being lost or not, or whether the quality of the material is changing for the worse.

If the operator compares his consumption unit with that of other companies, it can be observed whether there was any improvement in the process or not. Also, this comparison is necessary as basic data for process improvement. Collecting and exchanging information on production consumption units should be carried out domestically and internationally.

Without basic data it is impossible to appraise plans in order to improve processes.

In Viet Nam there are many differences between companies in terms of water and other matters related to consumption units. This reveals that little caution for operation management is paid, that there are few chances for exchange of information, and also that there is a great possibility for reducing costs and improving environmental conditions.

Regarding specific measures that need to be carried out in each sub-sector, these will be written later in more detail. For now, the only fact that should be remembered is that steps for improving management do not require large expenditures, and that these steps for improvement can be initiated right away.

2.2 Current Situation of Water Pollution in Vietnam

2.2.1 Yearly Change of Water Quality

Fig 2.3 shows yearly changes in BOD and COD at Lien Mac of the Red River. The water quality worsened after 1997.

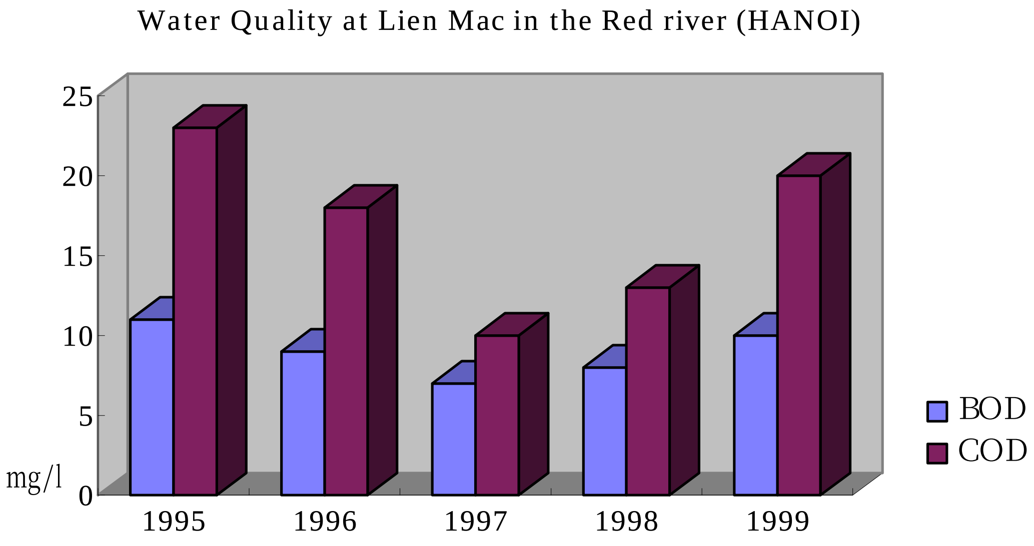


Figure2.3 Water Quality at Lien Mac in the Red River (HANOI)

Source: National Environment OAM Program

Fig 2.4 shows the changes in DO and COD in the River Tuy Loan in 1995_, 1996 and 1997.

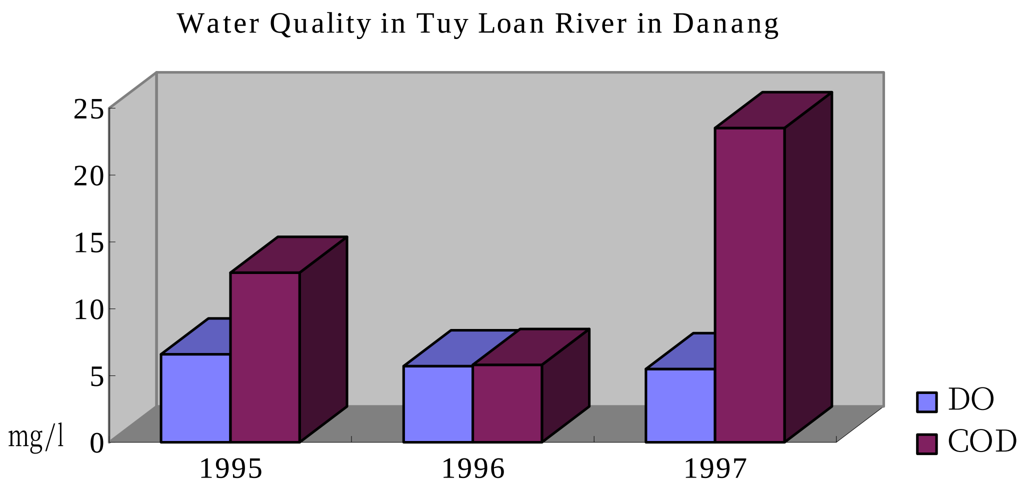


Figure2.4 Water Quality in Tuy Loan River in Danang

Source: National Environment OAM Program

The concentration level of Dissolved Oxygen (DO) shows the degree of pollution in wastewater. If the DO concentration is low, that means there is more organic matter in wastewater and that it is more polluted. The DO value has been getting worse year by year since 1995. On the other hand, the COD value improved around 1996, however, after that, it again became dramatically worse.

With regard to river water quality in the Southern region, a significant volume of industrial wastewater, as well as household wastewater, from more than 10 million residents is discharged into the Saigon-Don Nai River water system causing serious environmental problems. Figure 2.5 shows the yearly change of water quality in terms of DO concentration from 1995 to 1999, and increased organic matter pollution can be observed.

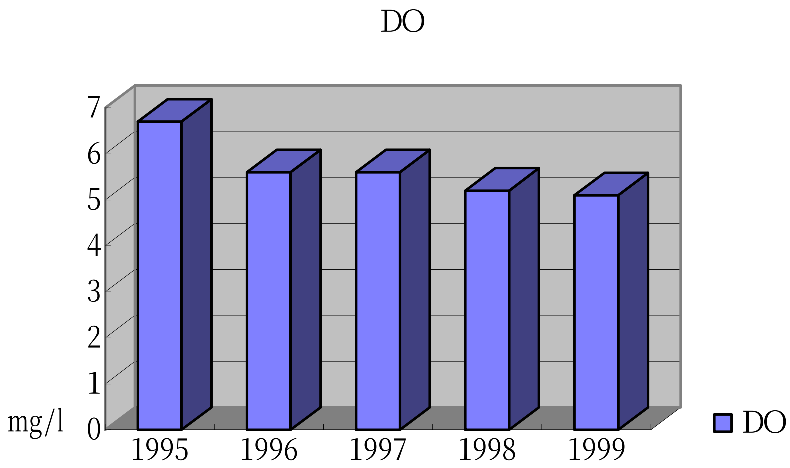


Figure 2.5 DO Concentration in the Sai Gon River (Ho Chi Minh)

Source: National Environment OAM Program

2.2.2 Pollution Distribution

(1) Current status according to a survey made by the Viet Nam side.

According to a water monitoring survey made in 1997, most of the rivers surveyed are classified as Class B (for ordinary use) according to the Vietnamese water quality standards. Only a few rivers are classified as Class A (for drinking). These include the upstream portion of the Red River in North Central Vietnam and the upstream part of the River Thi Vai. On the other hand, the River Cams in Hai Phong, the River Quan in Ca Mau, and the River Tac Thu are classified as seriously polluted rivers.

With respect to rivers, lakes, ponds, and canals in urban areas, Kim Nguu and To Lich which are considered to be canals, in Hanoi City, the Thi Nghe Canal in Ho Chi Minh City, and Lake Am Bien in Hai Phong are in a seriously polluted condition.

The Red River water system in the Northern region is badly contaminated, particularly during the dry season in areas where wastewater from paper manufacturing plants, phosphoric acid manufacturing chemical plants, and from the Viet Tri industrial area are discharged into it. In these areas, COD is 23.7 mg/l and BOD is 15.3 mg/l, which exceed the Class A water quality standard by 2.3 times and 3.8 times, respectively. Heavy metals, phenols, and agricultural chemicals are also detected in the same areas, but have not yet exceeded the standards.

In the River Thai Binh water system, industrial wastewater and urban wastewater are causing serious contamination in the River Cau in Thai Nguyen, and the River Thuon in Bac Giang.

In general, none of the rivers surveyed in the Northern region satisfy the Class A water quality standard (for drinking). They are all classified as Class B standard (for ordinary use).

Rivers in the Central region have good water quality at upstream and midstream, and satisfy the Class A water quality standard(for drinking). Water from the River Vinh Phuoc in Dong Ha, the River Huong in Hue, and the River Tuy Loan in Da Nang is supplied to cities, as well as being used as industrial water. However, the downstream portions of some of these rivers are polluted by organic substances, and are Class B water quality (for ordinary use).

A value of COD concentration in the Sai Gon river stops increasing in recent years, a value interval in 1997 was from 8.4 mg/l to 22.5 mg/l, which satisfies environmental standard B (for ordinary use). The value of oil concentration, range from 0.05 mg/l to 0.35 mg/l, also stopped increasing, compare to 1996.

Table 2.4 shows the measurement results of heavy metal levels in the River Saigon. Although some metals, including cadmium, are found to be above the maximum acceptable level at some measuring points, the report concludes that pollution by heavy metals is not yet sufficiently serious enough to create a risk to human health and aquatic life.

Table2.4 Concentration of Heavy Metals in Sai Gon River

Monitoring Station	Lead	Mercury	Chromium(VI)	Cadmium
Thu Dau Mot	0.024	0.001	0.0012	0.0038
Binh Phuoc	0.08	0.001	0.0072	0.0012
Nha Be	0.0045	0.0002	0.003	0.0021
Hoa An	0.0041	0.0006	0.0034	0.0048
Dong Nai Bridge	0.0041	0.0007	0.004	0.037
Cat Lai	0.0041	0.0002	0.003	0.043
Long Tau River	0.05	0.0002	0.003	0
Phuoc Khanh	0.025	0.0002	0.05	0
Standard Value	0.05	0.001	0.05	0.01

Source: National Environment OAM Program (unit: mg/l)

The DO concentration of the River Dong Nai is between 6.0 mg/l and 7.2 mg/l. This river is classified as Class A standard, since any contamination is relatively minor. On the other hand, the River Thi Vai is badly polluted with organic substances. In particular, contamination downstream from the Vedan plant to Port Phu My is serious. According to results of measurements taken in April and May 1998, BOD was very high, 48 mg/l to 72 mg/l, and COD was 114 mg/l and 180 mg/l at one measuring point (Go DauB). An increase in pollution by organic substances is likely.

With regard to the water quality of coastal regions, pollution by oil in the Northern, Central, and Southern regions is 0.34 mg/l, 0.13 mg/l, and 0.18 mg/l, respectively. Although measurements taken in 1997 show lower values than the previous year, there are still signs of pollution. The concentration of tin in the Northern, Central, and Southern regions is 0.04 mg/l, 0.03 mg/l, and 0.02 mg/l respectively. Colon bacillus levels were within the water quality standard at 804 MPN/100 ml in the Northern region and 78 MPN/100 ml in the Central region. However, the Southern coastal area showed 3,650 MPN/100 ml, which exceeds the standard level (1,000 MPN/100 ml), indicating pollution by organic substances.

The Bay of Ha Long, designated as a World Heritage Site, showed relatively high oil concentration of 0.4 mg/l on average, with some portions also contaminated by discharged household wastewater. As for metals, 0.12 mg/l of copper ion and 0.11 mg/l of zinc ion have been detected, both of which slightly exceed the maximum acceptable levels. In addition, there are concerns about damage to the coral and aquatic life in surrounding areas due to coal dust and wastewater discharged from mining developments and coal transportation.

(2) The Results of Water Quality Measurements Taken by the JICA Study Team

In order to grasp the quality and actual conditions of water, the Study Team selected main rivers located in the Northern, Central, and Southern regions in Viet Nam to survey water quality. Water quality was measured from December 1999 to January 2000. The results of measurements are shown in Appendix: Chapter 13. Sampling and water quality analysis was done by CECO, an analysis institution in Hanoi.

Four rivers, the To Lich river and the Kim Nguu river which flow through Hanoi City, the Cau river which runs through the suburbs, Thai Nguyen, Bac Giang, and Hai Duong County, and the Nhue river which flows through Hanoi to Ha Tay, were selected and measurements were taken as Northern region representatives. The To Lich river and the Kim Nguu river are typical urban canals, and are thought as drainage. There are many private houses, as well as machine, textiles, wood, food processing industries in small and medium-sized home manufacturing factories, along the rivers. BOD and COD value in the river water is 115-378 mg/l and 160-535 mg/l respectively, which reveals that serious organic pollution has been occurring as the same the results of Vietnamese side investigation because domestic and industrial wastewater is being discharged without treatment. In addition to this pollution, values of metal concentrations, such as lead, Mn, and Cu, are still high. The lead value especially, 0.125mg/l at sampling point R6-2 in the To Lich, and 0.855mg/l at sampling point r7-2 in the Kim Nguu, are very high. (See Table 13.6 and Figure 13.7)

These waterways have small flow rates, narrow widths, and small natural purification systems because of their small rate of circulation. Thus, infrastructure countermeasures, such as sewerage systems, should be implemented as soon as possible.

On the other hand, water quality measurement results on the Cau river show that phenol concentration values were 0.008mg/l at sampling points R5-2 and R5-5, which exceed the Class A standard value(for drinking), 0.001mg/l. The concentrations of metals, such as Mn, Cu are also high, and this is explained as being caused by wastewater discharged from iron manufacturing facilities. However, it is different from the results of Vietnamese side investigation, most of the values related to living environmental conditions, including DO, BOD and COD values, are in relatively good condition now. (See Table 13.5)

As Table 13.4 shows, the Nhue River has only a little pollution even though river water is muddied.

Han river water was measured as a representative river that runs through the Central region, and DO values at all sampling points are 6mg/l or more, which satisfies the Classs A standard (for drinking), 6mg/l or more. Both BOD and COD values are4.8-6.4 mg/l, and 6.5-9.2 mg/l respectively, and pollution related to the living environment is not so serious at this moment. Items that cause concern to human health, such as heavy metals, also show low concentration values, and it can be concluded that there is minor effect to river water by industrial wastewater. However, the measurement was conducted during the rainy season in the DaNang region, and it can be assumed that water quality would become worse during the dry season. (See Appendix Table 13.3)

Measurements were conducted at the Sai Gon river, which runs through the urban part of Ho Chi Minh City, and at the ThiVai river on wastewater from the industrial zone in Dong Nai province, which is discharged from BaRia to VungTau provinces, as representative rivers of the Southern region.

Table 13.1 shows that water quality in the Sai Gon River, from the point where it merges with the Don Nai River and on downstream, is getting worse. At the sampling point R1-5, which is underneath the Dan Xay Bridge, BOD and COD concentration values were 29mg/l and 40.8 mg/l respectively, and exceed the Class B standard values (for ordinary use), BOD 25mg/l and COD 35mg/l. Water in this river satisfies the environmental standards B (for ordinary use) according to the 1997 Vietnamese survey results. Thus, it is assumed that the pollution level is increased in last two years. The reasons for this are attributed to the discharge of domestic and industrial wastewater from high population density and factory areas along the river, which cause down stream values to worsen.

The Thi Vai River water quality has became worse due to the bad influence of industrial wastewater from the MyXuana and Go Dau industrial zones. As Table 13.2 shows, when comparing water quality upstream of the industrial zone to that down stream of the industrial zone where wastewater is discharged, at the sampling point R2-3 in the PhuocTai district in Don Nai Province, the COD value was28.8 mg/l. However, sampling points R2-4 and R2-5 in the MyXuan district in BaRia VungTaw province and in the GoDa-TanThanh district, have COD values of 120mg/l and 496mg/l, respectively.

Also, the concentration of cyanogen, one of the toxic pollutants measured, is 0.002mg/l at sampling point R2-3 which is immediately in front of an industrial zone, and 0.054 mg/l and 0.023 mg/l at sampling points R2-4, and R2-5, respectively. This can be explained as being attributable to wastewater discharged from the industrial zone.

The ThiVai River is seriously polluted by industrial wastewater, and this situation is expected to worsen because of increasing industrial activity and construction of more factories. Therefore, countermeasures for industrial pollution sources, such as the introduction of wastewater treatment facilities in factories, should be promoted.

(3) Geographic Distribution of Pollution

The geographic distribution of the above mentioned pollution can be explained as being dependent on the distance between the pollution sources and the water volume of rivers. For large rivers like the Red and Saigon Rivers, in the downstream portion the Class B standard(for ordinary use) is being exceeded, however it is not being exceeded to a point that could be called extreme. On the other hand, in the case of the small rivers, which has a small water volume, the Class B standard (for ordinary use) is being exceeded by as much as ten times, and the water cannot be used for irrigation. Because living organisms can't habitat in small rivers, countermeasures must be initiated at once.

Concerning pollution caused by industrialization, in the Northern region at the point where wastewater from the Viet Tri Industrial Zone flows into the Hong Water system, and the Thi Vai River in the Southern region can be mentioned. Between them, pollution in the Thi Vai River is remarkably bad, and there are points where COD is 14 times that of the environmental standard.

As for areas where industrial and domestic wastewater pollution is mixed, the To Lich River, which flows through Hanoi City, as well as the Kim Nguu River, both metropolitan waterways, should be mentioned. In the To Lich River and the Kim Nguu River, both which are considered to be canals, pollution is severe. With respect to this point, pollution is comparatively light in the Cau River which flows through the northern suburbs, and in the Han River which pours into DaNang Bay after flowing through DaNang City in the Central region. There are no problems in the upstream portion of the Saigon River, however, in the downstream segment the environmental Class B standard (for ordinary use) is being exceeded.

2.2.3 Pollution Sources

There are two types of wastewater that cause pollution, industrial wastewater and domestic wastewater. Table 2.5 shows each industry's pollution load in the main industrial zones in Vietnam.

Table2.5 Water Pollution Sources in Industrial Zones by Industry (Organic Pollution)

(1) Industrial Water Pollution Sources in HANOI (1996～1998)

No	Industrial Zone	Industries	number of employees	Pollutants		volume of waste water (m^3/day)
				SS (kg/day)	BOD_5 (kg/day)	
1	Thuong Dinh Industrial Zone	Machine	6171	2084.85	-	4,907
		Construction Material	640	490.17	1.59	54.16
		Textile, Shoes	5772	727.60	1588.57	1,015.00
		Foodstuffs, Tobacco	7655	1304.4	263.36	22,114
		Others	491	259.42	1.72	95
		Total	20729	4866.44	1855.24	28,185.16
2	Hai Ba Trung District Area	Machine	560	673.88	-	296.9
		Construction Material	1714	4890.12	19.497	3,816.7
		Textile and Garment	14217	3142.78	6542.13	18,243.30
		Office supplies	-	-	-	750.00
		Total	16491	8706.78	6561.627	23,106.9
3	Van Dien Area	Machine	884	1513.00	511.58	329.00
		Construction Material	324	2166.00	7.67	100.00
		Others	1040	371.63	0.48	1003.40
		Total	2248	4050.63	519.73	1432.40
4	Chem Area	Machine	930	617	-	135
		Construction Material	1334	110.17	-	727
		Others	844	47.67	96.92	785
		Total	3108	774.84	96.92	1647
5	Sai Dong Area	Machine	2638	71.33	-	2355
		Construction Material	750	1300.00	4.60	100.00
		Others	2307	591.49	480.00	76.20
		Total	5695	1962.82	484.60	2531.20
G-Total			48,271	20,361.51	9,518.17	56,902.66

Source: National Environment Agency

(2) Industrial Water Pollution Sources in PHU THO

No	Industries	Number of employees	Pollutants		volume of waste water (m^3/day)
			SS (kg/day)	BOD5 (kg/day)	
1	Machine	600.00	454.50	17.58	93.50
2	Construction Material	805.00	77,906.67	261.40	1,298.00
3	Chemical	2,304.00	4,936.00	2,210.00	43,882.00
4	Textile, Paper manufacturing	7,716.00	6,170.00	7,180.00	76,518.30
5	Foodstuffs	1,157.00	1,873.00	680.30	1,068.00
	Total	12,582.00	91,340.17	10,349.28	122,859.80

Source: National Environment Agency

(3) Industrial Water Pollution Sources in NAM DINH

No	Industries	Number of employees	Pollutants		volume of waste water (m^3/day)
			SS (kg/day)	BOD5 (kg/day)	
1	Machine	1,200	1,878	-	72
2	Foodstuffs	1,242	966.5	1,857.12	3,989
3	Textile	24,152	1,476.99	630.64	17,614.08
4	others	973	37.5	28	117.17
	Total	27,567	4,358.99	2,515.76	21,792.25

Source: National Environment Agency

(4) Industrial Water Pollution Sources in BAC NINH

No	Industries	Number of employees	Pollutants		volume of waste water (m^3/day)
			SS (kg/day)	BOD5 (kg/day)	
1	Glass Factory	-	82.37	0.58	600
2	Glass Factory in Dap Cau	-	1.04	599.2	800
	Total	-	83.41	599.78	1,400

Source: National Environment Agency

The total BOD discharge amount of these four industrial zones per day is 23 tons. This value was compared with the various industries surveyed to determine if the surveyed results were adequate or not in terms of order. The COD discharge amount coming from the 21 paper and pulp enterprises surveyed, which operate 240 days per year, reaches 760 tons per day. Even if BOD is half that of COD, 16.5 times the total discharge amount of the four industrial zones equal to that of paper and pulp industry.

In the same way, the total amount of discharged BOD coming from the 21 enterprises surveyed in the food processing is 11.7 tons per day, and 51 % of the total discharged amount of the four industrial zones equal to this. As far as order goes, in the case of food processing, the numerical value matches that of the Vietnam side.

As for the case of paper and pulp, because the contribution of the discharge amount of COD in a few factories is extremely large, it is thought that the total BOD discharge amount shown in the materials of the Vietnam side is adequate.

In addition, supposing that the total pollutant load coming from households is 50 grams per day per person, then the Hanoi area, with a population of 3,000,000, will produce 150 tons per day. This value matches a figure that is 15.8 times that of the 9.5 tons per day of the BOD discharge amount of the 5 industrial zones in the Hanoi area. Concerning BOD and COD household pollution, as sewer systems are not in place, the overwhelming majority of this amount consists of waste.

2.2.4 Pollutant Analysis

(1) Household Pollutants

When either of BOD and COD concentration values increase, the use of water for agriculture, fisheries and industry becomes limited, and foul odors are generated.

The general use environmental Class B standard for non-drinking water in Vietnam is 25ppm for BOD and 35ppm for COD. However, these environmental standard values are lenient compared to the wastewater discharge standard values which are 50ppm for BOD and 100ppm for COD, respectively. The values should be changed according to the purpose of water use.

For example, for general industrial or fishery use, the value should be 5ppm, a level which will not effect the development of fish, and for domestic purposes, the value should be 10ppm, a level where humans do not feel any uncomfort. Actually because the environmental standards in Vietnam are lenient in general compared to other countries like Japan.

Thus even if the wastewater pollutant concentration values satisfy the present standards, it is difficult to use this water for industrial, fishery or domestic purposes. It can be assumed that pollution is progressing to a degree several times that of the standards.

However, there are many rivers where pollution is progressing even on a basis of the Vietnamese standard. Water from rivers that are polluted with industrial wastewater, such as the Thi Vai river, have pollutant concentration values that are 5 to 15 times that of the value of the environmental Class B standard (for ordinary use), and it can be expected that water from these rivers will not be able to be used in fisheries, or validly for any other uses. Water from these rivers also has a very foul odor.

Sai Gon river water exceeds the environmental Class B standard(ordinary use) in it's down stream portion, however, there is no problem in meeting the standard for industrial and fisheries use in the upstream portion of the river.

Water in the Han river, the Nhue river, and the Cau river has no problems meeting the standards.

(2) Harmful Substances

According to materials submitted by the Vietnam side, lead and cadmium are the harmful substance concentrations that exceed the environmental standard in the Saigon river water, and the concentration values of these pollutants are several times that of the environmental standards.

According to analysis by the Study Team, copper and cyanogens in the Thi Vai river water, and copper in the Sai gon river water are exceeding the environmental standards. The lead value in the Kim Nguu water is 0.855 ppm, and in the To Lich water is 0.125ppm.

These figures show that the pollution level has reached a point that is close to a value where human health problems can be caused through the consumption of shellfish taken in the downstream portion of these rivers. In order to prevent lead poisoning, it is necessary to investigate the lead value in the contaminated shellfish living downstream. Also, it is very important to identify the pollution sources and implement countermeasures for preventing discharge.

Cyanogen produces toxic cyanogen gas in liquid acid and can be lethal for human beings. Because it resolves easily, the actual value can be expected to be higher than the measured value around the area the cyanogen is originating from. In order to prevent an accident, it is necessary to investigate the source.

2.3 Current Status of Industrial Pollution Prevention

2.3.1 Basic Framework of Policies on Industrial Pollution

(1) Environmental Protection Law

Vietnamese environmental policies are based on the Environmental Protection Law that was enacted in December 1993. This Law was approved and enacted at the fourth meeting of the ninth session of the Diet held on December 27, 1993 in accordance with the Constitution of the Socialist Republic of Vietnam, as established in 1992, and was enforced as a law on January 10, 1994. The Law defines the "Environment" as natural resources and environmental ingredients, and covers problems related to overall environmental conservation. It consists of seven chapters and 55 articles (See appendix).

The basic philosophy and objectives concerning environmental protection underlying this Law are:

① To conserve and improve the environment;

② To protect the foundations of ecosystems;

③ To prevent environmental destruction; and

④ To carry out appropriate development of natural resources and conserve resources.

The items to which the Environmental Protection Law applies are broad and include air, water, and soil, and extend to living creatures, ecosystems, and the protection of the biodiversity of living creatures. The Law aims to implement active measures for protecting the global environment, as well as industrial pollution control measures.

Organizations that are responsible for implementing environmental policies, the requirements of establishing national and municipal environmental management systems, and the responsibilities of relevant organizations are identified in the Law. The Law also specifies the environmental assessment system, environmental monitoring, penal provisions, and compensation for damage.

(2) The National Plan on the Environment and Development

As a master plan for promoting environmental protection, the "National Plan for the Environment and Sustainable Development 1991 – 2000" was prepared in 1991 and approved by the government in 1992 with the cooperation of overseas supporting agencies that included the United Nations Development Program (UNDP), Swedish International Development Agency (SIDA), and International Union for Conservation of Nature and Natural Resources (IUCN).

The National Plan proposes to develop a comprehensive framework for environmental planning and environmental management in both central and municipal sectors to allow early measures to be taken on major tasks that are designated as high priority. The framework for laws, systems, and policies is specified as follows:

① Specification of the authority of central and associated ministries on environmental issues

② Creation of policies, laws, and rules concerning the environment

③ Preparation of manuals for environmental impact assessment

④ Establishment of sustainable development strategies at municipal levels

⑤ Establishment of frameworks and strategies for the environmental monitoring system

⑥ Establishment of information gathering, information management, and networking systems

Governmental administration on environmental protection is coordinated according to this action plan. MOSTE was established in September 1992 as the government organization in charge of basic environmental policies.

(3) Organization and system

In Vietnam, MOSTE is the central body for the promotion of environmental policies. MOSTE takes care of national environmental policies, in cooperation with MOI, Ministry of Commerce, Ministry of Construction, and the departments in charge of environmentally-related issues and projects in other governmental ministries and agencies and local (provincial, city, etc.) governments.

NEA was established under MOSTE in July 1993, as the chief body in charge of environmental policy. The NEA, with a staff of approximately 80, monitors the cohesiveness of the environmental-management administration throughout Vietnam.

Local governments and municipalities under direct central administration have a DOSTE, which serves as the central body in charge of environmental conservation within the People's Committee. Prior to enactment of the Environmental Protection Law, some municipalities promoted environmental protection policies through a Science, Technology & Environmental Committee (Environmental Committee).

A. MOSTE

The organization and duties of MOSTE, which manages and coordinates the governmental administration with respect to environmental protection, are shown below.

- Minister — Vice Minister
  - Advisory Committee
  - Standard, Metrology, Quality Department
  - Industrial Property Department
  - National Environmental Agency
  - Office of the Minister
  - S & T Organization & Personnel Department
  - International Relations Department
  - Bureau of Inspector
  - S & T Planning & Financing Department
  - Research & Development Department
  - Technology Promotion Department
  - S & T Strategy Research Center
  - S & T Management Research Center
  - Nuclear Energy Research Center
  - Applied Technology R& D Center
  - S & T information Center
  - S & D Research Office
  - Project Coordination Office
  - S & T Publisher
  - Other relevant organizations

The following items are specified as the roles of MOSTE:

① Planning a national strategy and policies on environmental protection, and submitting it to the government

② Making annual and long-term plans concerning environmental contamination and prevention of environmental pollution and accidents, and implementing the plans after receiving government approval

③ Setting up and managing an overall environmental monitoring system

④ Monitoring and analyzing environmental conditions nationwide, and submitting periodic reports to the government and Diet

⑤ Evaluating and examining reports on implementation of environmental impact assessments related to development projects

⑥ Surveying and applying the results of scientific and technical studies to environmental protection, introducing and revising environmental standards, and managing training provided for the environmental administration
⑦ Instructing and supervising branches, regions, and organizations related to the enforcement of the Law on Environmental Protection
⑧ Seeking the government's approval for participating in international organizations and international conventions on environmental protection, and implementing appropriate international actions

B. NEA

Under the MOSTE, NEA is in charge of environmental administration and protective measures. The NEA has the following organization:

National Environment Agency
- General Affairs Division
- EIA Report Appraisal Division
- Pollution Control Division
- Policy & Legislation Division
- Assessment & Monitoring Division
- Environmental Inspection Division
- Education Training & Information Division
- Attached Technology Center

Duties that fall within the jurisdiction of the NEA, which plays a key role in the nationwide environmental administration, are specified as follows.
① Examining and submitting policies, measures, and legal documents on environmental conservation
② Examining compliance with the Law on Environmental Protection
③ Preparing and implementing national plans and action plans related to environmental management
④ Examining environmental impact assessment reports
⑤ Monitoring and evaluating environmental protection, and installing and managing forecasting systems
⑥ Preventing environmental pollution
⑦ Dealing with problems related to environmental accidents and incidents
⑧ Implementing international cooperation
⑨ Instructing environmental officers at related branches and municipal organizations

⑩ Planning and implementing training courses
⑪ Implementing studies on environmental management
⑫ Collecting information and documents on environmental issues

As for the related ministries and agencies in environmental conservation, they set their own policies and strategies for environmental preservation following national strategies and policies. In addition to work on management of environmental preservation plans and pollution complaints, they also cooperate with MOSTE/ MOI to carry out inspections on Environmental Impact Assessment reports that go together with enterprise activities, like development and production. Also, concerning surveys, appraisals of environmental conditions, and research on environmental technology and its applications, these items are regulated together with MOSTE.

Using the Environmental Protection Administration of Hanoi, a local government agency under direct central government control, as an example, we find that Hanoi started taking the initiative to protect the environment with the establishment of an Environmental Committee (the Hanoi Environmental Committee [Hanoi ENCO]) in May 1987. Hanoi ENCO is a governmental body in charge of environmental issues, under the Hanoi People's Committee.

Hanoi underwent organizational reform in May 1994, in line with the organizational restructuring that has been taking place on a nationwide scale since January 1994, to promote environmental administration and policies in accordance with the Environmental Protection Law. A DOSTE was established in Hanoi to take charge of environmental matters. DOSTE is composed of the following six divisions, three affiliated centers, and one sub-agency (as of Dec. 1999), and has a staff of 159 people.
① Information Technology Division: 6 people
② Science, Technology Management Division: 10 people
③ Information & Industrial Property Division: 8 people
④ Inspection Division: 6 people
⑤ Environmental Management Division: 20 people
⑥ Administration Division: 13 people
⑦ Microbiological Food Center: 29 people
⑧ Fundamental Survey Center: 5 people
⑨ Technology Transfer Center: 4 people
⑩ Standards, Metrology & Quality Control Sub-Agency: 48 people

Regarding environmental protection policy in centrally-controlled Ho Chi Minh City An Environmental Committee (ENCO) was established within the Ho Chi Minh People's Committee in August 1992, marking the real start of the city's serious handling of environmental issues. With the start of environmental-policy formulation at the national level, which was initiated by the enactment of the Environmental Protection Law, organizational structure related to environmental policy in Ho Chi Minh City underwent reform in January 1994. This resulted in the formation of a DOSTE (currently comprised of eight divisions with a staff of 95 people, and six associated bodies with a staff of 141 people as of Dec,1999). Within DOSTE the Environment Management Division is in charge of administrative work concerning environmental conservation. With a staff of 15 people, this body receives guidance from MOSTE for carrying out environmental management related matters such as preparing municipal environmental regulations, investigating and providing guidance regarding generation of pollution, monitoring air and water quality, and other indicators of environmental conditions, handling complaints and arguments related to the environment and providing environmental education and training.

C. MOI

Promotion of national environmental policy is greatly reliant on the promotion of environmental policy at plants and factories and other parts of industry. In other words, its success hinges on promoting efforts to improve the environment by implementing measures at plants and factories, which is where industrial pollution is generated. The main body in charge of this aspect of promoting national environmental policy is MOI. MOI is composed of the following 10 departments, and the Technology and Product Quality Management Department is in charge of dealing with industrial pollution.

① Planning and Investment Department
② Finance and Accounting Department
③ Technology and Product Quality Management Department
④ Organization and Personnel Department
⑤ International Cooperation Department
⑥ Office of the Minister
⑦ Ministerial Inspection Board
⑧ Geology and Mineral Resources Directorate
⑨ Legislation Department
⑩ Industrial Safety Engineering Supervision and Inspection Directorate

The Technology and Product Quality Management Department is responsible for conducting the following operations:

① Researching and proposing strategies, plans, and policies related to scientific and technological development; engaging in environmental protection and conducting quality management

② Formulating regulations, standards, and economic and technical criteria pertaining to companies

③ Supervising product quality and the application of advanced science and technology at companies

④ Providing guidance for the implementation of national rules and regulations; also, implementing technical measures to protect the environment against the adverse effects of industrial development and expansion

⑤ Arranging and confirming communications between MOSTE and related bodies, with regard to standardization, measurement, industrial assets, inventions, patent management, and quality control

⑥ Conducting scientific and technological surveys, assisting in the improvement of product quality at companies, planning and providing management guidance for projects and other matters related to environmental protection

⑦ Participating in the evaluation and approval of industry-related investment projects, evaluating technology and quality management, evaluating the environmental impact of investment projects and industrial reform

⑧ Building an information network pertaining to science, technology, quality control, and the environment; collecting and providing guidance for the effective use of economic and technical data for the corporate development of science, technology, quality control, and environmental conservation.

In reality, support from MOI is mainly limited to SOEs and support for industrial pollution prevention countermeasures for private enterprises is hardly being carried out at all. In addition, because MOI is playing no hand in so-called policy guidance methods, such as the promotion of the construction of joint treatment facilities, mediation for long-term, low-interest rate financing, or in technology guidance, private enterprises seldom seek support from MOI because they believe there are hardly any special merits for doing so.

In addition, a number of staff in MOI is not large, a number of staffs at the Technology and Product Quality Management Department that is in charge of guiding enterprises exceeds slightly forty, and it is not enough to cover all the enterprises over

600,000 to guide in terms of the number of personnel.

The body within local governments that is in charge of promoting measures to prevent industrial pollution is the Department of Industry (DOI), located within regional people's committees. Under the guidance of MOI at the national level and in cooperation with DOSTE, the DOI provides guidance and advice to companies for the implementation of environmental protection measures. This is performed in conjunction with other responsibilities such as the supervision of the companies under its jurisdiction, the formulating of factory location plans, and the carrying out of other operations to foster industry and offer related guidance.

D. Local Government

The role of local governments, who are under the guidance of the central government, for promoting environmental preservation countermeasures is regulated in Government Ordinance (Decree No. 175/CP) Article 6 which lays out the duties and responsibilities of provincial governments and centrally-administrated cities. The outline of the Ordinance is as shown below:

① It is possible for concerned administrative organizations to publicly disclose ordinances and notifications related to environmental preservation.
② Direct and supervise compliance with environmental standards at the national and local level.
③ Inspect Environmental Impact Assessment reports
④ It is possible to pick up certificates that certify environmental standards from the Enterprise Agency.
⑤ Carry out regulations with the national government for surveys and handling of breaches of the Law.
⑥ Solve problems concerning the environment such as strife, complaints and petitions, and send them on to other organizations.

Although there are many related organization established, each of them has limited human resources to implement efficient measures for environmental protection. For example, for the Technical and Quality Management Department of MOI which has only 40 staff, it is almost impossible to grasp the existence of the individual users of hazardous materials.

2.3.2 Regulations for Industrial Pollution Prevention

(1) Environmental Pollutant Standards

In Vietnam, as for the emission of environmental pollutants, until the Environmental Protection Law came into force, standards concerning the environment and hygiene were established and took effect in 1972. However, those standards which were set up by the Health Ministry and other authorities almost entirely conformed to WHO's standards. After that, from 1978 through 1991, standards for 60 items were newly adopted. As the laws were enforced and related ordinances and regulations were put into effect, MOSTE promulgated the Vietnamese Environmental Standards (VS) in 1995.

The said VS includes emission standards for environmental pollutants, general environmental standards regarding air quality, effluent standards, environmental quality standards regarding water quality, soil quality and the soil-residue-prone pesticide allowable limit, and regulations such as maximum allowable noise levels on roads, as well as in the general environment.

As for the water quality, the following 4 standards are in effect.

①Water quality standard of surface water (TCVN 5942-1995) for 31 items and 2 types
②Water quality standard of coastal water (TCVN 5943-1995) for 26 items and 3 types
③Water quality standard of underground water (TCVN 5944-1995) for 22 items
④ Effluent standard of industrial wastewater (TCVN 5945-1995) for 33 items and 3 types

For the wastewater standards themselves, removing the fact that standards have not been established for some new types of substances, like several different organochlorine compounds, the selection of polluted materials subject to the standards is adequate. However, a problem exists in that there is an unbalance between wastewater and environmental standards. Environmental standards, in contrast to the wastewater discharge standards, are lenient in some items.

(2) Environmental monitoring

For conserving and maintaining the environment, it is essential to properly understand the present situation of environmental quality using some appropriate methods and standards. For this reason, Chapter 4, Article 37, Clause 4 of the Law provides for environmental monitoring. As for the monitoring of the general environment in Vietnam, the monitoring systems to be operated on 4 levels (by the central, provincial, city and district governments) were introduced and came into effect in the late 80's. However, as the Environment Protection Law was enacted, the government decided to prepare thorough, full-scale monitoring systems.

NEA has been responsible for nation-wide monitoring activities, and the Environment Monitoring Center has been responsible for the monitoring and measuring of environmental quality. In 1994, they conducted a fixed-point measurement at 72 stations for air, at 109 stations for water quality, at 200 stations for acid rain, at 29 stations for radiation and at 52 stations for noise pollution.

As a part of water quality monitoring network, the Hydro-meteorological Service measured the water quality at 10 stations in reservoir areas, and at 51 stations along rivers. Since 1997, as a part of the NEA-supervised national measuring network, water quality has been monitored at 19 stations (13 stations on land and 6 stations off shore). In addition to these national measuring stations, many municipal governments have their own measuring stations for water quality. Items subject to such water quality measurement are water temperature, PH, SS, degree of turbidity, conductivity, total minerals, DO, BOD, COD, ammonium ion, nitrous acid, phosphoric acid, chlorine ion, all ions, total volume of colibacillus, pesticides and metals.

In addition, for monitoring the water quality in rivers there are many measuring stations set up throughout the country. For example, at 7 stations in Hanoi City and at 5 stations in Da Nang City, water quality is measured four times a year, once every 3 months. (Parameters measured range from general environmental items, including PH, SS, COD, BOD, etc, to those that have an adverse effect on public health, such as heavy metals like Cr, Pb, Cu, Hg, etc.)

Environmental monitoring was conducted, and some points were noticed where pollutant concentration values are exceeding the environmental standards, however, analysis on the reasons why the values are out of the environmental standards, as well as countermeasures for them, have not been implemented. Following this, there are many points where the environmental standards are continuing to be exceeded widely.

Besides the monitoring and measuring of the general environment, DOSTE checks the condition of polluted effluent periodically at pollutant generating sources like factories. In addition, factories also measure emission gas, effluent, etc. and report the results to DOSTE at regular intervals. However, most of the factories are not able to carry out analysis by themselves. There are some analyzing institutes that can be contracted to make analysis, however, small and medium-size enterprises do not usually request analysis because of the additional cost burden.

In order to improve the environmental situation, it is insufficient to use data taken only once a year by DOSTE as a basis.

(3) Inspection of environmental protection

MOSTE is responsible for specialized inspections for the purpose of surveying the condition of environmental protection. So, they carry inspections concerning environmental protection at each level of Ministry, local government, people's committee and so on, as well as checking how and what kind of measures for environmental protection have been implemented by enterprises and individuals. Associated with these enterprise surveys, MOSTE can request the authorities concerned to submit necessary documents and to reply to requests for information, and they may also carry out on-site inspections. If they detect an emergency situation that may lead to a serious environmental accident, they can notify the national authorities concerned and recommend a temporary shutdown of business activity. Inspectors in charge of the said surveys are from the central and municipal governments, and give advice and cooperate with the organizations concerned based on the results of the surveys to press ahead with environmental measures.

For pollution prevention, MOSTE, as well as DOSTE, give orders for making improvement plans. MOSTE does so at large enterprises that have terrible pollution conditions, and DOSTE at small and medium-size companies. However, even if enterprises make improvement plans according to the guidance of MOSTE and DOSTE, many cases exist where the plans have been left unexecuted.

The reason for this is the large majority of companies do not possess the precise technical capacity to handle the countermeasures, the ability to burden the required costs, nor the financing ability to execute a pollution prevention investment plan because there is no practicality built into the plan.

(4) Environmental Impact Assessment: EIA

As provided in Article 17 and 18 of the Environment Protection Law, as well as in Article 9 of Government Degree No. 175/CP, in the case the environmental impact caused by business activities of enterprises of a certain scale or larger is considered significant, the offending enterprise is required to conduct an advance evaluation with regard to environmental impact, prepare an EIA report (Environmental Impact Assessment) and submit it to the authorities concerned (MOSTE, etc.). This is done to prevent disruption to the environment and environmental pollution which may be caused by the implementation of business based development plans. The business activities for which an EIA report is required are as follows: (the business categories and scale are provided in the detailed rules of the Government Decree.)

① Businesses and urban development / measures for population control in association with regional development supported by national policies

② Projects for the economy, science, health, society, culture, security and self defense

③ Investment, support and aid in Vietnam by overseas and international institutions

The following 3 items are prescribed to be included in the scope of coverage of the EIA report; ① An evaluation on the current conditions of the environment, i.e. air quality and water quality at the project site; ② An evaluation of the environmental impact caused by the project; and ③ Measures for solving the environmental problems they are faced with at present. The EIA report is reviewed by MOSTE in the case of large-scale businesses, and is reviewed by provincial or municipal branches of DOSTE in the case of local, small-scale businesses.

The duration of the review is 2 months or less after the EIA report and associated documents have been accepted. Enterprises which were already in operation when the Law came into effect~~,~~ are also obligated to prepare and submit the EIA report.

For newly constructed factories, the Environmental Impact Assessment has produced a certain level of good results, and especially for the new investment of foreign enterprises, the Vietnam wastewater standards appear to be valid.

2.3.3 Tackling Pollution Control

(1) **Industrial Pollution Investigation**

In 1997, MOSTE conducted a large-scale survey throughout the country to investigate the state of industrial pollution discharged from factories.

According to the survey results, 3,311 factories were determined to be causing serious environmental pollution. Of these 785 factories, 23.7% were State-owned enterprises, and 2,526 (76.3%) were private industries. 2,722 of these factories are located in residential areas and 585 are located outside of residential areas.

The main pollution source sectors were determined to be as follows:

①	Food Industry	1,217 factories (36.8%)
②	Chemical Industry	457 factories (13.8%)
③	Construction Materials Industry	432 factories (12.3%)

The following provinces and cities are seriously polluted by these factories: The ratio of private industries (small and medium sized) among the polluters is high.

Province/City	Number of Factories	No. of Private Factories
1. Ho Chi Minh	1,103	1,020
2. Vinh Long	421	416
3. Kom Tum	237	232
4. Binh Thuan	224	210
5. Ha Noi	121	26
6. Ben Tre	96	91
7. An Giang	88	63
8. Quang Ngai	67	60
9. Phu Yen	67	63
10. Da Nang	45	16

According to the investigation made by NEA, the main reasons why these factories are causing serious environmental pollution are as follows:

① Use of old technologies, machines and equipment
② Lack of treatment methods and methods for reducing waste.
③ Lack of capacity to invest in waste treatment systems and to upgrade technology.
④ Unawareness of the concept of environmental protection.
⑤ Unsuitable spatial distribution of factories, especially those of private industry
⑥ Low management standards and capacity

In 1997, MOSTE coordinated with DOSTE in 61 cities and provinces in the country to implement a large-scale investigation on the environment. The investigation was conducted in 9,384 industries and 4,390 (47%) of them were fined for illegal operations at VND 1570 million totally and the operations of 114 factories were suspended due to serious environmental pollution.

According to the investigation results, the ratio of violations in each industrial sector are as follows;

①	Foreign affiliated joint venture enterprises	41%
②	State owned enterprises	43%
③	Foreign capital enterprises	47%
④	Private enterprises	58%

The investigation provided opportunities to gain experience in environmental protection management at all levels, partly contributed to the effectiveness of the Environmental Protection Law, improved environmental consciousness, and was supported and well assessed by the people involved. Since then, bringing into play the good results of this large scale investigation, MOSTE has continuously performed periodic investigations of the factories and built up a country-wide list of factories that are violating the Environmental Protection Law. However, penalties are lenient, industries do not have high-level technology and cannot afford financing, and there is a lack of governmental support system for weak enterprises. These problems have not been solved. Not many of the enterprises are conducting countermeasures for pollution, even though many enterprises have made plans for implementing such measures.

In the first 6 months of 1999, NEA coordinated with DOSTE in local governments to investigate 19 factories, and received and resolved more than 20 complaint letters on the environment throughout the country.

Since 1998, in addition to preparing the annual report on the current state of the environment for submission to the National Assembly, MOSTE has been given legal authority and has been supplying appropriate financial supports to ministries and industries to allow them to prepare their reports on the current state of the environment. These reports can be used as a basis for the management of environmental protection in ministries and industries.

In 1998, most of the seriously polluting factories prepared reports on the current status of the environment. In 1999, it is anticipated that this activity will be applied to some industries that are causing serious impact to the environment. However, remarkable improvement has not yet been observed.

(2) Pollution Prevention Activities

Pollution control all over the country has been performed regularly. Many measures and projects on pollution prevention and treatment for key areas and basins in the country have been proposed.

MOSTE, in coordination with ministries, branches and localities has dealt with some urgent issues on pollution controls, such as an urban and hospital sewage management project, pollution prevention for the Thi Vai river and toxic substance treatment in Gia Lai province, etc.

In 1998, a lot of improvement in environmental planning and implementation was made. MOSTE, in coordination with the Ministry of Planning and Investment (MPI), promoted instruction on and the development of national environmental protection in 1999. Environmental projects in different industries and locations are being financed by the Fundamental Investigations Budget that is managed by the MPI. They have been implementing and conducting research to improve the quality and efficiency of the projects that have been performed.

The "1998 National Environmental Conference" was held in Hanoi for the purpose of assessing the results of environmental research and protection during the years after the Environmental Protection Law was enforced, as well as for the purpose of orienting the development of these activities in the coming years.

MOSTE coordinated with industries and localities in researching and planning for an environmental information system and database. Initially, the Ministry set up a uniform information system connecting all the management boards of environmental protection and science research institutes.

Environmental protection in Vietnam has not met the requirements of their socio-economic development. One of the major reasons for this concerns the requirements of the Government Management Structure and Organization (from the central to the provincial level).

As environmental protection is not considered as a separate, national economic industry it does not receive independent and necessary investments. Although the government considers it a priority to invest in environmental protection, the priority and consideration given to environmental investment has been scattered and unremarkable in comparison with the demands.

At the local level, state managerial organizations on the environment are overloaded and unable to undertake increased duties due to a lack of human resources, finances and capability.

The government has considered many projects on strengthening the organization of State management on the environment at all levels.

In the last year, the National Assembly and the Science, Technology and Environment Committee have promoted and implemented many positive activities, such as environmental protection tasks, and the following measures were called for in the 1998 Congress Resolution:

① Strengthening the environmental observation and measurement system, as well as the weather forecasting system, in terms of management organization and equipment investment;

② Enhancing the implementation of legislation and environmental protection measures, especially in large cities, industrial zones and manufacturing units with large volumes of polluted sewage;

③ Severe treatments for serious environmental violations;

④ Raising the level of environmental education and propaganda on environment for citizens.

In addition, the Science, Technology and Environment Committee request documents were submitted to the central government. It includes requests for the establishment of an environmental management system in order to promote environmental preservation countermeasures, requests for investment in the construction of monitoring management nets throughout the country, as well as in special regions and sub-sectors, requests for receiving a certain level of preference for the environmental preservation field, requests for completely equipping the organization of the Environmental Agency in order to fulfill the duties and demands of environmental preservation, requests for making practical use of support from international organizations and foreign countries in environmental preservation, and requests for giving preferences to training programs concerning the environment by subject technical experts to plan for an increase in international cooperation.

2.4 Financial Support to Enterprises

2.4.1 International Cooperation and Financial Support

For international cooperation in environmental programs, the executing agencies of Vietnam are usually MPI, MOSTE and NEA , and cooperation has basically been focused on the construction of infrastructure and capacity building for environmental improvement through industrial pollution prevention. Little has been seen of foreign cooperation efforts to directly improve pollution prevention at polluting factories.

MOI, the counterpart of our study, is in a position to conduct the administration of the industrial sector, including SOEs and non-SOEs, and industrial wastewater pollution that comes from factories. However, little can be seen of the government's efforts, as well as of international cooperation for the purpose of preventing industrial wastewater pollution in individual factories. MOI looks to conduct its administration concentrating mainly on SOEs.

2.4.2 Financial Support

(1) Domestic Financial Situation

a. Domestic Financial Conditions

Judging from recent Vietnamese financial and monetary statistics, the government seems to be facing a shortage of domestic budgetary resources and VAT, Grants and ODA Loans, which recently have been gradually increasing, fill up their deficit. As for expenditures, about 50% of the current expenditures are for personnel costs, and the remaining 50% are continuous current costs of which the total amount is almost the same as capital expenditures. The 3 expenditure items mentioned above share the entire revenue amount in the 1998 Budget. That means, as a result, principal and interest repayments are made from funds financed by domestic or foreign resources.

Table 2.6 Industrial Production and Number of State Enterprises

	1994	1995	1996	1997	1998
Gross Industrial Production	23170	10375	118097	134420	15068 (100.0)
State Sector	16797	51991	58166	64474	69588 (46.2)
Non-State Sector	6373	25451	8369	31068	33148 (22.0)
Foreign-Invested Sector	-	25933	31562	38878	47948 (31.8)
By Industrial Branches					
Energy Combustible	5277	17966	20935	23871	28481
Metallurgy	461	3428	4086	4000	4240
Machinery	1852	10412	12581	13882	17004
Chemical Industry	1988	7358	9073	10751	11814
Other Manufacturing	3437	13166	14679	17431	19348
Food and Foodstuffs	7090	30985	35082	39438	41464
Weaving, Leather,					
Sewing, and Dying	2393	12696	14243	18201	20312
Printing and Cultural Products	242	1510	1515	1620	1744
Other Industries	5904	5904	5904	5227	6278
Number of Enterprises					
Number of Enterprises	2002	1958	1880	1843	-
Central Management	528	549	553	560	-
Local Management	1474	1409	1327	1283	-

Source: World Bank Donor Meeting Data (1998 Billion Dong)

Table 2.7 ODA Commitments and Disbursement

	1993~98	1993	1994	1995	1996	1997	1998	1999
Commitment *1	13.04	1.81	1.94	2.26	2.43	2.4	2.2	-
Disbursement *2	6,469	413	725	737	900	1,000	1,242	1,452

*1US Bil$, *2US Mil$ Source: Vietnam Government Report to CG Meeting 1999

Table 2.8 Main Items in the draft of the budget for FY 2000.

1.Revenues	74,535	(Including 1,900 in Grants)
2.Expenditures	86,705	
3.Balance(1-2)	△12,170	
1.Domestic Borrowing	7,573	Government Bonds
2.Foreign Borrowing	4,597	= Multilateral (3,915)+Bilateral(3,102) —Amortization(2,420)
3.Total(1+ 2)	12,170	

Source: MOF (Billion Dong)

b. Balance of Payments

Balance of Payments in 1998 show that the deficit of the current balance(△1,073Mil US$) and repayment(△1,050 Mil US$) are balanced by ODA disbursements(+1,120Mil US$), debt restructuring (+413 Mil US$) and FDI(+800 Mil US$).

c. Considerable Fiscal Support as the Short-term Program

Under present fiscal and BP conditions, it may not be realistic for the government to support polluting factories by increasing both the amount of tax reductions and direct budgetary expenditures as a Short-term policy, as one high-ranking Vietnamese official has suggested.

(2) Several Points Concerning the Vietnamese Banking Industry

Many people have suggested that the Vietnamese banking industry must improve in many business areas.

a. Lending Methods

As for credit assessment, strict credit assessment and financial analysis, which avoids the present personal relationship approach, needs to be stressed more.

Concerning SOEs lending, many reports, including reports by MOF point out that lending to SOEs will be one of the reasons that banking soundness will become worse because of an increase in bad loans in SOCBs.

The Law on Credit Institutions provides that financial institutions require borrowers of funds to put up collateral in order to secure loans. However, state owned enterprises are exempted from this requirement. Real estate and land are actually the most often used and most important type of collateral that enterprises use to borrow funds from financial institutions. However, there are many constraints for using real estate and land as collateral, except in the case of SOEs. Therefore, SMEs, especially non-SOE SMEs, cannot put up land and real estate as collateral to formal credit institutions. Therefore, they are unable to borrow necessary funds from them.

There are two kinds of collateral rights that have been established and are currently in use in Vietnam. One type is mortgages and the second type is pawning. Objects that are defined by the government as being eligible for mortgage resolution are; land use rights; houses and constructed objects attached to land; other real estate and movable properties; negotiable instruments, insurance covering movable property etc. This collateral system needs to be fundamentally amended so that the system can support sound financial practices that allow SMEs to have reasonable access to the financial resources needed for their normal business activities, and also should include the creation of a Commercial Paper System. Among other improvements, land and building use rights, which are actually the most important type of collateral used, and collateral procedures for them should be urgently improved to secure a smooth, formal financing method to non-SOE SMEs.

b. Collateral and land use rights

As for collateral, VN bank-officials are usually said not to have enough knowledge on collateral valuation, and foreclosure on real estate may be time consuming as legal channels and procedures are very complicated.

Many SMEs of non-SOEs are said to have difficulties obtaining financing from banks because of their difficulties in meeting the conditions for loans.

1) Major problems …Overall Official Attitudes and Policy

Until recently, the Communist Party and Government policy makers did not recognize the importance of SMEs, and this was perhaps the most fundamental and major problem concerning the SMEs. Fortunately, this situation changed with the recognition of the importance of developing SMEs to their full potential by the VIII Party Congress in June of 1996, and more recently, by the Government Decree 681/CP-KTN, that officially defines SMEs and calls upon MPI to work with other agencies, sectors and localities to draw up strategies for SME development. These are major steps forward in Communist Party and Government policy making and planning for SMEs.

c. Capital and Credit

SMEs borrow mainly from non-financial institutions, usually from relatives and friends, to meet their demand for credit. Sometimes they must pay informal lenders 3 to 6 times the official interest rates. In part, this is because it is very difficult for SMEs to access short, medium or long-term credit from banks and other formal credit institutions. Guaranteed loans are rarely provided to SMEs.

① Procedures for credit provided by banks and formal financial institutions are very complicated, leading to high transaction costs, and this makes the cost of such credit too expensive for SMEs. For most SMEs, these procedures and requirements make it impossible to obtain loans from banks.

② Complicated procedures and high transaction costs also make loans to SMEs less desirable from the point of view of banks because small sized loans to SMEs are as much, or more, trouble than large sized loans because the same procedures are involved regardless of the size of loan. As compared to SMEs, loans to non-state owned SMEs are more trouble and less profitable because of the collateral requirement, but the increased transaction costs cannot be covered by increased interest because interest rates for loans are fixed.

③ The regulations and requirements on collateral and investment projects are too stiff for many SMEs to meet in order to obtain access to credit from financial institutions. SOEs, on the other hand, have been excused from providing collateral to obtain credit.

④ Methods used to evaluate collateral are not clear and decision-making by bank officials, in this respect, is arbitrary.

⑤ SMEs cannot obtain assistance for project evaluation, for project feasibility studies, for preparing business plans or for identifying credit sources.

d. Land

1) Problems

① There is a lack of land available for SMEs enterprise activities.

② Obtaining land use allocation, or land leases, for SME offices and factoriesis fraught with many difficulties and, in many cases, is impossible.

e. Accounting principles

As for accounting principles, banks are required to report their financial statements based on the Vietnamese accounting system (VAS). However, because this system is limited in terms of disclosures and classifications, sufficient information to assess the annual performance of the bank, i.e. analysis of overdue loans, loan losses, non performing loans and provisions, is said to be difficult to obtain.

f. Audit and Supervision

According to some commercial banks, SBV is authorized to inspect and audit commercial banks. However, as it has been the only a short time since the bank started audits and inspections, there are many areas in the bank's control system that need improvement.

Table 2.9 An Examples of the Loan Characteristics of a SOCB (State Owned Commercial Bank)

Loan Characteristics	Number of Customers (%)	Total amount of loans(Bil dong)	Average amount of loans (Bil dong)	Interest rate
Total	100.0	27,806	———	0.85%/month
SOEs	93.7	26,037	7.0	Lowest
Cooperatives	0.1	32	0.5	---
LLCs ※	2.2	619	2.0	---
Private Enterprises	1.8	490	2.0	Highest
Household	2.3	628	0.3	

※LLCs; Limited Liability Company (From Interview with one SOCB. Figures are as of Dec.1999)

(In the case of this particular SOCB, the number of customers and amount of loans are concentrated to SOEs)

2.4.3 Present Situation of Viet Nam Enterprises

(1) Economic Reform Programs

At present, in Vietnam, programs for banking reform, SOEs reform and SMEs support are being carried out, as these are fundamental policies which the government of Vietnam has selected to develop in Vietnam under its transition economy. If the above TSL schedule for environmental pollution prevention is considered, these programs need to be proceeded with in line with "the Economic Reform Support Loan" provided by the Japanese Government last September.

An outline of the Economic Reform Program, which the Vietnam Government committed to the Japanese Government to carry out, is included.

(2) Banking Reform Program

The course of monetary reform in Vietnam started with the change from the mono-bank system to the establishment of an official two-tier banking system. A legal framework for banking operations has been established and has improved step-by-step. However, as in other transition economies, recent problems affecting the Vietnamese banking system have resulted in incomplete reform of the financial sector and SOEs. The SOCBs are still said to account for 80 % of loans and deposits, and their lending attitude is also said to be twisted by various kinds of intervention. Many problems can further be traced to the poor performance of state enterprises, which are the main customers of the banks ,especially the SOCBs. So that most bad loans of SOCBs are said to come from loans to SOEs (IMF report,'99).

As we observe here, banking reform in Vietnam needs to be accompanied by SOEs reform. When considering to extend financial support to environmental polluting factories through banking channels, we need to take into account these improvement.

(3) SOEs Reform Program

① Financial Conditions of SOEs

In spite of their financial problems, SOEs have continued to play a leading role in production and employment in the national economy. The SOEs sector accounts for about 30% of GDP, 20% of total investment,15% of nonagricultural employment and about one half of domestic bank credit. They also produce a dominant share of oil, cement, chemicals, and steel.

② Results of the Study by MOF

According to the results of a study on 1,044 general corporations by MOF (1997), 68.7% of these corporations are classified as either Low profit, High debt-equity ratio, High debt/Low profit or Poorest Performing.

We can see here that for improving bad business practices and getting better financial performance from SOEs, the present Vietnamese policy of SOEs reform through equitization and privatization is urgently needed for efficient and effective economic development.

When considering to give financial support through banking channels, it needs to be provided in a manner where equitization and privatization of SOEs is enforced.

Table 2.10 Financial Conditions of General Corporations（Total 1044）

(MOF)

Category	Classification	Number	General Recommendation
Group 1	Poorest Performing	117(11.2%)	Liquidation or Divestiture
Group 2	High debt/low profit	116(11.1%)	Credit and loss control and rationalization
Group 3	High debt-equity ratio	257(26.3%)	
Group 4	Low profit	227(26.4%)	Credit control and rationalization
Group 5	Others	327(31.3%)	Loss control and rationalization

(4) SMEs Support Program

With regard to environmental pollution prevention administration of individual factories, SOEs and non-SOEs, as well as large enterprises, SMEs, according to their definition, need to be included under this administration. SMEs support is an important priority policy for creating employment, as well as for the establishment of an efficient economy through support of the private sector. This is because 52.1% of SMEs are categorized as being private sector, while only 18.6% of SMEs are SOEs (See

Table below) and 70.3% of large enterprises are SOEs.

Table 2.11 Distribution of SMEs and other enterprise types by economic sector based on capital criteria

ENTERPRISES	(Total) Total number of Enterprises %	(Small)(A) Below VND 1billion Capital (number)%	(Middle)(B) VND1 to 5 billion Capital (number)%	(SMEs) (A+B) BelowVND 5billion Capital (number)%	(Large)(C) Over VND 5billion Capital (number)%
Total	100.0	100.0	100.0	100.0	100.0
1.Domestic Enterprises	97.1	99.2	97.4	98.9	83.9
1.1. SOEs	24.8	9.5	54.6	18.6	70.3
1.1.1Central SMEs	8.2	1.5	16.1	4.4	35.5
1.1.2Local SMEs	16.6	8.0	38.5		34.8
1.2.Cooperatives	7.9	9.8	4.4	8.7	1.7
1.3.Private	46.0	62.3	11.6	52.1	1.7
1.4.ShareholdingCompanies	0.5	0.1	0.8	0.2	2.4
1.5.Limited Companies	17.9	17.6	26.1	19.3	7.9
2.Enterprises with Foreign Investment	2.9	0.7	2.6	1.1	16.2

Source: Research Report by MPI&UNIDO in 1999

What this means is that when we support polluting factories with industrial pollution prevention investment, we need to consider to encourage the enforcement of financing for SMEs and the private sector.

At present, the Japanese Government is preparing to support SMEs in Vietnam after a recent JICA study on SMEs promotion. We also need to follow this study and support SMEs. Another new TSL for IPP based on this study may be prepared after confirming the successful result of this SMEs support TSL project.

(5) Infrastructure Construction Projects (Mid-term program)

Related to the above mentioned financial support, it is recommended that a study be carried out on constructing experimental industrial parks by industrial sector and relocating polluted factories by sectors to these sites. These industrial parks will be designed following the national regional development plan.

2.4.4 Estimated Investment Demand of Polluting Factories for Pollution Prevention

The estimated demand for pollution prevention, based on the survey by our Technical Team, is shown below.

Table 2.12 Preliminary Estimation of Total Demand for IPP Investment

(by Technical Team)

Sub Sectors	Surveyed (A)	Investment Demanded (B)	Estimated Demand (C)(Mil VD)	Demand per factory (C/B)(Mil JP¥)	Demand per factory (Mil JP¥)
Textile	19	13	91,027	7,002.1	58.3
Chemical	21	16	74,219	4,638.7	38.7
Paper	21	21	359,824	17,134.5	142.8
Food	21	19	101,440	5,339.0	44.5
Metal	22	12	92,400	7,700.0	64.2
Total	104	81	718,910	8,875.4	74.0
* The Total Demand for IPP Financing is Estimated at Roughly 718,910Mil VND(5,991Mil JP¥). June, 2000					

According to the preliminary results of the survey by our technical team, every factory surveyed has a strong demand for IPP investment and the total amount of demand of the 104 factories will reach about ¥5,991Mil. The estimated amount of the investment demand per factory is about ¥74.0Mil.

However, the above estimation was done using a preliminary survey and a more detailed feasibility study is necessary before this type of loan will be committed to by a foreign aid organization.

A regional allocation of financing for individual factories will be shown, for example, based on regional distribution of industrial out put, that is 24% in Hanoi, 4% in Da Nang and 72% in Ho Chi Minh city.

2.4.5 Strengthen Coordination Among Industrial Pollution Prevention Administrative Authorities

(1) TSL

As was shown earlier, environmental administration in Vietnam has developed along the lines of legislative arrangement and administrative organization in the 1990s, and foreign aid organizations have shown a willingness to cooperate in this development.

This cooperation seems to put priority on the construction of environmental infrastructure, and, for pollution prevention, on institutional building or pilot projects in polluted areas.

However, in order to ensure that factories comply with environmental standards and regulations, the regulatory framework for environmental monitoring activities by empowered, responsible authorities will have to be accompanied by the establishment of concessional financing facilities that provide incentives for environmental investment by targeted factories after confirmation of financing feasibility is determined. This financial support will be carried out under the supervision of consultants or experts for the purpose of :

1) Enhancing coordination with related executing agencies.
2) Helping assist with technical appraisals to ensure that factories invest in pollution control technology that meets effluent /emission standards.
3) Training of related officials in technical appraisal, evaluation, supervision, and monitoring of environmental projects.
4) Promoting this particular TSL project through environmental workshops in order to stimulate and encourage environmental investment by polluting factories.
5) If the Vietnamese government is considering to apply for this type of foreign assistance, it is recommended that they discuss and study the preparation measures necessary for the preliminary application process to receive funding from related appropriate donors（Short-term program）.
6) One past example of the interest rate and loan conditions for this scheme is shown below:

(1) The Donor to the Recipient ・ 0.75%, amortization 30 ～40 years
・ (grace period 10 years)

(2) The Recipient side ・0.75% + exchange rate risk,
+ Government guarantee fee
+ Administration cost, tax etc.

(3) The End users ・ Market Rate－several %
・Amortization 3～10years
・(grace period 5 years)

TSL Scheme

Connected with the financial policies mentioned above, Japanese ODA has been providing financial support to several LDCs, to encourage individual polluting factories to prepare necessary environmental investment using Two Step Loans (TSLs), offered through the banking system after confirmation of the feasibility of a project.

Different from the usual TA, Grants and Yen Credits, a Loan of this TSL type is characterized by direct financial support to individual factories through the banking channel.

The concept of this TSL-project consists of two aspects; one is financial support, and the other is technical support for banking and pollution prevention engineering provided by abroad technical experts or consultants.

The TSL scheme is as follows;

L/A is signed between donor and recipient. As the Executing Agencies, usually MOF, or the Central bank give authorization to several sound banks and a responsible line ministry is nominated. Qualifying sound users can receive the fund from the banking channel to invest in improving pollution prevention equipment after undergoing financial analysis.

When users apply for this fund, they can receive the necessary know-how or skills of the dispatched experts to assist them with consultation on banking and technical matters. After they return the fund, this fund can be revolved and provided repeatedly under the advise or supervision of related experts.

When Vietnam wants to apply for this kind of financial support for individual enterprises from domestic or foreign sources, they must take into consideration present Vietnamese Governmental priority policies like banking reform, SOEs reform, SMEs support and privatization for an efficient economy. On the other hand, it is recommended that MOI, as the core ministry responsible for environmental policy of individual enterprises, foster closer relations with MPI, MOSTE, NEA. In the provinces, MOI also needs to coordinate with related government branch offices and the Peoples' Committee.

Together with this domestic coordination with related ministries, MOI also needs to create strong relations with international aid organizations for effective environmental foreign cooperation.

At the same time, before the Vietnam government applies for this foreign assistance, they need to prioritize assistance sources based on their own present financial conditions.

Priority should be set first for domestic measures (central and local budgets and private financing) and then for foreign measures (ODA , FDI and foreign bank financing) which should be separated into the public sector and private sector. For foreign assistance, they should also prioritize TA, Grants and Loans according to financial and technical considerations.

2.4.6 Items the Vietnamese government needs to clear in order to apply for financial support of polluting factories.

(1) The government is expected to promote privatization and pursue an efficient and effective macro-economy consistent with national macro-economic policy

through foreign financial support.

(2) The government needs to recognize that SOEs Reform is the key factor for establishing an efficient macro economy. Fiscal support needs to be prioritized and given to equitized SOEs (Short-term program).

(3) Before applying for financing projects, the government is recommended to study and create an efficient and effective banking business scheme in Vietnam in order to ensure that disbursed funds can be invested by end-users correctly in line with the original purpose (Short-term program).

(4) In order to create trustworthy monetary and banking systems for domestic customers and foreign donors, the government needs to study the following matters(Short-term program);

①the legal system of the banking business, ②more effective collateral and financing systems, strict credit assessment methods and credit management skills, promoting capacity building of banking personnel, ③Creating effective and transparent bank-supervising standards after collecting and analyzing similar standards in other ASEAN countries ④promoting the rationalization and modernization of private banks etc.

(5) For establishing sound banking management, which will gain the trust of domestic customers and foreign donors, the government is expected to undertake the above mentioned study before applying for TSL financing programs and discuss with donors which aspects of banking system need to be improved in order to qualify for assistance. (Short-term program).

Chapter 3

Problem Analysis

Chapter 3　Problem Analysis

The following problems can be found in the previous chapters.

3.1　Insufficient Grasp of the Causes of Environmental Pollution (Industrial, Household and Agricultural)

3.1.1 Insufficient Grasp of Pollution

It can be said that rivers in industrial zones in Vietnam are polluted by industrial wastewater. However, concentration values of BOD and COD in rivers in cities are effected greatly by household wastewater. In this case, in terms of the costs of countermeasures, it will be sufficient to set up sewerage systems. Wastewater that comes from the livestock industry also affects the BOD and COD concentration in river water. Therefore, it might be very inefficient to implement industrial pollution prevention countermeasures without identifying the causes of pollution, especially for substances related to the living environment in cities. Toxic substances, such as heavy metals, are discharged mainly from industry. However, there are items other than industrial process that cause pollution, such as batteries in scraped cars, that can cause lead poisoning.

The current pollution prevention measures are promoted and implemented without grasping the reason for causes of pollution, even though each polluted substance has different sources.

The frequency of monitoring of both public water areas and of industrial wastewater is insufficient, the total volume of wastewater is not measured, and the rate of the effect of domestic, industrial and agricultural wastewater to the environment is not clear.(The Study Team estimated that in cities, effects of household wastewater on COD or BOD concentration values in wastewater are more than 10 times that of industrial wastewater).

Every enterprise and industry has a totally different pollutant load on the environment. Even though enterprises belong to the same industry, there are big differences, in some cases in this Study as much as a 40,000 times difference, between their respective~~,~~ effects on the environment.

In such cases, if countermeasures had been mainly implemented in a few enterprises that discharge a large amount of the pollution load, it would only have required a relatively little amount of effort and cost to improve industrial wastewater conditions.

For adopting the most efficient countermeasures, it is necessary to grasp the industry wide enterprise pollution effects on the environment. In order to do so, it is necessary to grasp the total amount of wastewater, and the concentration and total amount of key pollutant substances in each large scale factory.

3.1.2 Lack of Production and Environmental Management in Enterprises

Principal production data relating to profits, such as unit consumption of raw materials and utilities and production transformation rates, are not calculated in many enterprises, and as a matter of course, the amount of pollutants discharged to wastewater are not measured at most enterprises.

3.1.3 Lack of Sufficient Knowledge on Wastewater Measurement and Difficulty in Requesting Analysis from External Organizations

In small and medium-size enterprises, no wastewater treatment systems have been installed and there are no analysis technicians. Because of this, it is difficult for many enterprises to take measurements autonomously, even if they want to. There are some private technical consultants for pollution measurement, however, they usually charge about 7 US$ per item to be measured and 15 US$ per visit per person, and this cost is a large burden for enterprises that have low profits. These outside technical consultants were rarely observed conducting measurements in small and medium-size enterprises by the Study Team.

There are a number of analyzing organizations around Hanoi and HCMC, however, there are no such organizations outside of cities.

3.2 Insufficient Support Measures from the Administration to the Enterprises

Both a prior Vietnamese investigation and the investigation by the Study Team found that there are some places where pollutant concentrations exceed the environmental standards by 10 times for both household and toxic waste. These conditions are very harmful and dangerous for human health, especially for certain substances such as lead.

However, even though the situation is extreme, the government has not taken any aggressive action for implementing countermeasures and identifying pollution sources. If a serious hazardous pollution situation is found in the environment, the government has no grasp on which enterprises are using toxic substances. It is necessary to start making lists of enterprises utilize which toxic substances. There are many enterprises that did not execute countermeasures before the nation wide inspections were implemented.

One of the main reasons why enterprises do not execute pollution prevention countermeasures is that MOI, the administration in charge of industries, conducts administrative activities actually only for State-owned enterprises. In addition to this, there are an insufficient number of personnel in the MOI allocated to work on pollution prevention, and administrative support measures, such as providing low interest rate loans to enterprises, are not being executed.

Environmental Impact Assessment is an efficient measure for newer enterprises, however, it is not completely effective for existing enterprises. After all, besides the penalty system, there have been no sufficient countermeasures taken by the administration for enterprises that violate wastewater regulations.

Concrete problems are as follows:

a. Guidance on Pollution Prevention from the Administration to the Enterprises is Sometimes Insufficient

①MOI administrative activity is centered on state-owned enterprises, and is not sufficiently provided to private companies in comparison to state-owned enterprises.

After the implementation of *doi moi*, it was admitted that private enterprises increased production, however, private enterprises in Vietnam are mostly small size and their operation time period is short in comparison. Because of their small production level, the importance of private enterprise to MOI is relatively low for administrative measures.

② There is not so much demand for pollution prevention support measures private enterprises to the MOI.

Because private enterprises have less experience receiving MOI guidance on daily production activities, they do not demand pollution prevention support frequently from MOI.

③ Because of a lack of personnel in the supervisory administrative organization for pollution prevention, enterprise guidance is sometimes inefficient.

There is 40 staff in the Technology and Quality Management Department, which has been placed under MOI in charge of industrial pollution prevention. It is impossible for this number of people to implement administrative activities, such as analyzing pollution problems, and promote countermeasures throughout the country for each enterprise.

④Non-existence of policy guidance methods, such as technical guidance, providing loans and promoting the construction of common treatment facilities, by MOI.

Securing budgets for state-owned companies was a very important measure in the past, however after the enterprise privatization movement in Viet Nam was initiated, budgets for enterprise support became less necessary than in the past. Thus, at present, there are hardly any policy measures for guiding companies.

b. Environmental Impact Assessment is Inefficient for Existing Enterprises.

Environmental Impact Assessment is applied for new enterprises for pollution prevention, however, it is not easy to adjust and apply this measure to existing enterprises.

c. Insufficient Grasp of the Factories that are Using Hazardous Materials

Even if heavy metals are used for plating or other purposes, enterprises are not legally bound to report the use of such substances to the Administration. So, when toxic substance pollution occurs, enterprises that are causing the pollution can't be located. Measures must start with a listing up of factories that use toxic substances.

d. Environmental Standards and Wastewater Standards Have Partial Inconsistency. When Concentration Values Exceed the Environmental Standards, Pollution Will Increase Greatly.

Because the environmental standards are lenient, when a factory does not satisfy the environmental standards, the pollution level is already quite high. It is too late, at that point, to investigate countermeasures because subject enterprises have already installed equipment which is difficult to replace.

e. Insufficient Administrative Measures Cause Non-execution of Improvement Plans for Polluting Factories.

Even if MOSTE or DOSTE orders a polluting factory to make an improvement plan, both administrative bodies are not always able to guide the factory in implementing the plan.

3.3 Delay in Implementation of Enterprise Countermeasures for Pollution Prevention

Implementation of countermeasures for pollution prevention in enterprises is extremely overdue, and only less than 10% of the enterprises surveyed satisfied wastewater standards.

The direct causes of this matter are as follows:

a. Enterprises have no wastewater treatment facilities. b. enterprises have waste water treatment facilities, but have insufficient operational know how. c. adoption of Cleaner Production technologies has been delayed. d. maintenance of equipment is not performed.

The factors that are responsible for the direct causes of the delay are nearly common and are as follows:

① Enterprise profitability is weak and they can not bear the cost burden of countermeasure implementation. ② They do not have the technical capability to solve problems and the number of experts who can perform technical guidance, as well as provide information, are scarce. ③ Penalties are lenient. ④ There are few support measures in the field of finance, tax reduction to assist enterprises compensate for low profitability for investment in pollution prevention.

Table 3.1 Ratio of Interest Amount and Profits

Name	Short term interest rate%	Long term interest rate%	Total Interest amount thousand VND	Profit Thousand VND	Profit/Interest	Profit /Sale %
Food A	13.0	8.0	915581	-1025471	-1.12	-3.50
Food B	8.5		952884	9772628	10.26	-
Food C	13.8	14.4	7549147	305297	0.04	0.178
Food D			0	805838	-	1.48
Textile A	13.8	7.9	618061	76901	0.12	0.381
Textile B	15.0		5045000	0	0.00	0.00
Paper A	9.2		82323	-73653	-0.89	-0.259
Paper B	13.8	13.2	41692	6057	0.15	0.144
Paper C	7.0	4.5	2940000	1200000	0.41	1.90
Paper D	12.0	13.2	7304751	0	0.00	0.00
Paper E	10.0		242538	68348	0.28	0.40
Chemical A	8.8	3.00	308650	1079936	3.50	-
Chemical B	12.0	8.40	9900000	26400000	2.67	0.0289
Chemical C	13.8	13.20	7669120	11161665	1.46	10.91
Chemical D	13.2		7754455	39686787	5.12	8.81

Table 3.1 shows the amount of interest paid and profits among enterprises which were surveyed. Only one enterprise has no debt and 60% of enterprises earn low profits that are less than the amount of interest paid. Also, according to the

ratio of profits to returns, 2 out of 15 enterprises have a high ratio, however, there are nine enterprises, that account for 60% of the 15, earning no profits or low profits that have less than a 1 % ratio of profits to returns.

Paper & pulp and textile industries earn low profits, but the chemical industry shows relatively good profits.

The factors for low profit structure are also explained as being caused by: a low level of production management that causes loss of materials; small production capacity in equipment intensive industries; outdated production methods; disadvantageous factory locations, and the high cost of transportation. These matters are related to industrial policies.

The concrete problems are follows:

a. No wastewater treatment systems are installed.

① Penalties for violating regulations are lenient

It is more inexpensive to pay penalties, which in the highest case is 15 million VND, rather than to install a wastewater treatment apparatus for violating wastewater regulations.

② Lack of sufficient knowledge of pollution prevention technology

Enterprises have not established technologies to solve pollution problems and can not make investment decisions.

③ Insufficient numbers of technical consultants who can guide the implementation of pollution countermeasures

There are very few consultants who can provide advice to enterprises on the total amount of investment needed for pollution prevention, and on increases in yearly operating costs, so enterprises can not make decisions on pollution prevention investment.

④ Because of the low level of enterprise profitability, the ability to burden the costs of investment are low.

Enterprises have low profit structure, 60% of them in the Study were revealed to have profits less than the amount of interest paid. Also, 60 % of the enterprises earning low profits have less than 1 % ratio of profits to returns and they can not finance investment in pollution prevention. The factors of low profitability are as follows:

- The level of production management is low and the ratio of effective utilization of materials and fuels are low. This causes a reduction in profitability.
- Small and medium-size industries, like plating industries, have small

production capacity and this makes it hard for enterprises to invest in pollution prevention equipment and pay for operating costs.

- There is no assistance from the government for small and medium-size enterprises for installing joint treatment facilities.
- Financing conditions are strict for enterprises and this causes a low return on investments.
- There is no assistance, such as tax reduction for supporting enterprises to make investment in pollution prevention.
- Equipment intensive industries have small production capability and can not afford to pay the costs of wastewater pollution prevention equipment.
- Transportation system are inefficient and this causes higher transportation costs.
- The location of factories is sometimes not suitable. (If raw materials are changed over from domestic ones to imported ones and the factory location is suitable for domestic and not for imported materials, then it causes a disadvantage in cost and is less profitable.)

b. Even if enterprises possesses wastewater treatment systems, they have insufficient know how on their operation.

① Penalties for violating regulations for pollution are light.

In the textile industry, equipment which uses bacteria must be kept well maintained and installment itself is not effective if maintenance is not performed. In addition to this, installing equipment is considered to mean implementation of pollution prevention measure even equipment is not operated, and it is difficult to fine.

② Knowledge of Cleaner Production technology is insufficient.

Equipment, like the kind that uses bacteria, does not work if maintenance is not performed.

③ Number of experts on pollution prevention is insufficient.

The simplest methods, estimation of operating costs are not advised for various pollution cases due to a shortage of pollution prevention experts. This makes it difficult for enterprises to invest in pollution prevention.

④ Enterprises have a low profit structure and can not afford to pay the costs of pollution prevention.

Similar to case a., there are many enterprise which show low profitability. Therefore the additional cost of wastewater treatment will be greater than the reduction of production cost.

⑤ The pollution prevention equipment industry has not developed enough to substitute imported parts for the equipment. Expensiveness of the imported parts is one reason for financial burden of pollution prevention measures.

c. Delay in adopting Cleaner Production technology

① Penalties for violating regulations for pollution are light.

In the paper and pulp industry, the recollection of black liquor in the case of a large investment, and recollection of fibers in the case of a small investment, are possible and these technologies reduce production costs. However, opportunity cost for adopting such technologies is comparatively high due to the current light penalties.

② Knowledge of Cleaner Production is insufficient.

Even Cleaner Production that requires only a small investment is not implemented, which reveals a lack of technological information. Knowledge of technology for reducing equipment burden such as reducing volume of discharging water or ranking wastewater by quality for efficient reuse. Because valuables such as fibers from raw material of paper are dissolved in wastewater, there are many cases that production costs and wastewater pollution are increased due to decreasing a yield rate.

③ Production methods are sometimes outdated, production efficiency is low and the load to the environment is high.

The Kraft method in the pulp industry, a method in which black liquor can be recollected, and the ion exchange membrane method, which requires a low consumption of electric power, have not been adopted.

④ There is a lack of Cleaner Production experts.

There are a small number of experts whom enterprises can consult on Cleaner Production matters, and there are only a few enterprises which can accept experts from abroad.

⑤ Profitability in enterprises is low and profit accumulation is too small for investment.

Similar to case a., low profitability makes it difficult for enterprises to invest in Cleaner Production. Cleaner Production has the characteristic of reducing costs and is usually implemented voluntarily by enterprises. However, if they have a small amount of capital reserves and capital investment is large, investment will be actually difficult.

d. Low-level production management

Leakage of process wastewater from the bulb to the factory interior, and trouble with operational meters that have no figures etc., causes material loss and environmental pollution.

Without grasping material balances of raw materials and products, as well as unit consumption of materials and utilities, it is not possible to determine which part of the production process has problems, or how much volume of raw material loss occurs. In addition, it is also difficult to estimate expenses for countermeasures and the subsequent effects that will occur, and thus, it is difficult to make and implement plans for pollution prevention measures.

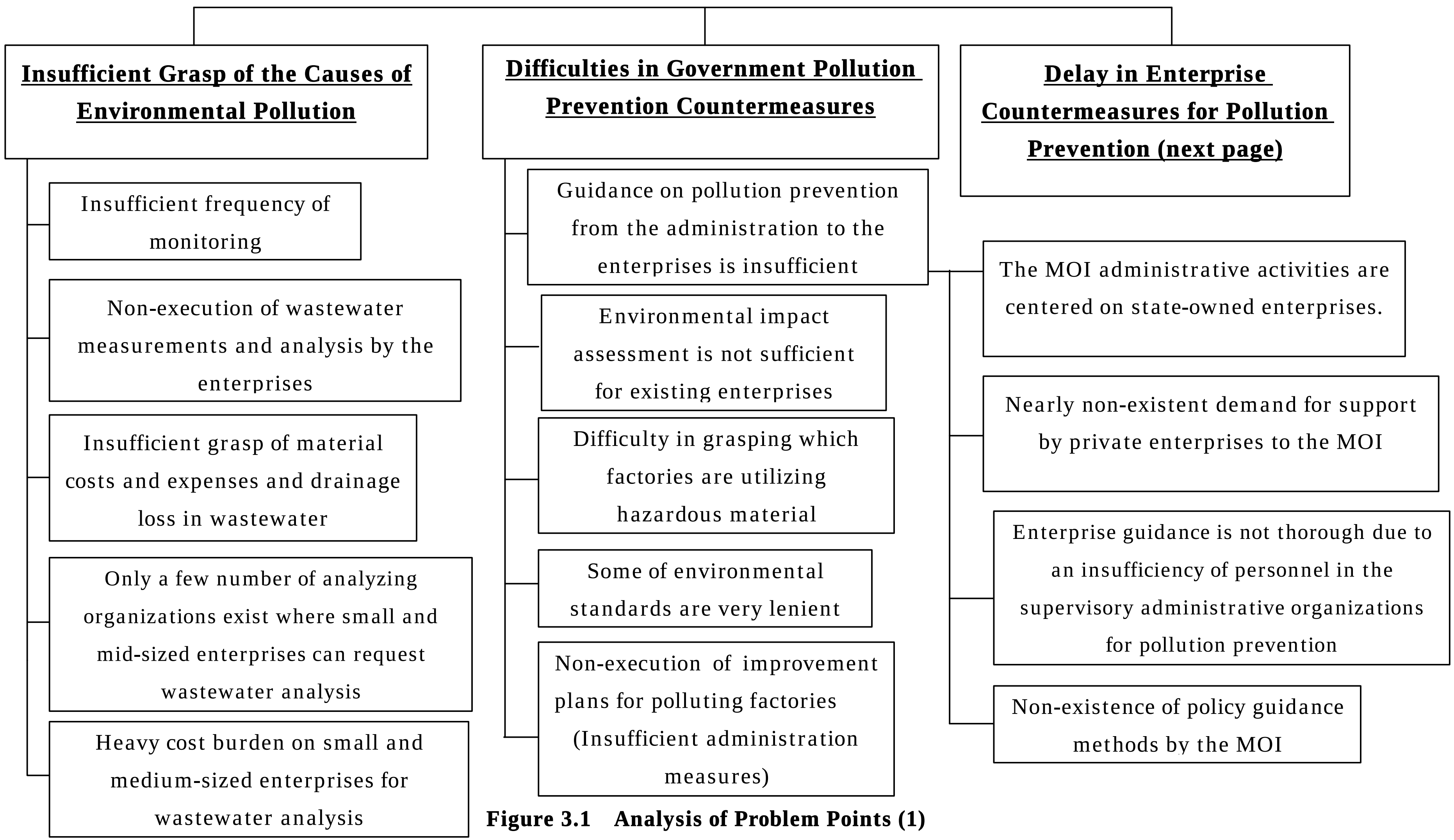


Figure 3.1 Analysis of Problem Points (1)

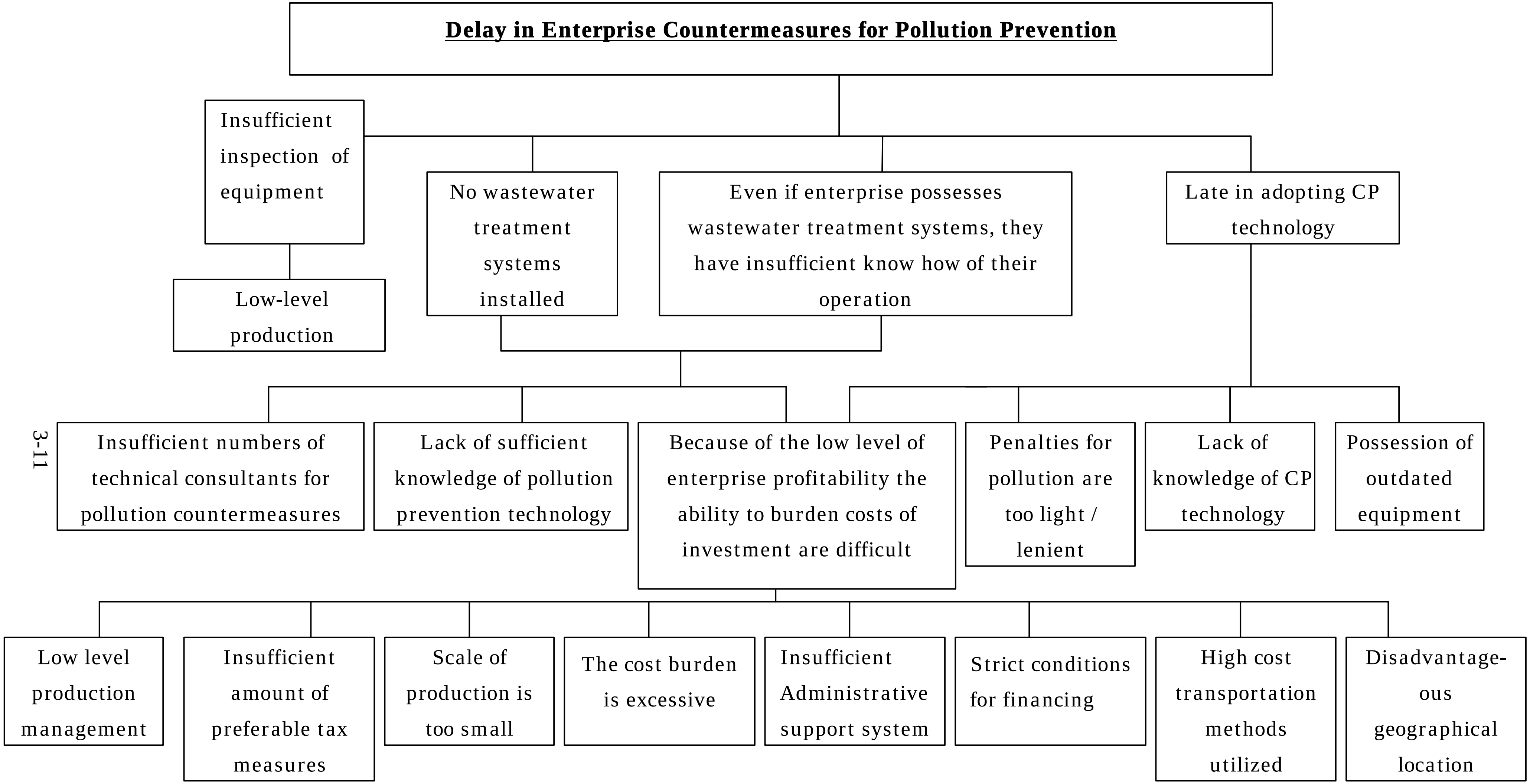


Figure 3.2 Analysis of Problem Points (2)

Chapter 4

Countermeasures and Their Anticipated Effects

Chapter 4 Countermeasures and Their Effects

4.1 Countermeasures for Problems

The thought process for measures for problems indicated in Chapter 3 are as follows:

4.1.1 Strengthening the grasp on the causes of environmental pollution

For grasping the causes of environmental pollution, the following measures are required:

① strengthening the monitoring system of public waterways and especially, of wastewater from enterprises which presently needs to be monitored more strictly.

② preparing the surrounding environment for supporting monitoring, including analyzing organizations, the training of analyzers and the assurance of monitoring accuracy.

As for ①, there are two methods possible for implementation; one is that the government directly enforces it, and the other way is for the government to encourage enterprises to implement autonomous measures while checking the data provided by the enterprises indirectly. The effects of these two methods are quite different, including the way they are propagated.

As shown in Table 4.1, it is difficult for the regulating authority to take data concerning a large number of enterprises due to limited human resources and costs, and therefore, monitoring ends up being insufficient. On the other hand, in the case that the regulating authority recommends enterprises to carry out self-imposed analysis, it is difficult to ensure the reliability of the data. To resolve these problems, a standardized manual of sampling and analyzing methods should be made with the aim of improving reliability, and harsh penalties should be imposed in the case false reports are made. In addition to these measures, by recommending the enterprises to sample and take data autonomously, enhanced productivity effects due to improved in-house management can be expected, and therefore, this will lead to the establishment of an autonomous management system.

As for ②, there are two methods possible for implementation; one is the utilization of a method that places emphasis on the use of special analyzing organizations, and the other is a measure that focuses on the training of expert analyzing technicians in enterprises. Both these measures have merits and demerits as shown in the comparative chart. As far as small and medium sized enterprises are concerned, it is not easy to employ an in-house wastewater analyzing technician and thus, external experts to whom they can easily entrust the tasks are definitely necessary. However, it is more efficient for the improvement and enhancement of expertise to establish a system where in-house and autonomous analysis is possible. Thus it is appropriate to first train external experts, and then afterwards, train in-house analyzers.

In general, there are two ways of regulation; one is a method which places emphasis on autonomous management by the enterprise (A) and another is a method which place emphasis on government-enforced monitoring (B). Method A is superior to method B from the viewpoint that measures of high importance should be implemented by first grasping the area wide total pollutant load but that governmental monitoring is inefficient and should be supplemented. From the point of view that enterprises should autonomously improve productivity and environmental management, as well as reduce costs and the pollutant load, method A is definitely needed. Method B should be adopted in the case that the enterprise has a lack of awareness for environmental management and/or in the case it is difficult for some small and medium sized enterprises to autonomously carry out analysis due to the cost burden of employing experts. In method A, enterprises carry out self-imposed control of their activities, which is the basis of ISO 14000 and 9000.

4.1.2 Strengthening Pollution Prevention Measures

First of all, regulating methods should be examined. Total Emission Control is a regulation method that focuses on the total emission of pollutants, in addition to the current pollutant concentration regulations. (See the table and section 16.1.5.) Regulation focuses on enterprises that discharge a large amount of pollutants in the Total Emission Control Method. In this method, a small amount of monitoring is required. Because of limited capital and human resources, it is more effective to reduce pollutant loads rather than the concentration regulations that are currently used. Also, this approach inevitably leads enterprises to adopt self-imposed controls through in-house monitoring and encourages pollution prevention managers to grasp the pollutant flow.

In addition, a registration system of enterprises using hazardous material, government sponsored human resource training and amendment of Environmental and Wastewater standards are considered to be other potential policy measures. As for these systems, there are no comparative approaches.

One of the factors for lenient government-enforced measures is that there is no coordination system in effect among the authorities concerned.

Between MPI, MOSTE (NEA) and MOI in the central government and among the People's Committees, DPI, DOSTE and DOI at the local government level, it is necessary to clarify the scope of responsibility, as well as strengthen the administration for preventing environmental pollution in terms of the environmental administration. It is also, especially important to strengthen pollution regulation in enterprises under the guidance and supervision of the administration.

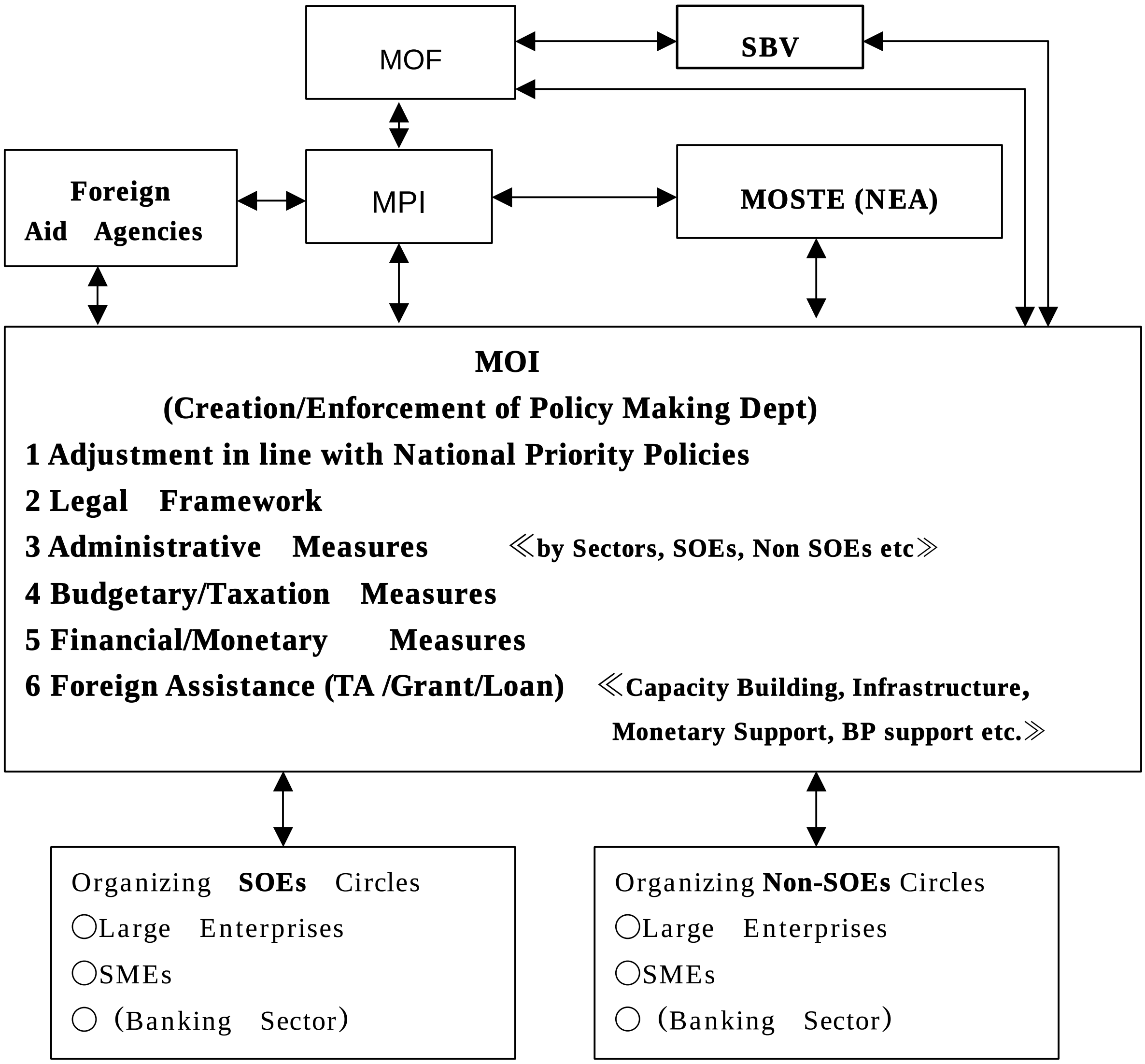


Figure 4.1 Coordination system of the concerned authorities responsible for pollution prevention.

4.1.3 Motivating enterprises to implement pollution prevention measures

a. Methods

In order to urge the enterprises to invest in pollution prevention, there are two measures that can be taken in a broad sense; one is to impose stricter penalties and the other is to provide support in order to lessen their burden.

In the case that an enterprise has the required technological capability and can obtain financing, just imposing a stricter penalty on the enterprise for not satisfying the regulatory standard is sufficient enough.

However, if any one of the said conditions is not satisfied, because the enterprise does not have the capability to comply with the regulation if a strict penalty is imposed, the enterprise may be forced to shut down operations due to the heavy penalty. This causes an increased burden on social costs, such as an increase in the number of unemployed, etc.. Therefore, we need to review which measures will be appropriate for each industrial condition, weighing one consideration against another.

Generally, for the reasons that the Vietnam government does not have much capability to raise funds for private enterprises and that the enterprises do not have high profitability, support for investment in EOP technology that has a low return on investment should be given low priority. In addition, some CP technologies require a big investment in equipment (black liquor recovery equipment for paper and pulp, continuous dye equipment for fibers, etc.). Thus, enterprises have problems in raising necessary funds, as well as in ensuring the availability of large equipment, so it is not easy to enforce these measures, and peer review is needed for each enterprise.

On the other hand, CP technologies that do not require a heavy financial burden and large investment are easy to implement, and high cost effectiveness is expected. Therefore, in this case, technological instruction, human resource training and information exchange are measures that should be given priority. In this Study, the following potential applications of CP technology were discovered, so prompt action is desired.

< Potential applications of CP technology>

Cases not requiring a large investment (easy to implement)

- A heavy metal solution and ordinary raw material are stored in the same way in the storage facility of a chemical factory. The area subject to cleaning of polluted material has been enlarged because of this situation, and therefore wastewater after cleaning is increasing in volume.

- In an agricultural chemical factory, pesticide is diffused on the floor and into the air at the sorting and packaging processes. Hazardous material is released to the environment, and at the same time, the yield of products is lost (Its countermeasure requires the cost for a cover).
- In a pulp factory, the size of chips is too large to be dissolved completely with caustic soda, which has caused limited yield and increased waste.
- In a pulp factory, caustic soda is not applied evenly to chips in the concrete bath, which has caused limited yield and increased waste.
- In a paper making factory an adhesive substance is stuck on the roll which cut the paper sheet. This situation has caused limited yield and consumed more raw material than necessary (cleaning needs to be carried out).
- In a paper making factory, wire for making paper is repaired by connection not by welding, and thus, the uneven connection ends up cutting the paper sheet. As a result, more raw materials than necessary is used and the environmental load increases.
- In a paper making factory, fine fibers of high quality are released in the waste water, which becomes a load to the environment and limits the yield of high quality fine fibers (a simple basket for catching fibers needs to be installed).
- The floor of a food processing factory is level and thus, cleaning water collects in a depression. This situation increases the amount of wastewater and lowers the efficiency.
- In an alcohol factory, an organic compound that can be reused as fuel if collectged is left in a distillation residue, which becomes waste.
- In a plating factory, toxic cyanide is used in a case where cyanide usage may not be necessary.

Cases requiring investment (need to raise funds)

- In a pulp factory, 4-stage cleaning equipment is available, but only 1 stage is presently used. As a result, a large volume of caustic soda is left in pulp and thus, the excess chemicals, together with coordinate for neutralization, are consumed (need to replace the failed equipment).
- Acid, not enzymes, is used for decomposing starch into carbohydrate, which places a heavy burden on wastewater treatment (need to partially replace the equipment).
- In a dye factory, the ratio of dying liquid to cloth volume is relatively high, which means too much dye is consumed (a big investment is needed, such as the

introduction of continuous dying equipment, etc.).

- In a dye factory, steam condensate is not recovered and hot water is discharged directly as effluent. As a result, much fuel is consumed and the environmental load increases (need to install piping).
- In a fabric factory, wastewater contains glue which causes an increase in BOD and COD (need to switch the equipment to a type where chemical glue can be used).
- In a fertilizer factory, phosphate rock that is the raw material, and about 2% of the products are released into the air in the form of dust and deposit at the site, which is causing a load on the surrounding environment (need to invest in the modification of the process).
- In a paper making factory, the diameter of a roll used for de-hydration is so small that it cannot accept much pressure, and therefore, water content in paper is high. As a result, much fuel is consumed and the cost burden and the environmental load increase (need to switch to a roll with a larger diameter).
- In a paper recycling factory screens that catch debris have holes of about 2mm, so debris is mixed in resulting in lower quality. Also, debris increases as SS content in the wastewater increases (a slit-type screen is needed).
- In a paper recycling factory, float-type ink removal equipment is not installed and thus, paper of low quality is manufactured. And also, ink is contained in waste water, which increases the environmental load (need to invest in ink removal equipment).
- In the pulp industry, black liquor recovery equipment has not been introduced in almost all factories. The recovery and combustion of black liquor saves fuel, and at the same time, caustic soda and sodium sulfate are recovered (a big investment is needed, one comparable to the construction of new factory).

b. Technological problems

As for the lack of capability to cope with technological problems: ① in-house training of human resources, ② technological instruction by experts such as consultants,③information exchange among enterprises and ④ promotion of ISO 9000 will be appropriate measures. Among these technological instruction is effective for solving independent problems in the short term, and technological guidance can be used as a short term measure. The training of human resources is effective for developing in-house, autonomous technological skills over the long term. No cost is required for exchanging information, which is an effective way for improving general technology. ISO contributes to improve overall management technology, not independent technology.

c. Financial problems

As for policies to solve the lack of cost burdening ability for industrial pollution prevention investment, ①loans ②tax preferences, ③ common treatment facilities, ④integration of equipment intensive industries etc. will be appropriate measures. Improving the system of ① and ② will directly effect individual enterprises, while implementing ③ and ④ is very effective but will require much time and effort to coordinate them among the entire industry. Therefore, it is necessary to tackle these measures in the mid and long term.

As for capital procurement, long-term loans are very effective, and moreover, a reinforced, complementary credit system is urged to be adopted only for enterprises which do not have reliable credit, and thus, can not raise funds.

As for financial instruments, a TSL needs to be carried out at enterprises to help them control environmental pollution. A TSL system needs to be adopted on the basis of a F/S, through official development assistance for the environmental field.

For implementing TSL, the dispatch of a combination of organizational, financial, and pollution control experts needs to become a norm, and guidance needs to be constantly provided to ensure capacity building on human development and the organizational system.

Other issues of importance include how to promote the following three measures such as the certification system, and reward system for improving measures to provide incentives to employees

It is largely agreed that a TSL to help control industrial pollution in Vietnam should be carried out by meeting the following conditions in addition to conforming to national macro-economic policies:

- Based on the understanding that reform of State-owned corporations is a basis of economic revitalization, with regard to State-owned corporations, precedence is given to companies which have been equitized (privatization).
- In conjunction with guidance offered by financial field experts or consultants, thorough investigation should be conducted on banking operations and the financial system of the recipient country. In addition, a scheme that provides for the effective flow of supplied funds to end-users should be established before implementation.

• The Vietnamese side needs to move away from their traditional way of thinking of giving precedence to State-owned corporations and establish a policy to improve economic efficiency through privatization and development of the private sector.
• A legal system for finance, a collateral system, policies for a capital distribution scheme, a bank screening system for lending and loan management, and a staff training system for developing competent bankers should be established. Criteria and a system for supervising banks should be developed and established and their transparency should be ensured. With these measures, streamlining and modernization of financial operations can be achieved so as to win confidence of donors who provide funds of this kind.

To these ends, ways for implementing an effective preliminary survey to realize funding, and methods for providing technical support should be discussed with the donor side.

With regard to Japan's yen loan and the four billion yen project to support small and medium-sized corporations in which the L/A has already been signed, preparation for the necessary implementation procedures are currently under way. This is the first TSL for Vietnam. Since the future development of this project will have an immense impact on future projects of this kind, all-out efforts should be made for the success of this project.

Among all Vietnamese state-owned commercial banks (SOCBs), bad loans account for 30 - 35% of the loan total, whereas the figure for the top two banks is 17 - 25%. The figure for the bottom two banks is some 40 - 47% according to the 1997 IMF International Standard. In the Philippines, on the other hand, according to the 1999 standard set by the Central bank, the executing banks reportedly have a single digit bad loan ratio. Since the Vietnamese Central Bank (SBV) doesn't publicize its supervising standard and the actual ratios of bad loans that banks have, we have used the IMF's coefficient to come up with an estimate. This fact indicates the lack of supervision standards for financial institutions and supervising administration in Vietnam.

4.2 Examining Policy Measures

Table 4.1 shows supposed policy measures. These measures can be classified into environmental monitoring, environmental regulations, governmental incentives, enterprise autonomous work, state owned enterprise reformation, consulting services for enterprises, and others, and each measure has merits and problems that might occur when measures are implemented. Implementing pollution prevention countermeasures are synthetically examined in two ways, one method emphasizes giving respect and consideration to enterprise self-management ability, and the other stresses a governmentally controlled regulation system.

4.2.1 Method based on self-management ability of enterprises

This method is shown in Figure 4.2.

(1) Short term measures

Technicians working at industrial sites know the most about their factory's production processes. Thus, creating an autonomous improvement system, one that is implemented by technicians who deal with processes, is required in order to improve efficiency of production processes and reduce the loss rate of raw materials by controlling the amount of raw materials being discharged into wastewater. Therefore it is preferable that pollution prevention managers be developed from among the technicians who are very familiar with the production processes, and also that pollution prevention managers should be placed in charge of productivity improvement.

The amount of raw materials and others utilized for production, and for waste, the amount of raw materials and others discharged into wastewater or that become solid waste, must be grasped sufficiently. The more materials or others are used for production, productivity will be improved, and the more they get discharged into wastewater, the more the pollution rate will be increased. Thus, the concepts of both types of management should be considered, and also as stated before, the same person should be involved in calculating and grasping both types of data.

Concerning discharged pollutants, the enterprises themselves should estimate the concentrations and calculate the total discharged amount of pollutants by conducting monitoring and making material balance sheets. Administration offices, basically, should grasp pollution conditions indirectly according to data submitted by enterprises. Monitoring conducted by the Administration should be used only for a spot check to determine if the data is correct or not.

Administrative authorities stand in a position to support autonomous enterprise improvement, and should promote enlightenment and the creation of commendation systems in enterprises in order to motivate employees. The Administration should also establish a technology committee for each industry in order to promote information exchange on unit consumption of main raw materials, and to promote Cleaner Production methods. For example, in the paper and pulp industry, the unit consumption amount of the main material, caustic soda, has a difference of as much as five times between the top and bottom level enterprises. There is much room for process improvement by exchanging information among enterprises.

(2) Mid-term countermeasures

It would be reasonable to conduct monitoring autonomously by promoting a monitoring manager from among in-house technicians because enterprises can grasp how much raw material is used for products and how much is being discharged. The introduction of an authorized certification system for analyzing technicians will be effective for maintaining a high level of analysis, and also serve to motivate the analyzing technicians.

In order to support enterprises, technology guidance, a substantial loan system, and a preferential tax treatment system are necessary. If a fund is set up that is to be used only for pollution prevention and that mitigates the strict collateral conditions of usual loans, it will become a kind of “Environmental Fund.” Because it will be necessary to find lenders who will entrust money to the Vietnamese side and are not connected in any way with the management of the fund to provide loans to prospective enterprises, the establishment of this “Environmental Fund” is considered to be more difficult than introducing a TSL scheme.

Instead of enterprises just making public announcements on pollution conditions to residents, actually concluding pollution Agreements with residents will have the same effects as a penalty. Because consensus is necessary between the enterprise and concerned residents, the Agreements should be made after the enterprises have developed an understanding about environmental conservation, or if not, they will be difficult to promote.

Once enterprises reach a level where they are able to deal autonomously with improvement measures, it will be possible to introduce the acquisition of the ISO 14000 series, which is related to environmental management, or the acquisition of ISO 9000 series certification, which relates to quality control. This will lead to improvement in enterprise management, improvement in enterprise public image, and increased production.

Highly efficient pollution prevention equipment that has low running costs is very useful for implementing measures in enterprises. Thus, in order to promote the pollution prevention equipment industry, measures such as ensuring initial demand for equipment, and providing loans and a preferential tax treatment system for the pollution prevention equipment industry are valid and preferable investment measures. An eco-labeling system for the purpose of creating name recognition and increasing sales of products that are considered to be "earth-friendly" only requires a small amount of expenditure. If candidate products for this measure do exist, it would be beneficial to examine the possibility of using them for environmental measures.

For industries where it is difficult for enterprises to install treatment equipment themselves, such as the plating industry, it is more efficient to promote the installation of joint treatment equipment.

(3) Long term measures

Equipment cost per unit of production decreases drastically when large-scale equipment is used in equipment intensive industries. Thus, for industries that especially require a big production process improvement for pollution prevention, it is very important to integrate enterprises, or concentrate them geographically, after making plenty of investigation within the industry for determining the best ways to reduce the investment required to make pollution prevention affordable.

4.2.2 Method based on administrative supervision factors

In this method, administrative authorities supervise and regulate enterprises, and this method is reasonable for preventing pollution occurring in industries that have a lot of small and mid sized enterprises whose ability to prevent pollution is low.

(1) Regulating

Monitoring should be conducted mainly by the administrative side, and it is very important to train monitoring experts in the administration as well. In addition to this, it is also important to improve analyzing facilities so that they can take over these kind of administrative tasks, and if this measure is carried out, then the demand for, and necessity of, developing in-house analyzing technicians will decrease.

In order to reinforce the monitoring system regulated by the administration side, pollution prevention managers should be allocated and set up in enterprises, and if possible, enterprises should be forced to report their total emission amount to the administration in order to adopt the Total Emission Control method, a method that is more effective than concentration regulation. Using this data, the Total Emission Control method should be calculated and a total discharge amount of pollutants should be allocated to each enterprise in order to satisfy desirable environmental standards. Since the discharge amount of each enterprise is quite diverse in Vietnam, efficient pollution prevention measures that target a small number of enterprises can be implemented by using the total pollutant control method.

The administration should establish an enterprise registration system for hazardous materials because the administration needs to get a grasp of the enterprises that are utilizing hazardous materials, such as heavy metals, in order to enforce regulations. When this system evolves and improves, it will become known as the "Pollutant Release and Transfer Register" system, and not only will the enterprises be registered, but also the total amount of pollutants, or the amount of pollutants transferred, will be disclosed. However, since enterprises do not currently grasp their total emission of pollutants at all, the system should aim for a point where enterprise registration is enforced for the time being, and if they have enough spare energy after this measure has been secured, then the system should be improved further.

Penalty reinforcement is also required for enterprises, as much as is the enterprise support system, once a reasonable total emission amount for every enterprise has been allocated through the introduction of the Total Emission Control method. Measures such as raising the amount of fines, social sanctions, such as publicizing and updating black lists, or collection of surcharges that are in proportion to the amount of the total allocated emission amount that is exceeded, should be enforced.

However, a surcharge method would be unfair for now because not all of the enterprises have an accurate grasp of their total emission amount that leads to environmental pollution. Introducing this method requires the implementation of a trading system for allocated emission amounts that gives enterprises the right to trade their emission amount allocated under the Total Emission Control method. A complete grasp of the total emission amount by each enterprise, which can be acquired by setting up continuous discharge volume meters, is a required condition of this trading system. After these conditions are satisfied, this method can be introduced, and thus, at present, it is too premature to implement this measure in Vietnam.

The Total Emission Control method does not require the trading of emission rights, however, a quota would be allocated mainly to enterprises that discharge a large amount of pollutants. The administration can support enterprises that have small allocated discharge amounts and whose costs for countermeasures are rather expensive, and assist them in trading their allocated emission amount. Thus, the Total Emission Control method, up to this level, can serve to control the discharged amount of pollutants without a large amount of investment throughout the entire industry, and should be promoted.

It is possible to use pollutant concentration regulation measures as well. However, if these measures are carried out, small and mid-size enterprises that discharge a small amount of pollutants will be required to install processing equipment, and costs will rise. However, even if this measure does require a lot of costs, the reduction in the amount of discharged pollutants won't be efficient.

In the case that a concentration regulation method is used, it is necessary to strengthen penalties more compared to the case where the Total Emission Control method is used. This is because when enterprises implement pollution prevention measures production costs will rise.

(2) Difficulties in improving productivity

It is difficult for the administrative side to grasp the real state of production processes within enterprises, and in the method based on administration supervision and regulation, there would be many cases where End of Pipe methods, rather than promotion of Cleaner Production technology, would be most suitable. Also, enterprises have difficulties in taking the initiative in preventing pollution. This method does not provide the condition that enterprises must autonomously grasp material balances, unit consumption of raw materials and utilities, and thus this method is not efficient for improving productivity.

(3) Increasing the responsibility of the administration

Because the enterprise side will receive no merits for implementing pollution prevention measures, the burden of the administration is large for measures such as conducting monitoring and reinforcing regulations, and additional staff and costs will be required.

4.2.3 Comparison of both methods

It would be reasonable to choose more rational methods by studying unbalance in the total emission amounts allocated to enterprises and the production management ability for grasping material balance and unit consumption of raw materials in enterprises. In addition, it would be appropriate if an investigation was made to determine if an industry is suitable for Cleaner Production or not, and also to determine the strength and technology levels of enterprises in each industry.

TABLE 4.1 Countermeasures and Their Effects

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
(1) Environmental Monitoring 1. Reinforcement of the monitoring system	A. Reinforcement of the monitoring function of regulating agencies	a. The facilities, machinery, and experts for implementation of monitoring are available.	a. This measure will make reliable, accurate monitoring possible so that Government and organizations under its control can directly obtain and analyze wastewater, even if the enterprises do not have the capacity or desire to analyze it. b. A fair application of penalties can be practiced. c. The effectiveness of the regulation can be verified through more accurate grasp of current environmental conditions and the actual conditions of waste discharge from enterprises.	a. The burden will be heavy in terms of cost and manpower because the government will directly carry out monitoring. Because of this, the frequency of inspections will be restricted and the amount of data will decrease. b. It will take long to carry out complete monitoring of all enterprises. Due to this, as an end result, monitoring may be insufficient.
	B Strengthener of the independent environmental management system	a. Enterprises possess the necessary equipment and personnel to carry out monitoring. Otherwise enterprises can easily contract external analyzing organizations for analyzing work.	a. The Government burden for both cost and personnel will be small. b. It will become easy to grasp the material balance and the unit consumption of raw materials in the enterprise c. Even if the number of enterprises is large, it will be possible to collect data in a short period of time.	a. Monitoring won't be carried out without penalties for violations. There is also a fear that analysis data may be falsified. b. Analyzing equipment and personnel will be required. A period of time and educational assistance costs will probably be necessary in order to nurture reliable analyzing technicians and external analyzing organizations. c. A cost-burden will be needed for the enterprises to use the data for production improvement because pollution prevention managers must be provided.
2. Maintenance related matters ① Development of analyzing technician human resources	A Analyzing organization technicians	a. Private enterprises take analysis data b. Analyzing organizations possess technicians that can receive requests for analysis from private enterprises.	a. The measure can easily be implemented in a short period of time with low cost because the number of organizations is small. b. Even small and medium-sized enterprises that don't have the ability to bear costs can contract the work to these expert organizations.	a. Analyzing technicians will not receive training if demand for analyzing does not increase.
	B Enterprise "in-house" technicians	a. Private enterprises take analysis data b. The existence of employees that possess the minimum technical knowledge required in order developing in-house analyzing technicians.	a. From improvement in self-management capacity, it is expected that CP Technology improvement will also occur.	a. Large development costs and time will be required because it is necessary to train a large number of technicians.
② Improvement of the accuracy of monitoring	A System for certifying analyzing organizations	a. There are public analyzing organizations, or analyzing businesses that have analyzing technicians, as well as necessary facilities.	a. It will be easy to ensure the reliability of analyzing data through the use of crosscheck data. b. As there will only be a small number of licensed organizations, it will require little time, cost, and labor.	a. If "in-house" analyzing technicians do not have sufficient analysis ability there will be little effect of CP Technology improvements.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
② Improvement of the accuracy of monitoring	B Analysis technician licensing system	a. There are a suitable number of technicians that possess expert knowledge of analysis.	a. It will provide an incentive to improve the technical ability for technicians, both in analyzing organizations and in the enterprises.	a. Effort, cost and a long period of time will be needed for executing examinations to each individual technician. b. Technological ability may fall because personal knowledge dulls as years pass by.
	C System for selecting analyzing machines	a. Available analyzing machines have been produced following international standards.	a. Improvement in accuracy of analyzing machines ensures a more exact grasp of environmental pollution conditions. b. Countermeasures are made more effective by grasping the amount of toxic materials.	a. The purchase of high-quality analyzing machines from abroad leads to increased investment in the environment. b. Human resource development for the operation and maintenance of high-quality machines is needed.
(2) Environmental Standards ①Effluent concentration regulations and pollutant load regulations	A. Effluent pollutant concentration regulations	a. The National Assembly approves the new regulation standards.	a. It is easy to judge if regulations satisfied or not by looking at a row data measured.	a. It is not effective unless there is sufficient monitoring of standards and harsh penalties for violation.
	B. Total Emission Control	a. The national Assembly approves the regulation standards. b. Factories themselves take measurements and record the total emission amount of pollutants.	a. Great and quick environmental improvement can be expected because it is possible to concentrate countermeasures on subject enterprises that have a large pollutant load. b. Starting with the production of necessary material balance charts, production improvement technology will rise, and it is expected that the unit consumption of raw materials will also improve. c. Once enterprise grasps their total emission amount sufficiently, they will be able to trade their emission allotment.	a. Monitoring costs for making material balance sheets in-house for discharged wastewater and for pollutants will increase. b. It is not easy to set rational and clear regulation standards. c. If the total amount of polluted material can't be calculated due to an insufficient grasp of an accurate total wastewater amount, a feeling of unfairness may be born between enterprises where these measures are executed.
② Grasp the state of hazardous waste	A PRTR(Pollutant Release and Transfer Register)	a. There is a system that can collect reports from enterprises. b. Enterprises grasp the amount of chemical substances in wastes.	a. It is possible to grasp the amount of chemical materials discharged and transferred to the environment.	a. It will add a burden to enterprises' work-load as they have to make a report about once every quarter. b. This measure alone will not be a powerful countermeasure because it is only a report.
	B Increase the frequency of monitoring	a. In the case where regulatory agencies carry out monitoring it is necessary to have sufficient personnel and equipment capacity. In cases where private enterprises are made to execute this measure they must be able to determine if they have adequate capacity. In addition, there has to be an external analyzing organization that can be hired to perform the work.	a. Actual wastewater data can be obtained.	a. Excessive expenses and investment in manpower and a long period of time are required in order to be able to judge potential dangerous conditions.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
③ Adjustment of environmental regulations	A Reconsider environmental regulations	a. There are staffs in the supervising administrative agency that can evaluate the existing amount of permitted polluted materials in the environment.	a. Wastewater standards will become more rational with the execution of area-wide pollutant load control. Required are no expenses, little man-power and time for the advancement of this measure.	a. A small investment in manpower is required.
④ Regulatory and Support methods	A Regulatory Policies (Strengthener of penalties)	a. Personnel budgets and supervisory ability for executing the strengthening of regulations exist.	a. The practicality of such regulation reinforcement will rise with small portion of the Government cost if the enterprises have the ability to bear the burden on profitability, and also, have the technical capacity to implement pollution prevention measures. b. Fair competition will be maintained in all enterprises. c. By considering the fines levied against enterprises as "income," it is possible for the Government to utilize this money for countermeasures for industrial pollution prevention.	a. In the long-term it is necessary to invest in human labor for enforcing regulations. b. The Administration will have more responsibility for taking sanctions against violations. c. The environment will not improve unless the enterprises have technological and financial capacity to carry-out realistic pollution prevention investment. d. If measures are taken to shut down operations, socio-economic costs will become heavy because production capacity will decrease, employment problems will rise with employees. In the case where enterprises re-locate, in addition to re-location expenses, the environmental impact at the re-location site will also increase.
	B Collection of Surcharges	a. The amount of discharged polluted material is fairly grasped.	a. Collection of surcharges that correspond to the amount of polluted materials reduces the total amount of polluted materials, which will produce large economic merits. b. If the surcharge collected is used for environmental measures, the effects will increase.	a. If the Surcharge is not collected properly, the regulation will not be obeyed.
	C Public disclosure of Discharge conditions in Enterprises	a. A disclosure system is set up with sufficient consensus of enterprises. b. Citizens possess enough concern for environmental problems.	a. Public disclosure of polluted materials discharged from the enterprises plays a public relations role in that enterprises feel pressured to comply with the regulation standards. While it puts pressure on the government and enterprises, it provides opportunities for building mutual relationships with consumers.	a. There will be no effect if the enterprises do not feel pressure to comply. b. Countermeasures might be executed with malice against specific enterprises.
	D Decentralization and Transfer of regulatory power to local government	a. The subject local governments have the capacity to handle office work related to the transferred authority.	a. Local government body that is familiar with the region is authorized to cope with deliberately according to the actual conditions. b. It will enable an increase in the number of monitoring staff.	a. It is difficult to establish a system comprising of organization, personnel or facilities in local government.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
④ Regulatory and Support methods	E Recording of discharge conditions in enterprises and creation of an inventory of pollutants	a. There is a system that inventory data is regularly grasped and recorded in enterprises.	a. Data can be used for identifying environmental pollution causes and for improvement in the environment or prevention of environmental pollution accidents. b. Appraisal of the potential environmental impact by enterprises on surrounding residential areas will be enabled.	a. In the case that there are no systems for reporting the establishment of new factories or there is an insufficient amount of data reported, a long period of time will be required to receive the complete data.
	F EIA	a. There are data and an investigational institution for appraising, forecasting and surveying items concerning business development activity.	a. The new environmental pollution will be mitigated. b. Local residents can participate in evaluation by joining a public hearing and the like.	a. It is necessary to acquire a wide range of knowledge. b. It is not efficient for existing enterprises.
	G Work on Voluntary Agreements	a. Enterprises have the will for signing agreements for environmental preservation on the consciousness for significance of cooperation with local citizens and local government bodies.	a. The enterprises promote cooperation and harmony with the region, and this will lead to smooth business activities. b. Local administrative offices and residents have the opportunity to meet with enterprises.	a. Because the power relationship between enterprises, local administrative offices and residents are easily reflected in these agreements if the enterprises power is too strong, the agreement will not be concluded.
	H The establishment of a regulating mechanism for related organizations	a. Related organizations have the will for harmonization with other organizations in their policies.	a. Countermeasures in harmony are more effective.	a. The execution of countermeasures will lag because adjustments will take time. b. Countermeasures will be impossible to execute if there are organizations that don't agree with regulations.
(3) Incentive system by the Government	A Human resource development	a. There are human resources that possess expert knowledge and have the ability to become trainers. b. The administrative side can afford to support human resource development. c. There are personnel and a margin to choose employees for attending training courses on the recipient side.	a. The pollution prevention manager will make, implement and evaluate plans independently for pollution prevention. It is expected that production costs will be brought down and quality will improve through Cleaner Production technology. b. By developing environmental technology consultants, even small and medium-sized enterprises that have few employees can plan pollution prevention through their consultation. c. By establishing courses on environmental engineering at universities, technicians with expertise can be developed for the future.	a. It will take a long period of time for training and to compare the technological guidance of the technical experts. b. The burden of the cost of labor and cost of development will increase for small and medium-sized companies that have few employees. c. If an attempt is made to widely cover technological problems in many fields, the number of human resources that must be developed will increase and labor, cost and time period required will rise. d. The expansion of courses in Universities requires the Government to maintain and pay the costs for educational and research facilities, and professors and other related educators.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
(3) Incentive system by the Government	B Management and Technical Guidance Support	a. Experts that have expert knowledge and experience on problem solving can be secured. b. The government can afford to burden the expense for recruiting technical experts. c. Enterprises have margins for burdening a degree of the expenses.	a. Solutions for technological problems are generally quite effective and fast, and in the case that capable technical experts can be secured, precise technological solutions are expected. b. The burden of their cost is light because technicians are not used on an every-day basis.	a. It is nearly impossible to expect daily improvement for production and quality after the guidance has finished. b. The cost burden will increase if an attempt is made to cover many enterprises. c. If this support is provided continuously for long time, it will prevent developing private consulting businesses.
	C Long-term financing system	a. There is of financial sources that may be lent to the Government. b. The lending side can judge on loan approval. c. A supplementary credit system like a collateral system is has been prepared.	a. Even enterprises lacking of finance procuring ability can introduce new equipment for pollution prevention by using the loan. b. Investment load on pollution prevention can be reduced with the loan system. c. If enterprises are able to obtain financing, the introduction of new equipment will be promoted, which will in turn promote actual pollution prevention in the early stages.	a. The system will not materialize without equipping banks and financial institutions with a loan system that can be utilized by small and medium-sized enterprises. b. The lending side is required to have an ability to judge whether enterprises have sufficient cost burdening ability. c. In the case where the technological capability for managing equipment in the enterprise is insufficient, the equipment will not function to its full capacity.
	D Provision of an Environment Fund, or other methods for procuring capital, outside of bank financing	a. There is a supplier that can offer capital at profitable conditions that are better than the general competitive market conditions. b. The fund can judge for financing.	a. Even in cases where bank loans are not functioning, this measure can provide a way of obtaining fund. b. Differently than loans, interest rates and the loan period can be set flexibly.	a. Costs and personnel are required for securing an adequate level of financial analysis. b. There is limitation in the amount of capital available.
	E A Preferential Tax Treatment System	a. There is a tax system for equipment. b. Targets of the preferential tax treatment system can be distinguished.	a. This measure will become a valid incentive for reduction in cases where the pollution prevention cost burden is heavy for enterprises. b. Costs for processing this measure are relatively low compared to other subsidy measures.	a. If original tax revenues are insufficient, the system will work inefficiently. b. The government tax revenue will decrease.
	F Official Commendation System	a. There is a trend in respecting commendations from the Government.	a. If the commendation comes from a Minister, or other top ranking government officials, the satisfaction level of the recipient will be high. b. This measure is easy to carry out, requires little labor and no costs, and it is possible to commence it immediately.	a. This measure is inefficient without trust between the administration side and enterprises. b. Effects are small without a condition where enterprises are in a position to consider investment.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
(3) Incentive system by the Government	G Development of the Pollution Prevention Equipment Industry	a. There is a machining industry that can manufacture industrial pollution prevention equipment.	a. The merits are exceptionally good for industries that utilize inexpensive pollution prevention equipment provided by machine makers that is easy to operate and whose results are good. b. A new pollution prevention equipment industry will be developed, which may create new employment. c. If there are foreign investments, technology transfers can be expected as well.	a. Without increase of demands for pollution prevention equipment, it does not become an industry.
	H Promoting "Environment ally Friendly Products"	a. There is a certain number of enterprises that have acquired ISO 14000 series certification in the country, or enterprises that have high consciousness on the environment.	a. Products and services that are friendly to the environment will be able to be promoted at a low cost.	a. It will be necessary to raise the judgment ability of the person in charge.
	I Eco-labeling	a. High level of consciousness by consumers for selecting environmentally friendly products when choosing products.	a. According to market principles, it will promote the utilization of products that are suitable to the environment and make consumers understand correctly the environmental aspects of products.	a. It is needed to promote and enlighten consumers.
	J Financial support for design and research and development	a. Enterprises posses technical capacity for design.	a. Development and introduction of facilities suitable for local conditions will be enabled. b. Development of facilities with lower costs will be enabled. c. Development of the local machinery industry will be promoted.	a. It is less effective if local technical development capabilities or human resources are inefficient. b. A large amount of capital for assistance is needed.
	K Dialogue between enterprises and NGOs	a. A possibility exists for information exchange between NGOs and the side that gets regulated, the enterprises. .	a. The Government will be able to grasp accurate information on the enterprises and on the needs of NGOs. b. Establishment of regulations and assistance that corresponds with the actual conditions of local enterprises is possible.	a. It is possible to ending up with just ineffective dialogue.
	L Introduction of Joint Waste Water Treatment Facilities	a. Capital and technology for the establishment of facilities are available. b. The quality of wastewater inflow is suitable for the management of wastewater at joint wastewater treatment facilities to be unitized.	a. It is possible to solve the problem of insufficient technological capacity of individual enterprises, as well as bring about substantial decreases in treatment costs. b. It is possible to reduce the cost of wastewater treatment and the number of the related operators or technicians through the integration of wastewater facilities owned by each enterprise. c. It is possible to treat wastewater more effectively by sorting.	a. If it is not wastewater treatment from the same industry, joint treatment will be difficult. This measure is limited to the mechanical, dyeing, and food processing industries. b. Only enterprises in the same industrial zones can be candidates for this measure. c. It will be necessary to use a lot of labor and a period of time to organize the Industry. It will not be possible to execute this measure in the short-term. d. There is a need for construction and operating capital, and to share the burden of the cost with participating in the scheme.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
(4) Autonomous Enterprise Activities	A Promotion of ISO 14000 and 9000 series	a. Enterprises have wills for obtaining ISO international standard certification for global environmental preservation, as well as for ensuring the quality of products. b. There are registered auditing organizations and consultants who have ability to provide guidance.	a. This measure is profitable due to improvement in factory environmental management, production management and self-management, although actual execution costs exist. b. It has an advantage for export to advanced countries. c. There is hardly any labor or cost burden for the Government, and these measures can be advanced by just simply enlightening enterprises on these programs.	a. If management within an enterprise does not improve sufficiently, and even if they have promoted management improvement by simply re-arranging employees and preparing paper-work, and believe that these measures alone are sufficient, the cost of acquisition and maintenance will only increase and the management situation will not be improved. b. If management standards are low, two or three years will be required for overall management to improve. c. Human resource development and other costs, such as the costs for acquiring certification or maintenance costs, are required.
	B Reward system for employee initiated improvements	a. An acknowledged consciousness for the difference in income that results depending on individuals job performance exists.	a. Employees will more actively undertake voluntary activities, and improvement in cost reductions and the environment will ensue. b. There will be no added cost burden because the payment of rewards is considered to be one part of cost reductions.	a. In cases where a fair evaluation cannot be made on the results, a sense of unfairness will be born among employees. b. There will be no effect if management does not have awareness for the program and does not seek to raise the level of concern in employees.
	C Improvement in consciousness for productivity improvement	a. Industry has a sufficient consciousness for the necessity of production improvement movements.	a. Improvement in productivity of the enterprises is expected to reduce the amount of polluted materials produced through the production process. b. The improvement in productivity leads to a rise in international competitiveness of the entire industry.	a. It is necessary to introduce technology for improvement in productivity and to develop human resources who can guide productivity improvement movements. b. It is necessary to lead activities throughout the entire enterprise, and throughout the entire industry as well, to improve consciousness.
	D Establishment of environmental inspections	a. It is possible to burden the cost and their is sufficient human resources for the implementation of environmental inspections.	a. The concepts and procedures of environmental conservation can be clarified by discussion and description.	a. It is necessary to take time and dedicate costs to develop human resources for this purpose.
	E Allocation of Pollution Control Officers(PCO)	a. The enterprises can afford to allocate human resources as PCO's.	a. The establishment and implementation of environmental improvement plans, voluntary environmental management and elevated environmental consciousness within each enterprise will be promoted. b. Establishment of a definite environmental management system within the enterprises will be enabled. c. The administration is able to clarify the person to contact in the enterprises for environmental related matters.	a. There is a need for investment in a training organization for human resource development. b. There is a need to ensure that a legal qualification system is put in place and to preserve a position for PCO's in the enterprises.

Countermeasures	Policy Method	Preconditions	Merits	Obstacles
(4) Autonomous Enterprise Activities	F Joint communication through industry wide organizations	a. Industries have the will to reinforce and promote cooperation of industrial organizations. b. Industrial organizations have information capabilities.	a. Specific information that each enterprise runs short of will be complemented. b. Technologies of advanced enterprises can be shared in the industries with less cost and human resource through information exchange.	a. A doubt exists whether or not advanced enterprises will provide information in the case there are big technological differences between participating enterprises. b. Obtaining information from foreign enterprises requires some personnel and other costs.
(5) State enterprise reform	A Improvement in consciousness in the enterprises, including Privatization	a. Both managers and employees possess a "survival of the fittest" consciousness, one of the basic principles of competitive markets.	a. Expected to improve productivity, which will lead to a reduction of costs. b. Early decision making, such as on investments, becomes possible.	a. In order to ensure profits, countermeasures that require costs, even if they are for the public good, may not be carried out.
	B Integration of equipment intensive industries	a. The industries and MOI have willingness to accept mergers for the purposes of cost reductions and improvement in international competitiveness among enterprises. b. In the case that unemployment results from this measure, social countermeasures must be in place in order to assist in unemployment relief and job conversion.	a. It will be possible to invest in high-cost pollution prevention measures due to reduction of production costs and pollution prevention cost through scale-merit. b. Improvement in profits, as well as in international competitiveness, will occur due to pollution prevention.	a. In the paper and pulp industry, for example, small-scale factories will cease pulp production. Therefore, it will be necessary, even for small-scale factories, to change to producing products that they are internationally competitive, like used-recycled paper, or specialty paper products. b. For enterprises that find it difficult to change over, problems will arise where society will have to bear the costs, such as for plant shut-downs and the like. c. While considering the expansion of present facilities, it will be necessary to tackle the problem over the long-term. It will be impossible to bring about effects in the short-term.
（6）The other	A Promote cooperation between governmental administrative organizations	a. There is a framework that makes it possible to exchange information and promote alliances among the related agencies.	a. The effects will increase if cooperation on regulations and support is made between supervisory regulating agencies and enterprise support organizations. b. There are almost no additional costs or investment required for labor, and cooperative results can be expected in the early stages.	a. There are no demerits.

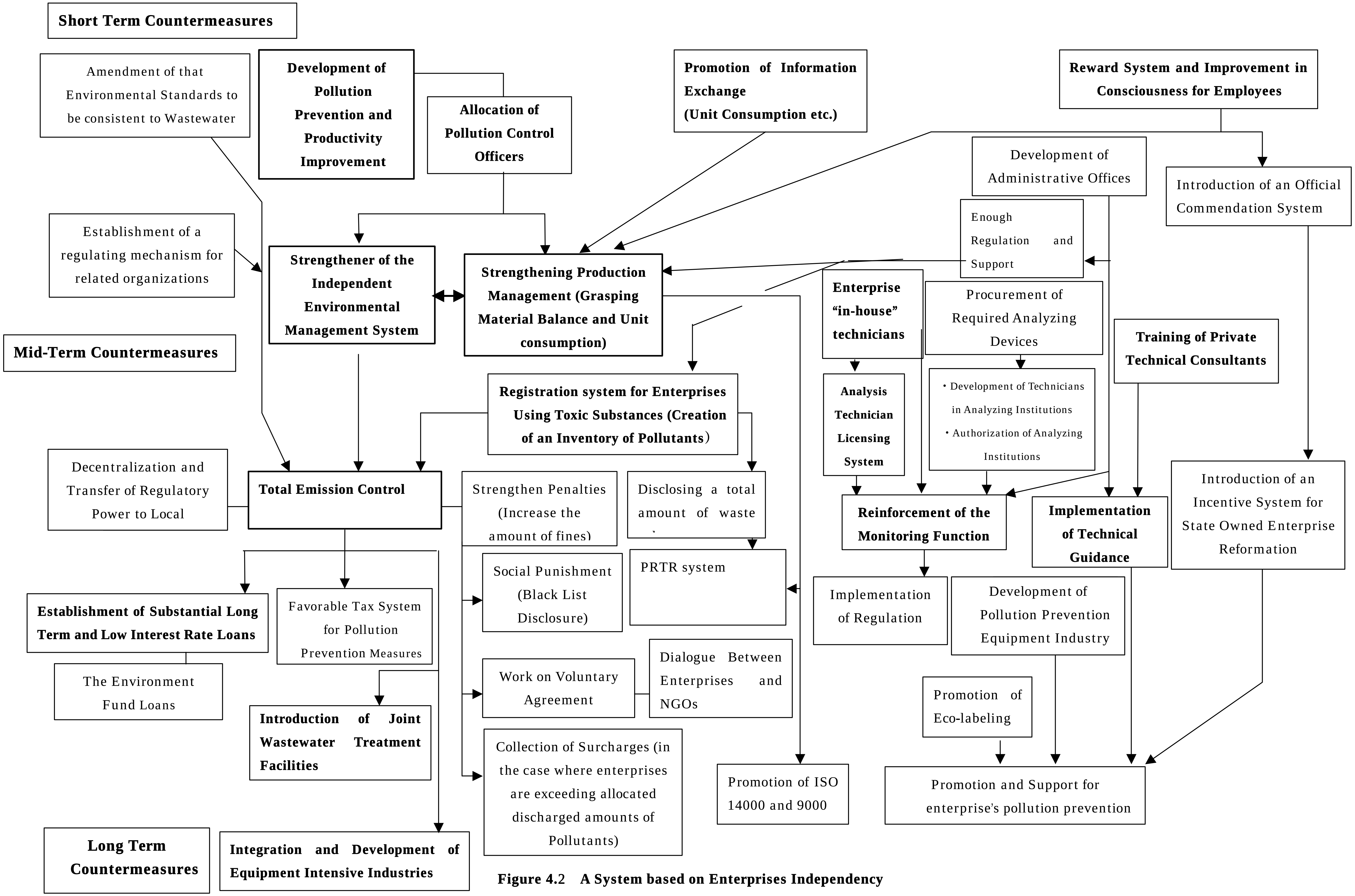


Figure 4.2 A System based on Enterprises Independency

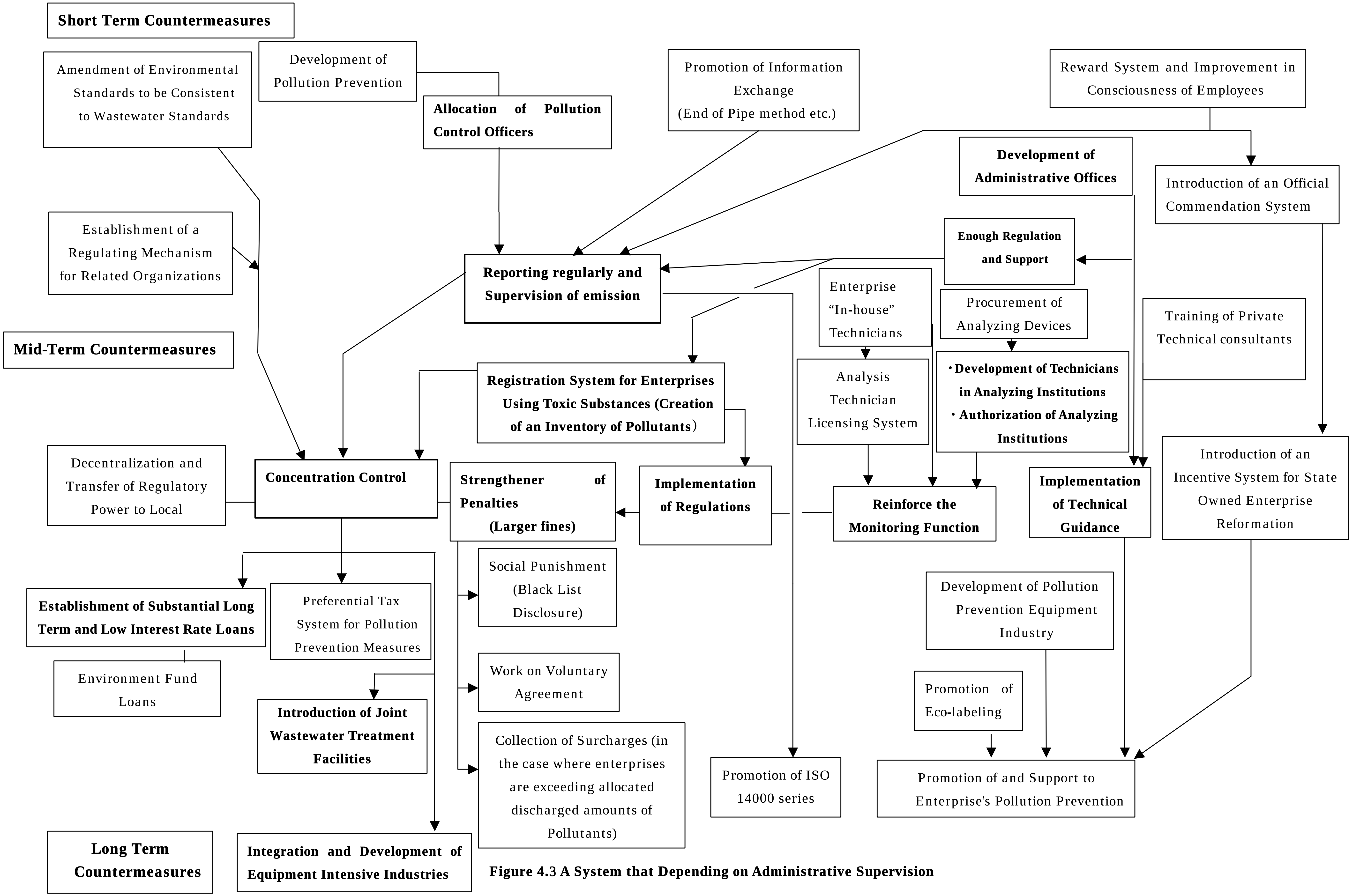


Figure 4.3 A System that Depending on Administrative Supervision

Chapter 5

Master Plan Proposal

Chapter 5 Master Plan Proposal

In this chapter, using the arguments made up through the last chapter as a base, a Master Plan Proposal and an action plan for pollution prevention will be presented.

5.1 Establishment of basic policies and objectives concerning measures for industrial pollution

5.1.1 Concept of sustainable development

In Vietnam, domestic industries have been developing remarkably recently, and one study has estimated that steel production will increase 8.2 times, urea 15.4 times and caustic soda 20 times from 1997 till 2010. New petrochemical products like vinyl chloride, polyethylene or polypropylene are also expected to emerge because of the Petrochemical Industry Development Plan. When considering that, at present, environmental pollution caused by industrial wastewater effluent is starting to become evident, mainly in the industrial zones of urban districts, it is easy to predict that the environmental load will increase more due to the maturing of industry.

The main countermeasure taken currently against such a tendency is the relocation of the pollutant source factories to the suburbs. This measure is quite effective against pollution when the damage is limited to the surrounding area of the factories, i.e. noise, vibration and offensive odors, and also, is effective when the generated volume of pollutants is small. This is because the concentration of pollutants is expected to decrease accordingly, due to dispersion.

However, because more industrial facilities will relocate to the same site, the generated volume of pollutants in the region will increase, and the advantages gained by the relocation of factories will gradually decrease. In the end, pollutants will be dispersed in the entire region and average concentrations will increase until they rise to a point that brings about pollution.

Therefore, considering that industries that cause large environmental loads will multiply many times over in the coming decade, it is feared that, if current policies in effect are left unchanged, industrial pollution will become more serious. Vietnam will be faced with such problems as a decrease in general environmental quality, adversely impacted agriculture and fishery industries, etc., as well as conditions that cause damage to human health.

The purpose behind the conservation of a good environment is provided for as follows in the Environment Basic Law: “The environment has an important relation particularly to the survival of human beings and living things, as well as for the development of nations, races, economics, society and culture. The environment has and will protect people’s health, protect our right to live in a clean environment, contribute to the endless development of nations and contribute to the protection of the regional and global environment.” Therefore, it is not reasonable that, even if industries are well developed, the people’s living standard decrease due to worsened environmental quality.

However, in comparison with other neighboring countries, GDP per capita in Vietnam is about 1/8 of Thailand and about 1/14 of Malaysia. Because of this situation, there is no doubt that further development of industries is also needed in order for the Vietnamese people to realize a comfortable lifestyle.

If emphasis is placed on the maintenance of the environment and only the regulation system is reinforced, under the present conditions of a lack of sufficient capital in enterprises and a low rate of return on investments, factories will be unable to endure the cost burden for preventing pollution and will have to shut down their operations.

At this point he concept of sustainable development is necessary. That is to say, we should not insist on choosing one over the other, either industrial development or preserving environment, but we should look instead for a way where improvement of environmental quality and industrial development can coexist.

A basic policy should be set here for promoting industrial development, and at the same time, continuing to improve the quality of the environment in Vietnam.

5.1.2 Specific objectives

Compliance with environmental standards should be set as a concrete target for now, and compliance with wastewater standards should be set as the ultimate, final target.

For setting specific objectives, we should consider separately human health related items and items that are related to the living environment. Human health related items include heavy metals, such as mercury and chromium, as well as substances that may directly damage human health, such as organochlorine compounds.

Because, during the survey, cases were found where lead, copper, cyanogens, manganese, and cadmium surpassed standards, measures need to be implemented to reduce these metal concentrations in order to satisfy the standards as soon as possible. Because it is assumed that these pollutants are coming from industrial wastewater, it is necessary to get a grasp of the factories that discharge these pollutants, and then implement measures in them.

Items related to living environment are rarely harmful for human health. Because industrial, agricultural and fishery wastewater are the cause of living environmental items, improvement needs to be made on all of these sources comprehensively, or no effects on the environment will be observed. As for over-populated areas, there is a high possibility that a healthy environment cannot be attained by regulating just the pollutant concentration levels, and therefore, the necessity of further review of the adoption of land use regulations, or total emission control regulation will probably rise in the future.

According to Vietnam's NEA, the BOD load being generated at the 5 industrial complexes in the Hanoi District is 9.5 tons per day (the load from households is estimated at 150 tons).

Industrial production in Hanoi was 8.315 trillion VND in 1998,which is equivalent to about 590 million US dollars. This means that industrial production per 1 ton of BOD was 52 million dollars. When comparing this data with data from the Nagoya Industrial Zone in Japan, which has a total COD volume of 82 tons (BOD is 41 tons using the conversion rate of BOD = 1/2 COD) contained in the industrial waste influent, a population of 10,898,000 and a total industrial output of 48,225 billion Yen, it is revealed that BOD in Hanoi City is smaller, but emission per industrial output is close to 180 times that of the Nagoya Industrial Zone.

Sewerage systems have not been satisfactorily constructed, so the load from household effluent is a direct load to the environment. For this reason, in spite of the fact that the industrial production level is low, the degree of pollution associated with items related to the living environment is higher. Thus, as for the items relating living environment, the ultimate object should be set as satisfying environmental standard through implementing the synthetic countermeasures that includes measures for household wastewater adding to the short term measures for factories to satisfy wastewater standards as an industrial pollution prevention measures especially around big cities.

5.1.3 Prerequisites for the Master Plan

(1) Urgent Sufficient Environmental Pollution Improvement

Some water areas do not satisfy the environmental standards in both human health related items and living environment items, which have been observed as being at the most, ten times over that of the standard value. Moreover, it is evident that water quality in these areas is getting worse year by year.

Heavy metal concentrations, such as lead in some canals, have reached a dangerous level where serious damage can be caused to human health. Thus, for policy execution, the most polluted items need to be given the highest priority for implementation. Also, when comparing this kind of items to items that are not seriously polluted, it is much easier to bring about improvement results from countermeasures for seriously polluted items.

(2) Effects of Speed

If a measure can effectively improve the environment directly, and also can be carried out very speedily, then the measure should be implemented as soon as possible. This kind of countermeasure should be given a high priority because of its cost effect. Concerning the term “cost effect,” the cost should be considered to include costs that occur not only during the time of countermeasure implementation, but also should include costs that occurred over the time the measure was being coordinated throughout the industry up until the time the measure is actually carried out.

(3) Difficulty of Achievement

Even if the implementation of a measure is considered to be urgent and little time is required to actually see positive results, the measure is of no use if it is not practical and cannot actually be implemented.

Therefore, if the possibility for implementation is higher, a measure should be given higher priority.

It is important to conduct investigations for the government side, by promoting countermeasures, and the enterprise side, by grasping data on discharged pollutants. Because there are different types of countermeasures, for example, a preferential tax system that increases the load on the government side, but does not cause a burden on enterprises, and on the other hand, a measure that introduces and provides for pollution prevention managers places a burden on enterprises, but does not increase the burden on the government, an evaluation of countermeasures needs to be made taking all factors into consideration for implementation.

(4) Previous Results

Countermeasures that have already been implemented more than once by the Vietnam government should be given higher priority because they have existing knowledge on the measures and understand that the measures support their policies. On the other hand, measures such as integration and concentration of equipment intensive industry are not in line with the Vietnam government's local industrialization policy should be evaluated and given low priority.

(5) Comprehensive Evaluation

The Survey Team evaluated countermeasures by taking the previously stated factors into consideration, and studied priority for implementation.(See Table 5.3)

5.2 Proposals for the Master Plan

5.2.1 Industrial Pollution Prevention Priorities

(1) Environmental Regulation Scheme

Introduction of pollutant load control method, which focuses on strengthening the monitoring system and minimizing subject especially polluted water areas, is highly recommended for improving regulations. Because environmental pollution in Vietnam is spreading rapidly, and there are some limitations for utilizing manpower and financing, grasping accurate pollution conditions and focusing measures on factories that are causing serious pollution will be more effective. There are two ways to strengthen the monitoring system, one is an indirect method that respects enterprise self-management ability, and the other method stresses that the administration itself conducts monitoring. Between two methods, the promotion of both production and environmental improvements based on a system that respects an enterprise's self-management ability is appropriate. A system, which includes the allocation of a manager for dealing with pollution prevention, calculating the total emission of pollutants, autonomous measurement, and self-management for productivity will be established by promoting the acquisition of ISO 14000 and 9000 series certification. In addition to this, the introduction of an incentive system for employees for development of autonomous improvement will become more effective.

(2) Industry Support System

The government cost burden is comparatively light for the development of environmental pollution control managers, who will become a pillar for executing autonomous environmental measures in enterprises, and for technological guidance, which can be expected to be effective in a relatively short period of time. These measures, along with the promotion of information exchange, should be given high priority.

Following these measures, measures that have strong effects, but place a heavy cost burden on the government, such as a long-term low interest rate loan system and installation of common wastewater facilities, should be given priority. After these, importance should be placed on enlarging environmental engineering courses in universities. In addition, priority should be given to constructing a cooperative structure for inter-governmental administration that requires no additional cost burden and is easy to implement.

Following these in order, the training of environmental engineers and environment technology consultants, a preferential tax system, which places a large burden on the government, the integration of equipment intensive industries, which will require a long period of time to implement, promotion of acquisition of ISO series certification, development of the pollution prevention equipment industry, and an incentive system for employees, should be given priority.

If it doesn't require any costs and is easy to implement, a commendation system could also be given high priority, even though this measure does not have a direct effect on improving the environment.

5.2.2 Details of the Master Plan

Table 5.1 shows the details of the proposals.

TABLE 5.1 Proposed Measures against Industrial Pollution

1.Environmental Regulation Side	Current Situation	Problems	Proposal Content	Consideration
Amemdment of Environmental Standards	Pollutants have been itemized.	There is little conformity with waste water standards. Compared to wastewater standards, environmental standards are not so severe.	It is estimated that a pollution level of approximately one tenth of the waste water standard should be appropriate for Environmental standard. As for the BOD values, the objective of the first stage should be 10ppm, which will not make the human body uncomfortable, and at the second stage it should be targeted at 5ppm, which will not damage the development of fish and shellfish.	
Determination of the Subject Water Areas and Pollutants for the Total Emission Control Method	Only the concentration levels of the pollutants, and not the quantity, has been under regulation.	Production management is not being carried out, nor is the concentration and volume of waste water measured.	Select a polluted river with toxic materials that are harmful to humans and is beyond the environmental standards. Then calculate the total amount of waste discharged from the factories along the river. Then, allocate the total amount of waste that each factory is allowed to discharge. With regard to COD, after the selection of an influential river, follow the same procedure as above.	Examine the total emission control method as a long term measure, and after the measurement is completely done, examine a system of trading emission allotment
Strengthening of Environmental Monitoring	The frequency of monitoring is less than once a year.	The results of infrequent monitoring may not reflect the actuality because seasonal and circadian fluctuation of pollutant amount is big.	To increase the frequency and the number of points for measurement in the polluted river for materials that are exceeding environmental standards.	
Introduction of a Qualified Analyzing Technician System	The value of BOD can vary among measuring organizations by as much as ten times.	The kind of bacteria has not been standardized for measuring BOD.	To license those who pass MOSTE skills and technical qualifications. As the number of qualified experts increases, qualified experts will be obligated to measure data for official use. Qualification will be awarded to those who complete the course by the designated authorities with a considerably good mark.	
Introduction of a Qualified Pollution Control Officer System	There are no employees qualified to supervise the amount of pollutants discharged from the enterprises.	Absence of responsible employees for environmental management within the enterprises makes it difficult to accurately grasp environmental pollution.	To obligate enterprises with over 300 employees, which is estimated to cover about 90% of the total amount of polluted substances, to allocate experts responsible for grasping and managing polluted materials and development of countermeasures. At the same time,the experts are recommended to play a part in guidance for improvement in productivity.	
Strengthening the Penalties for Pollution Violations	Penalties costs less than implementing countermeasures.	The level of the regulation standard is set higher than the operating level of pervading firms. In the circumstance that some firms implement the measures and others do not, the former have disadvantages over the latter in competitiveness.	To set more realistic environmental standards which the enterprises can comply with, such as the introduction of the total emission control method, and at the same time to strengthen the penalties that do not cause unfairness among the enterprises in terms of competitiveness.	
Public Disclosure and Promotion of Participation	Enterprises are not obligated to disclose information to the public.	It is difficult to grasp the current situation of environmental pollution because the monitoring system has not been established.	An annual announcement of the type, concentration levels and volume of the pollutants discharged from the firms, promotes the local residents participation as supervisors, so that the enterprises feel pressure to make efforts to reduce the pollutants.	If possible, agreement between residents and enterprises should be made.
Registration of Firms Handling Toxic Materials	There is no registration system.	It is unknown which firms handle toxic materials.	Submission of a report on the volume of consumed heavy metals that includes total quantity. This will serve as a measure against pollution in advance.	

2.Enterprises Assistance Side	Current Situation	Problems	Proposal Content	Consideration
A. Human Resource Development				
Environmental Analyzing Experts	No system for the development of experts exists.	There are few training opportunities for analyzing technology on the job. Data varies among analyzing organizations who adjust independently type of the bacteria used for experiments.	It is necessary to develop approximately 600 experts under the assumption that one-day measurements will be made in 10% of 630,000 total enterprises twice a year. There is a need to develop approximately 100 experts a year for 5 years.	To make use of existent analytical organizations, such as CECO or CETTIA as training facilities.
Pollution Control Officer	No system for the development of officers exists.	No appropriate training organizations for environmental managers in enterprises.	Approximately 3000 enterprises will be selected if the target is enterprises with approximately 300 employees. Assuming that training of environmental management together with improvement in productivity takes about a month and it is held three times a year, then it will take 10 years to train the PCO needed.	To make use of the research institutes belonging to MOI by the command of Industrial Energy and Environmental Office.
Environmental Technology Consultant	No system for development of consultants exists.	Lack of consultants who have the ability to consult on technology for measures, cost of facilities or cost burden.	Less than 100 consultants are needed for conducting consulting services at 3000 enterprises a year, assuming that consulting services are to be conducted at three enterprises a month. It is necessary to develop approximately 20 consultants, together with PCO, a year.	The same as above
B. Technical Guidance	No system to meet the demand of technical guidance from the enterprises exists.	Existence of many non-functioning facilities because of a lack of operating skills even if facilities have already been established.	To assemble human resources who are capable of guidance in the research institutes under MOI in cooperation with senior experts from overseas. Approximately 120 experts need to be developed under the assumption of conducting guidance at 50 enterprises a year, for the target of 6000 enterprises. Under the assumption that it takes 5 years to complete the training of the experts needed, then 24 experts need to be developed a year.	To train guidance experts of guidance through the use of a technical cooperation system under the command of Industrial Energy and Environmental Office of MOI.
C. Assistance for Investment in Pollution Prevention				
Long-term low interest rate financing system	No official system of financing for the enterprises.	Lack of financial organizations to implement financing mainly to the enterprises. Difficulty to provide assets as security.	To promote the establishment of a security system and request funds,such as TSL, from foreign donors.	Under the command of Industrial Energy and Environmental Office within MOI, request the cooperation of influential foreign donors and promote the establishment of a security system regarding domestic land use.
A Preferential Tax Treatment System	No preferential tax treatment system exists exclusively for pollution prevention exists.	Tendency not to invest in End Of Pipe due to the increases in cost that leads to tight management situation.	To promote the introduction of a preferential tax treatment system, such as land tax, in cooperation with MOF.	
Official Commendation System	No official commendation system exclusively for environmental management exists.		To commend enterprises or machine makers who make achievements regarding pollution prevention countermeasures or pollution prevention equipment.	Possible to stimulate the enterprises to promote countermeasures effectively due to the small amount of cost needed for implementation.
D. Introduction of Joint Waste Water Treatment Facilities in Industrial Zones	No industrial zones with joint waste water treatment facilities.		To get industrial associations and influential enterprises to summarize the specifications of treatment facilities and to promote the system under the MOI support structure.	Different specifications of joint waste water treatment facilities are adopted according to treatment capabilities, or the kinds of polluted materials.
E. Promotion of Information Exchange	Little chance for exchanging information on technology within the industry.	A wide variety in the original unit of consumption in the manufacturing of the same kind of products and no improvement in consumption of raw materials.	MOI creates opportunities for information exchange with regards to the original unit of consumption and technology for environmental conservation until each industry reaches a point where they voluntarily exchange information.	

3. Other Activities	Current Situation	Problems	Proposal Content	Consideration
A. Integration of Equipment Intensive Industries	Equipment intensive industries are of small scale and scattered to various area	That the industries are of small scale and consequently are less competitive is one of factors that makes it difficult to implement environmental measures.	To promote the non-equipment intensive industries in regions and to guide industries through the provision of a preferential taxation to the factories above a certain level of scale with regard to equipment intensive industries.	It is necessary to locate industry in regions from the viewpoint of ensuring employment
B. Promotion of ISO 14000 and 9000	Few enterprises possess ISO standard.	It is difficult to acquire ISO certification without thorough production management, and there is a possibility of being shut out of international market in the future without ISO.	To develop pollution control manager and productivity improvement manager and to hold seminars on information on technology often. For the Environmental Office to consider the establishment of a training center concerning the environment and productivity in cooperation with foreign donors.	Most effective to pursue for measures for environment and improvement in productivity, that is, for cleaner production that enables to grasp .
C. Development of the pollution prevention equipment industry	Only a small number of inexpensive, easy to operate, high performance pollution prevention equipment.	Difficult to manufacture machines effectively due to little accumulation of technology in the equipment industry.	To apply the preferential tax treatment system, not only to the industry that is the direct user of equipment, but also to the pollution prevention equipment industry.	
D. Improvement of environmental engineering courses at universities	No courses specialized in environmental engineering.	Lack of skilled engineers who have the capability of evaluating every process of production and technicians with sufficient knowledge who can aim for the integration of pollution prevention and improvement in productivity.	To improve environmental engineering courses in which environment and production are integrated.	
E. Establishment of an incentive system in the state owned enterprises	No reward system for good achievement.	Existence of inactive supervisors who have detailed knowledge on the production site and have the ability to propose improvements. Because their activities do not affect their pay level, which is disadvantageous to the enterprise.	To introduce a system in which a certain portion of profits are allocated to those who propose the scheme or implement it in the case that the proposal results in an improvement in productivity.	
F. Promoteion of interministerial cooperation	No alliance among administrative agencies with regards to regulation and assistance.	Even if assistance measures and realistic regulation approach are made, but they might be inconsistent without interministerial coordination.	To create opportunities for exchanging information among administrative agencies on regulation and assistance measures.	

5.3 Specific measures to be taken by the government

Concrete countermeasures are discussed generally in the following paragraphs. For regulations, policies that can reduce the cost burden of measures, and pollution prevention measures that focus on the Total Emission Control method, a method that is effective for environmental improvement within a short period of time, should be given higher priority. For guidance, improving management technology, mainly concentrating on production and production quality, should be given the highest priority. These measures can be implemented even if an enterprise lacks adequate financial resources and profits. Moreover, enterprises can work out adequate strategies, such as the introduction or refurbishment of appropriate equipment, by grasping the material balance of production processes clearly through the use of these activities. It is hoped that a system, which includes measures such as promoting the development of pollution prevention managers, conducting technical guidance in enterprises, and one that will encourage employees in the future to voluntarily take action for improving productivity, is carried out.

Secondly, a system where technical guidance can be provided for Cleaner Production technology that requires only a small investment is necessary. Even if machinery is old, Cleaner Production can be carried out, (i.e. in the paper and pulp industry, by changing the size of chips utilized, caustic soda can be sprayed equally in order to increase the production ratio and eliminate sticky compounds for prevention of paper break) and it is possible to bring about increased effects.

Technology guidance and information exchange will be the keys for this system. As a concrete example, a Quality Improvement Technology Center (QITC) should be set up, and an organization that can provide technical guidance to enterprises, and engineers who have experience working overseas in the area of technology, should be utilized. As a method for exchanging technological information, the establishment of a Technology Association should be promoted.

5.3.1 Environmental Regulation Scheme

The roles of the related administrative bodies for each countermeasure that needs to be implemented are as follow:

(1) Enactment, reform and abolition of regulations

The role of MOSTE

Wastewater standards, provided by law and currently in use, in Vietnam are appropriate, however, environmental standards are lenient compared to the standards in other countries. Therefore, in the case wastewater is discharged into rivers the dilution rate should be increased by 10 times, and the environmental standard value should be revised and targeted to be set at 1/10 of the value of the figure that is currently used. BOD and COD values, which already excessively exceed 1/10 of the wastewater standard values, should be temporarily set at a target value of 1/5 of the current standard, and then later, through revision and reform, appropriate environmental standards need to be established. Because new pollutants will be generated according to the conditions of industrial development, MOSTE should add pollutant standards for these new items, step by step, as needed. For instance, there are no standards for organochlorine compounds such as tetrachloroethylen and trichloroethylene that are already being utilized as cleaners.

(2) Setting Target reduction amounts for selected pollutants in the main water system

Determining if wastewater is harmful to human health, or whether or not restrictions should be made against utilizing water for industrial or agriculture use, is dependent on the existence of environmental standards in public water areas where industrial wastewater is discharged. If wastewater that does not satisfy wastewater standards is discharged to public water areas which have a large volume of water, there is a possibility that hardly any pollution will occur. For this reason, considering the reality that most of the enterprises have technical difficulties and lack financial resources to implement measures, controlling the volume of emissions to a point which satisfies environmental standards should be set as a temporary target. This measure should be carried out using the following steps.

・The role of MOSTE

① First of all, MOI should set BOD and COD concentration values of household wastewater objectively. Then, select a water system where the environmental standards are being exceeded, and also where it is necessary to control the amount of discharged pollutants. Regarding items harmful to human health, lead and cyanide are considered to be the most dangerous pollutants at present.

② Secondly, MOI should estimate the amount of selected pollutants that must be reduced in the water system. In this case, seasonal differences and an allowance for future increases in the regulation should be taken into account.

(A subjective water area should be estimated slightly smaller than actual size, and the decomposition rate should be taken into consideration when estimating the discharged amount of chemicals, such as cyanogen, that have a high decomposition and reaction rate in the environment. The reduction method is almost the opposite for pollutants that don't decompose, like a lead. It is important to remember that each pollutant has different vectors to compromise control.)

・The role of MOI, the Ministry that is Responsible for Overseeing Enterprise Production

① MOI should investigate factories in subjective water areas, and estimate the yearly total discharge of selected pollutants. In order to make this estimation, pollution prevention managers in enterprises need to be instructed on how to prepare unit consumption charts and material balance sheets. If actual measurement data exists, verify the data and calculate it as accurately as possible. As a matter of course, data must be compared and verified with different factories on total discharge amount of polluted substances per unit of production.

② MOI should allocate the amount of pollutant that must be reduced to each factory. In this case, if the allocated amount is too large for a factory, estimate the amount of discharged pollutants coming from household sources nearby the factory. Then the amount that needs to be corrected can be decided after consultation with the regulating government agency.

③ MOI should also implement enterprise support measures such as supplying financing and technological support in order to make the reduction of the amount of allocated pollutants for each factory possible. Allow each factory to transfer the allocated amount to other factories, and if needed, the Ministry of Industry should act as an intermediary or assist in the adjustment process.

(3) Reinforce the monitoring system

・ The role of MOSTE

MOSTE should substantiate the office that conducts environmental measurements and motivate the people in charge of measurement in the office, or in the enterprise, to improve their skills by providing training and awarding certifications.

(4) Training Pollution Prevention Managers

・The role of MOI

It is crucial to assign managers who have the ability to calculate the discharged amount of pollutants, and plan for the education and training of people among existing employees in enterprises of a certain scale (about more than 300 employees).

It would be desirable if MOI plans a system where this manager improves productivity using material balance sheets and unit consumption charts.

(5) Additional penalties for polluting enterprises

・The role of MOSTE

MOSTE should change the values of the standards temporarily to more realistic figures, and at the same time, demand that enterprises comply with these new standards. At present there are some enterprises that have difficulty complying with wastewater standards because of technological or financial reasons. Thus, there seems to be an attitude where enterprises don't care if they don't satisfy standards. Because of this, enterprises that are complying with regulations are at a disadvantage in the market because of increased costs.

If additional, harsher penalties are implemented, it will help strengthen compliance with standards by enterprises. For example, DOSTE in HCM City has made out a "Black Book" in which the worst environmental polluting source companies in the City are recorded. The companies listed in this "Black Book" have been pressured and strongly requested to modify their waste treatment systems, to relocate their factories from the central area, to shut down operations, and so on. However, these kinds of actions are more effective against those enterprises that have the capability to take measures, but fail to do so.

(6) Participation of local residents

・The role of local governments and MOSTE

MOSTE should support the participation of local residents in environmental preservation in order to make it easier for local residents to get information on the environment.

Residents easily can determine if enterprises are violating regulations because they are concerned about their local environment and are able to easily observe enterprise production activities.

Local citizens are expected to fulfill the role of a low cost, deputized regulatory body.

If there are problems or lawsuits between residents and enterprises, or they may appear in the future, a Voluntary Agreement for necessary pollution prevention measures should be concluded between the parties and enterprises should be given responsibility for the problems.

This can help provide measures that are tailored to the uniqueness of given areas and serves to re-assure local residents. MOSTE and local governments should promote and guide enterprises in signing Voluntary Agreements in order to prevent pollution problems and to solve troubles between residents and enterprises.

(7) A registration system for enterprises that use toxic substances

・The role of MOSTE and MOI

Enterprises are not exceeding the environmental standards for heavy metals, except for lead, because their consumption amount of these substances is not so large. However, in order to prevent pollution that might occur in the future, it is necessary for MOI to introduce a registration system where the name of enterprise and their consumption amount of heavy metals is reported to MOI at fixed intervals. The system should include a measure that calls for MOI to submit a list of enterprises using heavy metals to MOSTE, so that MOSTE can use the report for monitoring purposes.

5.3.2 Enterprise Support Measures

Enterprises support measures should be generally carried out by MOI, the ministry in charge of enterprise production management.

(1) Human Resource Training

① Training of productivity and quality improvement technicians.

・The role of MOI

The establishment of a pollution prevention manager is necessary for managing pollution prevention related to the discharge of pollutants. However, there are many enterprises that have difficulties carrying out pollution prevention measures from a profit standpoint.

Thus, MOI should promote not only environmental technology, but also the use of Cleaner Production methods that can improve the profit rate of enterprise by reducing costs and improving production quality, and also take into consideration enterprises production, are simple ways of investing in the environment.

In small and mid-size enterprises, it is realistic to put pollution prevention managers in charge of productivity and quality improvement.

② Support the training of quality improvement consultants

・The role of MOI

When enterprises make plans for pollution prevention, it is necessary to utilize consultants that have the ability to propose the best ways to apply technology, determine equipment costs, and handle cost estimation. It is necessary for MOI to utilize national university courses and establish a technical training center for consultant training.

(2) Technical instruction

The role of MOI

There are some factories that have installed activated sludge process equipment. However, because acid adjustment is insufficient, bacteria die and this equipment is not functioning properly as a pollution prevention measure. This is a good example of a situation where equipment has been installed, but technology for operating the equipment is not sufficient, and these kinds of factories are observed a lot in Vietnam. Therefore MOI should support developing a system where technical instruction can be given directly at the factory site. For the time being, a public organization that has the necessary technology should provide guidance, and when private consultants are trained and qualified in the future, the public system should be downsized so that the enterprises can fully utilize private schemes.

Through a joint effort of donor countries, a system should be created at a low cost that employs retired technicians that used to work overseas, or the owners of small and medium scale enterprises, and these personnel should be sent to Vietnam as instructors.

(3) Support for enterprises investing in pollution prevention

For pollution prevention, in general, it is necessary to manage capital funds and costs except for some methods of Cleaner Production. There are no support schemes for enterprises and therefore, there are many cases where it is difficult to implement countermeasures.

① Create a financing system at a long-term low interest rate

・The role of MOF and MPI

DOSTE in HCMC was provided with and disbursed, a one million dollar “Environmental Fund” from a foreign support source. The lending method they utilized to disburse the funds proved that providing funds like this in small sum, interest free loans can improve the execution rate of pollution prevention investment. At present, a financing system with long-term low interest rates, especially designed for investment in the environment, is in place in some limited municipalities, including HCM City, but in general such financing is not available. Furthermore, because the collateral system is inefficient for private companies, it is really hard for them to borrow equipment capital, as well as operating capital, from banks. Even if it is possible to procure funding, the conditions of loans are really unfavorable because actual interest rate reaches 6% when taking into account that the interest rate is 13 %, and the inflation rate is around 7 %. For this reason, the Vietnamese government has indicated their intention toward establishing an “Environment Fund” only for use in environmental improvements. However, they have not received support for this from foreign donors. As was mentioned earlier, only HCMC has been the recipient of foreign support in this area, and they received a one million dollar “Environment Fund” from ADB (Asian Development Bank), and this fund has been showing satisfactory results. The possibility of introducing a two-step-loan (TSL) system with international cooperation should be reviewed and discussed.

In Vietnam, there are now 15 support projects for Cleaner Production. However, these projects have all been limited to the level of administrative organizational and/or pilot projects, and no cases exist where the government finances funds directly for the companies and the companies use these funds to invest in facilities for Cleaner Production (under the instructions of experts).

With yen credit, the Philippines, Indonesia and other counties have started to give financial support to private, pollution generating factories taking advantage of a TSL scheme. This scheme stipulates a condition that enterprises are obligated to receive instructions from experts on environmental pollution prevention technologies when the loan is arranged. Taking into account that financial system and SOE and SME reform is already under way in Vietnam as one of the “three important policies,” Cleaner Production should be initiated to produce good results following these ambitious objectives. Also, a supplementary credit system, provided by MOF, that makes up for shortages in security should be introduced because the current system, where land titles are used for security, is not functioning well for small and mid sized private enterprises.

② Reduction and exemption from taxes

・The role of MOI and MOF

There is some preferential treatment given on corporate tax, land tax and value added tax. For example, preferential treatment is given for investment in poverty areas, acquisition of foreign exchange, and promoting high technology industries, but in general, there is no preferential treatment for investment in pollution prevention generally at present.

Except in the case of Cleaner Production, when enterprises try to invest in pollution prevention they usually face management difficulties because of added costs. Therefore, taking into account that investment for pollution prevention is more difficult than other usual investments where a return in profits can be expected, preferential treatment for the land tax, etc. should be introduced by MOI and MOF, especially for the environmental field.

③ Award system

・The role of MOI

MOI should establish an Award system to enterprises (both manufacturers and suppliers of the pollution prevention equipment), individuals and groups, which have contributed to pollution prevention should be awarded for their efforts as an incentive measure.

On one hand, this system hardly requires any governmental funding, and on the other hand, it is extremely efficient in terms of cost, and may serve to persuade enterprises that are debating if measures should be implemented or not, to proceed with implementation.

④ Foreign and domestic financial support

It is realistic and effective to implement both soft and hard measures for pollution prevention. In order to do this, current, basic economical reformation policies should be maintained, experts should be dispatched, joint pollution prevention equipment needs to be implemented by sectors and financial support needs to be provided by financial organizations (i.e.a TSL scheme which requires the acceptance of financial and environmental experts) through foreign support for technology, no interest loans and soft loans.

In other words, the order of investment for policies should be ①first of all, measures for central and regional financial funds, ② consideration for measures using funds from domestic financial markets and ③ seeking financial support from abroad. For ③, priority should be given first for ③-1, planning for FDI promotion measures from private donors abroad, and for ③-2, seeking ODA. For ODA, first choose a T/A scheme, which do not require repayment, and grants, and as a last option, loans should be chosen that have to be re-paid, but are easy to obtain. However, the ultimate selection should be made depending on the scale or character of the project. (See Table 5.2)

Table 5.2 Foreign and Domestic Financial Support

Finance ◄──► Prioritization

1 Domestic Finance

(1) Budget…Central /Local…Tax Reform
Tax Collection System Reform

(2) Private Finance …Banking Reform/SOEs Reform

2 Foreign Finance…Bi/Multi1、Co-Finance

(1) ODA…1) T/A…Technology、Capacity Building etc.
2)Grant…Facilities、BP Support
3)Loan…Interest、Repayment、Debt Issues

(2) Private Finance
1) FDI…Incentives、Promotion Policies
2) Banking…Condition、Deposit、Lending、Debt Issues

For donors, a prerequisite feasibility study for the confirmation of each project will be required in the case that the Vietnamese side asks for financial support from the domestic and foreign financial sources stated above.

5.3.3 Other Activities for Industrial Pollution Prevention

(1) Centralization and integration of industries

・The role of MOI

As for the paper and pulp industry, CP technology is already established. Black liquor is concentrated and re-used as an energy source, and at the same time, chemicals, such as caustic soda, are collected and reused, and pollution prevention and cost reductions are being realized. However, in order to implement this method, a large equipment investment, equivalent to that of building a new factory, is necessary, and small size factories will have difficulties adopting it. As for equipment-intensive industries, the production output per factory should be expanded to an international level to save production costs for the purpose of raising the international competitiveness of these industries and to give them the financial strength they need to be able to invest in the environment. MOI should promote centralization and integration of equipment-intensive industries such as the paper and pulp industry or the chemical industry in order to support this proposal. If surplus human resources become available through centralization and integration, measures for allocating such human resources to new industries should be started in parallel.

In remote, local areas where people do not enjoy the benevolent influence of industrialization, the industries well matched with local characteristics should be developed and other industries, such as tourism services, may be promoted in some cases for the purpose of correcting local differences. With regard to equipment-intensive industries, the practice of dispersing them throughout the nation is not advisable.

The small scale production industry is not a type of equipment intensive industry, but has a large cost burden for wastewater treatment facilities (i.e. the metal works industry), however, two methods:

Method A, where wastewater processing equipment is owned jointly in order to decrease the cost load, and method B, where a specified, strong enterprises is chosen for development, and where other factories can place production orders, is an effective method especially, in small scale enterprises in industries such as plating.

Manufacturing processes should be converted to modern one's instead of using out-dated production methods that are less competitive internationally.

At the same time, integration of equipment intensive industries should be promoted.

Factories that have lost international competitiveness because of disadvantageous geographical locations and/or changes in the procurement conditions of raw materials should be encouraged to relocate their factories.

Countermeasures such as rehiring employees, providing long-term low interest rate loans, tax reductions and selection of an advantageous factory location should be adopted for the sharing of selected, large-scale equipment.

As for other kinds of encouragement for the centralization and integration of large scale facilities of a certain scale or greater, measures should be taken such as providing financing with long-term low interest rates, applying a reduction of and exemption from taxes, providing favorable factory sites and re-hiring once laid-off employees.

(2) Creation of common treatment facilities in industrial zones for small and medium scale enterprises

• The role of MOI and DOI

MOI and DOI should install a common treatment facility for the dyeing or plating industry for small and medium scale enterprises including at existing industrial complexes in the same business line. The purpose of this measure is to operate the treatment facility commonly, at as low cost as possible. The possibility of adopting TSL needs to be reviewed for the creation of this industrial complex.

Two good side effects will be generated from this measure. It will improve the exchange of technologies between enterprises and opportunities for recycling are also expected to increase because of easy customer access.

(3) Development of the pollution prevention equipment industry

・The roles of MOI and MOF

MOI and MOF should support development of cost effective, high performance pollution prevention equipment by private companies through low interest rate financing and tax preferences, as well as a commitment to purchase the initial domestic demand amount of the equipment should be made by the government.

(4) Promoting ISO9000 series Quality Management, and ISO 14000 series Environmental Management

・The roles of MOI and MOSTE

MOI and MOSTE should encourage the promotion and introduction of ISO 14000 in factories needs to be carried out. ISO 9000, which deals with quality management at the same time in Viet Nam because increased profits due to production quality improvement can be expected.

Currently, in Vietnam, foreign organizations are relied on for examination registration for ISO series certification, and in addition, consultants from overseas are requested to assist in helping enterprises obtain ISO series certification. However, it is preferable that the development of domestic judging and registration organizations, as well as consultants, be carried out in order to promote ISO series acquisition in earnest.

Acquiring ISO 14000 series certification and allocating pollution prevention managers in enterprises have the same basic, purpose, and are alike in terms that they both start with implementing enterprise management system improvement. Acquisition of ISO 14000 certification is not compulsory, but is carried out voluntarily by the free will of enterprises. Thus, if the circumstance arises where the acquisition of ISO 14000 certification does not gain widespread popularity, in order to force enterprises to manage pollution prevention measures, it is necessary, mainly at big companies that have enough power to burden costs, or in industries that cause serious pollution, to enforce compliance with the introduction of the pollution prevention manager system.

(5) Guidance on establishing technology exchange organizations by industries

・The role of MOI

MOI should establish and provide a place for exchanging technological information within the industry because there are large differences in unit consumption of raw materials between enterprises. By collecting and exchanging information on raw material unit consumption values and highest values, the industry will be stimulated, and countermeasure will lead to the promotion of autonomous improvement activities and suggest improvement targets to low level enterprises.

(6) Promote the expansion of environmental engineering courses at higher education institutions

・The roles of MOI and MOE

MOI and MOE should expand courses on environmental improvement and productivity improvement in order to develop high-level technicians.

(7) Establish incentive systems at state owned enterprises

・The role of MOI

It is hard to develop and promote autonomous activities for quality control and the like for employees because, even if an enterprise's profits increase, it has no direct connection to their paychecks. Therefore, MOI should establish an incentive system, that is if costs decrease and profits increase because of autonomous employee activities where they use their own ideas, a certain % of the profit will be returned to the employees who implemented the activities as an incentive to promote autonomous activities for increasing profits.

This system improves profits because it is carried out only if the profit situation improves, and no cost is incurred by executing enterprises.

(8) Work in closer mutual cooperation between responsible administrative offices

Construct a cooperative structure between inter-governmental administrative offices in order to implement countermeasures, such as enforcing realistic regulations, creating support systems for enterprises under varied operating conditions, create both household and industrial wastewater treatment procedures that suit the environment, implement Cleaner Production and secure the funds required for it. These measures require cooperation between such offices.

5.4 Specific measures to be taken by other organizations, Especially Enterprises

(1) Improve Environmental and Production Management

Increasing the effective utilization rate of raw materials, or the amount of materials, leads to a decrease in the volume of wastewater and pollutant concentrations in wastes. Also, for the time being, it conserves the required raw material amount and reduces production costs.

Therefore, enterprises should put efforts into improving the effective utilization rate of raw materials at all times. In order to do so, operation records, such as how much raw materials were received, the transformation rate of raw materials, and the amount of material loss in wastewater, should be recorded and a material balance sheet should be made. Moreover, employees must be helped to understand that materials in wastewater are not just pollutants, but that more profits can be made if that material is reused for production. Operation records should be used for evaluating the change of yield rates of raw materials over a certain period of time, and reasons for decreases and increases should be analyzed. In the case a yield rate decreases, countermeasures for new leakage from production lines, or for the deteriorated quality of raw materials, should be prepared. In the case the rate improves, the primary factors for this improvement should be recorded and maintained. In addition, all employees should be made to understand the fact that management measures do not require a great deal of time, but that they are necessary for improvement.

(2) Acquisition of ISO 14000/9000

Enterprises that have acquired ISO 14000 or 9000 certification have to autonomously establish and implement steps for daily production management and improvement of environmental management. This might seems like a lot of work and quite a troublesome job. Thus, if they try to acquire ISO 14000 or 9000 only for measures such as export promotion, or to polish up their image to the public, the establishment of procedures and record making will only be implemented superficially, and cost burdens will increase because of the increase in related work. However, it is very important to grasp the flow of the series of processes, starting with implementing procedures, record keeping and evaluation, and then after results have been obtained from these initial steps, action planning, execution, and evaluation should be carried out. The flow of this work should be connected to development in order to realize more rational procedures for environmental and production management. If this is carried out, an improvement process for increasing profits will be established naturally. Therefore, acquisition of ISO 14000 and 9000 shouldn't be carried out strictly by the book, but should be implemented as a means to make substantial improvements.

(3) Autonomous daily improvement activities by employees

Employees who work on a production line know what kind of and how much unnecessary work exists in the line. Not all line managers know about irrational production processes. Thus, employees should be encouraged to grasp their company's level of unit consumption of raw materials and utilities, and to compare them to domestic or international levels. In addition, they should be encouraged to take part in autonomous activities aimed at improving enterprise conditions. If sufficient improvement is observed, a portion of profits should be given back to employees as a reward. These activities should be promoted until the time that all employees realize that these are really the employee's own tasks, and should be carried out to the point where employees can cope with activities autonomously in small groups.

Maintaining a healthy cycle, such as implementing improvement activities, leads to improved profits, and if employees are allowed to share in the profits that resulted from the improvement activities, it will promote more active improvement activities and will ultimately provide more profits to the enterprise.

(4) Grasping new technology trends

Attention needs to be paid at all times to the trends of new technologies in the same business category. Efforts should be made to introduce technologies that have smaller environmental loads. For promoting exchange of technical information, such as specific power consumption, opportunities need to be provided for such exchange to take place.

(5) Academic circles and universities

For enhancing technical standards and management systems of factories, places where persons concerned can exchange information autonomously in and among industries (technical committee of industrial society, etc.) should be provided. Opportunities for providing industries, including small and medium scale enterprises, with information on the trends of potential technologies and facilities (training, seminar, etc.) should be provided.

(6) Monitoring Institute

This Institute needs to make efforts that will enable low cost and accurate measuring, as well as improve measuring techniques.

(7) Consulting Institute

An institute should be established where appropriate technology, including appropriate Cleaner Production technology, can be provided depending on the operating conditions and scale of factories.

(8) Pollution prevention equipment industry

The mechanical industries in Vietnam have sufficient capacity for installing advanced equipment, such as activated sludge treatment equipment, and thus the development of further advanced equipment is expected. Moreover, the industry should consider introducing an “eco-labeling system” that would be used as a measure to persuade consumers to purchase superior, “environmentally-friendly” equipment.

5.5 Action plan

Table 5.3 shows action plan charts. Policies to be arranged by the implementing organizations are shown in Table 5.4.

Table 5.3 **Countermeasures for industrial pollution prevention**

- - - survey ——→preparation ⇒implementation

	administration	short term (1-2 years)		mid term (3-5 years)			long term (6-10 years)				
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1.regulations amendment of environmental standards	NEA	——	——⇒adjust ratio between emmission standards and environmental standards								
decide on a water area and target polluted substances	NEA,MOI	- - -	- - - - - ——	⇒NEA:①monitoring rivers, ②detect polluted substances, ③ make a decision on the total amount of emmision MOI: allotment of emmision to each factories - - - - - -	——————→	⇒amendment of allotment		⇒amendment of allotment		⇒amendment of allotment	
strengthen monitoring	NEA	- - -	- - - - - ——	⇒monitoring for necessary information of total emmission amount							
institute an "environmental monitoring"system	NEA	- - -	- - - - - ——	⇒set up environmental monitoring			⇒amendment of environmental monitor system				
institute an "environmental manager"system	MOI	- - -	——→⇒set up environmental managers in factories which were alloted polluted substances				⇒amendment of environmental manager system expand manager system to ordinary factories				
penalize enterprises for violations	NEA	- - -	—————→	⇒announcement of Black List, impose fine							
information exchange and participation of inhabitants	NEA	- - -	- - - - - ——	⇒announcement of total emmission and allotment to each factories							
registration of enterprises using harmful material	NEA,MOI	- - -	- - - - - ——	⇒registering factories which emmit heavy metals or harmful substances							
2.support to enterprises A. training of human resources											
manager for environmental monitor	NEA	- - -	- - - - - ——	⇒acquisition of ability for environmental monitoring							
manager for environmental prevention , productivity and quality	MOI	———	—→⇒acquisition of ability for unit comsumption and material balance sheet								
consultants for environmental technology	MOI	- - -	- - - - - ——	⇒training environmental consultants			⇒training environmental consultants (upper class)				
B. technical guidance	MOI	- - -	- - - - - ——	⇒environmental prevention , productivity and quality							
C. support for investment in pollution prevention											
long term and low interest loans	MOF,MPI	- - -	- - - - - ——	———→⇒supply finance							
tax reductions	MOF,MPI	- - -	- - - - - ——	———→⇒implementation of tax reduction							
commendation	MOI	———	—→⇒select enterprises which achieved environmental prevention								
D. carry out joint treatment in industrial zones	MOI	- - -	- - - - - ——	———→⇒construction of joint treatment facilities							
E. organize and promote information exchange	MOI	——→	⇒guide industries to exchange unit comsumption , productivity and quality								
3. other necessary activities A. concentration of equipment intensive industry	MOI	- - -	- - - - - —	————— selection of factories	————— making plan of re-structuring	—————→	⇒enlarge the scale and centralization				
B. promotion of ISO 14000 and 9000	MOI	- - -	- - - - - ——	———→⇒promotion to large scale factories			⇒promotion to middle and small scale factories				
C. foster the pollution prevention machine industry	MOI	- - -	- - - - - ——	———→⇒supply finance and tax reduction							
D. set up environmental courses in universities	MOE	- - -	- - - - - ——	⇒set courses of environmental prevention , productivity and quality			⇒enlarge courses of environmental prevention etc.				
E. set up an incentive payment system in SOE's	MOI	- - -	- - - - - ——	⇒implementation of incentive payment			⇒amendment of incentive payment to more effective way				
F. strengthen relations between governmental administration	All	——→	⇒exchange information and joint implementation of environmental preservation and production improvement								

Table 5.4 Industrial Pollution Prevention Measures in each Administration

	Basic Policy	Countermeasures	Proposals	Remarks
MO I	Support and guidance of implementing countermeasures for enterprises			
	(1) Development of enterprise environment and development of production managers	Development of pollution prevention managers	Approximately 3000 enterprises will be selected if the target is enterprises with approximately more than 300 employees. Assuming that training of environmental management together with improvement in productivity takes about a month and it is held three times a year, then it will take 10 years to train the pollution prevention managers needed.	The research institutes belonging to MOI are eligible to implement the measure by the command of Industrial Energy and Environmental Office.
	(2) Technology guidance (dispatching instructors to enterprises)	Development of instructors for Cleaner Production and End of Pipe technologies	Human resources who are capable of guidance should be assembled in the research institutes under MOI in cooperation with senior experts from overseas. Approximately 120 experts need to be developed under the assumption of conducting guidance at 50 enterprises a year, for the target of 6000 enterprises. Under the assumption that it takes 5 years to complete the training of the experts needed, then 24 experts need to be developed a year.	The research institutes belonging to MOI are eligible to implement the measure by the command of Industrial Energy and Environmental Office.
		Development of private consultants	Approximately 3000 enterprises will be selected if the target is enterprises with approximately more than 300 employees. Assuming that training of environmental management together with improvement in productivity takes about a month and it is held three times a year, then it will take 10 years to train the pollution prevention managers needed.	The research institutes belonging to MOI are eligible to implement the measure by the command of Industrial Energy and Environmental Office.
	(3) Ensuring necessary funds	Ensuring the loan amount	Necessary fund for industry circles should be requested to the related administration to be ensured.	
	(4) Reducing investment burden for enterprises and development enterprise financial condition	Preferential Tax Treatment System	Preferable tax treatment should be requested to the related administration for industrial pollution prevention.	
		Introduction of joint treatment facilities	Establishment of joint treetment facilities should be supported.	
		Development of pollution prevention equipment industry	The preferential investment treatment system should be applied to the pollution prevention equipment industry.	Application of eco-label system for excellent pollution prevention equipment is one of good promotion method that doesn't require costs.
		Integration of equipment intensive industry	While non-equipment intensive industry should be promoted in local, equipment intensive industry should offered a preferential treatment only for a certain scale factories that newly established or renovated.	
	(5) Countermeasures relating to supports	Promotion of information exchange	MOI should provide common meeting ground until enterprise autonomous exchanging information system for unit consumption and environmental technologies is established.	
		Introduction of incentive system for SOEs	A system should be introduced, in which a certain parcentage of profits is repaid to those who contributed to actual productivity improvement	
		Promotion of ISO 14000 and 9000 series	Pollution prevention manager and productivity improvement manager should be developed, and seminars for technological information actively should be held for the purpose of establishing a system that able to grasp material balance and pursue the improvement of environmental measure and productivity.	
	(6) Allocation of the total emission control allotment to enterprises and promote and adjust trading emission allotment when the total emission control method is introduced.	Allocaiton of the total emission control allotment to enterprises and promote and adjust trading emission allotment	The total discharge amount to be reduced from each of factories should be alloted .	The total discharge amount of pollutants from factories located along the designated water area should be estimaed by MOSTE
	(7) Grasp of enterprises using toxic substances	Registration of enterprises utilizing toxic substances	Factories should be obligated to report the amount of hazardous materials to be consumed so that MOI can prepare the measures for will-be expansion of hazardous materials consumption.	The list of total toxic substances amount should be submitted to MOSTE

MOSTE	Mainly implementing regulations			
	(1) Establishment, reform and abolition of Wastewater and Environmental Standards	Revision of Environmental Standards	Environmental standard should be amended to be approximately one tenth of the wastewater standard. For example, the standard for BOD should be changed to 10ppm for the time being, which will not make the human body uncomfortable, and in the future it should be targeted at 5ppm, which will not damage the development of fish and shellfish.	
	(2) Execution of control such as monitoring system, and impose penalties	Reinforcement of the monitoring system	The frequency and the number of points for measurement in the polluted river of materials that are exceeding environmental standards should be increased.	
	(3) Necessary Related Policies for executing regulations	Development of analyzing technician for environment	Skill and technical qualifications should be introduced. As the number of qualified experts increases, only qualified experts will be obligated to measure data for official use.	
		Determination of the total emission amount of pollutants (in the case of implementing the total emission control)	As for COD and toxic materials that is beyond the environmental standards, the permissible amount of toxic materials and COD discharged from the factories along the polluted river should be set.	Refer MOI-(7)
MPI	Promotion of foreign aid relating to pollution prevention and create investment plans	Funding planning	Necessary fund raising plan should be made for pollution prevention measures.	
		Promotion of international cooperation	Financial and technological cooperation should be promoted.	
MOF	Fund supply and credit complement for pollution prevention investment supplying, and execution of a preferential tax treatment system	Execution of a preferential tax treatment system for supporting pollution prevention measures	Tax reduction system such as for the land tax should be introduced with consultation with MOI.	
		Funds for pollution prevention investment	Long term low interest loans for pollution prevention measures should be provided to banks.	
		Improvement and development a credit complement system	Collateral system should be improved in Vietnam.	
MOE	Diversification of environmental courses in university	Diversification of environmental courses in university	Environmental engineering courses should be expanded in universities through integrating couses of environment and production.	

5.6 An Estimation of Mid and Long-term Demand for Investment in Industrial Pollution Prevention Countermeasures

5.6.1 An Estimation of Mid and Long -term Demand for Investment

An estimation of mid and long term demand for investment is shown in Table 5.5

Table 5.5 An Estimation of Mid and Long-term Demand by Sub-sectors Subject to the Survey for Investment in Industrial Pollution Prevention Countermeasures

(million VND)

Sub-sector	Survey	# of Enterprises	CP		EOP		Total	CP/EOP	CP/EOP
			# of enterprises	Amount	# of enterprises	Amount		Neither are required	Both are required
Textile	Detailed Survey	5	4	6,000	5	32,000	38,000	0	4
	Simple Survey	14		8,000	8	45,000	53,000	6	0
	Total	19	4	14,000	13	77,000	91,000	6	4
Chemical	Detailed Survey	4	4	32,000	4	15,000	47,000	0	4
	Simple Survey	17	0	0	12	27,000	27,000	5	0
	Total	21	4	32,000	16	42,000	74,000	5	4
Paper and Pulp	Detailed Survey	5	5	81,000	5	11,000	92,000	0	5
	Simple Survey	16	16	209,000	16	59,000	268,000	0	16
	Total	21	21	290,000	21	70,000	360,000	0	21
Food Processing	Detailed Survey	5	5	15,000	5	25,000	40,000	0	5
	Simple Survey	16	0	0	14	61,000	61,000	2	0
	Total	21	5	15,000	19	86,000	101,000	2	5
Metals	Detailed Survey	4	0	0	4	21,000	21,000	0	0
	Simple Survey	18	0	0	8	71,000	71,000	10	0
	Total	22	0	0	12	92,000	92,000	10	0
Total	Detailed Survey	23	18	134,000	23	104,000	238,000	0	18
	Simple Survey	81	16	217,000	58	263,000	480,000	23	16
	Total	104	34	351,000	81	367,000	718,000	23	34

Premise Exchange Rate

100 JP\ = 12,000 VND

1 US$ = 14,000

Chapter 6

Summary of Case Studies for Enterprises

Chapter 6 Summary of Case Studies for Enterprises

6.1 Objectives of the Enterprise Study

During the second and third field survey, the Study Team conducted factory studies of selected enterprises in five industrial sub-sectors. The objectives of the enterprise study are as follows:

1. To grasp the present state of the industrial sub-sectors, based on which the Master Plan is to be worked out;
2. To work out improvement countermeasures based on the analysis of the present state;
3. To make simple recommendations that do not require large investment for enterprises studied;
4. To propose plans for improvement by means of Cleaner Production technology and End of Pipe technology, including the estimation of investment cost required for implementation for enterprises that have improvement potential; and
5. To prepare basic data on financial demand for implementing industrial pollution prevention countermeasures in Viet Nam

6.2 Enterprise Study Procedures

Figures 6.6 and 6.7, attached at the end of this chapter, show the enterprise study procedure.

6.2.1 Enterprise Selection

(1) Phase Ⅰ: Simplified Enterprise Study

For phase Ⅰ enterprise studies, 104 enterprises were selected, as shown in Table 6.1, in Ha Noi city, Ho Chi Minh city, Da Nang city and from areas nearby these cities. Brief studies of all the selected enterprises were executed in one day for each enterprise mainly to gather information for identifying existing problems and potential for improvement in process technologies, as well as End of Pipe technologies. In the course of the enterprise studies in this survey, the study team made brief recommendations that do not require large financial investments.

Table 6.1 Number of Enterprises Targeted for the Study

Sub-sector	Area			
	Ha Noi area	HCMC area	Da Nang area	Total
Textile & Garment	7	8	4	19
Chemical	10	9	2	21
Paper & Pulp	12	9	0	21
Food Processing	9	10	2	21
Metal Works	13	9	0	22
Total	51	45	8	104

(2) Phase Ⅱ: Detailed Enterprise Study

Phase Ⅱ enterprise studies were made at several model enterprises in each sub-sector that were selected out of the targeted enterprises in Phase Ⅰ. Selections were based on the following criteria:

1. Enterprises which are considered to be causing a big environmental impact due to industrial wastewater discharge;
2. Enterprises which are considered to be financially sound and are capable of investing in industrial pollution prevention countermeasures;
3. Enterprises which are willing to participate in the detailed enterprise studies; and
4. Enterprises which agree to make the results and fruits of the study open to the public to a certain extent

In this phase, more detailed studies were conducted over three to five days at each enterprise to gather detailed data and information. Also, a more thorough analysis was made in order to be able to make more detailed recommendations to the targeted model enterprises. Recommendations to the model factories consist of the following:

1. Definition of improvement targets;
2. Recommendations for promotion of cleaner production technologies;
3. Recommendations for other pollution abatement technologies;
4. An implementation plan and time schedule;
5. A rough cost and benefit estimation and financial analysis

6.2.2 Grasp Present Factory Conditions

(1) Items to be Surveyed

It is important to get an exact grasp of present factory conditions in the enterprise studies. The present state of the targeted factories were investigated and the following items were put together by making, sending and recovering questionnaires for enterprises, through factory observations (equipment, layout, and operation status), by collecting factory data and information (drawings, books or statistics) and through discussions with factory members:

1. Overview;
2. Block flow diagram of the whole factory;
3. Material balance and energy balance;
4. Production facilities;
5. Amount of waste discharged; and
6. Management technology

(2) Wastewater Quality Analysis

1) Wastewater Analysis with Equipment Provided by the Study Team

A simple analysis of wastewater was made and pH, electric conductivity, dissolved-oxygen, turbidity, and temperature were measured using the measuring device "WATER QUALITY CHECKER U-10."

2) Wastewater Analysis by Local Consultants

Parallel to the analysis that was made with equipment carried by the study team, sample collection and analysis of wastewater were contracted out to the Centre for Environmental and Chemical Engineering (CECE) in the Chemical Engineering Corporation (CECO) and Center for Environmental Engineering of Towns and Industrial Areas (CEETIA). The wastewater parameters analyzed by the local consultants are shown in Table 6.2.

6.2.3 Extraction and Analysis of Problematic Issues

Based on the Study Team's apprehension of present enterprise conditions, problematic issues were extracted and classified into the following:

1. Problematic issues in production technology; and
2. Problematic issues in management technology

6.2.4 Work Out Improvement Countermeasures

Improvement countermeasures were worked out based on the analysis of problematic issues. Countermeasures through the promotion of Cleaner Production technology and End of Pipe technology are mentioned separately hereafter.

(1) Countermeasures through the Promotion of Cleaner Production Technology

The United Nations Environment Programme (UNEP) defines "Cleaner Production" as "the continuous application of an integrated preventive environmental strategy to processes, products and services to increase efficiency and reduce risks to humans and environment." "The integrated preventive environmental strategy" mentioned above includes conserving raw materials and energy, and minimizing, recovering and recycling wastes. It is based on movements to eliminate waste completely.

Therefore, in order to promote Cleaner Production technology, it is important to establish a management system that seeks to eliminate daily waste, instead of introducing already accomplished technologies like End of Pipe technology.

Cleaner Production technology will be implemented in enterprises in one of the following forms:

1. Introduction of a new process that provides resource and energy conservation and has high productivity and low environmental impact (requires a large investment and disposal of existing production facilities.)
2. Improvement of existing processes;
   (1) Partial improvement of process equipment;
   (2) Substitution of raw materials or sub-raw-materials; and
   (3) Improvement of operation procedures
3. Re-use of waste (including off-specification product) that is discharged from production process as a resource.

Each method mentioned above individually requires different amount of investment and has different improvement effects, advantages and disadvantages. Realistic improvement plans were investigated for each targeted enterprise that incorporate present enterprise conditions and existing future plans.

In order to avoid waste, it is essential to grasp the current state of management to determine the amount of waste being generated. This study concentrated on important points for Cleaner Production technology promotion, such as grasping the current condition of unit consumption of raw materials and utilities, and productivity improvement activities.

(2) Reducing Wastewater Volume

For this study, it is important that reduction of wastewater volume be investigated as one of Cleaner Production technology. Figure 6.1 shows the investigating procedure for wastewater volume reduction.

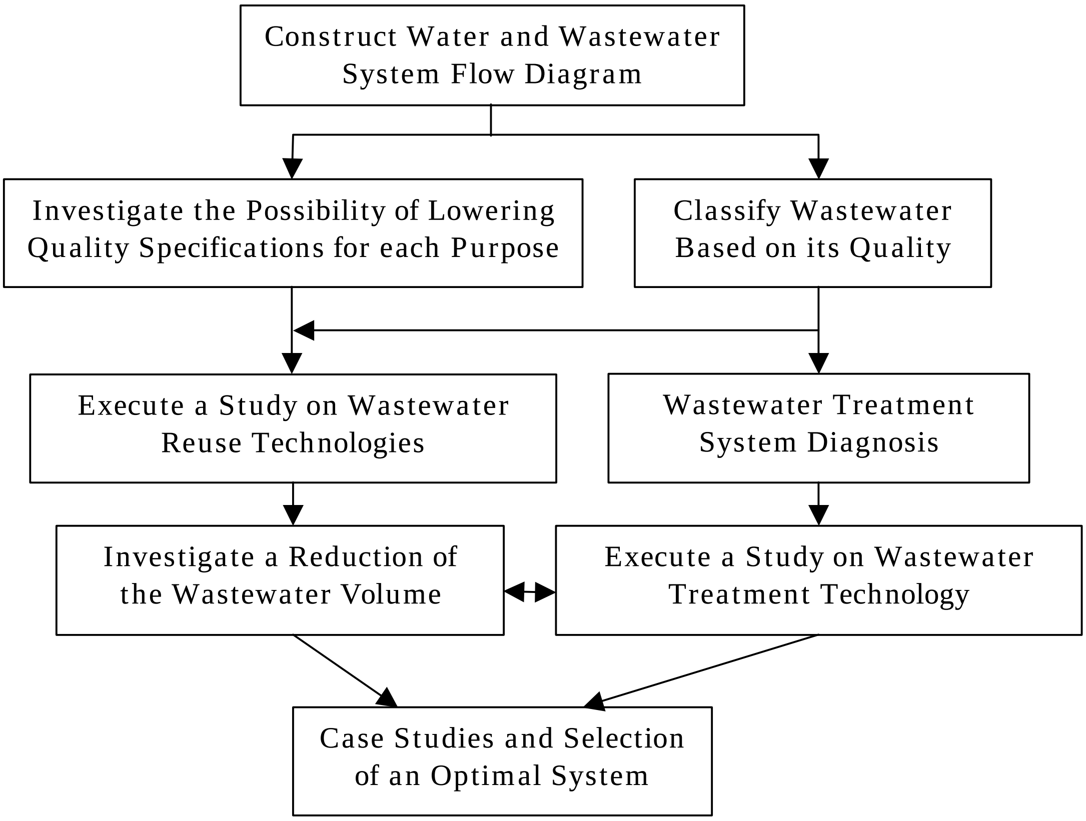


Figure 6.1 Procedures for Working Out Measures for Reducing Wastewater Volume

1) Construct a Factory Water and Wastewater System Flow Diagram

System flow diagrams that include the following items were drawn up through investigating water consumption, wastewater volume and water quality:

1. Consumption of every kind of water (cooling water, process water, including pure water, and domestic water);
2. Water consumption for each purpose;
3. Required water quality for each purpose (pH, Electric conductivity, Total hardness, Oil content, Metals etc.);
4. Recovered water volume (Cooling water, steam condensate); and
5. Wastewater volume (classify as clean wastewater or dirty wastewater)

2) Classify wastewater based on water quality (clean wastewater can be reused

simply)

3) Study the possibility of reusing wastewater by lowering water quality specifications for each utilization purpose

4) Diagnosis of wastewater treatment systems

5) Investigate measures for wastewater volume reduction

Based on the study of the current state of water utilization, the following countermeasures for wastewater volume reduction were to be investigated:

1. Thorough recycling of indirect cooling water;
2. Thorough utilization of steam condensate for indirect heating;
3. Wastewater reduction through thorough water management;
4. Wastewater volume reduction through washing procedure improvement and through processing order modification; and
5. Re-use of wastewater that does not require treatment

6) Investigate wastewater reuse technology

Although basically, it is desirable to reuse wastewater without treatment, technologies were investigated in cases where it was expected that wastewater would be reusable after treatment.

7) Investigate wastewater treatment technology

Based on investigation results for reuse, application of End of Pipe technology was studied for each classification of wastewater. It is necessary to release and treat a portion of recycling water as blow water because the concentration of pollutants in wastewater increases by reducing water consumption through the reuse of wastewater, and contaminants accumulate in the recycling water through continued recycling use.

8) Selection of optimal improvement measures

Case studies were carried out for the countermeasures mentioned above, incorporating process improvement measures. Optimal cases will be selected based on the following rough investigation:

1. Rough estimation of construction costs (process improvement, wastewater treatment systems, and facilities for wastewater reuse);
2. Variable cost estimation (increase or decrease in raw materials costs and maintenance costs);
3. Benefit estimation (improvement of unit consumption of raw materials or utilities, penalty reduction, valuable material recovery, etc.)

In order to carry out a benefit estimation for proposed improvement means, an estimation of investment cost was required for the implementation of proposed countermeasures.

Depending on the status of each enterprise, the amount of investment required for the implementation of the proposed improvements was estimated based on the following:

1. A rough estimation by the concerned enterprise;
2. In the case an estimation by the concerned enterprise was not available, a rough estimation was determined by multiplying a regional factor to the estimated construction cost in Japan.

The exchange rates used for conversion are 120 VND/Yen and 14,000 VND/US$, the rates that were prevailing in March 2000.

(3) Countermeasures through End of Pipe Technology Improvement

It is impossible to reduce environmental pollutants generated through production activities only by utilizing Cleaner Production technology, the core technology recommended in this study, because Cleaner Production technology enables enterprises to reduce environmental impact while maintaining and improving profitability. Therefore, industrial pollution prevention countermeasures were worked out by combining Cleaner Production technology and End of Pipe technology.

There are two methods for applying End of Pipe technology in factories:

1. Apply End of Pipe technology to current facilities without adopting Cleaner Production technology (by improving existing End of Pipe systems or installing new systems);
2. Apply Cleaner Production technology and adopt End of Pipe technology to a degree where environmental impact caused by wastewater is reduced to some extent

Basically, method 2 was studied for implementation in each enterprise, adhering to the aims of this study.

6.3 Summary of the Study Results

Chapters 7,8, 9, 10, and 11 summarize the results of the enterprise studies for each industrial sub-sector. The following are the present problematic issues that are common to each industrial sub-sector.

Approximately 93 % of the factories that discharge industrial wastewater among the enterprises studied are not presently satisfying the wastewater regulation standard. Causes that create this problem are analyzed as follows:

(1) Imperfect Functioning of the Existing Wastewater Treatment Systems

Nearly 60 % of the wastewater treatment systems which have already been installed are not functioning properly. Figure 6.2 shows the relation between factors causing this problem.

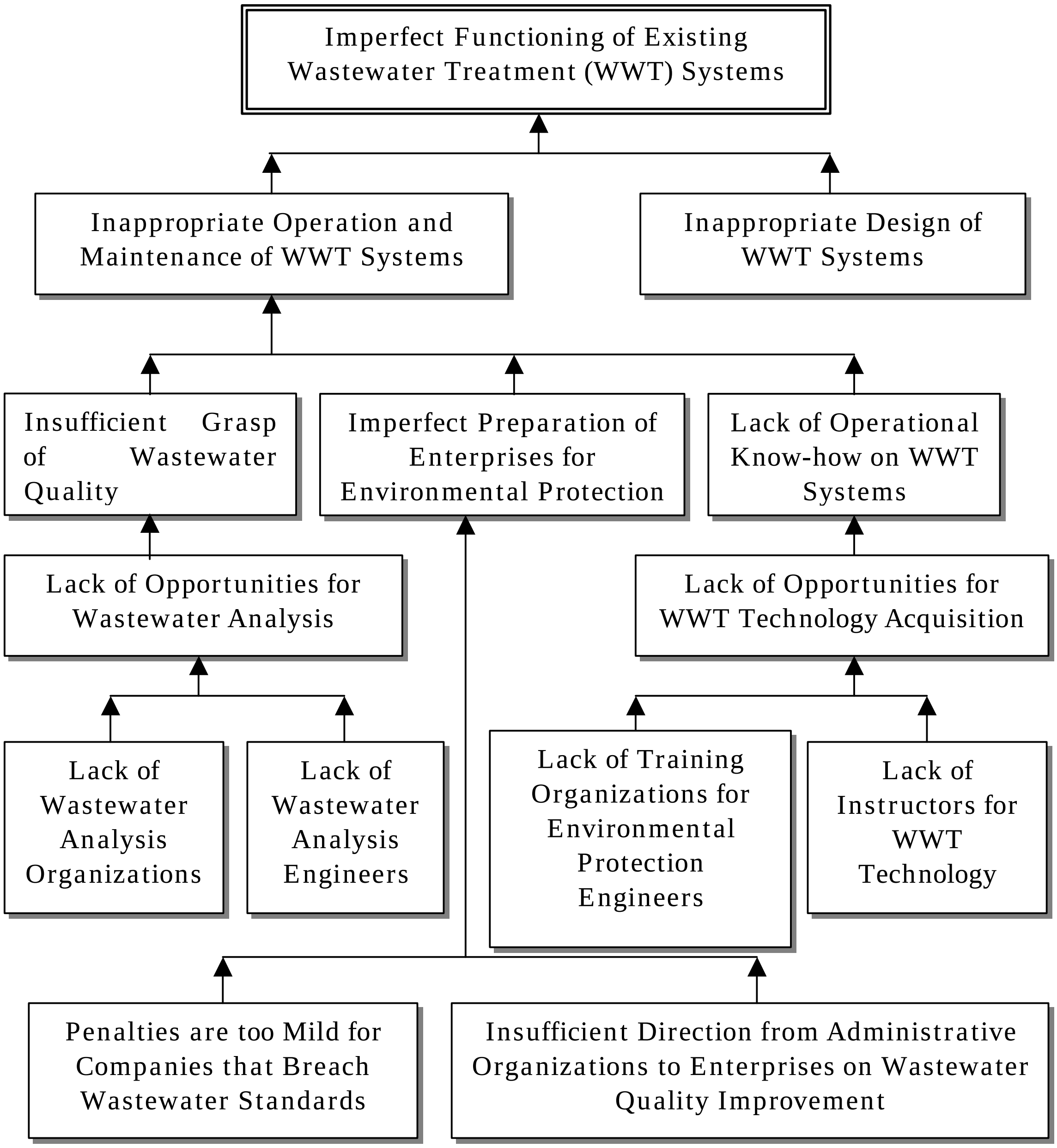


Figure 6.2 Causes of Imperfect Functioning of Existing Wastewater Treatment Systems

The following issues should be solved in order to make existing wastewater treatment systems function properly:

1. Preparation of educational and training organizations that provide enterprises with opportunities for acquiring operational know-how on wastewater treatment systems;
2. Preparation of organizations that provide enterprises with water analyses services necessary to grasp wastewater quality; and
3. Direction from administrative organizations to promote enterprise preparation for environmental preservation.

(2) Discharge of Valuable Materials into Wastewater

Valuable materials are discharged in process wastewater as pollutants. Figure 6.3 shows the relation between factors causing this problem.

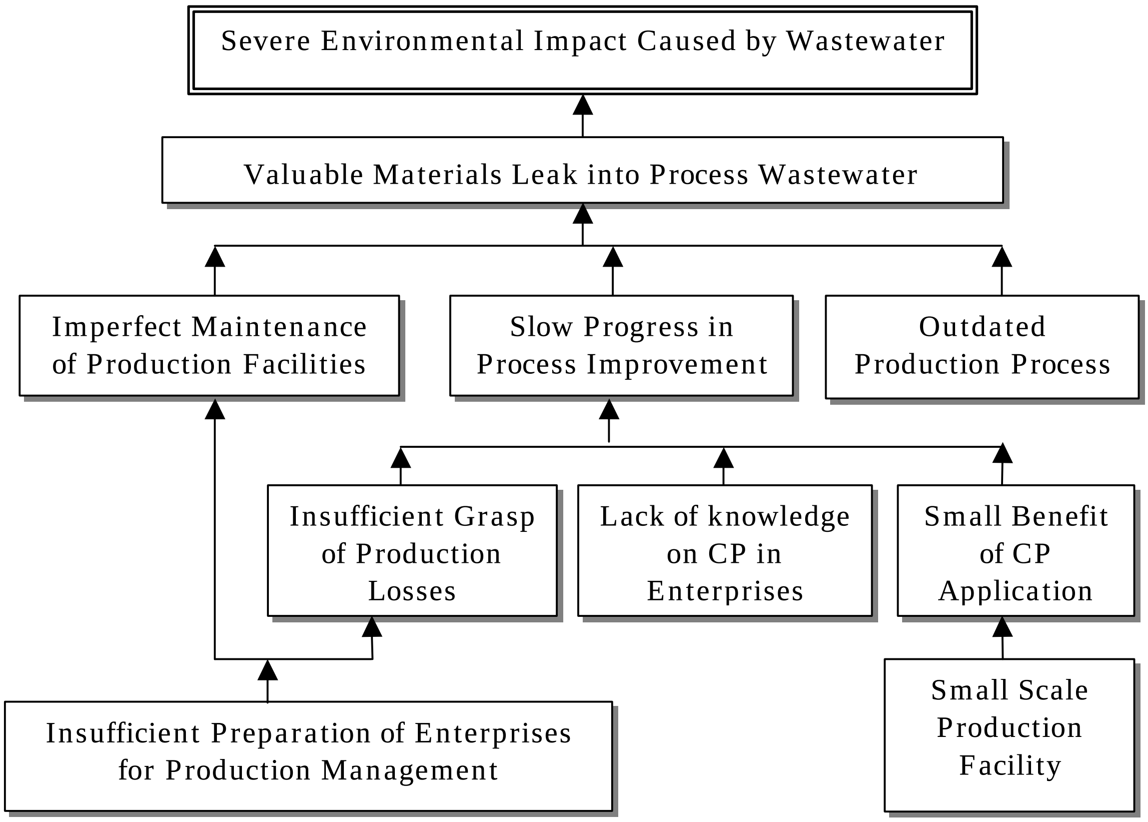


Figure 6.3 Relation of Factors Causing Valuable Material Discharge into Process Wastewater

In order to solve this problem, it is necessary to start by grasping the present state of production losses as the first step for applying cleaner production technology, which is the main subject of this study. One of the important tasks of the administrative organization is to establish organizations to direct enterprises in production management that emphasizes the importance of grasping the current state of production activities including the environmental impact caused by wastewater.

(3) Slow Progress in Wastewater Treatment System Installation

In 73 % of the enterprises that are discharging industrial wastewater, wastewater does not satisfy the regulation standards because wastewater treatment systems have not yet been installed. Figure 6.4 shows the relation between factors causing the slow progress in wastewater treatment system installation.

In general, enterprises cannot afford to invest in wastewater treatment system installation. Besides, it is not desirable to introduce wastewater treatment systems under current situations, because the cost required to install a wastewater treatment system is relatively high due to the following:

1. A large scale system is required to treat a large volume of wastewater, which is not currently classified and is mixed with clean wastewater and rain; and
2. A large investment is required to install a system to treat wastewater containing a large amount of contaminants, because valuable materials are mixed in with it as mentioned in the previous paragraph.

An urgent issue that requires action is a reduction in wastewater pollution impact by promoting the enforcement of production management that does not require a large investment.

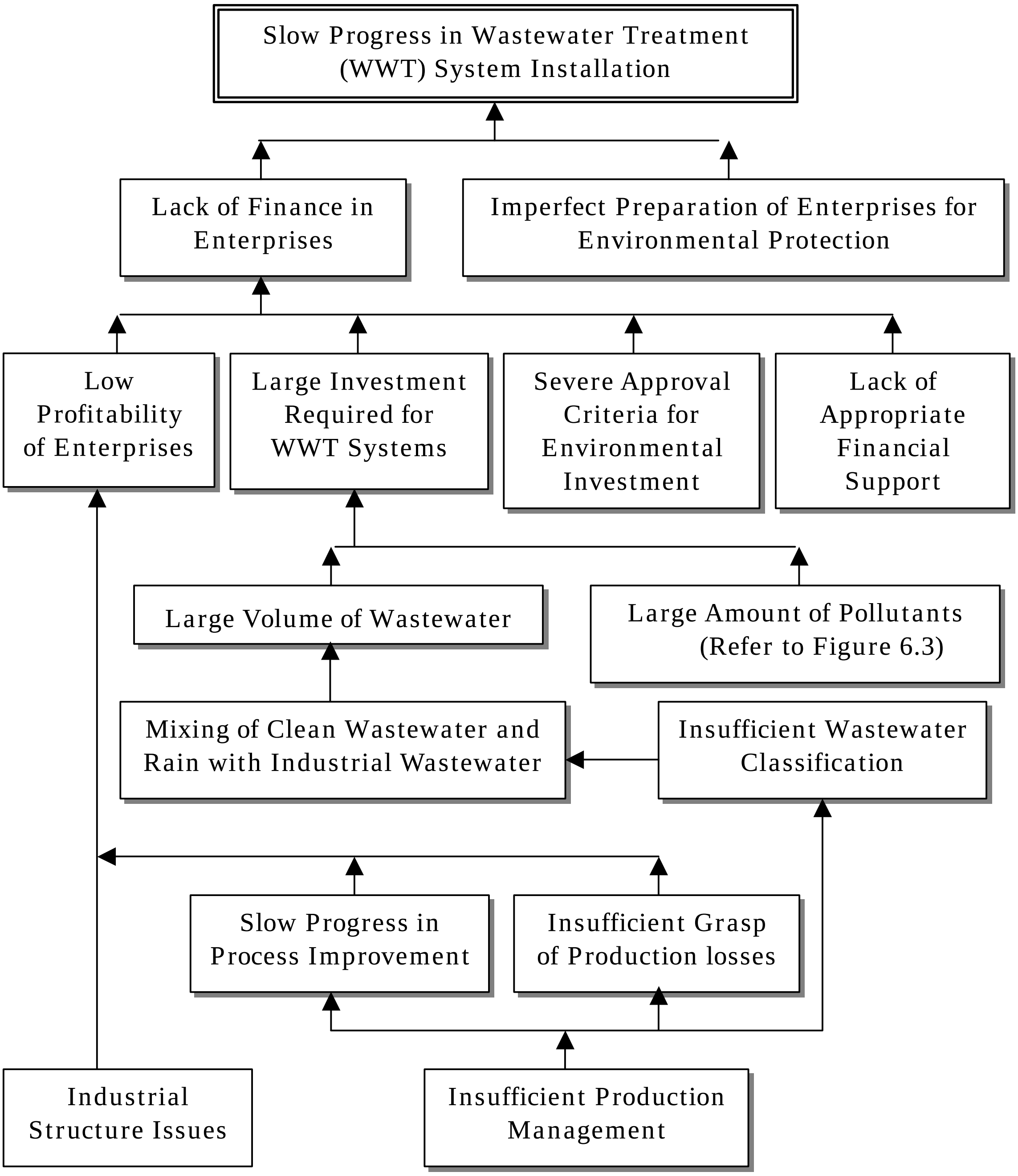


Figure 6.4 Causes for Slow Progress in Wastewater Treatment System Installation

(4) Industrial Sector Structure Issue

Process intensive industries in Viet Nam, such as the chemical and paper and pulp industries, are faced with the adverse structural condition of having many small factories dispersed geographically throughout Viet Nam. Figure 6.5 shows the relation between the factors causing this problem.

On a long-term basis, in order to improve the competitiveness of a process intensive industry, the infrastructure for logistics, and transfer of raw materials and utilities needs to be improved.

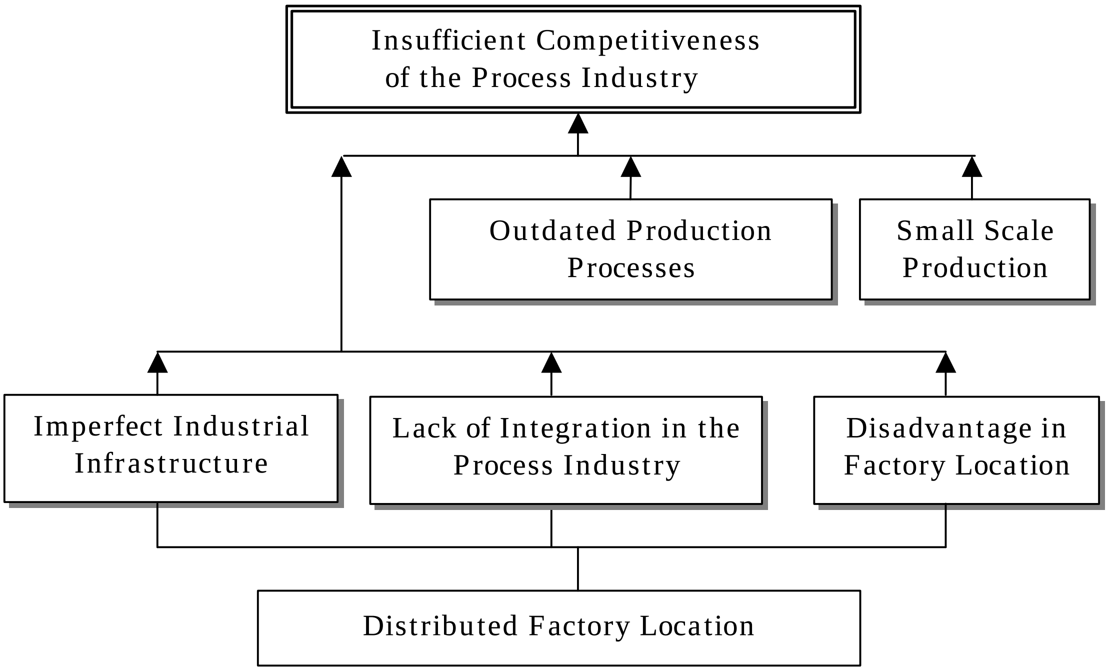


Figure 6.5 Factors Related to Industrial Sector Structure

Table 6.2 Wastewater Analysis Items

ITEM	Textile	Chemical Industry	Paper & Pulp	Food Processing	Metal Works
Temperature	○	○	○	○	○
PH	○	○	○	○	○
Electrical Conductivity	○	○	○	○	○
Turbidity	○	○	○	○	○
Greases & oils	○	○	○	○	○
BOD	○	○	○	○	○
COD	○	○	○	○	○
Dissolved Oxygen	○	○	○	○	○
Suspended Solids	○	○	○	○	○
Total Nitrogen	○	○	○	○	
Total Phosphate		○			
Residual Chlorine	○	○	○	○	
Fluorine		○			
Cyanogen	○	○			○
SO_4^{2-}	○	○			
Total Chromium		○	○		○
Zinc		○	○		○
Copper		○	○		○
Nickel		○			○
Manganese		○			
Iron		○			
Cadmium			○		○
Mercury		○			
Tin					○
Lead		○			
Arsen		○			
Surfactant		○			
Phenol		○		○	
Salt			○		

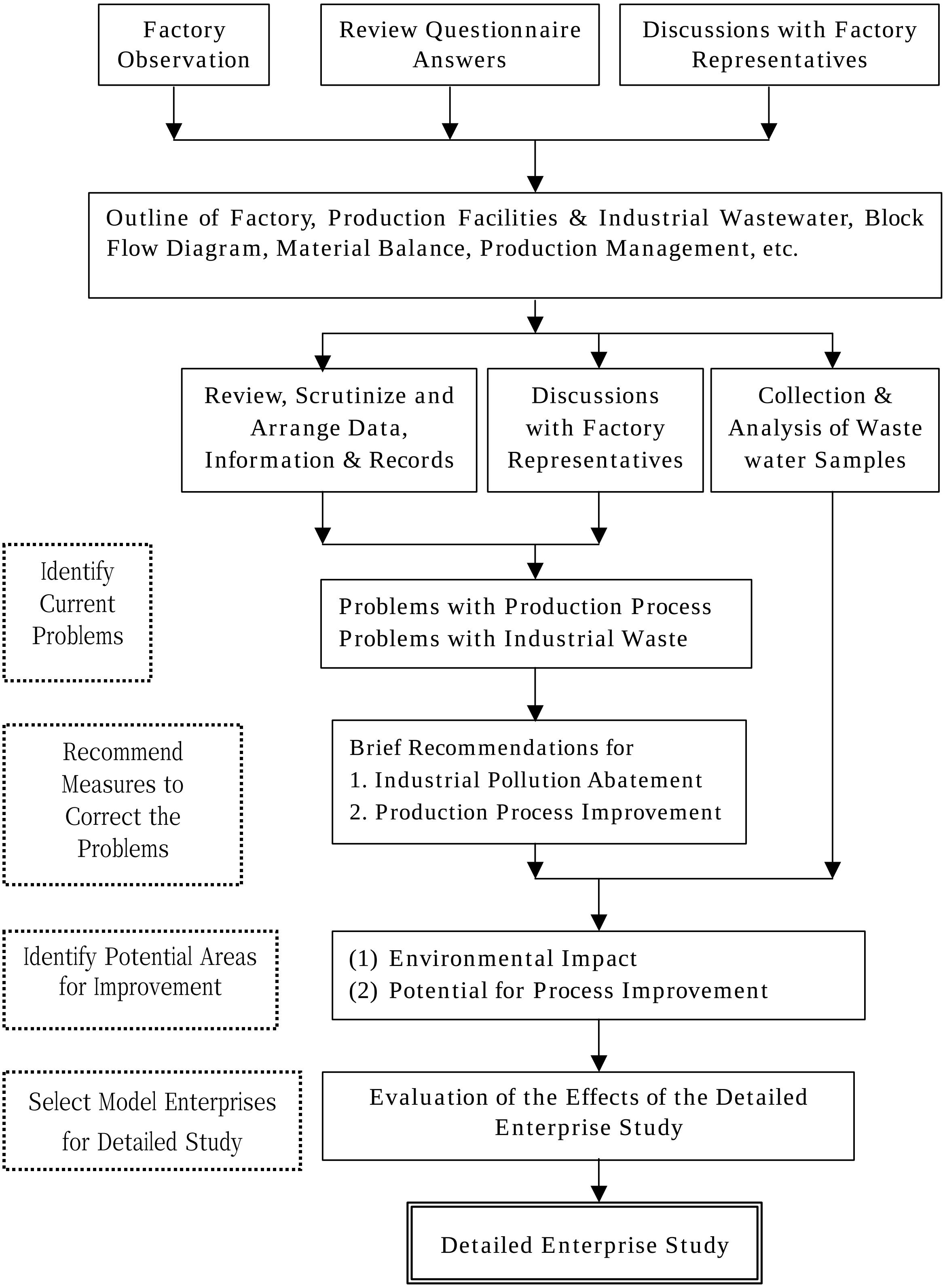


Figure 6.6 Outline of Enterprise Study Procedure (1)

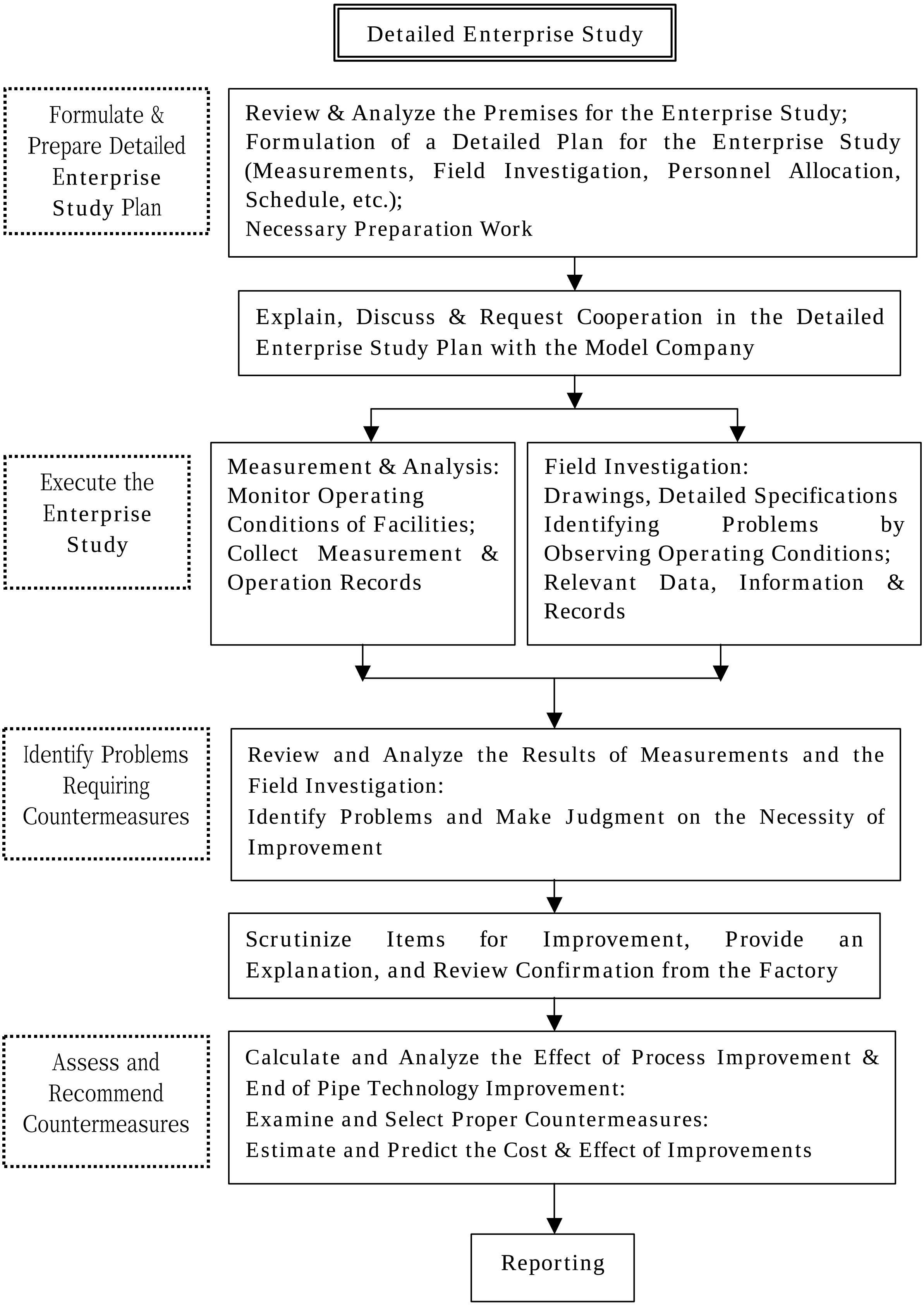


Figure 6.7 Outline of Enterprise Study Procedure (2)

Chapter 7

Countermeasures for Wastewater Pollution in the Textile & Garment Sub-sector

Chapter 7 Countermeasures for Wastewater Pollution in the Textile & Garment Sub-Sector

7.1 Present State of Wastewater and Productivity in the Textile & Garment Sub-sector

7.1.1 Enterprises Surveyed in This Study

The Textile Team investigated nineteen SOEs (17 enterprises administered by the Central government and 2 enterprises administered by the Local government) for this survey. 5 factories(T-01*〜T-05*) among these were surveyed in detail. The following Table 7.1 shows the scope of the survey:

Table 7.1 Enterprises Surveyed

No	Name of Enterprise	Number of Employees	Turnover Million VND	Consumption of Industrial Water ton/day	Kinds of Processes
1	T-01*	3500	495,000	3,600	SP., WV., DY., SW.
2	T-02*	480	38,931	500	KN., DY., SW.
3	T-03*	400	20,204	40	WV., DY., SW
4	T-04*	7500	378,000	7,000	SP., WV., DY., SW.
5	T-05*	1700	113,204	1,600	SP., WV., KN., DY.
6	T-06	2800	2,863	70	SW.
7	T-07	2000	76,195	600	SP., WV., DY., SW.
8	T-08	200	78,881	250	SW.
9	T-09	1200	75,722	730	SP., WV., DY., SW.
10	T-10	595	14,555	200	SP., CP., DY.
11	T-11	5000	208,000	0	SW.
12	T-12	1500	99,500	1,500	WV., DY., SW.
13	T-13	3700	440,000	4,800	SP., WV., DY., SW.
14	T-14	70	14,000	310	DY.
15	T-15	850	75,246	200	SP., WV., DY.
16	T-16	3000	225,000	4,800	SP., WV., DY., SW.
17	T-17	1300	40,000	60	SP., WV., SW.
18	T-18	1700	140,000	250	WV., DY., SW.
19	T-19	1800	160,000	300	SP., WV., KN., DY., SW.

(Remark) SP.= Spinning, WV.= Weaving, KN.= Knitting, CP.= Carpet, DY.= Dyeing, SW.= Sewing

7.1.2 Industrial Wastewater in the Textile & Garment Sub-sector

(1) Wastewater Quality

Table 7.2 shows the quality of wastewater in the textile & garment sub-sector analyzed in the second field study.

Wastewater in spinning & weaving factories is mostly used for running the air conditioning in the plants. Therefore, the quality of this wastewater causes no environmental problems because it has few pollutants.

Wastewater in dyeing factories includes various kinds of pollutants because the dyeing process uses many kinds of chemical stuff, such as dyeing and bleaching stuff. Pollutants such as pH, BOD,COD and SS, which are regulated by environmental standards, are big problems. As for garment factories, only the washing process discharges industrial wastewater.

The company uses some chemical stuff such as detergents or softeners, and they also use stones for denim products. For this reason, their wastwater includes SS, BOD and COD pollutants.

Table 7.2 Wastewater Quality in the Textile & Garment Sub-sector

	Unit	Spinning & Weaving	Dyeing & Finishing	Garment Factories	Vietnam Standard
Temperature	℃	24.7	35.3	30.3	
pH		7.3	8.93	7.5	5.5～9
Elec. Conductivity	μS/cm	290	370	270	
Turbidity	NTU	2.8	13.5	10.8	
Oil content	mg/l	0.04	0.02	0.02	1 or 10
BOD	mg/l	16.5	522	40.7	50
COD	mg/l	21.5	665	55	100
DO	mg/l	2.4	4.2	1.7	
SS	mg/l	5.8	17.3	12.1	100
Total Nitrogen	mg/l	19.1	9.2	7.9	60
Residual Chlorine	mg/l	Trace	Trace	13.5	
SO_4	mg/l	97.6	91.2	63.4	
Cyanogen	mg/l	0.02	Trace	0.02	0.1

(2) Dyeing Factory Wastewater

Table 7.3 shows wastewater quality of the dyeing factories surveyed in the study. Wastewater qualities were analyzed from discharged wastewater taken at factory outlets to city sewage.

Table 7.3 Wastewater of Dyeing Factories

	PH	BOD mg/l	COD mg/l	SS mg/l	Water m^3/day	W.W.T System
T-01	11.36	384	844	60	3,600	No
T-02	7.71	578.6	1133.1	33.7	500	No
T-03	10.12	222	325	62	40	No
T-04	11	47	260	10	7,000	No
T-05	9.53	135	360	19	1,600	No
T-07	10.5	132	158	74	600	Yes
T-09	7.9	40	41	15	730	No
T-12	11.3	784	957	19	1,500	No
T-13	10.0	77	269	45	4,800	No
T-14	10	308	2353	40	310	Yes
T-15	3.2	2	52	6	200	Yes
T-16	10.5	14	341	12	4,800	No
T-18	9.9	85	433	25	250	U．Cnst
T-19	9.76	273	920	18	300	Yes
Vietnam Standards	**5～9**	**50**	**100**	**100**		

＊**WWT**…… Wastewater Treatment System

1) Wastewater Quality

Industrial wastewater of dyeing factories generally has alkaline in it, so it is necessary to neutralize it with acids in a wastewater treatment system.

According to the results of this survey, many companies exceed allowable environmental standards in Vietnam. 11 companies for pH, 9 companies for BOD, 11 companies for COD and 1 company for SS were over the allowable limit.

2) Wastewater Volume

The average wastewater volume per factory in this study is about 2,000m^3/day. However, most of the companies have spinning or weaving units at the same site, so the actual volume of the dyeing factories wastewater is less than this.

3) Wastewater Treatment Facilities

Among the 15 companies surveyed in this study, only 4 companies are equipped with a wastewater treatment facility and one treatment facility is under construction at another factory. The other companies are discharging their wastewater without any treatment because they have no treatment facilities.

(3) Garment Factory Wastewater

Table 7.4 shows the wastewater quality of garment factories surveyed.

As for the wastewater quality, only one company exceeds Vietnam environmental standards for BOD.

The average wastewater volume is as little as $100m^3$/day.

Wastewater facilities are small, only small sedimentation tanks are used, and they cannot reduce the BOD or COD of the discharged wastewater before it goes into city sewage.

Table 7.4 Garment Factory's Wastewater

	pH	BOD mg/l	COD mg/l	SS mg/l	Water m^3/day	W.W.T System
T-06	7.8	33	52	11	70	No
T-08	6.1	79	88	40	250	No
T-11	—	—	—	—	0	No
Vietnam Standards	**5～9**	**50**	**100**	**100**		

(4) Future Subjects

According to the survey results of the second and third field studies, the following subjects related to industrial wastewater in the textile and garment sub-sector need to be worked on.

1) Priority

With the goal of preventing pollution in industrial wastewater, it is necessary to concentrate our effort on the dyeing factories because they emit a high density of pollutants and a large volume of wastewater. Of course, wastewater of garment factories is a problem, but their total environmental load is estimated to be 1～5% that of the dyeing factories, considering their density and volume. So, it would be wise to spend a lot of time and effort on dyeing factories.

2) Wastewater Treatment Facilities

Among the 19 companies surveyed in the second and third field studies, only 5 companies have installed wastewater treatment facilities. This number includes one facility that is now under construction. So, most of these companies are discharging their wastewater without any treatment.

It is very important to reduce the environmental load by improving processes. However, it is also necessary to install wastewater treatment facilities for the effective prevention of industrial pollution. The function of the few existing wastewater treatment facilities is not adequate because there are some design problems such as with the selection of the treatment method and the volume of the treating tank, so it is necessary that these be improved.

3) Wastewater Treatment Technology

According to the results of the second and third field studies, existing wastewater treatment facilities do not work sufficiently and the quality of their wastewater cannot clear environmental standards in Vietnam. It is also necessary to transfer wastewater treatment technology, in addition to improving facilities.

7.1.3 Productivity in the Textile and Garment Sub-sector

In this study, unit consumption data could not be obtained from the enterprises visited. It is certain that the productivity of all factories is considerably low compared with those of advanced countries.

Table 7.5 shows the comparison of labor productivity between a large Japanese factory and a medium-sized factory in Vietnam.

Table 7.5 Comparison of Labor Productivity between Japan and Vietnam

	Spinning Process		Dyeing Process	
	Japan	Vietnam	Japan	Vietnam
Capacity	80,000 sp	23,000 sp	55,000x10^3 m/year	15,000x10^3 m/year
Number of Labor	260	530	300	460
Productivity per Labor	308 sp	43 sp	183x10^3 m/year	33x10^3 m/year

There is more than a 5 times difference in labor productivity between Japan and Vietnam both in the Spinning Process and in the Dyeing Process. However, this data may not be suitable for comparison because there is a trend to ignore labor productivity in Vietnam due to the very low cost of labor there.

7.2 Causal Analysis

7.2.1 Present State of Production Technology in the Textile & Garment Sub-sector

Making assumptions based only on the enterprises the team surveyed, the results of our findings leave the Study Team no choice but to admit that the production technology of the Vietnam Textile and Garment Industry is at a low level. However, there are some enterprises that are preparing to improve their technology to produce products for export, and there are some considerably high level joint venture enterprises, financed with indirect foreign capital (not investigated directly), that seem to have a high level of technology.

From a “Cleaner Production” point of view, our investigation this time should have focused on the dyeing process where wastewater is discharged. However, the purpose of this study is to report on the current status of the enterprises, which includes the spinning and weaving processes, concentrating on areas where costs can be reduced and added product value of the total enterprise can be increased.

(1) Spinning Process

1) Study Summary

The Textile Team visited 19 companies during the second and third field studies, and among the companies visited there were 10 spinning factories which are shown in Table 7.6.

Table 7.6 Spinning Factories Surveyed

Area	Number of Companies	Number of Spinning Units	Equipment (spindles)
Hanoi area	7	4	166,152 spls
Ho Chi Minh area	8	4	175,600 spls
Danang area	4	2	70,000 spls
Total	19	10	411,752 spls

According to VINATEX（Vietnam National Textile Garment Corporation）the total amount of equipment in all Vietnam enterprises that have spinning works is estimated at 1,100,000 spindles. Therefore this study covers about 37% of the estimated total equipment.

2) Production Technology Problems

The machines that are equipped in Vietnam spinning factories are mainly old ones made in China or European countries. The factories in the Hanoi and Danang areas, especially, lag behind in modernization. Out of all the factories, a total of 30% of the equipment is achieving the global market standard, and most of these are mainly in the Ho Chi Minh area.

(a) Draft Parts

The draft parts in the drawing, roving and spinning processes are very important and are like the heart of these operations. However, the functions of the draft parts in old Chinese-made machinery are no good, and because of unevenness, this leads to poor yarn quality.

(b) Large Packaging System

On the old equipment, cans and roving bobbins, which contain semi-finished products of the spinning process, are too small. This causes low productivity because it requires many changing operations. The main problem with mistakes caused in changing semi-products is the decreased yarn quality.

(c) Splicing System

In the winding process, there is a splicing system which can produce knot-free yarn. This epoch-making technology was invented in Japan 20 years ago. Most spinning companies in Vietnam lag behind in the introduction of this modern technology.

(d) Electric Yarn Clearer

In the winding process, yarn faults existing in yarn produced in the spinning process are removed by a yarn clearer. For this yarn clearer, the modern, electric type is the global standard, but in Vietnam mostly old, mechanical types are used. This has a very important effect on yarn quality because many yarn faults remain in products if a mechanical yarn clearer is used.

(2) Weaving Process

1) Study Summary

The Textile Team visited 19 companies during the second and third field studies and, among the companies visited, there were 12 weaving factories which are shown in Table 7.7.

According to VINATEX, the total amount of equipment in use in all of Vietnam weaving is estimated at 20,000 looms. Therefore this study covers about 27% of the total equipment.

Table 7.7 Weaving Factories Surveyed

Area	Number of Companies	Number of Weaving Units	Equipment (Looms)
Hanoi area	7	3	2,600 Looms
Ho Chi Minh City area	8	5	2,262 Looms
Da Nang area	4	4	562 Looms
Total	19	12	5,424 Looms

2) Production Technology Problems

The loom is the heart of the weaving process, and shuttles have been used to insert weft yarn since the Industrial Revolution. Because these shuttle looms have technical limits of productivity and quality, some shuttle-less looms have recently been developed. So far, there have been several shuttle-less looms put into practice. One example is the Rapier loom, which uses rigid sticks to insert weft yarn. Another is the water-jet loom, which uses high pressure water, and also an air-jet loom, which also uses high pressure air for weft insertion.

Machines that use this new technology have realized high productivity and high quality.

(a) Modernization of the Loom

The old shuttle looms account for about 80 % of the weaving in the Vietnam factories visited in this survey. The Hanoi and Da Nang areas, especially, lag behind in modernization.

Most of the modern looms, such as the Rapier loom or the air-jet loom, are installed in Ho Chi Minh City area factories.

(b) Automation of the Shuttle Change Process

Among the old shuttle looms in use, many machines still utilize a manual-type shuttle change. This manual, shuttle change-type loom is not only low in productivity, but also has quality problems. Owing to machine stoppage at each shuttle change, fabric unevenness occurs because of variation in warp tension, especially in thin fabric weaving.

(c) Weaving Width

The width of weaving fabric is limited by the specifications of the loom. The weaving widths of old shuttle looms were mostly 1 yard (91.4 cm), according to old English standards. However, recently products woven from wide width machines of more than 150 cm are principally accepted in the market. In Vietnam there are many old shuttle looms with narrow widths, so the number of export products are limited because they are low value-added items.

(3) Dyeing Process

1) Outline of this Survey

The outlines of dyeing factories visited in this survey are shown in Table 7.8. This survey included a study of the apparel washing process at garment factories.

Table 7.8 Dyeing and Washing Factories Investigated

Investigated Area	Number of Enterprises	Number of Dyeing Factories	Number of Washing Factories
Hanoi Area	7	5	2
Ho Chi Minh Area	8	7	
Danang Area	4	3	1
Total	19	15	3

2) Production Technology Problems

(a) General

The dyeing industry is a prominent industry which generates a lot of industrial pollution because it uses a lot of water and chemicals, and discharges most of them outside the factory. With the advancement of dyeing technology, the quantity of water and chemicals used in the processes have decreased. However, this industry still consumes plenty of water and chemicals compared with other industries. For the ultimate dyeing process, a complete closed system which does not discharge any wastewater outside the factory has been studied, and has become practical because of the progress of membrane utilization technology. However, it will be far into the future before this technology becomes standardized because of its high cost. For this reason the standard method used for countermeasures for the prevention of industrial pollution in the dyeing industry cannot be anything but End of pipe. However, “Cleaner Production” has a lot of significance for End of pipe technology. In advanced countries, including Japan, “Cleaner Production” has been adopted and used as a measure to reduce pollutants through improvement of dyeing machines, the dyeing method, dyestuff, chemicals, etc. and the recovery of re-usable materials in wastewater. Furthermore, a reduction in production cost, including energy conservation technology for heat recovery, expansion of markets and an increase in profit ratio through the introduction of more valuable products has been executed. These help compensate for the additional cost which results at the End of pipe.

In the Vietnamese dyeing industry, the introduction of End of pipe technology is gradually advancing, but the introduction of “Cleaner Production” technology seems to be far away.

(b) Types of Dyeing Machines

The dyeing industry in Vietnam is generally made up of minor enterprises, so continuous dyeing machines which have high productivity are only slightly utilized. Only one factory among the factories surveyed has introduced a continuous dyeing machine. Some factories have introduced partial, continuous dyeing machines which continuously treat the scouring and bleaching process for towels.

Batch-type machines are the main machines used for fabric dyeing. Most batch type dyeing machines are for rope-like fabrics. Older machines are wince-type and relatively new machines are liquid flow-type. However, most of the liquid flow-type machines were made 10 years ago, and even relatively new machines use old technology. A considerable amount of jigger-type machines for spreading fabric are in use. Jigger-type machines are useful for special purposes, such as for heavy weight fabrics. However, many jigger-type machines are used for general fabrics, and when this happens the dyeing process is inefficient.

Most of the dyeing machines are made in Taiwan and Hong Kong, and some machines are made in Japan, the EU and the US.

(c) Low Liquid Ratio Dyeing

In batch-type dyeing machines (particularly, in the liquid flow-type) the volume of chemicals placed in the machine is determined by the concentration of the dyeing bath without relation to the weight of fabrics. Most of these chemicals are discharged into the wastewater. Therefore, a reduction of the liquid ratio is the most effective method for decreasing pollutants discharged from the dyeing process. In advanced countries, the liquid flow-type or the air flow-type, whose liquid ratio is 1:3～1:8, are popular. However, batch-type dyeing machines which are commonly used at the factories surveyed are based on this technology, as well as are old machines, so the liquid ratio of the machines is pretty high, between 1:10～1:12.

(d) Dyeing Technology

The factories investigated use popular dyestuff such as Reactive dye, Direct dye, Sulfur dye and VAT dye for cotton and Dispersion dye for polyester.

Used chemicals are popular too such as NaOH and Na_2CO_3 for scouring, H_2O_2, Na_2SiO_3 and NaClO for bleaching, and Acetic Acid and H_2SO_4 for neutralization.

Recently, the following new dyestuff and new dyeing technology has been developed:

1. Alkali proof-type dyestuff which can dye polyester under alkali conditions and omit the neutralization process after scouring.
2. Alkali decomposition-type dyestuff which can dye polyester/cotton mixture fabrics in one bath.
3. Multifunctional dyestuff which increases the fixing ratio of reactive dyestuff.

The factories surveyed use ordinary dyeing methods.

(e) Supply Water Quality

Most of factories surveyed utilize well-water. Only a few factories have installed water treatment systems. However, these systems are very simple and the treatment is imperfect. Therefore, supply water quality is very bad at most of the factories. Supply water quality is far out of range of the Japanese standard. In the dyeing process, chelate agents seem to be utilized for blocking ions, but this method seems to be imperfect (Details are unknown). One large factory directly takes water from a river and treats it by coagulation, sedimentation and then it passes through a sand filter. However, the quality of the treated water is not good. Water quality is a very important factor for determining the quality of products, so it is necessary for factories in the textile industry to install water treatment facilities.

(f) Finishing System

In the finishing process, the width and softness of fabrics are adjusted. In addition, some functions like anti-static, water-repellency, anti-crease, anti-bacteria, etc. are added. Such treatment is carried out using a stenter and then lastly, the fabrics are dried. In Vietnam, this treatment is carried out using a standard method, but most of the machines in use are very old and inefficient, so the addition of functions to fabrics is restricted.

(g) CCM

At dyeing factories, the color requested by customers is adjusted using a combination of several dyestuffs. This is called Color Matching. Usually, 50〜80 kinds of dyestuff are used at each factory. However, Color Matching does not only consist of adjusting colors, but in addition, the dyeing method, the cost of dyestuffs, color fastness, etc are also considered. Otherwise, if these items aren't taken into account, colors cannot be matched suitably. Recently, a computer system (CCM = Computer Color Matching) for color adjustment was developed and it has brought about a decrease in the numbers of test dyeing at color adjustments and helped cut down dyestuff and energy consumption. Product yield has also improved through an advance of reproducibility in production. This has resulted in dyestuff, chemical and others savings. Among the factories surveyed, several factories have adopted this system. However, at most of the factories, color matching is carried out manually. This computer system is expensive, therefore it is difficult to introduce it into minor enterprises. However, from now forth it will be necessary to introduce CCM in most factories.

(h) Color Kitchen

For dyeing, it is necessary that dyestuffs and chemicals be scaled to a prescribed quantity and mixed. Recently, through connecting to a computer with an automatic scale, a working robot has been developed for carrying out these operations. However, generally, chemicals are scaled, mixed and homogenized manually, or by an agitator. These operations are very important because they influence the quality of dyed products. Therefore, operation errors and the contamination of other materials have to be absolutely prevented. In the factories surveyed, all these operations are carried out manually. However, as a matter of cause, operation manuals are deficient and handling and storage of chemicals is very confused. Therefore, this increases the possibility of operation errors or contamination to take place and it results in deterioration of product quality.

(i) Laboratory Facilities

In dyeing factory laboratories, test dyeing is carried out based on a dyestuff and chemical recipe which is matched by CCM or a technician, and then finally the dyestuff and chemical recipe is decided. In addition, a color check of the dyed products is executed as well. Therefore, the laboratory plays a very important role for dyeing factories. In most of the factories surveyed, laboratory facilities are insufficient and the inside of the laboratories are in disorder. It seems that there are obstructions for making recipes and checking color.

(j) Automation

Automation of dyeing machines has become popular due to the progress of automation technology, in particular, micro-processor technology. In automatic, liquid flow-type dyeing machines, the dyeing step program is not only automatically carried out, but also the heating-up, cooling-down and volume of liquid, as well as multi-valves for discharge, are controlled. As a matter of cause, this contributes to simplify the operation and furthermore, helps improve the quality of products and increases productivity. In Vietnam, it will be difficult for automation to become widespread because labor cost is very inexpensive. However, from the point of view of improving product quality and increasing productivity, automation of dyeing machines should be considered. In the case new dying machines are procured, automated machines should be adopted.

(k) Heat Recovery

Typical examples of heat recovery in the dyeing process are as follows;

1. Recovery of steam condensation from the steam heater to the boiler
2. Reuse of warmed cooling water from the heat exchanger of dyeing machines as process water
3. Heat recovery from high temperature wastewater to process water
4. Heat recovery from exhaust gas of the Stenter and the Dryer

Among the factories surveyed, only a few factories reuse warmed cooling water. Some factories do not even recover steam condensation. Most of the factories do not recover heat energy from wastewater or exhaust gas from the dryer.

(4) Apparel Washing

Some apparel manufacturing factories wash apparel for cleaning, softening and stone washing. Facilities in these factories consist of horizontal washers, centrifugal separators and dryers. The washing process is simple and pollutants from this process are mainly suspended solids. However, in the stone washing and softening process, other pollutants are discharged. Some facilities are very old and not in good condition.

7.2.2 Present State of Production Management Technology in the Textile & Garment Sub-sector

(1) General

The present condition of production management in the factories surveyed is at a very low level except in some of the sub-sectors, and many factories are not under normal controls. Factories whose export rate is low are not aware of the quality issue. These factories are far away from being competitive internationally.

(2) Quality Control

Quality control is hardly carried out at the factories surveyed. There is little concern for quality control from the top management on down to the shop-floor workers.

The starting point for quality control is the standardization of operations. It is necessary to standardize all operations and make operation manuals. Workers should be trained and not left to operate the machines as they like. They should operate the machines following the instructions in the manuals. If this is done then variation in quality will be prevented and the company will be able to guarantee quality to it's customers.

It is important that operators participate conscientiously quality control activities and it is desirable that a proposal system for process or equipment improvement, notification of operation results and small group activities be implemented. Furthermore, it is necessary to introduce a TQM system.

Among the factories surveyed, some factories have already received ISO9002 certification and other factories have begun the certification program. It seems that many other factories want to obtain the certification in the near future.

These factories are motivated to get the certification in order to promote the export of their products. They attach importance to this program, for form's sake, without understanding the real essence of quality control. However, for ISO9002, operation standardization is a big theme. Therefore, in Vietnam, it may be an effective method to reinforce the quality control system.

(3) Cost Management

"Cost" has become a bigger and bigger factor for survival in international competition. The factories surveyed generally lack cost awareness. They do not even grasp the concept of unit consumption for each product which is a basic principle of cost management. For the time being, they need to grasp what the material balance of raw materials and utilities is as perfectly as possible. Then it will be necessary for them to analyze costs and study a scheme for cost reduction. (In Vietnam, the weight of labor cost is very low in the total cost, so labor productivity cannot help but be put off.)

(4) Maintenance

Equipment management ability is low at most of the factories surveyed and the maintenance of old machines is especially bad. The lack of a maintenance function results not only in the decrease of production capacity, but also has a bad influence on product quality, corrupts unit consumption, decreases equipment life and causes big damage to the factory. It is desirable that the maintenance function be reinforced in order to respond to ordinary maintenance needs and equipment troubles.

(5) Arrangement and Cleaning

Things are not kept in good order at most of the factories surveyed, and the inside of the factories are also very dirty. Improper arrangement, disorganization and poor cleaning habits result in materials waste, inefficient use of space, decrease in working efficiency, a loss of customer's trust, frequent occurrence of machine trouble, an increase in working hazards, environmental pollution generation, influence on product quality and a decline in employee's moral.

The "5S movement", which is carried out in some parts of Vietnam, should be adopted. There are only two plants in Ho Chi Minh City which are executing the "5Smovement" among the factories that were surveyed.

(6) Education & Training

Many of the factories surveyed are suffering from an insufficiency of engineers. The development of engineers is indispensable for helping solve technical and management problems. There is no technical education system for dyeing technology in the industry, so the factories have to train engineers by themselves.

This is a very important project that will help lift up workers' skill and morale as well. The factories surveyed have a tendency not to attach much importance on labor efficiency because of the low cost of labor. It is impossible to deny that this tendency results in a decline of work quality. However, lack of worker education and training causes costs to climb due to a decline in productivity and product quality which is separate from labor cost. Before anything else, worker education and training needs to be more thorough, operation manuals for quality control need to be put in place, and a system to upgrade morale, like the 5S Movement, Improvement Proposal System or Small Group Activities need to be prepared.

7.2.3 Relation Between the Problems and the Causes

Figure 7.1 shows a diagram of the relation between the causes and the problems.

7.3 Countermeasure for Technical Improvement in the Textile & Garment Sub-sector

7.3.1 Existing Problems in the Textile & Garment Sub-sector

The following problems currently exist in the Textile & Garment Sub-sector:

1. Superannuated equipment
2. Outdated production technology
3. Insufficient countermeasures for energy conservation
4. A lack of quality control
5. A lack of cost management
6. An imperfect maintenance system
7. Insufficient organization and a lack of concern for keeping factories clean
8. A lack of education and training
9. A lack of wastewater treatment equipment

7.3.2 Countermeasures for Improvement by Promoting Cleaner Production Technology in the Textile & Garment Sub-sector

(1) Machine Maintenance

(a) Improvement of Draft Parts in the Spinning Process

In order to improve the draft parts of machines in the drawing and roving process, it is necessary to replace the existing old-type machines with modernized machines.

For the spinning process, it is better to re-design only the draft parts rather than to replace whole machines because the investment cost of replacing spinning flames will become enormous if whole machines are replaced. With this improvement, the quality of yarn evenness will be improved and it will be possible to produce a high, value-added product.

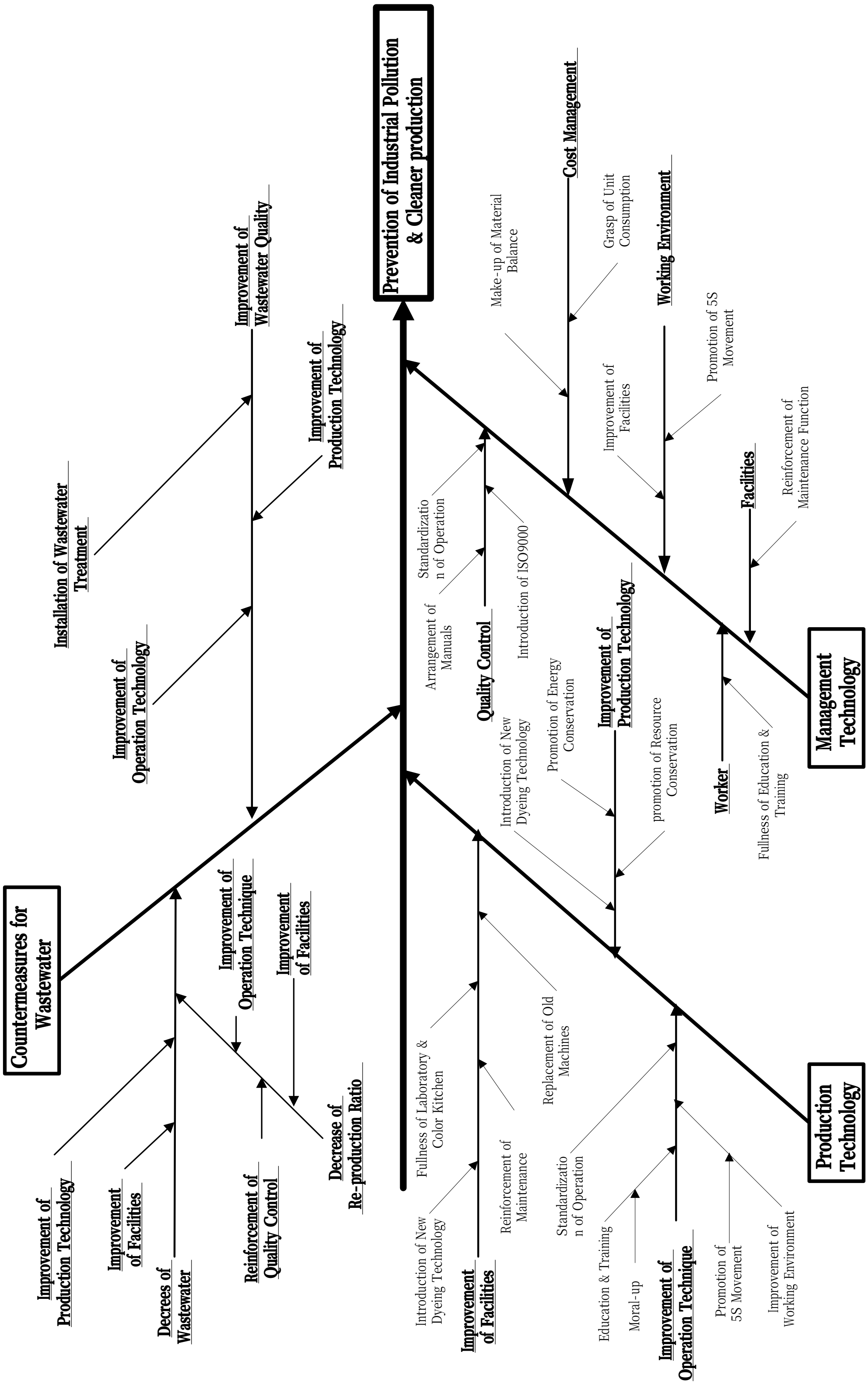


Figure 7.1 Problems and causes of Industrial Wastewater and Cleaner Production in the Textile and Garment sub-sector

(b) Large Packaging Systems in the Spinning Process

The target processes for installing large packaging systems that enlarge cans and bobbins are mainly the drawing and roving processes. In order to implement this system, it is necessary to replace machines with one's that have a more suitable design. This improvement should be implemented in the case the old type equipment is replaced, as suggested above. It is expected that quality and productivity will be greatly improved by taking this measure.

(c) Modernization of the Winding Method in the Spinning Process

There are two ways to introduce a splicing system in to the winding process.

One way is to install the most advanced, fully-automated machines, and the other method is to attach a manual splicing system to existing winding machines. Because investment in fully-automated winding machines is very expensive, and also because they consume a large amount of power, it is advantageous to choose the latter for the time being in Vietnam because the cost of labor is so inexpensive.

Like the splicing system, there are two ways for introducing the electric yarn clearer into the winding process. One way is to install fully automated machines, and the other way is to replace existing mechanical-type winding machines. Because the latter are inexpensive it is advantageous to introduce machines like these. It will be possible to produce high quality products that can be adapted to the export market through these investments in modernization.

(d) Modernization of the Weaving Process

There are many problems with quality and low operating rates of old shuttle looms in Vietnam. Therefore, these looms should be modernized by gradually installing advanced looms, like rapier looms or air jet looms. However, before the equipment is renewed, it is important to choose a model which can cope with the requirements of the market, and it is also important to select an appropriate fabric width when considering machine specifications.

Through loom modernization, it will be possible to produce high quality products that can be adapted to the export market. An increase in the production quantity and an increase in the operating rate of weaving factories is also expected to come along with this modernization.

(2) Introduction of Low Liquid Ratio-Type Dyeing Machines

Superannuated dyeing machines (mainly Wince-type) or inefficient machines (mainly Jigger-type) need to be renewed. Also an increase in low liquid ratio-type machines should be facilitated, as far as they have no functional problems. Accordingly, the quantity of discharged wastewater and chemicals will decrease. Furthermore, it will be possible to improve productivity and to produce high value-added products.

(3) Introduction of New Dyeing Technology

As much as possible, it is desirable for enterprises to introduce the following new dyeing technology:

1. The utilization of an alkali-proof dyestuff for polyester will enable reduction washing to be eliminated and it will result in the reduction of water, steam and chemicals.
2. Utilization of a one-bath dyeing method for the polyester and cotton mixture will enable the consumption of water, steam and chemicals to be reduced through process reduction.
3. Multi-functional dyestuff for cotton dyeing can improve the dyestuff fixing ratio and it will result in reduction of the volume of dyestuff discharged into wastewater.

(4) Laboratory and Color Kitchen Improvement

The following countermeasures are urged to be adopted:

1. Laboratory facilities need to be completed in order to improve test dyeing, recipe preparation and to rationalize product inspection, which will decrease the reprocessing ratio.
2. Introduce CCM (Computer Color Matching System) in factories in which it has not yet been introduced in order to improve the color matching method.
3. Prepare color kitchen facilities in order to improve the accuracy of scaling, prevent contamination and to improve the working environment.

(5) Waste Heat Recovery

The following countermeasures are urged to be adopted for better energy conservation:

1. Recover steam condensation where it is currently not being recovered. (Refer to Figure 7.2)
2. Recycle cooling water from the heat exchanger and use it as process water. This makes possible the recovery of heat energy and reduces the consumption of supply water. (Refer to Figure 7.3)
3. Recover waste heat of high temperature wastewater coming from dyeing machines through heat exchange between waste and process water. This results not only in the recovery of waste heat energy, but also shortens the heating time of process water and decreases the temperature of wastewater to a suitable level for wastewater treatment (Activated sludge system). (Refer to Figure 7.4)

(6) Reinforcement of Management System

The following countermeasures are urged to be adopted to reinforce the management System:

1. Reinforce the quality control system
   The first step for realizing this countermeasure it for top management recognize that quality control is essential. After that, it is necessary to reinforce the quality control system, make and observe standard manuals and educate employees on quality control are necessary issues.
2. Perform thorough cost management
   In order to do this, the flow rate of raw materials and utilities needs to be grasped in detail by measuring them directly or through an engineered calculation. Then a material balance chart needs to be made. After that the unit consumption for each product per month should be calculated. Through factory management utilizing this data, west-fullness will eliminated, management will quickly recognize items that need to be improved and cost reduction will be achieved.
3. Reinforce the maintenance system for facilities
   The performance of the facilities will be fully exhibited, productivity levels will be maintained and secured and the quality of products will be maintained. For this purpose, it is necessary for the company to come up with a management concept that focuses on maintenance and the training of maintenance staffs.
4. Thoroughly organize and clean the inside of factories through promotion of

the “5S movement”

As a result, a waste-fullness will be eliminated, a consciousness for maintaining cleanliness will be instilled in workers and those measure will be a leading force for securing quality improvement. Productivity will also increase and a gain in customer’s trust will follow. In order to implement these measures, strong leadership of top management is inevitable and the introduction of “small group activities” is desirable.

7.3.3 Countermeasure for Improvement by End of Pipe Technology in the Textile & Garment Sub-sector

(1) Equalization Tank

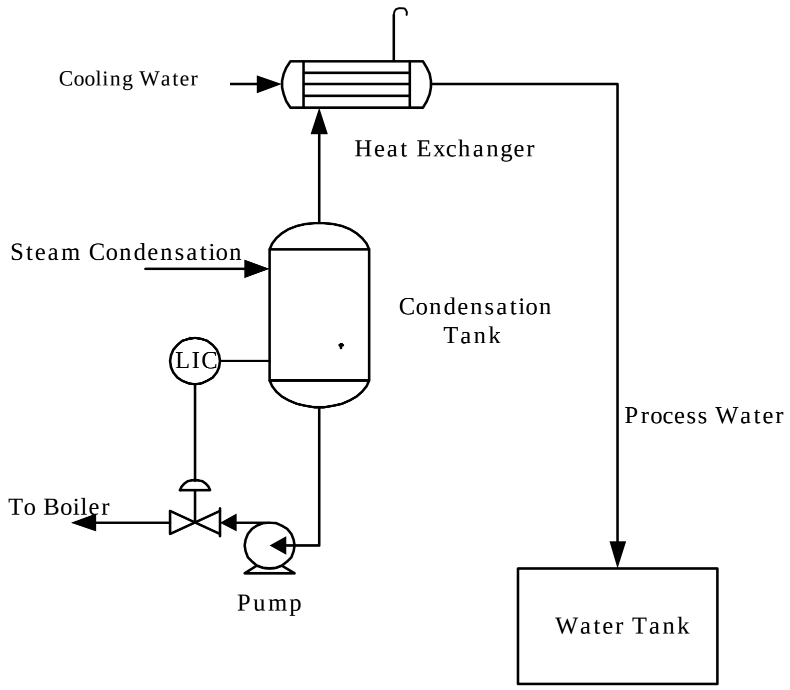
In Vietnam dyeing factories, most of the dyeing machines in use are batch type. Therefore, the wastewater quality changes drastically by time zone, because batch type machines discharge various types of wastewater intermittently such as dyeing, washing, scouring and bleaching wastewater. Because of this, it is first necessary to install wastewater tanks to equalize water quality before wastewater treatment.

The capacity of equalization tanks should be designed to hold more than 1/2 of the wastewater discharged per day.

(2) Wastewater Cooling

In Vietnam, most dyeing factories do not recover heat energy from wastewater. High temperature wastewater is discharged, as it is, outside of factories. High temperature drainage like this must be cooled because, not only does it have a bad influence on the ecosystem, but it also decreases the efficiency of biological wastewater treatment. The best way to lower the temperature of wastewater is through heat recovery using a heat exchanger or recovering steam condensation in the dyeing process.（ Refer to 7.3.2(5) ）

In addition to these methods, another way to cool high temperature wastewater is to install a trickling cooling tower after the equalization tank.

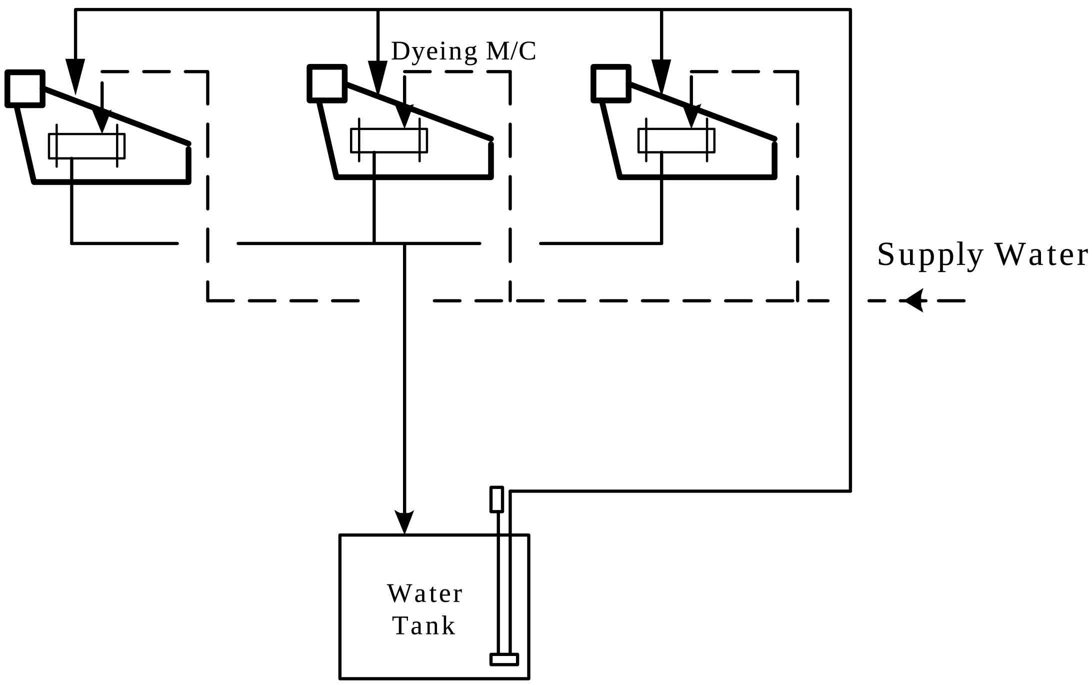


1. Process Condition	Case 1	Case 2
(1) Recovered steam condensation	5 t/hr	10 t/hr
(2) Temperature of condensation	80 ℃	80 ℃
(3) Temperature of supply water	30 ℃	30 ℃
2. Investment cost		
(1) Imported equipment	24,000,000 VND	24,000,000 VND
(2) Domestic equipment	15,000,000 VND	20,000,000 VND
(3)Construction	30,000,000 VND	45,000,000 VND
Total	69,000,000 VND	89,000,000 VND
3. Cost merit		
(1) Recovered heat	250,000 kcal/hr	500,000 kcal/hr
(2) F.O. reduced	26 lit/hr	52 lit/hr
(3) Cost of F.O. reduction	46,800 VND/hr	93,600 VND/hr
(4) Electricity increase	1.52 kWh	2.2 kWh
(5) Cost of electricity increase	1,200 VND/hr	1,760 VND/hr
(6) Cost merit per year	164,000,000 VND	3300,000,000 VND

Note: Price of F.O.= 1,800 VND/lit Price of Electricity = 800 VND/kWh

Operating hours = 12 hrs/day Operating days = 300 days/year

Figure 7.2 Recovery System of Steam Condensation



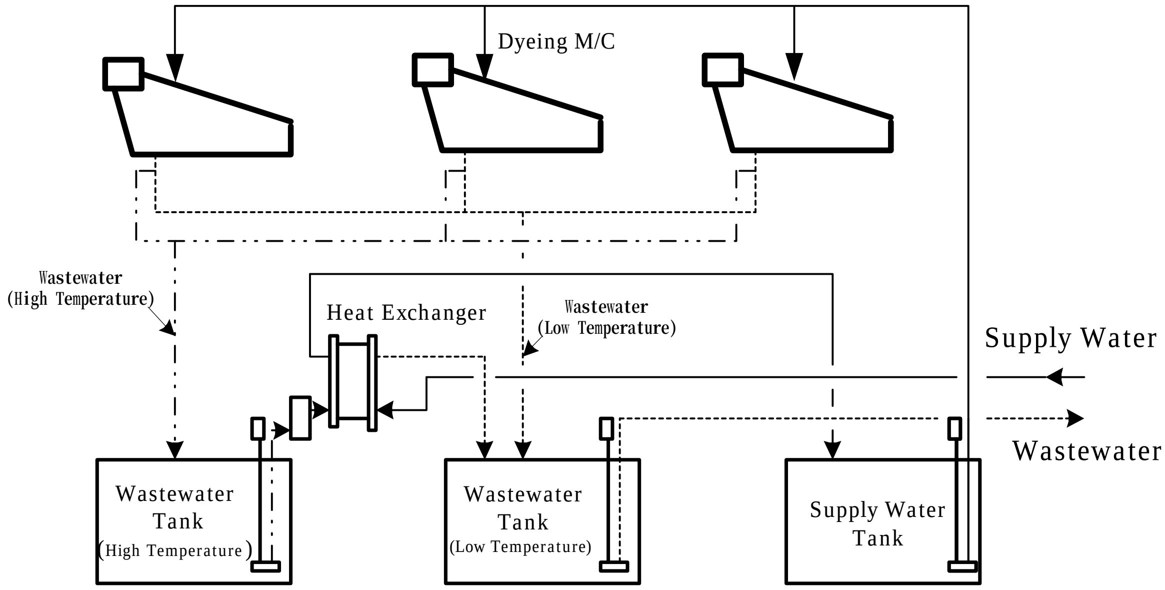
Process Condition	Case 1	Case 2
Rate of Wastewater	10 m^3/hr	20 m^3/hr
Temperature of Supply Water	30 ℃	30 ℃
Temperature of Recovered Water	40 ℃	40 ℃
Construction Cost		
Domestic Equipment	5,000,000 VND	7,000,000 VND
Construction Work	65,000,000 VND	85,000,000 VND
Total	70,000,000 VND	92,000,000 VND
Cost merit		
Heat recovered	100,000 kcal/hr	2,000,000 kcal/hr
F.O. reduced	10 lit/hr	20 lit/hr
Cost of F.O. reduction	18,000 VND/hr	36,000,VND/hr
Electricity increase	2.2 kWh	3.7 kWh
Cost of Electricity increase	1,760 VND/hr	2,960 VND/hr
Water reduced	10 t/hr	20 t/hr
Cost of Water reduction	10,000 VND/hr	20,000 VND/hr
Cost merit per year	94,460,000 VND	190,940,000 VND

Note: Price of F.O.= 1,800 VND/lit Price of Electricity = 800 VND/kWh

Price of Water = 1,000 VND/t (City water)

Operating hours = 12 hrs/day operating days = 300 days/year

Figure 7.3 Recovery of Cooling Water



Process Condition	Case 1	Case 2
Rate of Wastewater	20 m^3/hr	50 m^3/hr
Temperature of Wastewater(Inlet)	80 ℃	80 ℃
Temperature of Wastewater(Outlet)	40 ℃	40 ℃
Temperature of Supply Water(Inlet)	30 ℃	30 ℃
Temperature of Supply Water(Outlet)	70 ℃	70 ℃
Construction Cost		
Import Equipment	480,000,000 VND	800,000,000 VND
Domestic Equipment	15,000,000 VND	24,000,000 VND
Construction Work	265,000,000 VND	380,000,000 VND
Total	760,000,000 VND	1,204,000,000 VND
Cost Merit		
Heat recovered	800,000 kcal/hr	2,000,000 kcal/hr
F.O. reduced	83 lit/hr	207 lit/hr
Cost of F.O. reduction	149,400 VND/hr	372,600,VND/hr
Electricity increase	8 kWh	20 kWh
Cost of Electricity increase	6,400 VND/hr	16,000 VND/hr
Cost merit per year	514,500,000 VND	1,283,700,000 VND

Note: Price of F.O.= 1,800 VND/lit Price of Electricity = 800 VND/kWh
Operating hours = 12 hrs/day Operating days = 300 days/year

Figure 7.4 Recovery of Heat from Wastewater

(3) Biological Treatment Improvement

According to the results of the field study this time, most of the biological treatment in Vietnam dyeing factories is not effective for improving wastewater quality.

In order to improve the effect of wastewater treatment, pH adjustment inside the aeration tank is very important. Activated sludge treatment becomes most effective with a pH factor of around 6 or 7. If pH stays out of this range, the treatment ability of the bacteria decreases. Therefore, it is necessary to install a neutralization tank that can adjust pH right before the biological treatment tank.

For biological treatment, it is very important to breed bacteria that is suitable for the wastewater from each dyeing factory. These bacteria should be raised among other microorganisms which are suitable for the climate of Vietnam.

(4) Sludge Dehydrating System

As for dyeing factory wastewater treatment methods, it is possible to attain environmental standard compliance through the adoption of a combination of the activated sludge process and coagulating separation. However, both methods discharge large quantities of sludge during normal operations. So, it is necessary to install a sludge dehydrating system for the effective treatment of this surplus sludge.

7.4 Conclusion and Recommendations for Industrial Pollution Prevention in the Textile & Garment Sub-sector

7.4.1 Suggestions for Prevention of Industrial Pollution in the Textile & Garment Sub-sector

Countermeasures which are urged to be taken are shown in Table 7.9 and Table 7.10.

7.4.2 Measures Requested of Administrative Organizations

It is necessary, and also inevitable, to have the positive involvement and back up of the administrative organizations responsible for industrial pollution prevention in order to execute the " Proposals for Prevention of Industrial Pollution" outlined in the above paragraph 7.4.1. The Study Team proposes that the following countermeasures be taken by the administrative organizations:

(1) Promotion of Investment in Countermeasures for Industrial Pollution

The proposed countermeasures for industrial pollution will not bring in profits directly to the company. Therefore, it is reasonable to expect that enterprises will not tackle these matters constructively. Moreover, the Study Team has heard that even some of the administrative organizations that control SOEs have a conservative point of view regarding these matters.

The administrative organizations should take a positive attitude for investment in countermeasure for industrial pollution and clarify, and promote their position by hammering out policies that favor investment such as tax reductions, low interest rate financing or subsidization of investment in countermeasures for industrial pollution.

(2) Support an Elevation in the Technology Level

Technologies proposed as countermeasures for improvement have already been put to practical use on an international level. However, it is necessary that practical uses for technology be investigated by enterprises in Vietnam in order to develop or introduce suitable technologies for each enterprise. For this purpose, an elevation of the technology level at each enterprise, and in the industry as a whole, is necessary. Moreover, it is desirable that each enterprise develops technology or that the industry does. The following measures are necessary on the side of the administration to support an elevation of the technology level at enterprises, or for the entire industry.

1. Collect technical information from overseas and furnish it to enterprises.
2. Cultivate or dispatch talented engineers to help develop technology.
3. Develop basic technology at the request of enterprises.
4. Develop technology under the leadership of the administration.

(3) Diffusion of Management Techniques

The management techniques utilized play a great role in the success or failure of countermeasure for the prevention of industrial pollution. The role of the administration is important for promoting management techniques. The administration is urged to organize a system for promoting management techniques such as ISO 9000 series certification acquisition, enlightening employees on management techniques and popularizing the factory management systems like TQM, TPM or 5S.

(4) Set Up Model Enterprises or Model Factories

The administration needs to study the possibility of up setting a model enterprise or a model factory that utilizes Cleaner Production technology, energy conservation technology and technology for reducing industrial pollution. The administration should help finance or subsidize this project and open it to the public. It will offer the public the chance to see and hear about the actual conditions, the merits or usefulness of these technologies in relation to other enterprises, and it will result in the popularization and promote the introduction of these technologies.

Table 7.9 Recommended Countermeasures for Industrial Pollution Prevention (Short Term Countermeasures)

No.	Items	Merits
1	Installation of steam condensation recovery systems	To save energy Refer to Fig. 7.2
2	Recycling of cooling water	To save energy Refer to Fig. 7.3
3	Installation of heat recovery systems for wastewater	To save energy
		To lower the temperature of wastewater Refer to Fig. 7.4
4	Reinforce laboratory facilities	To improve test dyeing & recipe preparation
		To rationalize product inspection
5	Reinforce color kitchen facilities	To improve the accuracy of scaling
		To prevent contamination
		To improve the working environment
6	Reinforce quality control systems, including standardized operations and production of operating manuals	To prevent variation in quality
		To reduce production costs
		To guarantee quality to customers
7	Make up material balance charts and grasp unit consumption for each product	To eliminate waste-fullness
		To recognize items to be improved by management
		To reduce production costs
8	Reinforce the maintenance system	To maintain full performance of the facilities
		To maintain and secure productivity level
		To maintain quality of products
9	Promote the “5S Movement”	To eliminate waste-fullness
		To instill a consciousness for maintaining cleanliness in workers
		To secure quality improvement.
		To increase productivity
		To gain customer's trust

Table 7.10 Recommended Countermeasures for Industrial Pollution Prevention

(Long & Mid-Term Countermeasures)

No.	Items	Merits & Demerit
1	Introduce low liquid ratio-type dyeing machines	(Merits) Decrease the quantity of discharged wastewater and chemicals Improve productivity and produce high value-added products
		(Demerit) Expensive (In some cases, not economical)
2	Introduce new dyeing technologies	(Merits) Reduce consumption of water, steam and chemicals Reduce the volume of dyestuff discharged into wastewater.
		(Demerit) Need to develop or introduce the new technology
3	Introduce CCM	(Merit) Improve the color matching method
		(Demerit) Expensive
4	Install wastewater treatment systems	(Merit) Decrease Industrial Pollutants
		(Demerit) Expensive

7.4.3 Investment Demand for Industrial Pollution Prevention Countermeasures in the Textile & Garment Sub-sector

The demand for investment is shown in Table 7.11.

Table 7.11 Investment Demand for Countermeasures for Pollution Prevention

	Cleaner Production	Wastewater Treatment
Factories in the detailed investigation	5,600,000,000 VND	31,940,000,000 VND
Factories in the simple investigation	8,000,000,000 VND	45,487,000,000 VND
Total	13,600,000,000 VND	77,427,000,000 VND

Note: Investigation for Cleaner Production is only for energy saving.

Appendix 7

Outline of the Textile & Garment Sub-sector

1. Present Status

The Vietnam Textile and Garment Industry has been a very important industry in the Vietnamese economy over the past four decades. This industry has created thousands of jobs and attempted to meet the ever growing demand for clothing by the Vietnamese people. More important than this, the Vietnam Textile and Garment Industry stands fourth highest among foreign currency earning industries behind oil, rice and one other industry. The change in foreign currency earning of the Vietnam Textile and Garment Industry is shown in the following Table 7.A.1:

Table 7.A.1 Change in Foreign Currency Earning

Year	Foreign Currency Earning (million US$)
Year 1992	USD 211 million
Year 1993	USD 350 million
Year 1994	USD 550 million
Year 1995	USD 750 million
Year 1996	USD 1100 million

The average production growth rate in the Textile and Garment Industry is about 10.7% per year. 80% of the production capacity of the present Vietnam Textile and Garment Industry is accounted for by state-owned entities (including the Central government and local government-owned entities). The scale of private enterprises is very small and their production capacity is rated small. However, recently foreign invested enterprises (joint ventures or 100% foreign capital) have been remarkably increasing in number.

From the aspect of international relations, especially after entering into diplomatic relations with the United States, the diplomatic and trading relationships with foreign countries have been active. Vietnam has increased its international relationships rapidly by becoming an official member of ASEAN, entering into an agreement on the trading of textile products with the EU, and by having the Vietnam Textile and Garment Industry join the Asian Federation of Textile Industries.

The status of the Vietnam Textile and Garment Industry as of 1996 is as follows:

(a) 187 state-owned textile and garment enterprises (Central and Local), of which 72 are spinning, weaving, and dyeing finishing enterprises;

(b) Approximately 500 limited, joint stock or private companies, of which 460 are garment and embroidery enterprises which have mostly been set up since 1988. Some of them are quite well-equipped and are classified as having medium size production capacity. They make apparel for export to the EU or other countries. The number of small and medium size spinning, weaving, and dyeing finishing enterprises, especially knitting synthetic ones, have been increasing;

(c) Over 170 joint ventures and 100% foreign capital invested enterprises were granted. By the end of September, 1996, total foreign investment amounted to approximately 1.2 billion USD. 40 of these enterprise projects were either spinning, weaving, or dyeing finishing enterprises and accounted for more than 980 million USD;

(d) Among foreign capital investing countries in Vietnam, Taiwan and South Korea rank first and second in investment in spinning, weaving, and dyeing finishing enterprises. Besides these two countries, Japan and Hong Kong are the biggest investors in the sewing industry; and

(e) If projects expected to be initiated by the year 2000 are all approved, foreign invested enterprises will start production of the following products in the Textile Industry shown in Table 7.A.2

Table 7.A.2 Production Forecast in 2000 for Foreign Invested Enterprises

Products	Production Capacity (per year)
All kinds of fabric	400 million meters per year
Cotton & TC yarns	87,000 tons per year,
PE fiber	64,000 tons per year
POY	32,000 tons per year
PTY	25,000 tons per year
Embroidery & Sewing thread	1,000 tons per year
Knitted products	12,000 tons per year
All kinds of towels	4,000 tons per year
Woolen products	1 million units per year
All kinds of garment products	100-120 million pieces per year
Nonwoven fabric	28 million yards & other garment accessories

The Vietnamese government established the Vietnam National Textile-Garment Corporation (VINATEX) in 1995. VINATEX is one of eighteen State corporations designated to be operated by sector in the form of Groups and directly controlled by the government and the Ministry of Industry. This corporation is a leading organization in the Vietnam Textile and Garment Industry with 55 member enterprises, including 45 central state-owned enterprises. In addition, through its own finance company, investment funds targeted for business activities of its enterprises are supplied to a certain limit. The purpose of establishing this organization was to decrease unnecessary competition by uniting the textile and garment industry and simultaneously changing the industry structure to a more harmonious one by accumulating capital for its long-term development.

On the other hand, the Vietnam Textile-Garment Association, an association that all of the enterprises in the Vietnam Textile and Garment Industry are a member of, was established in September of last year with the aim of harmonizing business activities of its members without regard to business classification. (state-owned, private or foreign capital)

In the Vietnam Textile and Garment Industry, under the leadership of state-owned enterprises, most of its plants have a history of over 40 years. It has become necessary, without delay, to renew equipment and modernize, especially equipment that has been in use for 20 years or more. Between 1991 - 1995, a total of USD 200 million was spent for replacing spindles, weaving looms, knitting machines, sewing machines, and printing and dyeing finishing machines. In 1996, 100 million USD was invested, and it seems that about 30 – 50 % of old facilities were renewed.

Due to the introduction of new machines, the present total production capacity of the Vietnam Textile and Garment Industry per year is shown in Table 7.A.3.

Because the Vietnam Textile and Garment Industry cannot create raw materials, equipment, chemicals, and fashion designs by itself, subcontracting is a main source of income.

Not only does Vietnam have the right climate and the right type of land suited for silk and cotton production, but in addition, the oil industry is also developing remarkably. However, domestic cotton production could only meet 12% of the total needs in 1995 due to a lack of capital. Vietnam imports 100 % of its polyester yarns and cotton from foreign countries. In the polyester field, Vietnam has been calling for technology cooperation and investment from overseas.

Table 7.A.3 Annual Production Capacity of the Vietnam Textile and Garment Industry

Product	Production Capacity	Breakdown
All kinds of yarns	90,000 tons	Combed yarn: 22%, Carded yarn: 40%, T/C-CVC yarn: 36%, Wool, Acrylic, Jute, etc.: 2%
All kinds of fabric	380 million meters	High-quality products for export: 20%
All kinds of knitted products	22,000 tons	Warp knitted fabric & printed fabric are increasing rapidly.
All kinds of towels	25,000 tons	
Garment products	400 million sets	

The Vietnam Textile and Garment Industry has been severely hit by the influence of the Asian economic crisis and also, by imports from China, for the last few years. As other Asian countries place high priority on exporting goods to advanced countries because of the economic crisis, Vietnam has lost countries which Vietnam mainly exported to in the past. Furthermore, due to the collapse of Soviet Union, Vietnam's exports to the Soviet Union and Eastern European countries, where Vietnam was once allotted priority, have rapidly decreased. On the other hand, from China, which borders Vietnam on the north, many cheap goods are smuggled into Vietnam. These Chinese goods drive Vietnamese textile products out of the market.

The development of a fair market is, to a great extent, dependent on the recovery of the Asian economy and diplomatic efforts.

2. Future Prospects

Adjusting to take on upcoming opportunities, the Vietnam Textile and Garment Industry has planned to achieve the following:

(a) An average growth ratio from 1996 – 2000 of 15% per year;

(b) In the year 2000:

i. The production target for all types of fabric will be set at 1 billion meters, 30 – 50% of which will be made of domestic cotton;

ii. The export value of fabric products will be set at 2 billion USD, 40 – 50% of which will be made of domestic cotton.

(c) In the year 2010:

i. The production target of all types of fabric will be set at 2 billion USD, 60

– 70% of which will be made of domestic cotton;

ii. The export value of fabric products will be set at 4 – 5 billion USD, 60 – 70% of which will be made of domestic cotton.

To achieve the above targets, it is necessary to invest over 5 billion USD. More foreign capital invested companies need to enter into the Vietnam market and the Textile and Garment Industry needs to receive financial aid and loans from governments and banks all over the world.

According to the long-term development plan of the Vietnam Textile and Garment Industry, processing industries should gather in industrial zones where craftsmen who are superior in the production of raw materials, traditional weaving, or sewing goods, can give full scope to their ability. Consequently, the Vietnam Textile and Garment Industry will focus on the development of the following major industrial zones:

(a) Southern industrial zone under the leadership of Ho Chi Minh City

(b) Northern industrial zone under the leadership of Hanoi City

(c) Central industrial zone under the leadership of Hue and Da Nang

The Vietnam Textile and Garment Industry is trying to overcome its present hardships and aims for the same successful future that Japan, Taiwan and Korea have already achieved.

Chapter 8

Countermeasures for Wastewater Pollution in the Chemical Sub-sector

Chapter 8 Countermeasures for Wastewater Pollution in the Chemical Sub-Sector

8.1 Enterprises Surveyed

8.1.1 Selection of Enterprises for the Survey

(1) Enterprises Selected as Candidates for the Survey

53 enterprises were selected in the chemical sub-sector by MOI, the Government of Viet Nam as candidate enterprises.

(2) Selection Procedure and Selection Results of Enterprises Surveyed

1) General Survey Outline

21 enterprises were selected by MOI chemical experts and the JICA Study Team by evaluating data prepared by MOI on candidate enterprises, such as the scale of the enterprises, the volume of waste water discharged, the degree of pollution in the waste water, the location of the enterprises and other related data. The enterprises selected are located in the Hanoi region, Ho Chi Minh City region and Da Nang region respectively, and belong to SOEs governed by MOI, or are joint ventures with MOI and local government owned enterprises. This means that there were no non-SOEs among the enterprises selected.

The enterprises selected in the chemical sub-sector belong to the main chemical industry in Viet Nam and consist of the following industries;

Inorganic Basic Chemicals	4	enterprises
Fertilizer	4	enterprises
Rubber and Tires	4	enterprises
Detergents	4	enterprises
Battery and Dry Cell	3	enterprises
Pesticides	1	enterprise
Inorganic Gas Products	1	enterprise

The enterprises selected are located in the following regions;

Hanoi and Surrounding Region	10	enterprises
HCMC and Surrounding Region	9	enterprises
Da Nang and Surrounding Region	2	enterprises

Based on turnover in 1998 and the total number of employees, the enterprises surveyed were analyzed and the results are shown in Table 8.1.

Table 8.1 Turnover and Number of Employees of Enterprises Surveyed

Number of Employees	Turnover (billion VND)				
	<10	10-100	100-1,000	1,000<	Uncertain
<200					
200-500		SOE* 5	SOE 1		SOE 1 JV* 1
500-1,000		SOE 4	SOE 1		SOE 2
1,000<		SOE 2	SOE 3		SOE 1

(Data submitted by each Enterprise)

SOE: State Owned Enterprise / JV: Joint Venture Company

2) Detailed Survey

Four enterprises were selected as chemical sub sector representatives for a detailed survey based on investigation results and evaluation made by chemical experts from MOI and JICA, the degree of environmental pollution level and influence of the pollution level on the environment of each enterprise, and the possibility of good correspondence with the enterprise.

Fertilizer	2	Enterprises
Battery and Dry Cell	1	Enterprise
Pesticides	1	Enterprise

2 factories selected are located in the Hanoi and surrounding region, and 2 in the HCMC and surrounding region.

8.1.2 Industrial Wastewater Discharged from the Chemical Sub-Sector

(1) Types of Industrial Waste Water

There are many types of industrial wastewater discharged from chemical factories depending on the products, raw materials, additives and the processes utilized. The sources of industrial waste water vary and include discharged water from reactors and other equipment, washing water used for raw materials and intermediate products, washing water used for the production equipment or floor of the factory, cooling water etc. Also there are continuous discharges of water and batch wise ones.

In general the production plant for inorganic chemicals discharges acidic or alkaline waste water or water containing inorganic salt as a solid substance. Battery production plants discharge acidic waste water and water contaminated with heavy metals. The production plants for organic chemical products such as rubber products, detergents and insecticides discharge waste water showing relatively high COD or BOD value, and sometimes water that contains high SS outside the factory.

(2) Quality and volume of Industrial Waste Water

The results of analysis of the industrial wastewater samples collected at the final discharge point of each factory are shown in Table8.2.

The amount of industrial wastewater discharged from each enterprise according to the data explained or submitted by factory representatives is also shown in Table 8.2.

Table 8.2 Wastewater Quality of Enterprises Surveyed

Enterprise Number	Quantity (m^3/day)	Quality Parameter (mg/l) COD	BOD	SS	Oil
C01	180,000	26.4	15.8	114	0.2
C02*1	0	18	14	36	0.2
C03*2	30	120	48	4	0.19
C04*3	9,600	96	54	310	0.37
	2,880	74.6	29	270	0.42
C05	1,500	142	52	1,122	0.35
C06	200	220	78	61	0.2
C07	6,000	120	27	39	1.6
C08*4	40	520	350	56	1.2
C09	210	49	16	17	0.05
C10	830	124	76	56	0.15
C11	360	316	144	255	0.9
C12	Batch	320	193	59	0.19
C13*5	0	1,040	367	36	0.07
C14	700	19	11	5	0.16
C15	1,000	64	24	18	0.28
C16	816	23.2	9	45	0.13
C17	42	340	118	3,336	0.17
C18	500	1,120	560	1,000	0.23
C19*1	0	14.4	10	26	0.12
C20*5	0	40	19	81	0.25
C21	250	32	18	3	0.1
TCVN5945-1998		100	50	100	10

Source : (Data : Analyzed by the Chemical Engineering Corporation)

*1 Wastewater pool, no discharge to outside (only a reference)

*2 Wastewater from battery production

*3 Two kinds of waste water from different products

*4 Domestic waste water

*5 Recycling water

(3) Wastewater Treatment System

There are various kinds, scales and functions of wastewater treatment systems and these depend on the kind of wastewater itself. However, wastewater treatment systems in the chemical sub-sector in Viet Nam mainly have adopted primary level treatment such as primitive neutralization and sedimentation utilizing natural precipitation. Among the 21 chemical enterprises surveyed there are two enterprises that are adopting a secondary wastewater treatment system, such as activated sludge treatment.

(4) Waste Water Management

Almost all the enterprises surveyed have never implemented a periodical analysis of their industrial wastewater for all the necessary pollution items required to be monitored to improve productivity and avoid environmental impact. Periodical testing of pH is implemented in several enterprises on a daily basis. Not all, but some enterprises have submitted the results of EIA for checking their environmental impact, but the frequency of such reviewing should be increased more in the future. Many cases were observed where the sedimentation tank is filled with sediment because of insufficient management practices.

According to the results of sample analysis in this survey, much of industrial wastewater from the enterprises surveyed does not satisfy the national environmental code, TCVN 5945. Furthermore, there is no equipment for monitoring and alerting the factory on the quality of industrial wastewater, except in one activated sludge treatment system installed in a subsidiary company.

(5) Problems Related to Current Condition of Wastewater Treatment

According to the results of factory investigation, the following problems can be observed relating to the current condition of wastewater treatment.

a. Discharging high load wastewater because of insufficient management of production equipment
b. A large amount of discharged wastewater due to the outdated production method
c. Insufficient management of wastewater treatment facilities and moreover, decrease of treatment capacity because discharge wastewater all together
d. Inappropriate maintenance and remodeling of wastewater treatment facilities
e. Appropriate treatment is not done for material specific that requires to have a treatment

(6) Improvement for Waste Water Management

The important points for improving wastewater treatment systems are classified into two methods, improvement in the production process and improvement in the waste water treatment facility, including management.

< Improvement in the Production Process >

1. Maintenance and Modification of the Production Facilities

There are cases where the effectiveness of the wastewater treatment facilities has been decreased because of the influence of an increased pollution load caused by inadequate maintenance control of the production facilities and a lack of repair work. For instance, in one enterprise a huge amount of lubricant oil has been leaking from a big rotating machine into their drainage for other wastewater, and this was caused by inappropriate maintenance and a lack of awareness of the problem.

Such kinds of situations allows us to give very important, instructive and informative suggestions. This case brings light to several serious problems, such as the expensive cost of the loss of lubricant oil, cost for recovering waste oil, additional investment and increased maintenance costs for waste water treatment facilities, and these problems are additional to the problems of finding investment for improving or revamping machines and eliminating the continuous pollution flowing into the public watershed.

2. Reducing the Amount of Waste Water in Production System

There is one case where the discharged amount of wastewater greatly exceeds the optimum water usage and this is caused by inadequate operation control. For instance, a lack of attentive and quantitative management in the unit operation, washing or cooling of intermediate products or final products, such as in the production unit of tires and tubes, or batteries, causes a big loss of industrial clean water into wastewater. This results in an increase in clean water cost, increase in the electric energy cost for the water feed pump and a negative influence on the capability of waste water treatment facilities. This kind of water may not be so seriously contaminated if a recycling system is adopted to recover and reuse almost all water in the factory.

3. Separation and Classification of Discharged Water from Production Facilities

The polluted wastewater discharged when washing lead plates and the floor of production buildings, or through the washing of the H_2SO_4 container in the battery production factory pollutes other industrial wastewater from the factory. This is because such kinds of washing water usually is contaminated by heavy metals or strong acids.

In such cases, enterprises are faces with the difficulty of investing in larger scale wastewater treatment facilities that have preferable treatment methods or are more efficient for all the wastewater in the factory.

< Improvement in the Waste Water Treatment Facilities >

1. Maintenance and Modification of the Waste Water Treatment Facilities

The maintenance of wastewater treatment facilities is very important. There is one case of inappropriate maintenance in a large sedimentation facility for basic chemical production. The white, muddy and dirty wastewater is discharged directly into the common drainage even after passing through the sedimentation facility in the factory. Both of the two large sedimentation ponds in the factory are filled with accumulated precipitate of salt, and non removal of the huge amount of this solid causes the treatment of this expensive facility to be ineffective. Periodically undertaking maintenance to remove precipitate from each pond, in turn will make the sedimentation treatment in the factory highly efficient.

2. Appropriate Operation Controls for Waste Water Treatment Facilities

The treatment for removal of heavy metals is necessary for industrial wastewater in battery production and there are neutralization ponds and sedimentation ponds in the factories. However, there is one case where inappropriate operation control is causing a discharge of heavy metal contaminated water into the public watershed.

For example, in the case of neutralization by $Ca(OH)_2$ or caustic soda, lead is stabilized and precipitated as an alkaline salt at a pH value of around 9.5. However, if the pH control fails and is out of the expected range, the lead should be dissolved again in the water, but at this point it becomes difficult to catch lead for removal. Thus, even a pH adjustment is very important for effective industrial wastewater treatment and full utilization of the treatment facility.

3. Changing the Procedure for Waste Water Treatment

If the procedure for industrial wastewater treatment is inadequate, the quality of wastewater will not improve. For example, in the case of the washing water used for the equipment in the H_2SO_4 production, the procedure where only lime solution is added to acidic water is not enough for effective neutralization. In addition, there is wastewater discharge without pH control.

Operations like these cause a fluctuation in the flow rate and pollution level of wastewater in the whole factory. The installation of neutralization ponds and a moderate discharge of wastewater is a preferable countermeasure, and an adequate procedure for stabilization and improvement of all the waste water pollution in the factory.

8.1.3 Productivity in the Chemical Sub-Sector

The reasons why high load burden wastewater is discharged from factories are insufficient maintenance management for production equipment and leave bad conditioned equipment as it is. For example, a large volume of lubricant oil leakage occurs and oil flows to ditches because of poor maintenance; however, large oil separation equipment is installed instead of taking fundamental measures. This condition involves cost burden for renovating outdated equipment, and leading constant river water pollution as long as losses such as cost burden for buying lubricant oil, investment and maintenance costs for improving wastewater treatment equipment capacity, cost for collecting waste oil.

There are many factories operated without basic awareness of production management.

8.2 Analysis of the Current Status of the Sector

Current problems and their causes in the chemical sub-sector in Vietnam are as follows:

1) Process technologies used in each of the enterprises in the chemical sub-sector are said to be very outdated compared to current one's used in advanced countries. Production scale is also rather small and productivity is very low in many cases.
2) Old fashioned production processes and equipment are still in use in the chemical sub-sector, and technical improvements are not being implemented for modernization.
3) Automatic measurement devices and automatic control systems that are necessary for process management and technology improvement are not installed. Data analysis using statistical methods is also not fully conducted.
4) Even though there are many highly skilled personnel in the industry, improvement of process technology, and investigation and improvement of environmental pollution prevention technology concerned with processes are not being pursued.

5) Not only just for process technology, but it is hard to create a basic consensus for any kind of technology improvement among the industry because there are few systems for collecting and exchanging technical information within the industry.

Because of a lack of competitive experience among enterprises, and on an international level as well, especially in state owned enterprises, there is no consciousness for decreasing production costs and improving production quality. This may have brought on the current problems that now exist in the chemical sub-sector.

All enterprises belonging to the chemical sub-sector in western countries and in Japan are always facing competition from other enterprises, and both the administration and enterprises put a great amount of effort into every day activities to promote the industry and survive under these conditions. The administration implements countermeasures in order to prevent unfair competition and collects information and analyzes the information in cooperation with other industries. Individual enterprises try to reduce costs and improve production quality through collecting and analyzing data and information.

In order to solve problems in the chemical sub-sector in Vietnam, it is necessary to find problems and plan countermeasures for these problems, determine methods, procure necessary manpower, gather information, develop technological know-how, and procure financial resources. The following issues are very important for the chemical sub-sector in Vietnam:

1) Educating technicians and collecting information are very important. That is to say, strengthening technology and research and development functions, creating a technology information center, providing education and training for basic items related to production, and environment and equipment management. It is also important to hold seminars and invite lecturers from enterprises that are implementing advanced measures.
2) It is essential to modernize production processes and innovate at the same time by strengthening production capacity by grasping chances to expand production that go along with economical development. In order to do so, it is crucial to introduce improved technology with the support and financing of advanced countries, including establishing joint venture companies with these countries.

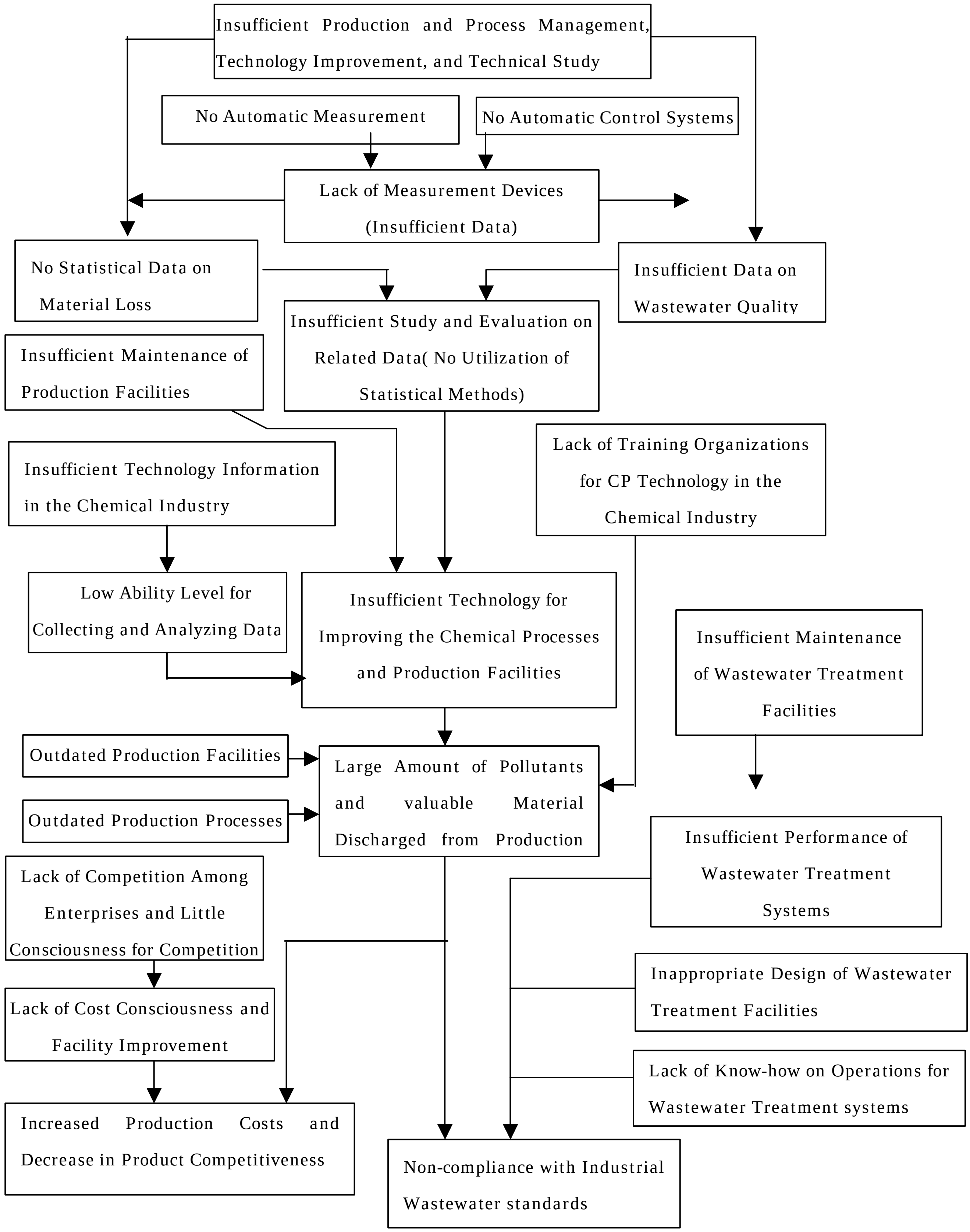


Figure 8.1 Problems and Causes

8.2.1 Current Status of Production Technology in the Chemical Sub-Sector

In general, the facilities utilized by the state-owned enterprises belonging to the chemical sub-sector in Viet Nam were installed mainly after the 1960s. However, some of these facilities were constructed in the 1910s, 1940s and 1950s and are still in operation now. These older facilities were built by domestic construction companies and also imported from the former Soviet Union, China, Taiwan and Korea. There are some exceptions, like a joint venture enterprise established in 1995 which owns their new facility and whose technology is supported by Western companies.

The current status of production technology for the 21 enterprises surveyed this time are summarized in the next section and examples of production technology for chemicals currently being introduced in the chemical sub-sector in Viet Nam are shown in the following diagrams. As a whole, the technology for producing chemicals is rather old fashioned and average, but depending on the chemical product and recent licensing by foreign companies, some kinds of advanced technology for chemicals production have been built into some facilities.

Production technology in the chemical industry field is used in many areas such as processing, production management, production quality management, facility maintenance, safety management of chemicals, processing and labor, environmental management, including pollution prevention, working environment, and to improve technology management so that other technologies mentioned before can be improved. This production management technology will be discussed later.

In this section, processing technology will be mainly discussed. The problems in the chemical sub-sector in Viet Nam are as follows:

1) Comparing processing technology used in the chemical sub-sector industries in Viet nam to that used in advanced countries, it can be said that Vietnam process technology is old fashioned, and stale. Also, there are many cases where productivity is relatively low because the scale of production is small and costs are rather expensive.
2) Many enterprises in the chemical sub-sector industry still use processes and equipment installed initially when the enterprise was established, and have not made any technological improvements in order to modernize.
3) Essential equipment for processing management and technological improvement in the chemical industry, such as automatic measuring and automatic control systems, are rather old and have no merits. Also, data

analysis using statistical methods has not been carried out successfully.

4) Even if they do have sufficient manpower of chemical industrial engineers, investigation and development of environmental pollution prevention controls in the processes comes with technological improvement to processes and most workers are not interested in this area.
5) Not only just for processing technology, but there are little efforts being made to develop other technology, like gathering and exchanging technological information with enterprises within the same industry. With only this kind of effort being made it is kind of difficult to make a firm basis for technology innovation.

Thus, in order to solve these problems, it is crucial to determine what causes the problems, and also to evaluate the problems. More over, solutions, manpower, information, technology and financial resources are needed in order to form and implement countermeasures.

The following are very important issues that need to be dealt with in the Chemical sub-sector in Viet Nam.

1) Raising the manpower level and collecting information are key tasks that need to be carried out. In order to raise the manpower level, education and training have to be provided to managers, technical experts, and engineers. Also, strengthening the function of technology and research and development, and the creation of a functioning technological information center are needed.
2) It is very important to grasp chances for expanding production following economical growth. In that case, it makes it easier to implement plans for expanding production capacity and modernize production-processing technology. It is also very important to make efforts to reform various aspects of the industry. To do so, it will be crucial that new technologies be introduced and installed with the support of advanced countries.

Concerning equipment management technology, there are examples where entire factories are maintained clean and in order. Also, these factories have a great concern for natural environmental maintenance, such as tree planting. On the other hand, they are not well managed from the aspect that production equipment is not well maintained and organized, and the unit site is not clean. Dramatic development is needed in maintenance management in order to maintain production equipment correctly.

On top of this, standards for maintenance management, as well as for the installation of safety and environmental pollution prevention equipment, are insufficient. It will be necessary to strengthen and improve these areas from hereforth.

(1) Inorganic Basic Chemicals

① Caustic Soda, Hydrochloric Acid and Liquefied Chlorine

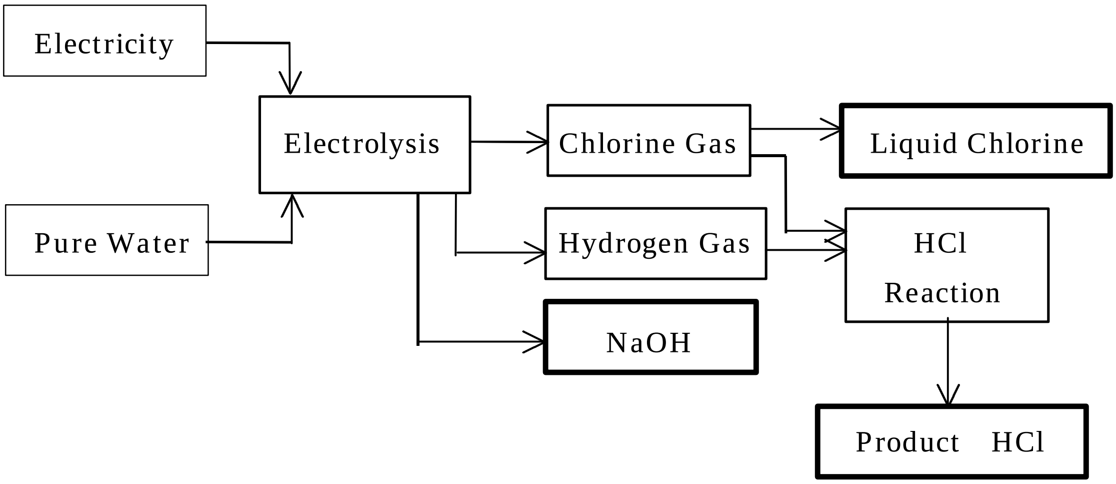


Figure 8.2 Block Flow Diagram of the Caustic Soda, Hydrochloric Acid and Liquefied Chlorine Production Process

① There are no problems with wastewater pollution caused by mercury, because they do not use mercury in their electrolysis method.

② On the other hand, the process, which is based on a diaphragmatic method, is taking care of the asbestos problem because the diaphragm is changed.

② Sulfuric Acid

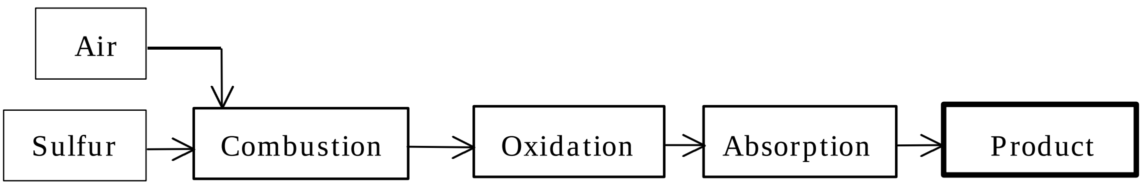


Figure 8.3 Block Flow Diagram of the Sulfuric Acid Production Process

① As a raw material, sulfur itself seems to be more preferable than pyrite. Only one factory uses both pyrite and sulfur because the production process is simplified and does not require a purification unit for removing dust and impurities when sulfur is used.

② Recovered Sulfur is imported at present in Viet Nam, but domestic recovered sulfur will be available when the petroleum industry is more developed in the future.

③ At present, although there is no use of recovered sulfur compounds from the exhaust gases for reducing sulfur resources used in the above mentioned three factories, a study on a recovery system might be necessary in the future from the point of view of environmental conservation and use of sulfur as a resource.

④ Even though all three factories have exhaust heat recovery boilers on each roasting furnace for raw materials, usage of steam from the boilers is inefficient.

(2) Superphosphate Fertilizer

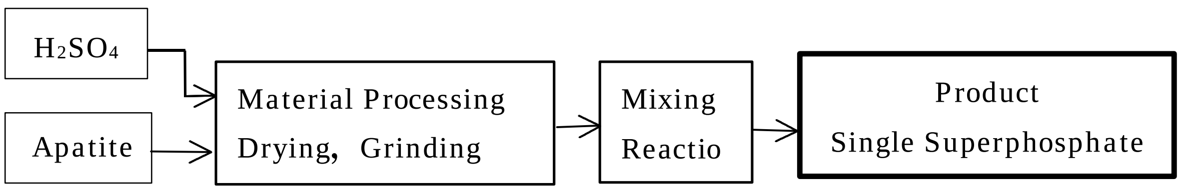


Figure 8.4 Block Flow Diagram of the Superphosphate Fertilizer Production Process

① More phosphor in apatite should be utilized through process improvement in the future.

② The concentrations of phosphor, fluorine and SS, and also turbidity in wastewater are much higher than expected.

③ A study on improvement for utilizing useful components such as phosphor and fluorine as raw materials is necessary in the future and would be effective for decreasing water use.

④ Heavy metals should be removed more efficiently from wastewater through precise pH control. There is a strong possibility that they can be recovered and used as useful resources.

⑤ Due to a slump in the business in pesticide market where the recovered fluorine was used, the merits of collecting fluorine are getting smaller. It is crucial to find new ways to use recovered fluorine, and to collect and reuse it efficiently.

⑥ Scattered phosphate rock, a raw material in the factory, makes for an unpleasant odor and creates a bad working environment and raises product costs. In order to reduce costs, collecting equipment needs to be improved, and management measures for strengthening collection must be implemented.

(3) Rubber

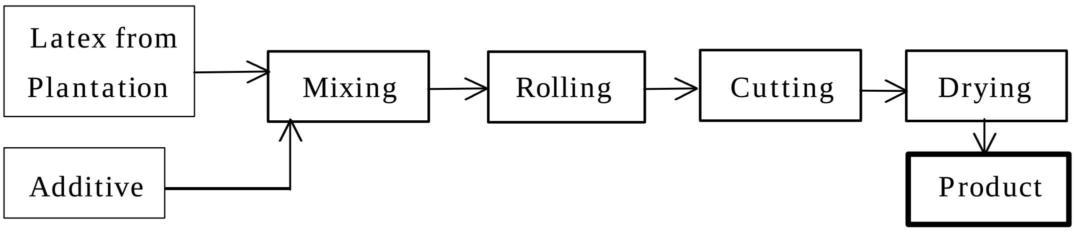


Figure 8.5 Block Flow Diagram of the Rubber Production Process

① Ammonia and formic acid are purchased in small containers, but the utilization of large size containers is recommended for reducing additive costs.
② A further study on the washing water system is urged for reducing water usage in the factory.

(4) Tires

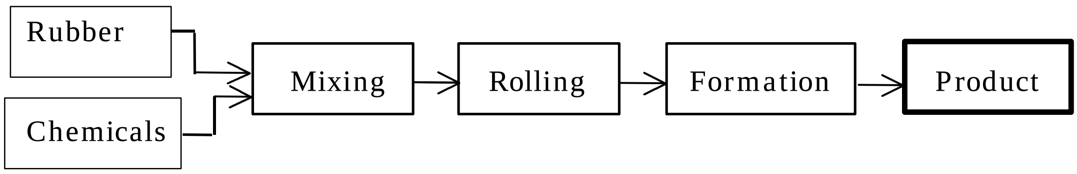


Figure8.6 Block Flow Diagram of the Tire Production Process

① Lubricant oil and fuel oil leakage from production facilities, boiler plants and transportation vehicles causes wastewater pollution and dirtiness in the factory. Stricter maintenance of facilities and vehicles are urged. Also, spilled oil should be cleaned up at all times.
② Carbon black and sulfur are scattered on the floor of the production lines. This also causes water pollution and dirtiness of the facilities. Countermeasures for the prevention of scattering and periodical cleaning of the floor are expected in the future.
③ Energy saving for fuel consumption and electricity consumption is possible through improvement of facilities, including effective maintenance.

(5) Powder Detergent

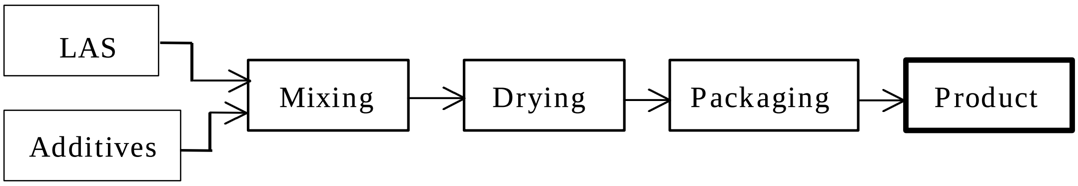


Figure 8.7　Block Flow Diagram of the Powder Detergent Production Process

① Work on fuel oil storage must be carried out more carefully to avoid oil spills on the ground, or oil will become one of the pollution factors for their wastewater in the future.

② In general, the packaging unit in powder detergent production is one of the key points for improvement of productivity. An automatic measuring and packing system should be adopted in the future.

(6) Battery

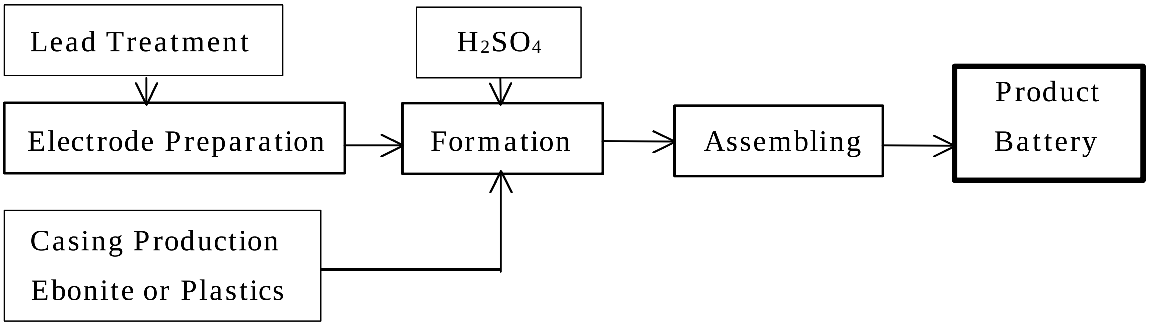


Figure 8.8　Block Flow Diagram of the Battery Production Process

① Wastewater at a low pH level and with high concentrations of contaminated heavy metals are the main problems in battery production. Stricter management of wastewater is urged for improving productivity and the environment. For example, for the water recycling system, periodical quality control on washing water and wastewater are necessary in the near future.

② In order to reduce the amount of washing water used, the area where washing water is used needs to be decided and countermeasures for wastewater quality, such as pH management using automatic pH analyzing equipment linked with controlling the amount of neutralizer, needs to be implemented.

③ Improve local ventilation systems and strengthen management of the working environment because a lot of sulfuric acid fumes generated by the battery production process makes the working environment worse.

(7) Dry Cell

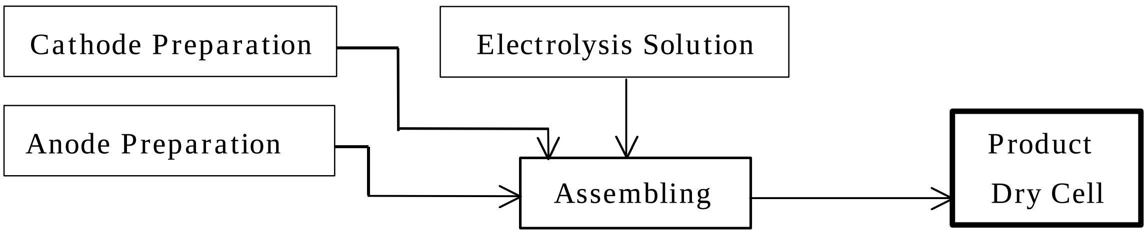


Figure 8.9 Block Flow Diagram of the Dry Cell Production Process

① Wastewater at a low pH level and with high concentrations of contaminated heavy metals are the main problems in dry cell production. Stricter management of wastewater is urged for improving productivity and the environment. For example, for the water recycling system, periodical quality control on washing water and wastewater are necessary in the near future.

(8) Pesticide

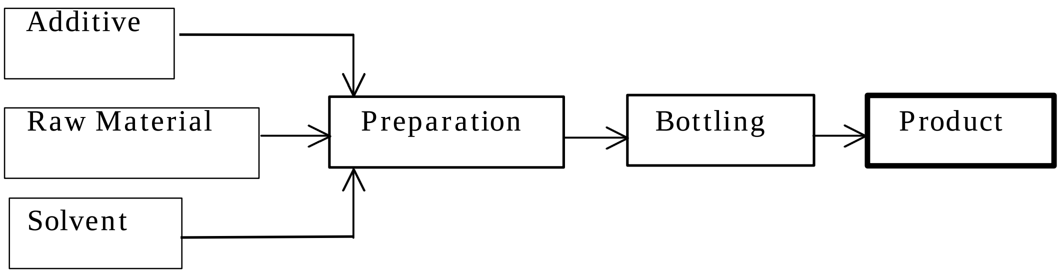


Figure 8.10 Block Flow Diagram of the Pesticide Production Process

① There is a bad odor caused by various chemicals used for pesticide production. Countermeasures for prevention of the bad odor should be taken in the near future. For example, modification of facilities such as protection from leakage and accumulation of the bad odor fumes using a draft system should be considered. For treatment and removal of the bad odors by activated carbon, absorption using an acidic or alkaline solution, or incineration are necessary.

② Wastewater is treated through activated sludge process equipment in a related company near by. However, heavy metals that are very hard to purify in activated sludge equipment, need to be eliminated through neutralization and precipitation processes in the factory before the activated sludge process. The activated sludge process equipment capacity in the neighboring factory is close to its limit. Thus, new activated sludge process equipment should be installed considering the amount of chemicals they use to produce products and the rate of contamination in the factory predicted according to production rates in the future.

③ The liquid pesticide packing process is nearly automated. However, because the packaging unit is not closed completely, improvement of equipment and a ventilation system are necessary.

④ Powder pesticide is packed manually using human-wave tactics, and is not automated. The working environment in the packing process is harsh because of scattered fine particles and their foul odors. Thus, the installation of automated packing equipment for powder pesticide, without delay, is necessary in order to improve the working environment and productivity.

8.2.2 Current Status of Production Management Technology and Problems in the Chemical Sub-Sector

Production management technology, not only in the chemical sub-sector, but in the entire manufacturing industry, can be divided roughly as follows:

1) Management for production itself

① Management of production plant operations

② Countermeasures for production troubles

③ Quality management for products, raw materials, and additives

④ Collection, analysis, evaluation, and determination of practical uses of production information and data.

⑤ Administrative activities for productivity improvement.

2) Management for supporting production

① Purchasing and inventory management for raw materials and additives

② Utility management

③ Stock and distribution management for products and by-products

④ Safety management for stable production

⑤ Environmental pollution control management for continuous, stable operation

⑥ Personnel management

The current status of production management technology in the 21 enterprises surveyed this time is summarized generally in the next section.

(1) General Production Management

1) The management technologies stated above are not used efficiently or implemented conscientiously in this sector. Many enterprises are using production management only for meeting their targeted production targets nowadays.
2) In addition, production equipment in use has few measuring devices, which are essential for obtaining needed data. As stated before, there are only a few cases where automated equipment is used for taking measurements, keeping records, and controlling systems. It can be said that production management information is not being provided successfully.
3) There are few observed cases where technological examination based on accumulated data, is being used in order to improve production management. Generally, in the chemical sub-sector, it is common to use data for changing the production situation and improving efficiency over the long term, as the basis for continuing and complying technical and management improvement for productivity.
4) It has to be said that environmental and safety equipment used for smoothly and efficiently supporting production management is unsatisfactory at this moment. When environmental issues are brought up or an accident occurs at a related plant in the chemical sub-sector, the factory has to take action, such as production adjustment or shutdown. In order to avoid these troubles, it is very important to find out the primary factors for the change in order to solve the problems.

   From this viewpoint, it is crucial to introduce practical and efficient production management in order to have the power required to win in enterprise or industrial competition against other countries. It is also very important to improve the production management system as soon as possible.

(2) Quality Control

Almost all enterprises belonging to the chemical sub-sector put their management priorities on cost reduction and quality control to comply with the competition in the domestic market, which includes imported chemical products. Although, realistic and practical quality control systems in the chemical sub-sector in Viet Nam should become a big issue for all chemical enterprises in the near future, they all realize the importance of it. However, their actual operating systems show that they need to put more effort and thought into them. For example, in the powder detergent and pesticide packing unit, the products are made uneven because they are packed by hand. Moreover, because they don't conduct quality analysis on their products, raw materials, and additives regularly, it can be said that practical management for improving the production quality level is low.

The objectives of realistic quality control systems should be to establish an improvement in productivity and to provide the best product for their clients or consumers. In this sense, the current quality control condition of the enterprises surveyed does not reach this level except in a few enterprises.

(3) Standardization

Three enterprises among the twenty-one enterprises surveyed have already been certified with ISO 9002, and six other enterprises are expected to obtain ISO 9000 certificates within the year 2000. In addition, two other enterprises are preparing for application for ISO 9000. Furthermore, two of three enterprises certified with ISO 9002 are working on applying for ISO 14000 and hope to obtain it within the year 2000. Also, two other enterprises have started to work for ISO 14000.

There are a great many state-owned enterprises in the chemical sub-sector that have a high level of consciousness for standardization of their management. Such current conditions for standardization will help lead to big improvements and the development of the chemical industry in the future.

Promoting standardization in the chemical sub-sector is expected to raise awareness for productivity problems, and to improve product management.

(4) Productivity Improvement

Many enterprises surveyed seemingly put their top priority on maintaining clean factories at all times in spite of their old facilities and buildings. Especially, the enterprises located in the suburbs take into account the co-existence between nature and the chemical factory from the viewpoint of environmental conservation. They plant many trees, flowers and some times prepare nests for birds like a park.

All these considerations and activities for factory maintenance are evaluated as a base of improvement for their productivity.

However, production management for real improvement seems to be a big issue for the chemical sub-sector in Viet Nam, because the current conditions of maintenance of production equipment and the operating conditions of production seem not to be appropriate for optimum production, with the exception of a few enterprises. This situation is considered to be a basic, common problem throughout the chemical sub-sector.

In order to attain high productivity and maintain optimum production, while at the same time considering productivity improvement and environmental conservation, more precise and attentive production management will need to be taken up as a common issue of all chemical enterprises in the future. For example, managers need to reduce the loss of raw materials, additives, energy and manpower or stabilize operating conditions against fluctuations, as well as record and evaluate periodical data for operations and production.

It should be mentioned especially that the joint venture enterprises have been performing the activities for big productivity improvement such as Small Group Activity, Proposal System for Improvement (KAIZEN Activity), Total Productive Management or Maintenance and 5S Activity. These kind of activities will bring bigger profits to the enterprise as a whole, because these activities are precise and attentive production management is carried out under the cooperation of all people in the enterprise, including top management.

8.3 Technological Countermeasures for Industrial Pollution Prevention in the Chemical Sub-Sector

8.3.1 Problems related to the status of technology in the Chemical Sub-Sector

1) Low productivity from production equipment that has become superannuated.
2) Relatively high costs which are related to small scale production systems.
   It is difficult to gain scale merits which are characteristic of the chemical industry, because the scale of production capacity and facilities is relatively small in the chemical sub-sector in Viet Nam.
3) Because of aging equipment and a lack of adequate repair work being done on them, production losses occur and emissions to the environment increase.
4) A shortage of automated measuring equipment and automatic control devices which are essential for production management.
5) Inefficient installation of treatment equipment, which is directly related to emissions to the environment. Management, operation and maintenance of equipment are also not executed precisely. These factors are not being performed efficiently for environmental protection.
6) A lack of information on and opportunities for training, which are needed for improving production technology.
7) Several enterprises share or exchange their raw materials, additives, energies, intermediate products, final products and by-products. However, the rational effect of integrating the correlation between related enterprises is not expected to improve productivity because of the dispersed locations of each chemical enterprise.
8) Labor costs will rise because automated processes for handling raw materials or products were introduced recently and are not very universal throughout the industry.
9) There are many cases where enterprises are able to cope with cost increases resulting from a lack of necessary infrastructure in the relatively large scale chemical sub-sector. For instance, because there is no stock point near one factory they have to purchase and import their chemical raw materials in 30 liter cans from Germany at an expensive price. Also, there are many cases where transportation costs and time are increased due to a lack of optimum means of transportation and a transportation network, such as a rapid railway, highway, and wide, paved roads for large sized lorry cars and lorry trains.

10) The high price of electricity pushes up costs for chemical production. For example, caustic soda production utilizes electrolysis, which consumes much electricity. This is a phenomenon caused by the lack of infrastructure.
11) There are no information exchange opportunities concerning production management, improving technology, and environmental management between related enterprises. This fact proves to be an obstacle for targeting or promoting technology investigation for improving production and the environment.
12) It is hard to exchange information concerning private enterprises, foreign-owned corporations, and joint enterprises. For example, energy issues, environmental pollution issues, and product quality issues in these enterprises are hard to put together and grasp. Thus, it is difficult to guide or make suggestions for strengthening international competitiveness or strategy for the chemical industry in Viet Nam.

The current state of the chemical industry:
① small scale businesses that deal only with basic chemical products② aging or outdated equipment ③ imported raw materials ④ long distance transportation of raw materials and products domestically nullifies the advantage of having a large scale, strategic-type chemical industry. This advantage is being utilized to its fullest.

On the other hand, the chemical industries in developed countries have opted to reinforce their international competitiveness by increasing profits through the improvement of productivity in their companies. In order to accelerate the implementation of such a strategy, through specialization, mass production, higher additive profiting and other technological measures, they have been concentrating on the development and adoption of advanced technologies, such as bio-technology, information technology, robot technology, advanced engineering and so on.

According to the above mentioned current status of the chemical sub-sector, the following steps for further development of competitiveness in the chemical industry in Viet Nam will be imperative in the near future:
① Integrate correlated factories by type of chemical industry and by production capacity levels for the purpose of reducing costs and pollution per unit of

production.

② Implement mass production for the production of basic organic chemicals and increase productivity of abundant domestic raw materials such as petroleum and coal. This will enable the industry to reduce production costs and make good use of domestic resources.

③ Increase the additive value of the chemical industry by producing many kinds of chemical derivatives from basic chemicals and reduce transportation costs by installing large scale-type stock facilities that are connected to the chemical derivatives.

④ Build up the infrastructure such as the transportation system, for providing low cost and an abundant supply of chemicals for industrial raw materials for other industrial sectors. We expect this have a multiplier effect for improvement among all industries in Viet Nam.

⑤ Develop and produce necessary chemicals which satisfy necessary quality, amount and performance requirements for other industrial sectors through domestic R&D in the future. The overall level of the chemical industry and an increase in international competitiveness will be expected with this change.

⑥ Accelerate capacity building, reinforce the R&D function and technology transfer in the industrial chemical field. To do so, it is crucial that experts, managers, engineers, and technicians all increase their working level to manage this new improved chemical industry.

There is an urgent necessity for establishing a strategy for middle and long term plans for the chemical industry in Viet Nam at the governmental level. This kind of strategy will bring increased international competitiveness to the chemical industry in Viet Nam in the long term.

8.3.2 Countermeasures that Propel the Introduction of Cleaner Production Technology in the Chemical Sub-sector

1) Create and implement countermeasures for prevention of and a collection system for leakage. Detection and ascertainment of reasons why losses, such as leakage, or spillage of raw materials, semi-finished goods, and products in chemical equipment, happen should be performed.

   As the starting point for this measure, we suggest that small group activities which require the participation of all employees, such as a 5S movement, or a proposal system for making improvement, be enforced.

2) Conduct and implement an economic examination, along with a technological examination, on the effects of investment in order to reduce and conserve energy, such as water, electricity, and oil for cooling, heating, drying, washing, and transporting.
3) Make efforts to collect information on Cleaner Production in chemical industries in advanced countries. This information is very useful and valuable because, when the equipment production ability is increased for expanding production, it is usual to promote the use of Cleaner Production for the production process itself.
4) Establish an institute for training and facilities to obtain and exchange technological information because promoting Cleaner Production technology itself is considered a very important step for the chemical sub-sector in Viet Nam at present.

8.3.3 End of Pipe Technological Countermeasures in the Chemical Sub-Sector

1) In order to execute equipment management and to find out the optimum operating conditions for wastewater treatment equipment, operation management and equipment maintenance management should be conducted regularly. As a starting point, it is especially necessary to control the pH value in wastewater.
2) It is very important to understand and comprehend the effects of processing equipment. The appropriateness of present operation management concerning wastewater levels and processing equipment capacity needs to be reconsidered, and countermeasures need to be taken according to the results of this investigation and re-assessment. Depending on the level of toxic substances in the wastewater, countermeasures to minimize the wastewater load need to be taken as the first step for treatment and afterwards, appropriate measures, like the utilization of an activated sludge treatment, should be carried out.
3) Exchange useful information regularly within the same industry on improving and reforming End of Pipe technology.
4) Enterprises should use the inter-net or other information sources to get hold of trends in End of Pipe technology in advanced countries, and consider introducing that technology into processing equipment of their own company.
5) In particular, promote the efficient use of energy by recycling wastewater and collecting heat, and try to reduce processing costs.

8.4 Conclusion and Recommendations for Industrial Pollution Prevention in the Chemical Sub-sector

[Conclusion]

1) It is difficult to reduce the pollution load from wastewater if production capacity is continuously increased because this also leads to increased industrial pollution in the chemical industry.
2) It is crucial to take countermeasures and thoroughly reform production systems discharging environmental loads in order to prevent industrial pollution, and at the same time strengthen industrial competitiveness and increase production capacity. Introducing Cleaner Production technology, such as energy and resource saving technology, and activities for production improvement related to Cleaner Production are needed.
3) Environmental pollution prevention technology in the chemical industry is already established in advanced countries. It is important to introduce suitable technology in the appropriate places in the Viet Nam chemical industry.
4) It is very important to establish training facilities in order to improve the effect of introducing these technologies and for spreading technology throughout the industry. Also, the performance level of managers, engineers, and technicians needs to be raised as soon as possible.
5) It is important that future plans be made and action taken for strategic and comprehensive administrative plans, pollution prevention plans, and industrial improvement, not only by state owned companies, but also by private, foreign capital, and joint ventures enterprises as well.

8.4.1 Recommendations for Industrial Pollution Prevention in the Chemical Sub-sector.

Short term countermeasures

1) Introduce production management system technology.
2) Introduce small group activities for improving production capacity and the working environment.

Mid-term countermeasures

1) Introduce Cleaner Production technology, mainly related to saving resources and energy conservation.
2) Introduce and install technology for minimizing the wastewater pollution load and choose suitable “End of Pipe technology”, based on the effects and results of other proposals stated above.

3) Establish training centers for training and introducing technology. Also create an administrative organization for supervising the centers and helping spread these technologies.

Long-term countermeasures

1) Strengthen the research and development function in order to improve technology, as well as internally developing technology autonomously.
2) Promote the modernization of production by renewing equipment, and increase production capacity keeping good balance with the demand and supply situation in each industry.
3) Promote the strengthening of industrial competitiveness by integrating enterprises by industries. Also, execute concrete countermeasures in order to strengthen the competitiveness of all enterprises.

Further details concerning Cleaner Production and End of Pipe technology are explained as follows:

< Production Process Improvement >

In general, by utilizing Cleaner Production for improvement of production processes considerable effects can be attained through the adoption of innovative and advanced technologies for the respective processes, facilities and management system. However, considering the current situation of investment for environmental improvement and conditions of existing production facilities in the chemical sub-sector, an improvement method that requires less investment seems to be preferable for the chemical sub-sector in Viet Nam. Several examples of such preferable procedures for improvement, primitive, but necessary, are shown below.

1) Short-term countermeasures

① Implement periodical daily or hourly observations of the production facility and equipment and take action to make problems clear, as well as countermeasures to solve problems.

② Precisely grasp operating conditions in order to determine fluctuations in production, equipment conditions, and production losses. Also make records of operation data to determine changes in production conditions in the long term. Pick up problems for detailed discussion for future improvements.

③ Reduce the loss of raw materials, additives and utilities caused by inappropriate maintenance and decrease the frequency of equipment troubles through continuous maintenance of production facilities.

④ Introduce activities for increased employee participation, like the 5S Activity, to disseminate cost consciousness and productivity consciousness, and to realize even small improvements through attentive and precise management of production facilities. Also, keep the factory clean at all times, so that problems can be found easily and prevent environmental and safety accidents in advance.

2) Mid-term countermeasures

① Take technical countermeasures for bottlenecks in processes. Implement plans for simultaneous improvement of productivity and environmental impact, taking into consideration efficient investment for the causes of pollution.

② Promote production management technicians who are in charge of technology improvement.

③ Establish a productivity improvement technology research center.

< Improvement of Waste Water Treatment Facilities >

As described earlier, it seems that there is no steady and continuous control of current wastewater treatment systems used in the chemical sub-sector in Viet Nam. In addition, there is no assurance of the effectiveness of the treatment and of the function that treatment facilities performed in each enterprise in the past. Even though there are wastewater treatment facilities, industrial wastewater only passes through some of these facilities in vain without any improvement effects on the quality of the water. In order to improve this situation, preferable improvement procedures for management of wastewater facilities are described as follows;

① Change the concept of wastewater treatment facilities. Wastewater treatment facilities should be considered as being as important as production facilities for generating better productivity. Implement periodical daily or hourly observation of the wastewater treatment facilities and equipment and take action for making problems clear and also take countermeasures.

② Precisely grasp the operating conditions of wastewater treatment facilities by recording operation data and analysis data. Know and find the important points for maintaining and improving the capability of facilities.

If it is possible, take action for improvement on operation procedures and on small modifications of the facility itself.

③ Check the supply condition of neutralization chemicals and additives for wastewater treatment and also, remove precipitate or accumulation in the treatment facilities in order to maintain the performance of wastewater treatment.

④ In the case of changing operating conditions of production plants, or a change in wastewater quality, review the procedures for treatment, or determine the treatment condition that should be implemented as soon as possible. Also, verify actual and preferable treatment conditions and the performance of the facility.

⑤ Build capacity and increase the performance ability of engineers, operators and analysts through education and training.

8.4.2 Measures that Should be Taken by the Administration

Measures that the administration should take in the chemical sub-sector are very important and will play a substantial role in improving the chemical industry in Viet Nam. In brief, the following items should be carried out as soon as possible regarding economical development in the early twenty- first century in Viet Nam, and for the national strategy for developing the industry.

[Measures that should be taken by the local government]

1) Set a clear vision for the future of the chemical industry.
2) Make clear the position and role of the chemical industry among all industries in Viet Nam.
3) Work out a program which helps to promote the chemical industry from an international point of view.
4) The plan for promoting the chemical industry should include measures for strengthening the international competitiveness of the industry.

[Measures that should be taken by the Administration]

1) Promote enterprise improvement, for example, by establishing a technology committee for exchanging information between enterprises in the same area of the chemical industry and conducting inspections mutually, or through joint research projects.
2) Establish goals and provide instruction for productivity improvement for enterprises in the same industry using the top runner method.

3) Establish a Chemical Industry Association whose members are made up of most of the main enterprises for increasing and establishing strategic connections. The Association should function to collect and exchange information, create a scenario for industry improvement, create industry wide environmental and safety guidelines, and serve as a liaison office to the administration.
4) Collect and analyze information dealing with international standards for the chemical industry. Provide instruction for the enterprise and assist in industry reorganization using a database made from this information.

These countermeasures should be undertaken, not only by state-owned companies under MOI, but also by private, foreign capital and joint venture enterprises. Otherwise, they won't be an effective part of the national strategy for chemical industry improvement.

Using these strategies, the case will undoubtedly arise where a chemical enterprise can not cope with important issues without the help of the administration. In such a case, a state administrative office has to set basic policies and plans, give orders to the local administration and control industrial circles.

In order to do this, all administrative functions should be controlled by one ministry. For example, MOI controls measures related to the chemical industry, such as a subsidy and taxation system, legislative laws for promoting energy saving, creates managing organizations for pollution prevention, and promotes the improvement of industrial structures.

The following are important subjects that are necessary for improving the chemical industry:

1) Ensure a smooth "supply and demand" and efficient use of resources and energy.
2) Create a supply and demand system for raw materials and ensure the efficient use of them according to the needs of industry.
3) Re-design chemical industry groupings so that they can work in closer cooperation with each type of industry, and all enterprises. Also, create and operate highly efficient production systems, which include environmental pollution prevention measures. Viet Nam is facing the issue of having to re-shape the chemical industry according to each enterprise's future plans and

their location.

4) Set up strategic policies for providing materials and other functions to other related industries, mainly agriculture.

These provisions should include low costs for products and services, and measures for improving the quality of products.

8.4.3 Necessary Budget for Countermeasures for Industrial Pollution Prevention in the Chemical Sub-sector

In general, especially from the view of Cleaner Production and environmental pollution prevention, a large budget is needed in the chemical sub-sector in order to improve the industry and strengthen industrial competitiveness because the chemical industry is considered to be largely responsible for environmental pollution issues.

In order to improve production efficiency, reduce production costs and minimize environmental pollution, the following items should be considered:

1) Modernize production systems.
2) Increase and condense production scales.
3) A long term, mid-term and short-term budget for conducting countermeasures, such as improving technology, production efficiency, and education for people in the industry need to be made.

The Survey Team estimates about 74,700 million VND is needed for the budget for countermeasures for production improvement and environmental pollution. This was estimated according to the data the Survey Team received from the enterprises where the outline survey and detailed survey were conducted, investigations took place and discussions were carried out.

The details of the budgets needed for countermeasures widely vary from investment for improving processes to direct investment for environmental pollution. The budget also includes measures for the working environment. In addition, each industry's situation also varies widely from industries that don't need any further investment to an industry that needs 18,800 million VND as max. About 3,600 million VND was estimated as the average investment required for an enterprise in the chemical sub-sector.

A certain degree of short term investment is needed in the chemical sub-sector in Viet Nam. However, on the other hand, there are many countermeasures that exist for improving productivity without any investment.

The following Japanese examples: ① 5S movement ② Kaizen proposal activities

③ and TQC activities are recommended. Conducting small group activities like these bring about results in production efficiency and reduce costs.

These activities produce very effective results, especially in the following cases:

1) Countermeasures that decrease production losses, such as resource and energy saving, and are related closely to the everyday operations of the production unit.
2) Countermeasures that solve small problems and help maintain steady production for equipment management.

The key for making these activities successful is to ensure that all the members in the enterprise, roles depending on each member's position, take positive and to develop activities continuously using close teamwork. By introducing these small activities, it is expected that cost competitiveness will not only improve, but also that production technology will improve and know-how will be disseminated throughout the entire enterprise.

One example of financial demand in the chemical sub-sector, Table 8.3, shows the estimated investment demand required for Cleaner Production and environmental pollution prevention in four enterprises where the detailed survey was conducted.

Table 8.3 Estimated Financial Demand in the Chemical Sub-Sector for Industrial Pollution Prevention (Example)

Unit: Million VND

Enterprise	Financial demand (Total)	Improving Processes Improvement equipment	Improving Processes Introduction of new equipment	Environmental Pollution Prevention
A	18,800	800	13,800	7,000
B	3,400	800	1,700	4,200
C	10,000	2,000	1,000	800
D	15,000	8,700	3,300	3,300

Appendix 8

Outline of the Chemical Industry

The 21 enterprises surveyed this time consist of 18 state-owned, 2 local government-owned and 1 joint venture by a state-owned enterprise. The chemical industry in Viet Nam like other domestic industries, has a big possibility for development in the 21^{st} century, especially agriculture, that utilizing their abundant natural resources. Main products of the chemical industry in Viet Nam are superphosphate fertilizer, pesticide, rubber products like tires and tubes, detergent, batteries and inorganic chemicals. The full-scale development of the chemical industry in Viet Nam, utilizing natural resources like petroleum and natural gas, will start in the beginning of the 21^{st} century.

Because there are few references that describe the history of the chemical industry in Viet Nam, the article written and provided by Mr. Do Thanh Bai, Director of the Center of Environmental Protection and Chemical Safety, Institute of Industrial Chemistry, is introduced as follows;

＜ THE VIET NAM CHEMICAL INDUSTRY, HISTORICAL PERSPECTIVES AND PRESENT STATUS ＞

Viet Nam is a country that already has a developed agriculture industry, and it is gradually developing more and more in variety, volume and quality. Thus, one of the focuses of the chemical industry, since the first day of its development has been to provide for the increasing chemical demand of the agriculture sector.

Before1975 : Right at the beginning stage of the chemical industry in Viet Nam in the 1950s, there were three centralized chemical industrial zones: Hanoi, Hai Phong and Viet Tri- Lam Thao. At that stage, the chemical industry was concentrated mainly in the North with a total of 15 factories that served two main functions: Providing material for other industries such as super-phosphate fertilizer, caustic soda, acid and consumer goods which includes such things as: bicycle tires and tubes, batteries, detergent, etc. Many factories were established during this period with the help of the former Soviet Union and China. These factories were mostly medium or small scale and had an average level of technology.

During this period, the chemical industry developed very fast. From 1955 to 1960, some industries such as super-phosphate, apatite and sintering super-phosphate increased nearly 50 folds.

In the first stage of chemical industrial development, local industries gained a relatively important position in the first few years, providing goods for almost the whole population, especially goods like detergents, paint and pesticides.

After the reunion of the country (1975), the chemical industry of Viet Nam took over some of the small facilities in the South. These facilities were more advanced in technology compared to those in the North.

From 1976-1990 : Fast investment in the chemical industry occurred. Some of this investment was for capacity extension such as the Lam Thao Super-Phosphate Plant, other was for new investment such as the Hai Hung Chemical Plant, Ninh Binh Super - Phosphate Plant, Hanoi Synthesis Paint Plant, and the Lao Cai Apatite Complex.

During this period, local industry still accounted for 49% of the production by State industry. State industry accounted for around 70% of the total chemical industry production of the country.

From 1990-2000 : This is the period which saw the most investment. There are, in total, 85 development projects with a total investment of 825 million US$ including investment in the industries of:

- Fertilizer and Pesticide : 14 projects
- Detergent : 13 projects
- Paint and Construction Chemicals : 21 projects
- Rubber Project : 14 projects
- Other chemical products : 23 projects

The petrochemical industry of Viet Nam is now in its infant stage. In Viet Nam up to now, there was no elementary petrochemical industry to produce ethylene, aromatics and the raw materials for petrochemical products.

①Characteristics of the Chemical Industry in Viet Nam:

- Most production plants are small in scale with relatively old technology. The recent investment in the industry has not been enough to gain an advantage in the competitive market.
- Lack of an elementary industry, i.e. Lack of an industry that produces the raw products, such as basic organic chemicals and chemical mechanics which facilitate

the development of the whole sector.

- The main products of the chemical industry are fertilizer and other products that serve the agriculture industry. Thus, the chemical industry in Viet Nam has not yet shown much impact on other industries such as electronics, automobile and motorbike production, energy, etc.

- The petrochemical industry is still in its beginning stages, and yet, this is the industry that will take the most important position in the development of the chemical industry as a whole.

② Factors that advantage the Chemical Industry in Viet Nam:

- The open policies of the government for facilitating the economic development, and open international cooperation are moving the industry in a positive direction. More and more foreign investment in terms of number and scale is now concentrated in the industry.
- The economy is developing rapidly, especially agriculture, energy, etc. This will facilitate more industrial development.
- The tightening of relationships with other ASEAN countries has lead to the widening of the market.
- Raw material prospects for the chemical industry are becoming more prominent, oil production has increased and natural gas is also more promising, etc.
- In general, the Viet Nam chemical industry has a big advantage in terms of raw materials. In particular, for raw materials used in petrochemicals, natural gas, aptite, natural rubber, salt and other mineral materials.

Plan from 2000-2010 :

- Provide better service forward other industries and fields such as agriculture, rural industrialization, etc.
- Develop selected industries in both production of material products and consumer goods.
- Make better use of internal and external investment. More focus will be put on exportation especially for traditional products such as fertilizer, pesticide, basic chemicals, rubber products and plastics.
- Give the highest priority in terms of foreign investment to the industries of basic chemical, petrochemical, pigments, alkaline batteries and industrial inert gases. Internal investment will occur in the form of joint ventures, equipment importation, and technology transfer.

The total production of the main products in the chemical sub-sector in Viet Nam is shown in Table 8.A.1.

Table 8.A.1 Total Production of Main Products in the Chemical Sub-Sector

Product	Unit	1995	1996	1997	1998 (Prel.)
Sulfuric acid (State*1)	t	9,768	17,943	15,173	22,775
Caustic soda (State*1)	t	7,307	9,099	7,676	10,288
Insecticides*3	t	15,566	20,007	19,078	19,998
Chemical fertilizer*2	1,000 t	931	965	982	974
Paint*4	t	21,081	28,995	26,285	28,388
Medicinal ampoules*3	mill. tubes	425	452	429	462
Medicinal tablets*4	mill. pills	14,065	14,728	17,062	19,109
Liquid medicine*3	1,000 l	3,651	3,457	3,328	3,270
Soap and powder*4	1,000 t	129	167	213	216
Tubes & tires for car*1	1,000 sets	57	95	138	140
Bicycle tires*4	1,000 pieces	9,703	8,656	10,245	13,626
Bicycle tubes*4	1,000 pieces	11,917	12,588	14,044	13,500
Glass products*4	1,000 t	77	93	66	67

(Source: Statistical Yearbook-1998, Socialist Republic of Viet Nam, General Statistical Office)

*1 State enterprise
*2 State enterprise & Non-State enterprise
*3 State enterprise & Foreign Investment
*4 State enterprise, Non-State enterprise & Foreign Investment

The General Statistic Office annually publishes statistics, including statistics on the chemical industry, which are categorized into “Chemicals” and “Rubber and plastics”. The gross output of the chemical sub-sector and the whole manufacturing sector for four years since 1995 is shown in Table 8.A.2. It is understood that the absolute increase of the gross output of the whole manufacturing sector grew year by year, though the growth rate tended to slow down. In comparison with the gross output of the whole manufacturing sector, the gross output of the chemical sub-sector has developed at a higher rate so far.

Table 8.A.2 Gross Output of the Chemical Sub-Sector
(at Constant Price of 1994)

Unit： billion VND

	1995	1996	1997	1998 (Prel.)
Chemicals	5,085.6	6,283.1	7,222.5	7,799.5
		(+ 23.5%)	(+ 15.0%)	(+ 8.0%)
Rubber and Plastics	2,272.0	2,798.7	3,528.0	4,014.9
		(+ 23.2%)	(+ 26.1%)	(+ 13.8%)
Manufacturing Total	83,260.6	94,787.8	107,662.4	119,476.5
		(+ 13.8%)	(+ 13.6%)	(+ 11.0%)

(Source: Statistical Yearbook-1998, Socialist Republic of Viet Nam, General Statistical Office)

Related to the trade of chemical products, the rubber produced from abundant plantation resources is the only main exported product. On the other hand, the importation of chemical fertilizer, medicament, plastics in primary form and insecticide & its material are increasing gradually.

Table 8.A.3 Main Chemical Product for Exportation

	Unit	1995	1996	1997	1998
Rubber	1,000 t	138.1	194.5	194.2	191.0

(Source: Vietnam Socio-Economy ; The Period 1996-1998 and Forecast for the year 2000)

Table 8.A.4 Main Chemical Products for Importation

	Unit	1995	1996	1997	1998
Chemical Fertilizer	mill. t	3.9	2.6	2.4	3.4
Medicament	mill. US$	69.1	206.5	312.0	312.0
Plastics in primary form	1,000 t	223.1	312.2	284.0	311.0
Insecticide & material	mill. US$	100.4	124.4	114.0	126.0

(Source: Vietnam Socio-Economy ; The Period 1996-1998 and Forecast for the year 2000)

The Structure of the Chemical Industrial Sub-Sector

The chemical industrial sub-sector in Viet Nam is characterized by a number of the small-scale non-state owned enterprises as well as other industrial sub-sectors. The number of enterprises in the chemical sub-sector is shown in table 8.A.5. The number of SOEs tends to remain the same or to decrease. On the other hand, the number of non-state owned enterprises and foreign investment enterprises is increasing at a considerable rate.

Table 8.A.5 Number of Enterprise in the Chemical Industrial Sub-Sector

	Ownership	1995		1996	
		Number	%	Number	%
Chemicals	(1) State owned	125	7.4	125	6.3
	(2) Non State owned	1,522	90.8	1,808	91.5
	(3) Foreign investment	30	1.8	43	2.2
	Total	1,677	100.	1,976	100.
Rubber & Plastics	(1) State owned	44	1.6	38	1.4
	(2) Non State owned	2,657	97.2	2,666	97.2
	(3) Foreign investment	32	1.2	38	1.4
	Total	2,733	100.	2,742	100.

The gross output for the chemicals industry is shown in table 8.A.6 and for the rubber and plastics industry in table 8.A.7 at the constant price of 1994.

In the chemicals industry, the SOEs have accounted for more than a 67% Share since 1996. The non-state owned enterprises have only around a 10% Share and have stayed at that level so far. The development of gross output for the whole chemical sub-sector has depended on the SOEs and foreign investment enterprises.

Table 8.A.6 Gross Output for Chemicals Industry
（at Constant Price in 1994）

Unit: billion VND

Ownership		1995	1996	1997	1998（Prel.）
State-owned	Central	2,271.7	2,537.3	3,145.1	3,433.1
	Local	1,586.0	1,729.1	1,888.4	1,902.0
	Total	3,857.7	4,266.4	5,032.6	5,335.0
（Growth rate %）			(10.6)	(18.0)	(6.0)
Non-state Total		486.2	622.1	707.9	785.9
（Growth rate %）			(28.0)	(13.8)	(11.0)
Domestic Total		4,343.9	4,888.5	5,740.6	6,121.0
（Growth rate %）			(12.5)	(17.4)	(6.6)
Foreign Invested Total		741.7	1,394.6	1,481.2	1,678.5
（Growth rate %）			(88.0)	(6.2)	(13.3)
Grand Total		5,086.6	6,283.1	7,222.5	7,799.5
（Growth rate %）			(23.5)	(15.0)	(8.0)

(Source: Socio-Economic Statistical Data of 61 Provinces and Cities in Vietnam-1998)

The gross output of non-state enterprises in the rubber and plastics industry has been expanding since 1996 and this has become the motivating force for development of this industry. The state-owned enterprises and foreign investment enterprises have also been expanding at a constant rate.

Table 8.A.7 Gross Output for the Rubber and Plastics Industry
（at Constant Price in 1994）

（Unit： billion VND）

Ownership		1995	1996	1997	1998（Prel.）
State-owned	Central	793.1	826.6	1,040.1	1,160.9
	Local	212.0	225.3	247.9	280.3
	Total	1,005.1	1,051.9	1,288.1	1,441.2
（Growth rate %）			(4.7)	(22.5)	(11.9)
Non-state Total		953.1	1,339.3	1,587.1	1,771.7
（Growth rate %）			(40.5)	(18.5)	(11.6)
Domestic Total		1,958.2	2,391.2	2,875.2	3,213.0
（Growth rate %）			(22.1)	(20.2)	(11.7)
Foreign Invested Total		313.8	398.5	652.8	801.9
（Growth rate %）			(27.0)	(63.8)	(22.8)
Grand Total		2,272.0	2,789.7	3,528.0	4,014.9
（Growth rate %）			(23.9)	(26.5)	(13.8)

(Source: Socio-Economic Statistical Data of 61 Provinces and Cities in Vietnam-1998)

The average output for the chemical sub-sectors in their respective industries is shown in table 8.A.8. In the chemicals industry, the development rate of foreign investment enterprises is high and also, SOEs and non-SOEs have been developing steadily as well.

In the rubber and plastics industry, the development rate of SOEs is relatively higher, but also the foreign investment enterprises and non-SOEｓ have been steadily developing. Though, the average output for the non-SOEs has been increased at very low rate in comparison with the other type of enterprises in each chemical industry.

Table 8.A.8 Average Output for the Chemical Sub - Sector
(at Constant Price in 1994)

Unit: billion VND per Enterprise

	Ownership	1995	1996
Chemicals	(1)State owned	30.862	34.131
	(2)Non-State owned	0.319	0.344
	(3)Foreign invested	24.723	32.433
	Total	3.033	3.180
Rubber & Plastics	(1)State owned	22.843	27.682
	(2)Non-State owned	0.359	0.502
	(3)Foreign invested	9.806	10.487
	Total	0.831	1.017

(Source: Socio-Economic Statistical Data of 61 Provinces and Cities in Vietnam)

Chapter 9

Countermeasures for Wastewater Pollution

In the Paper and Pulp Sub-sector

Chapter 9 Countermeasures for Wastewater Pollution in the Paper and Pulp Sub sector

9.1 Present State of Wastewater and Productivity in the Paper & Pulp Sub-sector

9.1.1 Enterprises Surveyed

Enterprise case studies were carried out on 21 enterprises, namely 12 in the area around Hanoi and 9 in the Ho Chi Minh City area. The enterprises in the Hanoi area are aiming to expand facilities and production, while some of the enterprises in the Ho Chi Minh area, in striking contrast to Hanoi, are not in full operation.

The paper production capacities of the enterprises surveyed ranged from 500 t/year to more than 60,000 t/year, showing more than 100 times disparity. Also, the production processes vary for the pulping system and for raw materials, which in some enterprises are only pulp or waste paper that has been purchased.

Five enterprises were selected for a detailed study based on production capacity, the kind of pulp produced, and the state of waste liquor recovery. These enterprises include two SOEs, one provincial SOE and two private enterprises.

Table 9.1 Enterprises Selected for the Detailed Study

Enterprise Number	Ownership	Production t/year(1998)	Pulp	Recycled Fiber
P-1	State-owned	3,802	AP	W.P
P-2	State-owned	33,868	BKP	W.P
P-3	Private	8,827	SCP	Carton
P-4	Provincial SOE.	1,000	SCP	-
P-5	Private	15,000	SCP	W.P

9.1.2 Production and COD Discharge in the Paper & Pulp Sub-sector

(1) Paper & Paperboard Production

Table 9.2 summarizes paper and paperboard production of four Asian countries, extracted from Table 9.A.1.

Table 9.2 Paper & Paperboard Production of Asian Countries (Main Status)

	Japan	Taiwan	Thailand	Vietnam
Production 1,000 t/year	30,013	4,436	2,036	204
Growth Rate %/year	1.1	4.5	15.1	22.6

(2) COD Effluent

Table 9.3 shows the total COD effluent of the 21 mills surveyed in this study compared with that of all of Japan.

Table 9.3 COD Effluent in Viet Nam Compared to that in Japan

	Production t/year	COD discharged t/year	Rate %
Japan 1970	12,973,240	2,200,000	17.0
Japan 1989	26,808,792	200,000	0.75
Ratio : 1989/1970	2.07	0.91	4.4
Vietnam 21 Mills 1999	212,343	183,229	86.3
Ratio : Vietnam 1999 / Japan 1989	0.0079	0.916	11,500

Note : At present, COD/ton of Paper and Paperboard of Viet Nam is estimated to be more than 300 times that of Japan, because COD of Pulp and Paper in Japan that flows to the main sea area was only 118 t/day. From this figure, total COD was estimated to be less than 66,000 t/year in 1996.

The total production of the 21 mills which were surveyed is 212,000 t/year.

This figure is only 7 % of Japanese production, but COD in Viet Nam is nearly equal to the COD in Japan in 1989. Therefore, in the Japanese Pulp and Paper Industry, COD & BOD levels are not a problem, so there is no data available on COD, because the Japanese Pulp and Paper Industry has been concentrating its efforts on reducing AOX and/or Chloroform. However, over the past ten years, they have made efforts to reduce COD by nearly 1/3 by bringing up the recovery ratio of Black Liquor and recovering fine fiber in the effluent.

Ms. Junko Nakanishi wrote in her book titled " The Strategy Plan for Water Pollution (Mizu no Kankyou Senryaku)" that the COD amount would increase to 4,500,000 t/year from 2,200,00 t/year by production increases over the 29 years from 1970 to 1989. However, if actually decreased during that period to only 200,000 t/year. 58 % of this reduction was due to a change in the pulping method and 26 % of this decrease was due to bringing up the recovery rate of Black Liquor. Therefore, it can be calculated that only 16 % of this reduction was due to use of End of Pipe methods.

9.1.3 Industrial Wastewater in the Paper and Pulp sub-sector

As a result of the water quality analysis carried out by CEETIA in this study, BOD values were found to be extremely lower than the values that are normally estimated based on the correlation between BOD and COD of pulping waste liquor. Consequently, COD has been adopted as the evaluation criterion of wastewater instead of BOD.

(1) Wastewater Quality

Table 9.4 shows the wastewater quality of the 21 enterprises surveyed in this study.

Table 9.4 Wastewater Quality of the Enterprises Surveyed

No.	Product t/year	F.Water km^3/year	Rate m^3/t	pH -	E..Cond. μ S/cm	BOD mg/l	COD mg/l	DO mg/l	VSS mg/l	TSS mg/l	Phenol mg/l
1	3,802	950	250	9.95	1,220	319	5,320	7.72	100	289	0.280
2	3,800	668	176	7.17	394	166	430	3.01	115	229	0.052
3	1,667	1,200	720	6.93	243	273	420	2.43	23	66	0.047
4	60,000	17,000	283	9.63	2,020	861	9,340	3.33	240	773	0.340
5	7,285	1,800	247	9.12	1,050	281	525	7.14	90	158	0.161
6	483	244	505	7.53	1,180	826	2,893	0.97	69	83	0.000
7	60,619	4,449	73	6.53	179	141	360	3.88	67	105	0.000
8	23,823	10,237	430	6.49	3,140	196	669	2.50	160	215	0.119
9	4,660	1,650	354	7.67	221	32	128	4.76	8	100	0.002
10	1,238	420	339	6.40	5	72	392	4.35	432	500	0.013
11	4,275	864	202	7.66	141	63	259			350	0.000
12	2,000	40	20	10.17	1,740	910	2,230	4.11	84	250	0.025
13	2,000	60	30	7.75	1,300	10	61	1.52	7	13	0.000
14	8,827	396	45	7.62	494	460	1,200	3.21	361	407	0.002
15	1,194	655	549	9.11	254	57	71	8.02	356	424	0.022
16	3,310	840	254	7.22	276	121	345	2.85	26	127	0.003
17	1,750	159	91	7.78	1,990	89	922	0.49	14	98	0.047
18	1,000	23	23	7.73	4,784	578	5,120		120	149	0.320
19	15,000	301	20	8.91	1,460	355	2,680	4.30		257	0.028
20	1,800	90	50	7.94	2,717	840	8,320	4.68		204	0.268
21	4,000	576	144	7.11	210	896	8,990	0.36		1,190	0.024
Mean	10,121	2,517	229			359	2,413	3.66	134	285	0.08

Table 9.5 shows the absolute amount of COD and VSS discharged from the 21 mills studied. The annual amount of COD discharged from the 21 factories studied is approximately 115 times higher than the 1,500 t/year that was normally discharged from a factory producing 200,000 t/year of paper products in 1989.

1) COD

Only two mills out of the 21 surveyed are achieving the regulation standard for COD of 100 mg/l or less for their industrial wastewater. One of them, in fact, is in a very critical situation as the amount of water they are consuming is 549 times higher than that of the paper production.

2) SS

Five mills, corresponding to about one-fourth of the 21 surveyed, are complying with the discharge standard of 100 mg/l for SS. Three of them, however, are using a large volume of water, 720, 505 and 354 times that of the paper production, respectively. Therefore, only two mills, or about one tenth, are substantially clearing the restricted value of 100 mg/l. Only one mill is clearing the standards for both COD and SS.

Table 9.5 COD and VSS Discharge from the Enterprises Surveyed

No.	Production (t/year)	Water 1000m^3/y	m^3/t	COD			VSS		
				mg/l	t/year	kg/t	mg/l	t/year	kg/t
1	3,612	950	263	5,320	5,054	1,399	100	95	26.3
2	3,800	668	176	430	287	76	95	63	16.7
3	1,667	1,200	720	420	504	302	23	28	16.6
4	60,000	17,000	283	9,340	158,780	2,646	240	4,080	68.0
5	7,285	1,800	247	525	945	130	90	162	22.2
6	483	244	505	2,893	706	1,461	69	17	34.9
7	60,619	4,449	73	360	1,602	26	67	298	4.9
8	23,823	10,237	430	669	6,849	287	160	1,638	68.8
9	4,660	1,650	354	128	211	45	8	13	2.8
10	1,238	420	339	392	165	133	432	181	146.6
11	4,275	864	202	259	224	52			
12	2,000	40	20	2,230	89	45	84	3	1.7
13	2,000	60	30	61	4	2	7	0	0.2
14	8,827	396	45	1,200	475	54	361	143	16.2
15	1,194	655	549	71	47	39	356	233	195.4
16	3,310	840	254	345	290	88	26	22	6.6
17	1,750	159	91	922	147	84	14	2	1.3
18	1,000	23	23	5,120	118	118	120	3	2.8
19	15,000	301	20	2,680	807	54			
20	1,800	90	50	8,320	749	416			
21	4,000	576	144	8,990	5,178	1,295			
Total	212,343	42,623	4,818	50,675	183,229	8,752	2,252	6,982	631.8
Mean	10,112	2,030	229	2,413	8,725	417	132	411	37.2

3) Mercury and Chromium

It should be noted that wastewater from some factories contains Mercury and Chromium. For high levels of BOD, COD etc. the resulting problems are foul odors and a low fish survival rate. However, heavy metals directly harm and affect human health.

It is believed that Mercury comes from the materials caustic soda. Chromium is also considered to come from caustic soda material. It was organic Mercury that caused the Minamata disease, which resulted in the death of many patients in Japan. Mercury from caustic soda is non-organic Mercury, but there is a possibility of a conversion of non organic Mercury to organic Mercury through a reaction in the hot boiling process with organic compounds. So, it would be better to improve this situation where levels exceed wastewater standards.

Wastewater that contains Mercury was found as follows:

A: 0.88 mg/l (30 times the standard); B: 0.623 mg/l

Wastewater that contains Chromium was found as follows:

C: 0.85 mg/l; D: 0.28 mg/l

Table 9.6 shows sodium hydroxide analysis results. Factories that were analyzed have problems with a high heavy metal content in wastewater and with a high consumption of water due to the fact that chemical recovery is not being carried out.

Table 9.6 Sodium Hydroxide Analysis Results of Four Mills

	Unit	P-1	P-2	P-3	P-4
VSS	%			0.146 %	
TSS	%			0.156 %	
Pb	mg/kg	<1.12 (mg/l)	<0.92	5.56	13.11
Cd	mg/kg	<0.1 (mg/l		0.988	0.875
Hg	mg/kg			29	45
Cr(Total)	mg/kg	<0.01(Vl)(mg/l)	<0.04(VI)	2.04	2.04
Zn	mg/kg	89(mg/l)	<0.2	119	156
K	mg/kg	<1(mg/l)	12	372	117
NaOH	%	84.63 %	88.32	76.80 %	87.66 %
Cl-	%	1.03 %	1.47	1.58 %	1.21 %
Al	mg/kg	<0.01(mg/l)		<0.01	

4) Phenol and Chloroform

It should be noted that chloroform, as well as phenol, is generated from the pulping process and the bleaching process, which utilizes chlorine. Table 9.7 shows the analysis results of SCP saturation in wastewater. Special attention should be paid to wastewater evaporators because oxalic acid and silicic acid, both of which contain calcium salt, are insoluble and are forced to the wastewater.

Table 9.7 Analysis Results of Saturation of Waste Liquor

	TSS	COD	BOD	Phenol	Chloroform	Oxalic Acid	SiO_3
mg/l	752	6240	4056	0.75	1.16	136.7	357

(2) Excessive Use of Water and Fiber Loss

There are five mills which have a high VSS out of TSS. VSS is considered to mainly consist of recyclable, good quality, fine fiber. Therefore, it is highly possible for these mills to recover their invested funds through cost reductions, for instance by installing a concrete settler with a low construction cost as proposed in Table 9.10 of section 9.3.2. It should be taken into consideration that, as shown in Table 9.8, the average water consumption of the 21 mills is 229 times as high as the paper production because of a comparatively low water cost of 148-2,000 VND/m^3.

As an example, the cost of the water in one mill, where a level 283 times higher than the average amount of water, 800 VND/m^3, is used is 226.4 VND/kg. This is not a small cost. When VSS of 240 mg/l is discharged from the mill, useful fiber of about 6.8 % drains out. Through recovery of this fiber, the above-mentioned cost reduction is possible. This also greatly decreases the amount of stock material flowing into rivers and practically decreases COD by 40 %. In addition, water consumption is decreased through recycled use of water.

(3) High Content COD Wastewater Discharged Without Treatment

The major problems are with the mills that discharge wastewater that contains hundreds to thousands mg/l COD without any treatment. Nine mills, or about half of the mills studied, have COD levels in wastewater of over 1000 mg/l COD. Three mills have levels between 500-1000 mg/l and six mills are between 250- 500 mg/l. Accordingly, out of the remaining three mills, including the one with a nearly acceptable mark of 128 mg/l COD, one mill needs to start recycling fiber by installing the aforementioned settler because of its high TSS level, and the other two mills are the ones mentioned above that both have simple wastewater treatment systems, and can be said to be good mills. Further more, one of these mills has an activated sludge treatment system, which is the only one among the 21 mills studied. It utilizes only imported OCC material, and uses a comparatively low amount of water that is 30 times greater than the amount of its paper products. The mill has a very low pollution load of 61 mg/l COD and 13 mg/l TSS.

Table 9.8 Material & Chemical Prices in Viet Nam (1998)

	Vietnam		Japan		Vietnam/Japan		
	Min VND/t	Max VND/t	VND/t	¥/t	Min. %	Max. %	
Bamboo Chips	266,100	390,000					
Bamboo Freaks	330,000	330,000					
Bamboo Powder	2,200,000	2,200,000					
Wood	420,000	470,000	1,012,500	7,500	41.5%	46.4%	Viet 1/2Japan
Imported Pulp	4,000,000	7,000,000	10,125,000	75,000	39.5%	69.1%	Viet 1/2Japan
Local Pulp	172,400	7,284,756	8,100,000	60,000	2.1%	89.9%	
Banknote Pulp	2,935,000	2,935,000	5,400,000	40,000	54.4%	54.4%	Viet 1/2Japan
Edge Trimming	5,200,000	5,200,000	4,050,000	30,000	128.4%	128.4%	Viet 4/3Japan
Waste Paper	1,220,000	1,700,000	1,687,500	12,500	72.3%	100.7%	Viet Japan
White Waste Paper	3,800,000	5,200,000	3,375,000	25,000	112.6%	154.1%	Viet 4/3Japan
Waste Carton	1,300,000	1,325,000	1,687,500	12,500	77.0%	78.5%	Viet 3/4Japan
Imported Carton	23,000,000	23,000,000	4,725,000	35,000	486.8%	486.8%	?
Pattern Paper	12,000,000	12,000,000	5,400,000	40,000	222.2%	222.2%	Viet＞2Japan
NaCl	630,000	630,000	2,025,000	15,000	31.1%	31.1%	Viet 1/3Japan
NaOH	3,300,000	5,000,000	3,645,000	27,000	90.5%	137.2%	Viet Japan
Na2CO3	1,950,000	2,600,000	0				
Na2SO4	1,300,000	1,300,000	0				
Cl2	3,400,000	6,027,000	3,955,500	29,300	86.0%	152.4%	Viet Japan
Ca(OCl)+ NaOCl	197,000	197,000	86,940,000	644,000	0.2%	Na_2Cl(ClO	
Na2SiO3	1,100,000	1,126,000	0				
H2O2	4,244,000	5,040,000	6,817,500	50,500	62.3%	73.9%	Viet 3/4Japan
CaO	380,000	380,000	3,105,000	23,000	12.2%	12.2%	
CaCO3	1,984,400	2,250,000	2,362,500	17,500	84.0%	95.2%	Viet Japan
H2SO4	1,952,000	1,952,000	2,025,000	15,000	96.4%	96.4%	Viet Japan
Rosin Size	5,117,800	10,739,000	0				
Al2(SO4)3	1,600,000	1,900,000	0				
S	1,850,000	2,400,000	0				
Caolin	740,000	740,000	0				
Imported Powder	6,600,000	6,600,000	0				
TiO2	24,775,000	24,775,000	27,000,000	200,000	91.8%	91.8%	Viet Japan
Talc	1,471,000	1,595,000	3,375,000	25,000	43.6%	47.3%	Viet 1/2Japan
Fluorescent	120,000,000	126,791,000	0				
Color	6,583,000	79,253,600	74,250,000	550,000	8.9%	106.7%	
Resin	689,000	689,000	0				
Anion Starch	8,075,000	8,075,000	0				
Retention Chemical	112,671,000	112,671,000	0				
Chem.Wet Strength	17,504,000	17,504,000	105,165,000	779,000	16.6%	16.6%	Viet＜1/5Japan
Fuel Oil	1,550,000	1,800,000	2,160,000	16,000	71.8%	83.3%	Viet 3/4Japan
Coal	186,900	290,000	810,000	6,000	23.1%	35.8%	Viet 1/3Japan
Electricity(kWh)	660	930	675	5	97.8%	137.8%	Viet 4/3Japan
Water	148	2,000	270	2	54.8%	740.7%	

(4) Existing Wastewater Treatment Systems

Only four mills among the 21 studied have wastewater treatment systems in addition to simple settling ponds.

1) Example-"Enterprise A"

A recovery boiler made in Sweden for KP waste liquor has been installed, as well as a new wastewater treatment system, which was also made in Sweden. In the wastewater treatment system, two out of three 110 kW pumps are in operation for circulating and deodorizing the wastewater in an underground water vessel. Thus, so-called KP odors like hydrogen sulfide (H_2S), methyl mercaptan (MM), methyl sulfide (MS), and dimethyl disulfide (DMDS) are emitted into the air through a 50 m high chimney, so the discharged wastewater does not smell, and sodium hypochloride is added in order to reduce COD. In addition to a high water consumption amount, 283 times higher than that of paper production, a 9,340 mg/l COD level in the actual wastewater is the worst among the 21 mills, and the VSS level of 240 mg/l is also high. The company's advanced equipment is not being utilized effectively.

2) Example-"Enterprise B"

Recovery of KP waste liquor is being carried out. After concentrating the liquor using an evaporator, chemicals are recovered with a recovery boiler. In this mill a recovery boiler and a recovery system, started only two years ago, are smoothly operating, and the COD concentration in wastewater is 669 mg/l, a level 1/14 that of Example-A, despite the high production ratio of BKP. Improvement is expected to be seen in the water quality of the wastewater through improvement in the recovery of the diluted black liquor, which has not been recovered yet because of an insufficient processing capacity.

(a) Washing System: It is possible to use a 4 stage - 4 drum process, but at present they are only using a 1 stage - 4 drum process.

(b) Evaporator for BL: It is designed as a 4 effect/4body type for an E/S above 3.2. However, its actual E/S is only 1.0.

At present, high class, complicated systems without instrumentation systems should not be acceptable in Viet Nam. Simple systems should be selected and utilized for the next several years.

3) Example-"Enterprise C"

Three opposing, pyramid-shape settlers made of steel plating, each of which are in the primary and the secondary, are used for dehydration of the pulping waste liquor. Since the fresh water of the settlers is recycled, the amount of the water used, 91 times that of its production, is very small for a pulp mill. Fiber is also recycled, and therefore, VSS in the wastewater of 14 mg/l is outstanding.

4) Example-"Enterprise D"

Fiber recovery is done using pyramid shaped settlers made of steel plating Fresh water is recycled as required, and the surplus is sent for activated sludge treatment. Although the activated sludge vessel is used simply for surface aeration, COD levels of 61 mg/l and BOD of 10 mg/l are the best among the 21 mills studied.

(5) Un-treated Wastewater

Most of the mills, other than those mentioned above, release the entire amount of their wastewater into simply dug settling ponds and the settled fiber, etc. can only be recovered at best for use in low grade paper. However, many mills, after the de-hydrating and drying process, have this fiber carried out of the company by a transportation agent, paying freight of about 1,500 VND/4tons for use as brick making fuel. In many cases, pulping waste liquor with unusually high COD levels and a high specific gravity is introduced into a simply dug settling pond. The liquor permeates into the soil and may mix with underground water. It is conceivable that pulping waste liquor with a high specific gravity gets mixed into pump water from a well some kilometers down the water vein. According to an actual example, once such a phenomenon occurs, the black liquor mixing problem will remain unsolved over a long period of time, even if countermeasures are taken. This happened at a mill where pulp black liquor of considerably high consistency (presumed specific gravity of 1.04-1.05) alone was introduced into a simply dug settling pond.

9.2 Causal Analysis of the Present State and Problematic Issues in the Paper & Pulp Sub-sector

9.2.1 Present State of Production Technology in the Paper & Pulp Sub-sector

(1) Pulping Process

Pulping equipment is largely classified into the following four types:

These methods look like the system that was used 50 or 60 years ago in Japan.

1) Chemi-ground Pulp (CGP) by Cold Soda Method

In the cold soda method, bamboo chips are treated with sodium hydroxide at a normal temperature. Chips are filled in a 5 x 5 x 2.5 m concrete pit and are merely sprayed with a hose using a sodium hydroxide solution pump, for 3-4 days. The degree of sodium hydroxide that saturates into the chips depends in part on pit. The entire quantity of black liquor is discharged as wastewater.

As mentioned above, a 5m square saturation tub is standardly used. No circulation liquid is sprinkled around a 1m circumference of the 5 m square. The area of this is 16/25 of the whole tub.

2) Alkaline Pulp (AP) Method

Chips are filled in a ball-shaped batch digester that is rarely seen in Japan and then cooked with sodium hydroxide. Without chemical circulation, chips are heated with 7 kg/cm^2 steam. The digester in use is not equipped with a thermometer, only with a cooking pressure gauge. Only two mills recover a very small amount of black liquor, which other mills discharge without treatment.

3) Kraft Pulp (KP) by Sulfite Method

KP by sulfite method is used to cook chips in a big ball-shaped batch digester by adding sodium hydroxide and sodium sulfide.

Two mills are now adopting this method to manufacture BKP. In both mills, however, the black liquor recovery rate is very low and the color of wastewater is fairly black. Due to inefficient cleaning practices, the chloride consumption ratio is approximately 6 %, which is more than 50 % higher than the normally recognized figure in Japan.

It is possible to reduce the chlorine by 2/3, or 1/3 by changing the cooking and washing methods. Thereby, it is possible to reduce AOX and Chloroform.

4) Recycled Paper from Waste Paper (WP)

Pulpers for the liquefaction of waste paper have been installed in several factories.

Although good quality waste paper is being used, the quality of the remanufactured pulp is bad because screen equipment and cleaners are poor and there is no flotation equipment installed, which is most important for the extraction of soot. Many ink stains and adhesives are observed on the surface of the paper. This adhesion dirties the rollers and the instruments on the paper machine and causes many instances of paper break.

The equipment is presently used for the treatment of waste paper. In most cases a beater is used for bamboo pulp and washing is performed at the bleaching processes separation, washing, dirt extraction, and even in some cases. That is the reason why a large amount of water is used and a large amount of the good quality fiber is discharged. Consequently, a large amount of SS and COD are discharged with the effluent.

5) Technological Issues in the Pulping Process

Technological issues in the pulping process, other than those mentioned above, are summarized below.

(a) Chip Size

At present, Sodium hydroxide is required to be added, in excess of usual amount, because the chip size is larger than a pack of cigarettes. In bigger chips, the saturation efficiency of chemical liquid is bad, and therefore the center part of the chips does not dissolve. Due to an excessive addition of chemicals, not only small chips, but even optimal sized chips are overly dissolved. Consequently, the content of dissolved material becomes high, and the yield decreases causing the wastewater quality to worsen.

The uncooked, large chips are called “knot” and are usually re-cooked, although there are exceptions. In some specific cases for paper that is used in Buddhist ceremonies, these chips are ground with a grinder. Cases like these require excessive electric power for pulping, and bring about an increase in minute fibers and a loss of washed away materials.

An adjustment of the blade shape, or an upgrading of the “chipper,” is necessary. There are factories where, for a long period of time, the blades have not been adjusted or grounded.

(b) Washing Efficiency

Cold water washing is the usual practice in Viet Nam, and this method requires a large amount of water and bleaching material, as washing efficiency is not sufficient.

In some cases, cold water, several hundreds times that of the product, is used. If the amount of water used increases, the COD of discharged water is apparently lowered. In fact, however, only large particles such as “knot” and some binding fibers are recovered in the wastewater treatment system. All other fine fibers and particularly, fine and delicate fibers necessary for the transparency of the surface of paper, are discharged and lost.

This causes problems where, for example, some soft and pliant products such as tissue paper cannot be produced, or necessitates the need for a great amount of electric energy to recover the fine fibers.

(c) Dirt Removal Equipment

Most of the factories in Viet Nam use Janson Screens with 3ϕ plate holes, which makes it impossible to remove small particles.

The Centri Cleaner, with a diameter of over 200ϕ, is also widely used. However, it can only clean away sand and bigger particles. Due to its low efficiency, there are cases where it is used in a two-stage series, and in these cases, despite the fact that the rejection rate is two times higher, a greater part of the pulp flows away in the sedimentation pit.

A high concentration cleaner makes it possible, by pouring water, to clean away only metal particles, pebbles, and sand, without losing pulp.

However, there are also cases where ordinary cleaner is used in a simplified manner. In these cases, because of the large quantity of the outflow of the raw material, a three or five stage cascade system is applied and the alien particles are enriched and dissolved.

(2) Paper Machine

1) Wire Cylinder and Yankee Dryer

Generally, paper machines consist of wire cylinder and Yankee dryer types, and in a few cases, Fourdrinier plus multi-cylinders types are also in use. Dryer hoods are semi-closed type. Drives are, in many cases, of the cone pulley type and some of them lack a speed adjustment device. In many mills the speed of the paper winding reel is adjusted manually.

2) Technological Issues in the Paper Process

(a) "Doctor" Maintenance

The poor maintenance of the "Doctor," which is used to remove the scum in the dry cylinders, and a preference for an angle of nearly 45° in many mills, causes frequent paper cuts between the dryer and the reel in some mills. In those cases, the phenomenon of the paper cut was caused by adhesive substances of waste paper pulp sticking on the dryer surface, and paper consequently stuck to the sticky surface. In one specific case, the "Doctor" has been installed upside down.

(b) Cylinder Wire

In one mill, defects in the cylinder wire were found and every time the cylinder rotated big holes were made. This suggests that an insufficient maintenance technology level exists in the factory for repairing damaged wire.

(c) Low Material Feed Temperature to Paper Machine

Wet paper, after going through the de-watering process, contains much water because of the low temperature, 25 ℃, of the material feed to the paper machine and being too the low "Nipper" Pressure (NIP) exerted due to the diameter of the press roll small. None of the factories have data based on actual measurements of the water content after de-watering.

(d) White Water Recovery

In most factories in Viet Nam, wastewater is generally collected to a final sedimentation pit, although there are factories where black liquor and "knot" are separately treated in the pulping process.

The screening and cleaning of the dirt apparatus, having separation of fiber clusters and vinyl scrap, mixes together unbleached and bleached pulp, even the colored pulp. Therefore, this mix can only be used as raw material for the lowest quality cardboard. On the other hand, because there is also a large amount of discharged scrap, it maybe appropriate to install a cardboard paper machine in some factories.

(e) Cylinder Wire Vat

A large amount of floating particles and foam are found on the surface of the vat. Foam causes problems, such as uneven paper which is thinner on the side that has foam, hole openings adhesive pile up and scrap appearance, which results in paper cutting and dirtying of the paper surface. In order to prevent these problems a shower is needed. However, there are cases where, even if a shower pipe is installed, the entire system is still inefficient because the shower water pressure is low and the angle of the shower is not appropriate. The most important thing to remember is not to allow foam to accumulate on the cylinder.

(f) Emission of Sulfur Dioxide

There are factories where sulfur powder is combusted and a Sulfur Dioxide (SO_2) gas is blown into a dryer hood.

In one factory, the annual sulfur consumption for burning reaches 1,408 t and this means there is a discharge of more than 2,700 tons of SO_2.

(3) Measuring Instruments

As for measuring instruments, only pressure gauges for steam are mounted on the cooking digester and the dryer in the paper process, although some of them appear unreliable. No flow-meters for expensive and influential dyes and chemicals were observed and the study team worried about an insufficient control of purchases and inventory. A truck scale has been installed in only two mills and the weight of the purchased chips are measured using a balance in one mill. In the mills where materials are carried in by bicycles, it is unclear how the weight of the material is measured. It is doubtful that one ton of paper is made from 2.2 tons of bamboo that contains about 50 % water. Through an actual rough calculation of stock material flowing out, it can be estimated that it cannot be but some 10 %.

It is especially well known that the moisture content of bamboo differs greatly depending on the number of years it has been growing. Therefore it is very important to measure the moisture to determine a suitable amount of NaOH additive.

9.2.2 The Present State of and Problems Concerning Production Management Technology in the Pulp and Paper sub-sector

Six (6) of the companies surveyed have some kind of management scheme, but the others do not use flow sheets, records or management schemes. There is also a lack of management leaders and this makes it difficult for employees to increase their own self-management ability.

No measurements are being carried out for the Kappa Number (KN) that indicates the de-lignin degree, chemical concentration for cooking and impregnation, or pH.

9.2.3 Problematic Items in the Current Wastewater Treatment System

This issue will also be mentioned in section 9.3, which is concerned with the merits of recovering fibers and chemicals, and with simple methods of recovery. In Viet Nam's case, only the bamboo price is lower, and chemicals prices are almost at that of the international level. As for fuel, coal prices seem somewhat lower than the international level, but in consideration of its calorific value and the cost for ash treatment, there is no real substantial difference. Heavy oil is at the international price level and electricity is twice as high as international prices. For working out improvement measures, it needs to be kept in mind that fine fiber flowing into rivers is a very expensive substance.

Furthermore, as mentioned above, an extremely high amount of water consumption, despite a low price, will lead to the use of much more electric power and chemicals. The temperature of paper-making materials becomes nearly the same as the temperature of the water, and then the water content in the wet sheet at the press outlet increases, which causes the use of extra, rather expensive, fuel as mentioned above. Incidentally, it should be noted that the energy cost at each of Japan's major paper making companies is, as shown in Table 9.9, several per cent of the total cost, while Viet Nam's energy cost is comparatively high, around 20 % of the total cost, although the bamboo price is low.

9.2.4 Existing Problems in the Pulp and Paper Sub-sector

The problematic issues in the Pulp and Paper Sub-sector are listed below, summarizing the previous sections.

(1) Production Process

1) Pulping Process

1. Large chip size (refer to 9.2.1 (1) 5) (a));
2. Inappropriate chemical circulation (refer to 9.2.1 (1) 1));
3. No recovery of cooking steam and waste liquor;
4. Low efficiency of washing (refer to 9.2.1 (1) 5) (b));
5. Low productivity and low product quality of waste paper machines (refer to 9.2.1 (1) 4)); and
6. Insufficient maintenance of dirt removal equipment (refer to 9.2.1 (1) 5) (c))

Table 9.9 Sales Figures, Raw Material Costs, Fuel Costs and Chemical Costs of Seven Major Japanese Pulp and Paper Enterprises

	Nihon	Oji	Daishowa	Daio	Mitsubishi	Hokuetsu	Chuetsu	Total
Paper/Pulp Sales	464,624	727,139	313,817	192,357	168,481		111,746	103,094
	467,020	727,024	305,019	191,774	168,025	108,607	103,730	2,071,199
Raw material Costs	104,607	168,792	90,416	47,996	35,173	26,845	29,519	503,348
	102,550	173,472	102,293	45,466	35,964	27,310	29,658	516,713
Fuel Costs	22,364	39,969	23,802	10,034	6,480	5,142	5,014	112,805
	18,678	34,316	18,786	7,318	5,974	4,536	4,608	94,216
Chemical Costs	53,146	68,031	36,937	24,318	26,027	15,901	10,516	234,876
	52,063	66,264	32,482	24,099	25,216	15,290	10,552	225,966
Sub-total	180,117	276,792	151,155	82,348	67,680	47,888	45,049	851,029
	173,291	274,052	153,561	76,883	67,154	47,136	44,818	836,895
Percent Sales	%	%	%	%	%	%	%	%
Raw material Costs	22.5	23.2	28.8	25.0	20.9	24.0	28.6	24.2
	22.0	23.9	33.5	23.7	21.4	25.1	28.6	24.9
Fuel Costs	4.8	5.5	7.6	5.2	3.8	4.6	4.9	5.4
	4.0	4.7	6.2	3.8	3.6	4.2	4.4	4.5
Chemical Costs	11.4	9.4	11.8	12.6	15.4	14.2	10.2	11.3
	11.1	9.1	10.6	12.6	15.0	14.1	10.2	10.9
Sub-total	38.8	38.1	48.2	42.8	40.2	42.9	43.7	40.9
	37.1	37.7	50.3	40.1	40.0	43.4	43.2	40.4
Production Level	3,268	5,634	2,660	1,750	923		869	809
	3,252	5,563	2,632	1,714	933	838	833	15,765
Production Cost/t	1000 yen/t	1000 yen/t	1000 yen/t	1000 yen/t	1000 yen/t	1000 yen/t	1000 yen/t	1000 yen/t
Raw material Costs	32.0	30.0	34.0	27.4	38.1	30.9	36.5	31.6
	31.5	31.2	38.9	26.5	38.5	32.6	35.6	32.8
Fuel Costs	6.8	7.1	8.9	5.7	7.0	5.9	6.2	7.1
	5.7	6.2	7.1	4.3	6.4	5.4	5.5	6.0
Chemical Costs	16.3	12.1	13.9	13.9	28.2	18.3	13.0	14.8
	16.0	11.9	12.3	14.1	27.0	18.2	12.7	14.3
Sub-total	55.1	49.1	56.8	47.1	73.3	55.1	55.7	53.5
	53.3	49.3	58.3	44.9	72.0	56.2	53.8	53.1

Upper : Mar. 1997, Lower : Mar. 1996

2) Paper Machine

1. Inappropriate washing system;
2. No recovery of white liquor (refer to 9.2.1 (2) 2) (d));
3. Low feed material temperature (refer to 9.2.1 (2) 2) (c));
4. Foam in the cylinder wire vat (refer to 9.2.1 (2) 2) (e));
5. Insufficient maintenance of the “Doctor”(refer to 9.2.1 (2) 2) (a));
6. No draw adjustment system installed on paper machines; and
7. Emission of sulfur dioxide (refer to 9.2.1 (2) 2) (f))

(2) Production Management Technology

1. Lack of information on Cleaner Production and End of Pipe technology;
2. Lack of basic operation data collection (refer to 9.2.2);
3. Lack of technical materials such as process flow sheets (refer to 9.2.2); and
4. Lack of a production management scheme (refer to 9.2.2)

(3) Industrial Wastewater Treatment

1. Waste liquor permeation into the soil through the settling pond (refer to 9.1.3 (4));
2. No treatment of discharged wastewater that contains high COD, phenol, or chloroform (refer to 9.1.3 (4));
3. No treatment of discharged wastewater that contains mercury (refer to 9.1.3 (1) 3); and
4. Low reliability of wastewater analysis (refer to 9.1.3)

9.3 Countermeasures for Technology Improvement in the Paper and Pulp Sub-sector

9.3.1 Countermeasures by Promoting Cleaner Production Technologies

In this Section, countermeasures applicable in Viet Nam will be proposed after introducing the history of Cleaner Production (CP) in Japan.

Generally speaking, the KP (Kraft Pulp) method including the black liquor recovery system which burns organic materials like lignin etc., and the recovery of chemicals, is the most effective method for reducing water pollution. However, this system is very expensive, especially for small capacity plants like Viet Nam factories. Therefore, Cleaner Production Technology, which can be adopted easily with only a small sum of money, is recommended.

Anyway, it should be remembered that pulp mills cannot continue to run without recovering organic material and chemicals in the effluent in the near future, due to pollution and financial problems.

(1) Cleaner Production History in the Japanese Pulp and Paper Industry

Until the first half of 1950's, chemical pulp was manufactured in Japan using a Ca-based SP method. Because of their low cost, chemicals were not recovered and the effluent was diluted with a large amount of water and discharged. Just like the present situation in Viet Nam, an amount of water hundreds of times higher than that of pulp production was used, and a large amount of pulp fiber, as well as chemicals and dissolved organic constituents, were discharged.

In the latter half of 1950's, the Na-based KP method began to be adopted because of a need to increase the pulp yield under the tight supply and demand conditions for material woods that caused material prices to increase. It was also adopted to improve the strength and quality of pulp that was low in SP.

In the 1960's, with a rapid increase in demand for paper, large investments in KP were made. At that time electric power was under severe pressure, as coal prices increased, pushing the price of power higher.

Under such circumstances, the KP method was a two-birds-in-one-stone solution. In this method recovered waste liquor was burned in a recovery boiler to generate high pressure steam for turbine power generation. Since around the middle of the 1980's, after the second oil crisis, the temperature x the pressure of the steam generated by a recovery boiler has been over 500 °C x 100 kg/cm^2, and the power generated by the steam and the steam exhausted from the turbine has become nearly double that of that used in the pulp manufacturing processes. This is enough to cover the power and steam needs in the paper making processes.

(2) Course of Cleaner Production Technology Promotion in Viet Nam

In Viet Nam now only a small amount of bamboo and planted eucalyptus are available, and inland mountains are bare all the way up to their summits, not to mention the areas around Ho Chi Minh City and Hanoi. Even twigs and bushes are used as household fuel and brick burning fuel.

Average consumption and production of Pulp and Paper in Viet Nam during 1990-1996 showed explosive increases of 25.6 % and 22.6 %, respectively. In the case of such rapid growth in consumption, chips have to be imported at international prices and therefore, a switch over to the KP method needs to be primarily planned in order to improve the quality and yield, and to save energy. However, introduction of the latest, advanced equipment that mainly consists of imported machinery seems to be difficult under the present situation of excess imports.

Two mills in Viet Nam have already installed recovery boilers with the help of foreign aid, though they are low pressure and low-temperature type. In spite of such large investment, however, chemical recovery rates are low, presumably around 30 % and 70 %, respectively in each mill. Due to a low washing efficiency of black liquor, the consumption of bleaching chemicals is high, and in one factory, chlorine consumption is as high as 6 %, which increases adsorbable organic bound halogen (AOX) exhaustion.

On the other hand, although prices for import goods are almost at an international level as shown in Table 9.8, low cement prices and labor costs enable the construction of buildings and structures at 1/10 cost of that in Japan. Machinery can also be procured at nearly 1/10 cost if manufactured in country. Accordingly, when implementing a production increase plan, CP could be tentatively planned in an attempt not to increase, or even to decrease, environmental impact despite increased production. Furthermore, reduction of the COD load, to some extent, is thought to be possible without adding additional facilities, but by making more economical use of expensive chemicals and high calorific dissolved organic constituents which are at present discharged in wastewater. At many mills, where the use of the recovered fiber for low-grade paper is the better case, the whole quantity of mill effluent now undergoes terminal treatment. However, in many cases, sludge is recovered with great efforts, including a large amount of fiber, and is transported out of the factory by paying freight for its use as brick burning fuel.

By installing a simple, low price system to recover the fine fiber in the effluent at each process, the quality of the paper products will improve, paper cuts will be reduced and the operational efficiency increased. Thus, a production increase, to some extent, and considerable improvement in yield and energy consumption are expected.

Table 9.10 Construction Cost

ESTTIMATION OF BUILDING & ASSEMBLING COSTS					
No	Accounts of work	Unit	Quant	Unit price	Price
	BUILDING COSTS				
1.1	Regulation tank	m^3	25	700,000	17,500,000
1.2	Neutralization and Decolorization chemical	m^3	8	700,000	5,600,000
1.3	Aeration tank	m^3	40	700,000	28,000,000
1.4	Sedimentation tank	m^3	15	850,000	12,750,000
1.5	Mud-Containing tank	m^3	2	850,000	1,700,000
1.6	Pumping station	m^3	15	600,000	9,000,000
	Total 1				74,550,000
	COSTS OF PIPELINES, ACCESSORIES	Set	1	50,000,000	50,000,000
	Total 2				50,000,000
	COSTS OF ELECTRICITY				
3.1	Monitoring cabinet	Set	1	6,000,000	6,000,000
3.2	Source cable	Set	1	8,000,000	8,000,000
	Total 3				14,000,000
	Total 1+2+3				138,550,000
	COST OF EQUIPMENT				
4.1	Railing	Set	1	2,000,000	2,000,000
4.2	Western Europe waste	Set	2	18,000,000	36,000,000
4.3	Western Europe mud	Set	1	15,000,000	15,000,000
4.4	Air pump (aerator)	Set	1	25,000,000	25,000,000
4.5	Decolorization apparatus	Set	1	35,000,000	35,000,000
4.6	Decolorization apparatus	Set	1	35,000,000	35,000,000
4.7	Acid mixture apparatus and qualitative pump	Set	1	40,000,000	40,000,000
4.8	Decolorization chemical mixture apparatus	Set	1	30,000,000	30,000,000
4.9	Dry mud Pressing machine	Set	1	13,500,000	13,500,000
	Total 4				231,500,000
	OTHER COSTS				
5.1	Design cost				25,000,000
5.2	Design examination &				180,115
5.3	Estimation of costs Examination & Approval				173,188
	Total 5				25,353,303
	In which	Building &	138,550,000		
		Equipment	231,500,000		
		Other costs	25,353,303		
		Total	395,403,303		
	Total investment capital for building work	Round 1	395,400,000		
	additives over 3 years		104,600,000		
	Total cost		500,000,000		

(3) Countermeasures by Promoting Cleaner Production Technology

1) Promotion of "Seven (7) S"

In order to ensure safety, strict enforcement of "Three (3) S's" are essential, namely SEIRI (=putting things in order), SEITON (=arranging things in the right order) and SEISO (keeping things clean). In Japan, since the latter half of the 1940's, safety campaigns have been conducted in all companies and today many companies are promoting the movement as a "Five (5) S's" campaign by adding, in general, two (2) S's, i.e. SEIKETSU (=cleanliness) and SHITSUKE (=discipline). By further adding two (2) more, i.e. "Save Energy" and "Save Material", the promotion of a "Seven (7) S's" campaign is required for today's Viet Nam.

However, it seems necessary to start with "Three (3) S's" in order to know from where, what and how much effluent is flowing out, and therefore, no countermeasure will be adopted until this information is determined. Moreover, in Japan there is another campaign known as the 3M Elimination Movement , MURI (Unreasonable), MUDA (Useless) and MURA (Un-uniform) which has been partly introduced and these principles are important for the improvement of safety and quality and for the reduction of costs.

2) Cleaner Production in the Pulping Process

a) **Adjustment of the Chip Size**

In order to solve the problem of large chip size, an adjustment of the shape and length of the "chipper blade" is necessary. In some cases expansion of the "chipper" is necessary. As a result of the reduction in "knot," it is expected that the amount of bleaching material used will be greatly reduced.

b) **Regulation of Chemical Liquid Circulation**

In order to improve chemical circulation in the cold soda method, it is recommended that PVC pipes be installed for sprinkling chemical liquid around. Through this countermeasure it is expected that "knot" will diminish and the electricity used in the succeeding grinding process will be greatly reduced.

c) **Re-use of Boiled Steam and of the Effluent (discharged liquor)**

The old method which efficiently uses gas and steam, has been effectively applied in both the SP method and the KP method.

In the KP method there is the problem with rotting of timber, and there is a global tendency now of using high grade, continuously burning, wooden cauldrons.

In recent years due to the established sequence of re-using cooking liquor and steam, there is little heat loss, manpower is small, and in the case of the batch type method, positive effects can be seen. That is why examples can be seen of this method being applied in some of the big plants.

Savings of several % of steam and a saving in chemical costs of over 20 % is possible by using simple devices and pipelines. Moreover, due to the above measures, the concentration of the cooking liquor becomes high and it is possible to achieve a drastic reduction of steam for enrichment in the case of the recycling of black liquor.

In addition, in Viet Nam today, earthenware cauldrons which are used measure 8 m^3 – 20 m^3. If with a circulation apparatus a wooden cauldron used in the batch type method, commonly in Japan, is introduced, it would be possible to re-use the black liquor in a better way. However, it measures approximately 80 m^3 – 170 m^3, which would make it ten times larger than the apparatus used in Vietnam currently.

d) **Discharged Liquor Recycling**

The cold soda method is applied in the pulping process of bamboo pulp and in the CGP. However, the effluent is not being recycled. Through re-use of the effluent, it is possible to re-use caustic soda and to establish an economical recycling system by increasing the concentration of the effluent made into concentrated black liquor.

A conceptual flow sheet of this method is shown in Figure 9.1. The recovery procedures are as follows:

1. I Pit saturation is finished.
2. V-II→ P→ V-22→ V-23 → II Pit

   1/2 of the Black Liquor of I Pit is sent to II Pit for re-use, at the same time NaOH is added by V-Na.
3. Diluted Black Liquor is fed from the washing process to I Pit by V-H.W..
4. Black Liquor is sent to the II Pit first, and then to the Black Liquor Tank via the fiber screen where fine fiber is collected and sent to the stock chest.
5. Fresh water is fed to I Pit by V-FW open.
6. Wastewater is sent to a wastewater tank via a fiber screen, where fine fiber is collected and sent to a stock chest.
7. Saturation circulation is done by V-21→V-22→V-23→II Pit line.

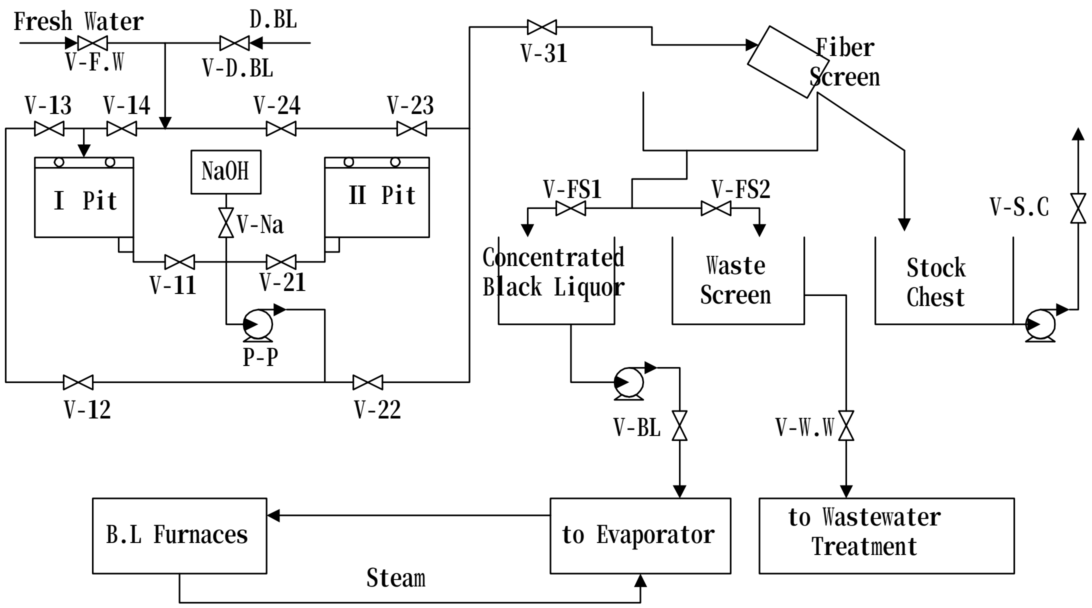


Figure 9.1 Conceptual Flow Diagram of Waste Liquid Recovery in CGP

Compared to the CGP, in the case of the AP method, the percentage of the additive in the caustic soda is high, and as a result of steam boiling, lignin and other organic material are discharged in great quantity. Because of this, recycling is more lucrative from an economic basis than it is for CGP. As for the recycling system mentioned in the previous paragraph, there is an additional recycling of gas from steam. This process is complicated, but is similar to the one in paragraph 1.

e) **Improvement of Washing Efficiency**

The higher the temperature, the better the washing efficiency. This is because the particles which have adhered to the fiber, and the chemicals and organic material used during the pulping process will wash away more easily when the temperature is higher.

Moreover, if the temperature of the dissolved material is lowered, attached water molecules will increase drastically, and the molecular weight will also increase. For example, in the case of Na_2CO_3 at a temperature below 35.4 °C, there is 1 H_2O, at the level of 32.0 °C – 35.4 °C there is $7H_2O$, and at a temperature lower than 32.0 °C it will change to $10H_2O$, so it is difficult to carry out washing at a low temperature.

Since the 1940's, for black liquor washing in KP, a multi-stage counter current method has been used and, in general, the dilution factor is approximately 2.5 in water at approximately 60 °C. The washing efficiency can reach a level of 98 %.

Recently, the regulations for discharged water have become very severe. There are even cases where in particular, AOX is limited to under 1.5 kg/t. There are also examples of the ECF method where over a 99.5 % washing efficiency has been achieved.

When the DF=2.5, in some cases the amount of water used has a concentration of 15 % at the exit of the washing machine. This dilution factor is 8.5 times greater, and at an 18 % concentration it is normal for the effect to be 7.5 times greater.

Considering the multi-stage washing system, if the amount of water used is reduced, there will be no drainage loss of fine fibers, dissolving chemicals can be recycled, the amount of bleaching material will be reduced, and the impurities in the effluent wastewater will be reduced.

Figure 9.2 shows a "Beater" which, if produced domestically in Viet Nam, will not need a large investment. The concentration of the recycled black liquor will not be so low, and keeping in mind the merits mentioned in the above paragraph, the profits could also be considerable.

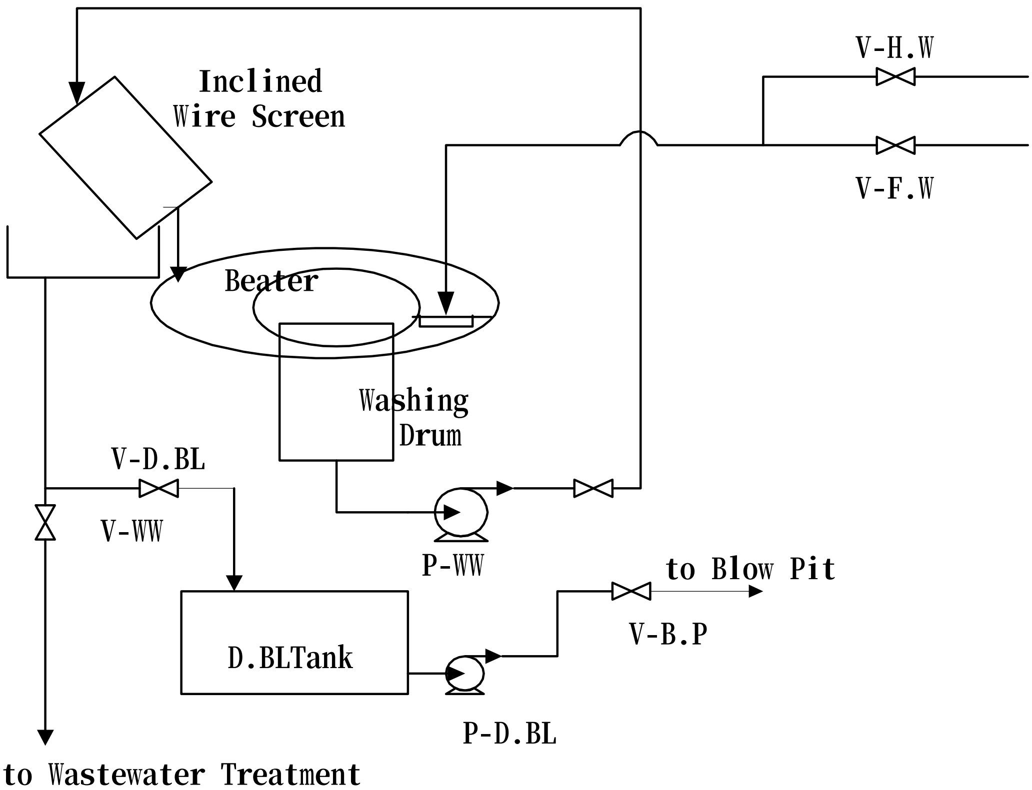


Figure 9.2 Conceptual Flow of Washing Black Liquor Recovery

The following is the procedure for Black Liquor recovery based on Figure 9.2:

1st step

a. Hot water is fed to the “Beater” by V-H.W.
b. Wastewater from washing drum flows to the inclined wire screen.
c. Recovery fiber flows to the “Beater”.
d. Waste black liquor goes to the DBL Tank and then goes to the Blow Pit through P-D.BL.

2nd step

a. Fresh water is fed to the beater by V-F.W.
b. Wastewater is fed from the washing drum to the inclined wire screen.
c. Wastewater from the inclined wire screen goes to wastewater treatment through V-W.W.

f) **Simplified Combustion System of Chemicals and Caustification Equipment**

The present high temperature and high pressure recovery boiler in use is very advantageous for cogeneration in Japan because of high energy costs in Japan. In Viet Nam, because the cost of coal is low, it is better to establish a simplified chemical recycling combustion system with the aim of recycling the high cost caustic soda.

Until the 1970's in Australia, enrichment and combustion of the effluent in the AP method was done with a lime kiln heating furnace. In contrast to the KP method, no offensive smell is generated.

In addition to the re-use of the effluent, if simple effluent recycling equipment is installed in the blow pit where the pulp dissolved from the dissolving pit is discharged, over 50 % of the effluent could be recycled.

If the black liquor, thus recycled, is enriched to 40-50 % in a three-stage multiple effect evaporator, combustion in a kiln type heating furnace is possible, and caustic soda used in the AP method can be recycled as sodium carbonate. Recently in Japan, 6-stage multiple effect evaporators that give approximately a 75 % concentration are commonly used, although a heat transfer space many times larger is required. Because of this an enormous investment in equipment is required.

By transforming this sodium carbonate into caustic soda through simplified caustification equipment, a part of the caustic soda consumption can be reduced. Moreover, if a heat transfer apparatus is installed in the heating furnace in order to generate steam in the exhaust gas, it will be possible to generate more than the necessary steam required for the evaporator.

This will also provide the steam necessary for bleaching in the production of AP.

In Viet Nam, as shown in Table 9.8, the cost of CaO is cheap - 2800 yen/t, and in order to transform $CaCO_3$ into CaO, there is no need to use mud recycling equipment or a lime kiln. Consequently, the process of causticyzing requires very simple equipment and it is not necessary to use a high class plant.

The discharge of mercury contained in the effluent in some factories, depending on the caustic soda used, could be significantly reduced. There are some factories that have an annual discharge amount of 8.9 t/year with a maximum 2 mg/l concentration. With respect to environmental policy, the effect of caustic soda is enormous.

g) **Improvement of Paper Recycling Equipment**

Figures 9.3 and 9.4 show trends in the rate of waste paper consumption and unit energy consumption in Japan, respectively. A 10% increase in the consumption of waste paper reduces energy consumption by 26.8 %.

Since 1973, which is the year used as the standard, but also was the year of the first oil crisis, Japan started to develop an energy efficiency strategy. After the second oil crisis, in particular, large-scale investments were made, due to which very significant energy efficiency was established by reducing electricity costs by 1/30 to 1/50 of initial costs through the substitution of mechanical pulp with De-inked Pulp (DIP).

In Viet Nam, the annual consumption of paper is small – only 5.2 kg/year per capita in 1997. However, due to a high cultural level, this consumption will rise rapidly in the future, and the recycling of paper will also, rapidly increase.

The rate of waste paper use in Viet Nam (waste paper consumption/pulp and waste paper consumption) is 38.43 %, which is the lowest in Asia, known throughout the world for its high waste paper consumption. Because timber resources are also limited, it is necessary to promote an increase in the waste paper consumption rate. The energy cost for paper and paperboard production in Viet Nam accounts for 20-30 % of the entire cost, while the energy cost in Japan is only several percentage points, as shown in Table 9.9.

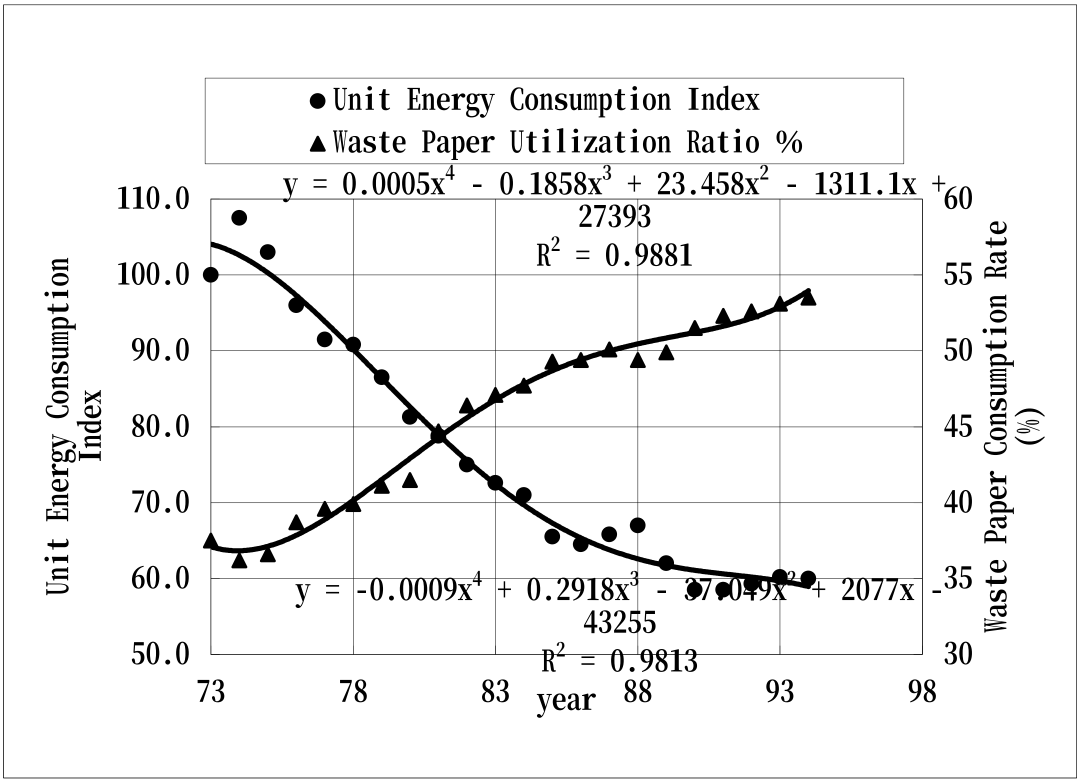


Figure 9.3 History of the Waste Paper Recycle Ratio and Unit Energy Consumption in Japan

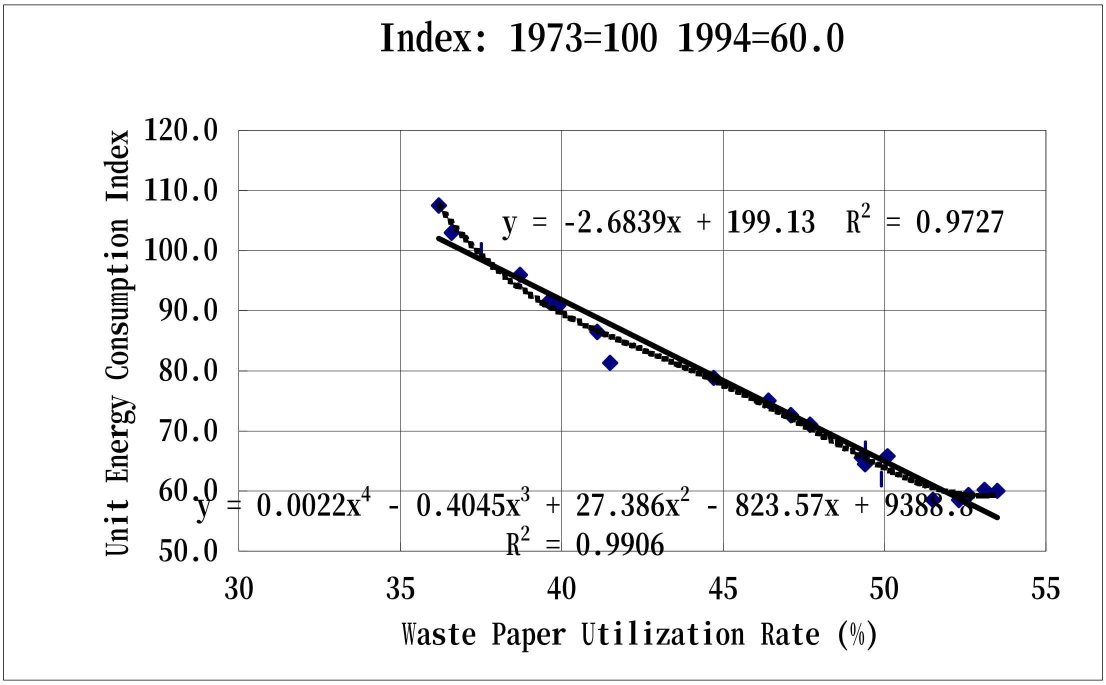


Figure 9.4 Relationship Between the Waste Paper Recycle Ratio and Unit Energy Consumption in Japan

In Japan, there is already 100 % DIP paper production for newspapers and over 80 % DIP paper production for high quality paper and coating paper. Expenses for equipment have increased from the initial cost of 10 million yen/daily output t to around 30 million yen. However, keeping in mind the KP equipment cost using timber, it is comparatively cheap.

Nevertheless, the present production scale in Viet Nam is small, thus, there is no need to introduce costly, high technology equipment that would eliminate all production problems. It is possible to produce high quality DIP with low cost equipment, provided that the alien particles can, to some extent, be sorted out and separated.

Among the factories investigated, one factory that has had foresight, is planning the introduction of a "Flotator."

It is recommended that the following measures be implemented in Viet Nam:

a) Preconditions

1. Classify waste paper based on type for cargo collection;
2. Manually remove incompatible material and particularly large foreign particles and vinyl cords.

b) Introduce the "tower system" for medium concentration (8-12%) pulp

Pulpers with low concentrations (3-7 %) of fractionated alien particles, such as adhesives, and high concentration pulpers with a 12-16 % concentration of ink and adhesive fractions, are smeared on the fiber and that is why the electricity cost is comparatively high. Instead of the pulper, a simple wet-type shredder could be used which has low electricity consumption, does not split the alien particles, sorts out the waste paper, adds caustic soda, hydrogen peroxide, etc. and stores the material in a medium concentration tower for a long time.

The above mentioned tower system is widely used in Japan, and there are no particular problems, but the equipment is rather costly.

Additionally, there is a kind of pulper known as the fiber float, but it is comparatively costly for small-scale plants, and particularly in Viet Nam where concrete is cheap, it would be less expensive to build a bigger tower. This would make exfoliation easier without splitting the ink and the adhesives.

c) Coarse screens for the removal of ink, adhesives and other alien material without splitting.

d) Introduction of a kneading system

This system enables ink and adhesives to be peeled off from the fiber which was not dissolved by the coarse screen mentioned above, but was only made softer. This system operates through scrubbing at a temperature below 60 ℃. In Europe, in general, a disperser system is applied for grinding, where the temperature is increased with steam to over 100 °C. However, when adhesives gather up in a large amount, it is difficult to peel off the dissolved adhesives. This system was widely used for cardboard-making in the 1950's, but in recent years in Japan it has almost completely disappeared from use.

e) Introduction of a "Flotator" which can clean away minute adhesives of less than 5μ.

f) Installation of a cleaner for removing heavy and light foreign particles

There are many light foreign particles, such as adhesives and small pieces of film, on coating paper which cannot be cleaned away by a "flotator" and this creates problems for the quality of the paper and the paper machine. Therefore, it is recommended that a cleaner for removal of heavy and light foreign particles be introduced, because this type of cleaner for light foreign particles does not exist in Viet Nam.

In Europe and in North America in recent years there have been many cases of double installation i.e. of cleaners for both light foreign particles and heavy foreign particles. However, this is unsuitable for Japan and Viet Nam where electricity costs are high. Besides, at present there is no cleaner that has a high cleaning efficiency for light foreign particles. Therefore, it is more profitable to have a cleaner for both light and heavy alien particles working simultaneously.

g) Installation of equipment for washing and cleaning away filler and adhesives.

When a large amount of filler and ashes accumulates, it causes a big problem for making tissue paper and newspapers. The colour which adheres to filler is called red ball or blue ball, and this ruins the image of quality. Recently, a machine has been developed in Japan that allows 10 % of the material containing ashes to be reduced to less than 5 %, and has the possibility of reducing a further 5 % of the material to 2 %. However, unless such high efficiency is necessary, other more simplified equipment is available.

h) Dirt Screening Improvement

In order to improve the Janson Screen efficiency, it is recommended that a slit type plate of 0.45 S be adopted. It this measure is introduced it is expected that adhesives and small particles will be caught and, not only will the quality improve, but also paper cutting will be reduced.

In case ordinary cleaner is used, it is recommended that a three stage system be installed in small-scale factories. For smaller quantities, the use of a stock sever with three stages, including one pump is recommended.

3) Cleaner Production of the Paper Machine

(a) Cleaning System Improvement

In order to improve the cleaning system, it is recommended that water hoses and air hoses be installed in the wet part and in the dry part respectively, at an appropriate interval. It is recommended that water pressure be higher than 2 kg/cm^2 in the least, but preferably 3 kg/cm^2 as it is in the shower type.

It is absolutely necessary to install air hoses with a pressure of 4-5 kg/cm^2. Apart from that, a steam hose is also necessary to clean up the adhesives on the wires and the rollers.

It is necessary to strengthen the jet propulsion effect of the spearhead of every hose, and for that purpose it is more efficient to install tight nozzles. These are particularly efficient for large scale paper machines.

(b) Recycling of White Water from each Paper Machine

It is recommended that recycling equipment be installed for good quality fiber at every technological process. If this is carried out, the amount of recycled fine fiber will increase without having to revert to the previous processes, and the amount of SS in the effluent will greatly diminish.

There is no specific problem with reverting back to the previous process, but reverting to the initial process will necessitate the cleaning away of dirt and adhesives using the apparatus mentioned above.

The water clarified after SS recovery can be used as substitute for fresh water that is required in large quantities, and this will help lead to a drastic reduction in the consumption of water. This will also reduce the wastewater volume and the investment required for the installation of a wastewater treatment system.

Through implementing short cycle recovery of white water, the water from the bleaching process will be re-circulated and, therefore, water consumption will be reduced and the temperature of the re-circulation process will rise using a smaller amount of steam.

(c) Warm Shower Washing

It is recommended that warm water be used for the shower in the washing process.

As mentioned in 9.2.1 (2) 2) (c), with an increase of temperature the viscosity of the pulp slurry is reduced, water dehydration gets better, and it is possible to reduce the moisture of the paper after pressing. The following benefits will be obtained:

1. The retention of the fine fibers will improve and the quality of the surface and the transparency of the paper will also improve.
2. The moisture of the damp paper will be reduced so the strength of the damp paper will increase. This will result in diminished paper cutting. The paper before and after cutting becomes return paper which is usually called "broke." An increase in the rate of combination of "broke" leads to poor dehydration, and if the screening and cleaning of the dirt apparatus used for "broke" treatment is imperfect, a large amount of foreign particles will be mixed in and paper cutting will follow continuously. Therefore, applying the above method will result in a reduction of paper cutting, increased production, as well as greatly increasing the unit efficiency of steam and electricity.

   A large amount of white water is discharged at the time of paper cutting. When the cutting continues incessantly, there is also a discharge of raw material, so that not only does the cost increase, but also the environment is greatly polluted.
3. With the dehydration capacity increased, the drying capacity at the dry part allows for more scope and, thus, the speed can be increased and productivity will improve. The electricity consumption of the paper machine will become more economical, and depending on the conditions, the situation with the steam will almost be the same, which will result in great energy efficiency.

   Example: Using increased speed by 20 % the electricity unit consumption is $(1.2)^{(2/3)}/1.2=0.941$ which is a 6 % reduction.

(d) Steam Humidification for Damp Paper

At present, a large amount of fresh water is used in both the pulping process and the paper making process. Therefore, the temperature of the raw material at the paper machine is close to the fresh water temperature of 20-30 °C, or 25°C in factories using well water.

It is recommended that a simple steam box be installed before the press roller in order to reduce the moisture of the damp paper at the exit of the press through steam humidification. The steam consumption at the dryer can thus be reduced several times.

Example 1:

Humidity at the exit of the dryer part: 75 %

Humidity at the exit of the press part: 65 %

Humidity of the finished product: 7 %

Steam needed to raise temperature by 10 °C

= (75/25+1*0.24)*10/620*1.3=68 kg/t will lead to 3 % reduction of humidity.

Drying humidity at the dryer

= ((65/35 - 7/93) – (68/32 – 7/93)) / (65/35 – 7/93)*3500 = 433 kg/t.

Consequently, the amount of steam consumption saved = 433– 68= 365 kg/t, which means that the 3,500 kg steam unit consumption can be reduced by another 10%.

Besides the economic effect of the steam as a result of the reduced dehydration of the damp paper, paper cutting is also reduced and energy efficiency improves greatly.

(e) Countermeasures for Foam at the Cylinder Wire Vat

In order to prevent foam and floating material from collecting at the cylinder wire vat, it is recommended that a shower be installed. In addition, it is necessary to maintain the pressure and angle of the shower water. Most importantly foam should not be allowed to accumulate on the cylinder.

(f) Doctor

The "Doctor" is very important for removing paper powder (dust) and adhesives on the roller and the dryer cylinder, and for maintaining uniformity for dehydration and drying. In some cases, use of the "Doctor" shortens the life span of the instruments. The worst case is when it causes the break up of the instruments.

The angle of the doctor is 40°, but there are many cases where it has a larger angle and it is necessary to change the angle to approximately 30°.

(g) Paper Machine Draw Regulation Apparatus

It is recommended that an adjustment apparatus be installed in paper machines that do not have draw regulations, because the loss caused by paper cutting and paper tear up is great.

(h) Sulfur Dioxide Absorber

The burning of sulfur powder should be stopped from the aspect of human protection and environmental protection.

It is recommended that a simple absorption tower be installed for making SO_2 water which could be added to the pulp slurry raw material.

9.3.2 Countermeasures for End of Pipe Technology in the Paper & Pulp Sub-sector

The paper & pulp sub-sector in Viet Nam has a high potential for reducing environmental impact through the promotion of Cleaner Production technology. The investment demand for pollution prevention can be reduced by adopting End of Pipe technology after reducing environmental impact through the implementation of Cleaner Production measures.

The following wastewater treatment technology should be improved in the sub-sector:

1. Replacement of excavated sedimentation ponds with tanks made of concrete;
2. Introduction of appropriate wastewater treatment systems that use biological treatment methods.

9.3.3 Example Model of Cleaner Production and Expected Merits

Construction costs of Cleaner Production and End of Pipe after Cleaner Production is completed for the 21 mills surveyed is roughly estimated at 360 billion VND.

On the other hand, construction costs for reducing the effluent pollution by only End of Pipe without Cleaner Production is estimated at 740 billion VND, which is 2 times higher than the figure mentioned above. Besides, so much running cost is necessary for chemicals and electricity in the case of adopting only End of Pipe.

The following shows the example benefits of Cleaner Production applications.

(1) Example 1 Improvement of CGP Yield

1998：Bamboo 2,620 t/Pulp 1,000 t Yield=38.2 % NaOH=210 t/year

After CP：Yield=55 % Bamboo 1,818 t Bamboo Save=802 t NaOH=146 t/year

Merit: 802＊320,000=257 million VND/year

NaOH 64＊3,500,000=224 million VND/year Total 581 million VND/year

(2) Example 2 Improvement of BAP Yield

1998：Chip 43,075 t/Pulp 10,045 t Yield=23.3 % NaOH=5,239 t/year

After CP：Yield=40 % Chip = 25,113 t/year

NaOH=3,054 t/year Difference =2,185 t/year

Merit: Chip Save=17,962T＊420,103=7,546 million VND

NaOH Save=2,185＊4,154,000=9,076 million VND

Total=16,622 million VND/year

(3) Example 3 Recommendation for Using High Efficiency Pumps

Although electricity in Viet Nam is very expensive, as much as around 800 VND/kWh which is more than double the international price, efficiency of pumps is too low at less than 40 %. The efficiency of Japanese pump was upgraded after the Oil crisises as shown in Table 9.11. A roughly 11 kW pump could be changed to a 6 kW pump, making it possible to reduce 5 kW.

Merit：５kW＊8,000 h/year＊800 VND＝32 million VND/year

Cost：65 million VND

<u>Example:</u>

6kW→ 3kW Δ 3kWx8000h/year x 800 VND =19,2 million VND, save 50%

6kW→ 4kW Δ 2kW x 8000 h/year x 800VND = 12,8 million VND, save 33 %

11kW→6kW Δ 5kW x 8000 h/year x 800VND=32 million VND, save 44.5%

Investment Cost 500,000 Japan Yen = 65 million VND

Table 9.11 Japanese Pump Efficiency

Type / Size	Pulp pump				Water and white water pump			
	PLSM	NCM	HPLM	YTM	EEM	CDM	HDM	DSM
50x40					48			
65x50					62			
80x50			48					
80x65					65			
80x80				57	69			
100x80	48	50	50	57	71			
125x100				64	75			
150x100	55	54	55	73				
150x125				75	79			
200x125				77				
200x150	65	60	66	81				
250x200	70	70	72	82	83			
300x250	74	70	72	82		67	75	83
350x300				82		71	77	83
400x350				83		73	73	84
450x400				84			75	85
500x400							78	85
500x450								86
600x500								88
700x600								88
800x700								89
900x800								89
Year	53~66	53~68	65~	77~	80~	51~62	55~67	66~

(4) Example 4 Low Yield of Recycled Paper

Recycled Paper Product 483 t/year

Recycled Paper Use 819 t/year 644 t/year 175 t/year Down

Pulp Yield 59.0 % 75% Merit 21.4 million VND/year

Though this mill uses high quality used paper, the pulp yield is too low.

It is possible to obtain more than a 75 % yield by using dirt removal apparatuses and a “settler” for the White Water. Therefore it is possible to reduce used paper usage as much as 21.4 % as well as COD of wastewater, which is too high at 2,890 mg/l.

If these measures are implemented, the scale of the wastewater treatment system can be changed to smaller one.

(5) Example 5 Special Cases of Poor Maintenance and Design Errors

1) Optimization of Chip Size

It should be easy to reduce the size of the chips by simply adjusting the blades of the chipper. However, since the processing capacity will decline, it will be necessary to increase operating time. Moreover, it is necessary to install a chip screen and reduce large chips to a smaller chip size using a “crusher.”

Rough cost: 20 million yen = 2.6 billion VND

2) Total Renovation of the Brown Stock Washing Process (4 stage washing)

(a) Fitting of washing machine disk valves - 4 sets

(b) Rehabilitation of pumps and agitators - approximately 30 units

To ensure that seal water does not infiltrate into black liquor, all pumps need to be replaced with mechanical seal pumps, and ample spare parts should be provided for.

(c) Piping and valve replacement

(d) Use of warm water of 60 ℃ or more for washing water.

(e) Rough cost: 50 million yen = 6.5 billion VND

3) Upgrade Washing Machines at each Stage of Bleaching

(a) Piping needs to be installed to enable part of the diluted bleach water at the outlets of later stage washing machines to be used as washing water in washing machines at earlier stages.

(b) Rough cost: 30 million yen = 3.9 billion VND

4) Remodel the Feed Can for the Black Liquor Evaporator

(a) Since the temperature of black liquor is low, remodel the feed method according to recommendation in the flow chart. Also, it is better to re-model Can No. 1 into a falling film type.

(b) Since the evaporation capacity is high, external heaters are bypassed and E/S increases.

(c) Replace all pumps with mechanical seal pumps and always provide spare parts (approximately 10 units.)

(d) Rough cost: 30 million yen = 3.9 billion VND

5) Boiler and Turbine Renovation

Since actual conditions are unknown concerning this matter, it is not included in the Cleaner Production items and cost, but it is certain that investment can be retrieved within one year.

6) Required Funds

Rough cost: 130 million yen = 16.9 billion VND

7) Rough Estimation of Profits

The largest benefit of black liquor recovery is obtained by improving unit consumption of NaOH by 500 kg/t-pulp (from 520 kg/t-pulp to 20 kg/t-pulp,) or 20.9 billion VND as calculated as follows:

0.5 t/t-pulp x 10,045 t-pulp/year x @4,154,000 VND/t = 20.9 billion VND/year.

Moreover, as is indicated below, the ripple effect is massive.

a. Reduction of the wastewater load in brown the stock and bleaching processes;

b. Reduction of drainage loss of useful fine fiber 200 t/year 1.5 billion VN;

c Increased recovery and concentration of BL (black liquor);

d Reduction of 4,000 kl/year in consumption of heavy oil for steam generation due to increased steam generation and reduced V/E use in BLB (black liquor boiler) 6.7 billion VND;

e 2 % reduction in usage of Cl_2 in the bleaching process (from 6% to 4%) 200 t/year 1.2 billion VND.

Total 20.9 + 1.5 + 6.7 + 1.2 + = 29.3 billion VND

End of Pipe: If the above-mentioned Cleaner Production is implemented, the capacity of wastewater treatment system required can be reduced roughly to 1/3 of the case where Cleaner Production is not adopted.

(6) Example 6 : SO_2 gas for the Dryer Hood to SO_2 Water

1,408 t/year of solid S was burned to make 12,500 t/year of paper in 1999, and almost all of the SO_2 gas was emitted to the atmosphere. This corresponds to 11.4 % of paper production.

It is possible to reduce this to less than 70 t/year, corresponding to only 0.5 % of solid S (= 1.0 % of SO_2 gas) per paper ton by using an absorber. It is possible to reduce harmful SO_2 gas by using a scrubber system, and then putting SO_2 water into the pulp stock to reduce NaOH.

By burning 1,408 t/year of solid S, more than 2,700 t/year of SO_2 is exhausted.

$S + O_2 = SO_2$ Solid S 32 g = SO_2 gas 64 g/22.4 l : air = 29 g/22.4 l

9.4 Conclusion and Recommendations for Industrial Pollution Prevention in the Paper & Pulp Sub-sector

9.4.1 Recommendations for the Paper & Pulp Sub-sector

The following countermeasures need to be taken in the sub-sector.

(1) Short Term Countermeasures

1. Promotion of 7S Movement (refer to 9.3.1 (3) 1);
2. Adjustment of the Chip Size (refer to 9.3.1 (3) 2) (a));
3. Countermeasure for Foam at the Cylinder Wire Vat (refer to 9.3.1 (3) 3) (e)); and
4. Utilization of Low Mercury Caustic Soda (refer to 9.1.3 (1) 3) (f))

(2) Mid-Term Countermeasures

1. Improvement of Dirt Screening (refer to 9.3.1 (3) 2) (h));
2. White Liquor Recycling (refer to 9.3.1 (3) 3) (b));
3. Warm Water Shower Washing (refer to 9.3.1 (3) 3) (c));
4. Steam Humidification of Damp Paper (refer to 9.3.1 (3) 3) (d));
5. Improvement of Paper Recycling Equipment (refer to 9.3.1 (3) 2) (g)); and
6. Wastewater Treatment by Biological Methods (refer to 9.3.2)

(3) Long-Term Countermeasures

1. Regulation of Chemical Liquid Circulation (refer to 9.3.1 (3) 2) (b));
2. Reuse of Cooking Liquid and Steam (refer to 9.3.1 (3) 2) (c));
3. Recycling of Discharged Liquid (refer to 9.3.1 (3) 2) (d));
4. Improvement of Washing Efficiency (refer to 9.3.1 (3) 2) (e));
5. Combustion and Caustification Equipment (refer to 9.3.1 (3) 2) (f));
6. Improvement of Paper Recycling Equipment (refer to 9.3.1 (3) 2) (g)); and
7. Wastewater Treatment by Biological Methods (refer to 9.3.2)

9.4.2 Measures Requested of Administrative Organizations

It is necessary, and also inevitable, to have the positive involvement and back up of the responsible administrative organizations for IPP in Viet Nam to execute the countermeasures in paragraph 9.4.1. The study team proposes that the following countermeasures be taken by the related administrative organizations.

(1) Support an Elevation in the Technology Level

The paper & pulp sub-sector could be the most promising sub-sector among the five targeted in this study for achieving effective implementation of Cleaner Production technology to prevent industrial pollution. The technology standard in individual enterprises at present, however, are not high enough to implement Cleaner Production technology independently.

It is recommended that MOI promote enterprise guidance and training for enterprise employees through the development of human resource in the institutes under its direction, so that these institutes can direct enterprises on Cleaner Production and End of Pipe technology.

(2) Promotion of Voluntary Improvement Activities in SOEs

In order to promote the implementation of industrial pollution countermeasures in enterprises, the administrative organizations should work out and implement on a mid-term basis, measures that promote voluntary improvement activities. This should be done, especially in SOEs, utilizing a partial return system of profits to employees using "Improvement Proposals" and Cleaner Production implementation.

(3) Incentive Measures

In order to resolve the situation that most enterprises are not able to invest in environmental protection, the administrative organizations should work out measures that encourage investment, such as tax reductions, low interest financing or subsidization of investments as countermeasures for industrial pollution.

(4) Industrial Structure Improvement

The Pulp and Paper industry is a typical equipment intensive industry. At present the enterprises in the Pulp and Paper sub-sector in Viet Nam are generally small in size and lack competitiveness.

Considering that the Pulp and Paper industry in Viet Nam will be more dependent on imported waste paper for raw materials, it is proposed that the administrative organizations work out a long term measure for locating a new, large-scale paper factory near a sea-port by integrating several small factories currently distributed throughout local provinces.

(5) The Incidental Terms of Government Permission for Expansion

The growth rate of paper and paperboard production is large as shown in Table9.2. Therefore, wastewater pollution of paper and paperboard industries will become a big problem in Viet Nam, if pulping wastewater is not recovered.

Since effluent pollution caused by Viet Nam paper and paperboard mills is enormously high at present, abatement of the present pollution load is needed for the enterprises who wish to obtain grants for increasing production, especially for those whose pollution rate is exceeding regulation values by a great extent.

However, on the contrary, now is the right chance to start Cleaner Production.

In case that an enterprise makes an application for the production capacity expansion by n times, an incidental condition on the approval should be imposed that the environmental impact be decreased to about $1/n$ or $1/n^2$. Through this measure, the environmental pollution per unit production can be reduced to $1/n^2$ or $1/n^3$.

9.4.3 Investment Demand for Industrial Pollution Prevention Countermeasures in the Paper & Pulp Sub-sector

The total demand for investment for industrial pollution prevention is estimated at approximately 360 billion VND, as is shown in Table 9.12.

Table 9.12 Investment Demand for Industrial Pollution Prevention Countermeasures in the Paper & Pulp Sub-sector

Unit: million VND

Type of Study	No. of Companies	Cleaner Production		End of Pipe		Total
		No.	Amount	No.	Amount	
Detailed study	5	5	81,000	5	11,000	92,000
Simplified study	16	16	209,000	16	59,000	268,000
Total	21	21	290,000	21	70,000	360,000

Appendix 9

Overview of the Paper and Pulp Sub-sector

1. General

The paper and paper products industry in Viet Nam has recently been growing at a rapid pace. From 1995 till 1998 total sales increased 15%per year. However, the consumption amount per person in Vietnam is still low and high growth is expected to continue in the future.

Tables 9.A.1 and 9.A.2 respectively, show the production and consumption of paper & paperboard in Asian countries from 1985 to 1996.

Table 9.A.1 Production of Paper & Paperboard in Asia

Unit: 1,000 t/year

	1980	1985	1990	1995	1996	Average Increase %/y (1990-1996)
ASIA	29,808	38,248	57,071	77,855	82,081	6.2
Japan	18,088	20,469	28,086	29,659	30,013	1.1
ROK	1,693	2,312	4,524	6,877	7,681	9.2
Taiwan	1,479	2,018	3,337	4,243	4,337	4.5
China	5,350	9,112	13,710	24,000	26,000	11.2
Hong Kong	12	40	80	280	340	27.3
ASEAN	1,047	1,286	3,196	6,978	8,036	18.6
Indonesia	232	506	1,438	3,426	4,388	20.4
Thailand	355	432	877	1,969	2,036	15.1
Malaysia	75	65	275	581	692	15.6
Philippines	334	216	488	613	658	5.9
Singapore	6	10	80	87	80	▲4.7
Vietnam	45	55	50	202	204	22.6
India	1,088	1,590	2,206	3,025	3,025	4.7
Others	1,051	1,419	1,834	3,100	3,150	9.4

Table 9.A.2 Consumption of Paper & Paperboard in Asia

Unit: 1,000 t/year

	1980	1985	1990	1995	1996	Average Increase %/y (1990-1996)
ASIA	33,364	42,002	61,851	85,570	91,656	6.8
Japan	17,926	20,301	28,220	30,015	30,859	1.5
ROK	1,561	2,291	4,310	8,580	6,973	8.3
Taiwan	1,412	2,063	3,320	4,698	4,489	5.2
China	5,882	9,693	14,429	25,499	30,277	13.1
Hong Kong	600	840	800	1,104	1,291	6.2
ASEAN	2,078	2,344	4,719	8,549	8.954	11.3
Indonesia	513	690	1,372	2,641	2,916	13.4
Thailand	417	630	1,190	2.248	2,301	11.6
Malaysia	445	374	1,015	2,002	2,052	12.4
Philippines	457	367	563	770	831	6.7
Singapore	140	220	510	648	591	2.5
Vietnam	45	60	66	237	259	25.6
India	1,488	1,770	2,525	3,455	3,855	7.3
Others	2,424	2,700	3,428	4,670	4,985	6.3

The biggest producing sector is the state-owned enterprises, and the central state owned sector produces 39.2% of total sales. The local state owned sector accounts for 17.8%, and the total state owned sector occupies 57% of sales. Following the state sector, the private sector is also large, and this sector produces 28.1% of total sales. This sector is divided into private companies, households, collectives and mixed. Recently the number of private companies has been growing at a rate of 96.4% per year, but this sector occupies only about 10% of the private sector and contributes 3% of total sales.

The foreign sector accounts for 14.9% of total sales and the portion of this sector has not been increasing in recent years.

From the view point of growth ratio per year, the private sector is the fastest growing, and it's growth ratio is 21.3%. Following the private sector, the foreign sector is growing expediently and has a growth ratio of 14.0%. Next comes the state owned sector and its growth ratio is 12.7%. In Viet Nam it is rare that the private sector grows faster than the foreign sector, so the private sector of the paper industry is quite remarkable.

Table 9.A.3 and Figure 9.A.1 reflect these statistics on the paper and pulp industry.

Table 9.A.3 Sale of Paper and Paper Products (billion VND 1994 price)

	1995	1996	1997	1998	Growth rate (%)
Foreign invested sector	298.3	349.0	390.5	442.1	14.0
State-owned sector	1,179.9	1,346.2	1,500.3	1,687.8	12.7
Private sector (excluding foreign)	468.6	5910	753.0	831.1	21.3

Source: Socio Economic Statistical Data

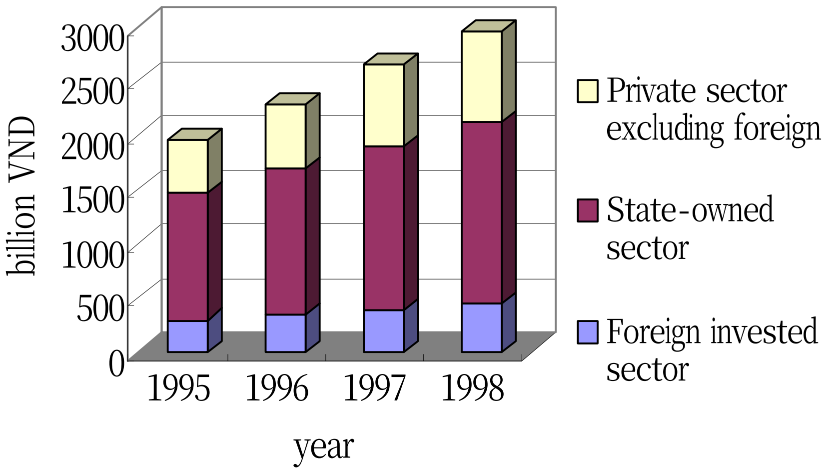


Figure 9.A.1 Sale of Paper and Paper Products (billion VND 1994 price)

Concerning the total number of enterprises, in 1996 there were 42 in the state-owned sector, 13 in the foreign sector, and 1,453 in the private sector for a total of 1508. Of course, in the private sector there are many small households operating, so the production scale in this sector is quite low.

Comparing production scales, the state-owned sector averages 4190 tons per company, followed by the foreign sector at 308 tons, and the private sector averages only 28 tons(1996 figures).

According to export/import statistics up to October 1999, for the total of all of Vietnam, the excess of imports is only one percent (1%) over exports, but there are big variations according to region. In the areas with large import excess, Hanoi had US$ 1,279 mill. over exports, an amount 2.5 times higher than total exports, and on the contrary, Ho Chi Minh city's exports exceeded imports by US$ 845 million, an amount 1.25 times higher than total imports. The sum of imports for paper was US$ 86 million and the unit price of 53.3 Yen/kg is considerably lower than the international price. Whether it was caused by these factors or not, there are many mills around Hanoi that are considering a production increase of about 50 tons/day or 15,000 tons/year.

2. Conditions of Mill Location and Materials

Table 9.A.4 shows the consumption of pulp and recycled paper in Asia in 1997.

Table 9.A.4 Consumption of Pulp and Recycled Paper in Asia (1997)

Unit: 1,000 t/year

Country	Pulp				Recycle Paper			
	Prod.	Export	Import	Consump	Recycle	Export	Import	Consump
Japan	11,365	61	3,271	14,575	16,546	312	362	16,596
China	11,264	22	1,542	12,784	8,760	3	1,618	10,375
Korea	610	0	2,080	2,690	4,531	-	1,556	6,086
Taiwan	347	3	863	1,207	2,789	-	1,306	4,095
Indonesia	2,979	1,000	1,100	3,079	1,163	-	1,133	2,296
Malaysia	120	-	94	214	698	16	48	730
Philippine	191	22	130	299	211	-	109	320
Singapore	0	10	11	1	392	427	72	103
Thailand	573	103	349	819	943	-	622	1,565
Vietnam	104	0	61	165	102	-	1	103

The country of Vietnam lost most of its forests nation wide due to the influence of the war with America. The present main raw material of bamboo is also becoming short in supply. Especially in the area around Ho Chi Minh City, where it is difficult to obtain a sufficient bamboo supply, and in addition, because it is financially difficult to invest in wastewater treatment systems, they are giving up manufacturing bamboo pulp, and instead, gradually switching over to pulp production using waste paper as the main material. Some of these enterprises are purchasing bamboo pulp from a factory located more than 100 km away.

There are also many mills using higher cost, imported pulp. Under such situations, the mills located around big cities, which in the past enjoyed a competitive advantage for the transportation of bamboo, wood material and paper products, are now losing the reason for their existence. Japanese paper mills, which have used a large amount of water since long ago, are situated at the mouths of big rivers. Big harbors constructed near these river mouths have led to great development of the many nearby mills that depend upon imported chips, heavy oil and coal, even now. The demand for paper in Vietnam is surely expected to increase rapidly and therefore, we think that the mills that rely upon imported chips should choose coastal locations for the long run.

However, the problem of location is too big and is out of the scope of this survey. The Study Team has tentatively proceeded with the Cleaner Production investigation with the goal in mind of figuring out how to, on a short-term basis, make these small-scale mills which use old machinery as they did during the Meiji era (1867-1911) in Japan, able to run pollution free without spending too much money in the process.

Chapter 10

Countermeasures for Wastewater Pollution in the Food Processing Sub-sector

Chapter 10 Countermeasures for Wastewater Pollution in the Food Processing Sub-sector

10.1 Present State of Wastewater and Productivity in the Food Processing Sub-sector

10.1.1 Enterprises Visited

As a part of the case studies for the Master Plan Study, the Study Team visited 21 enterprises in the following areas during the second field survey. Five out of these 21 enterprises were visited again during the third field survey for a further detailed study.

Ha Noi and surrounding area	9
Ho Chi Minh City and surrounding area	10
Da Nang	2

Except for one joint venture, the enterprises visited were all State-owned. The main products of the enterprises visited cover a wide range and include dairy products, beer, liquor, soft drinks, sugar, glucose syrup and confectioneries, spices and seasoning, processed seafood, vegetable oil, instant noodles and cigarettes.

The products and location of the five companies that were visited in the third field survey are liquor and confectioneries in Ha Noi, processed seafood and vegetable oil in Ho Chi Minh City, and beer in Da Nang. The enterprises visited were analyzed based on turnover in 1998 and the total number of employees, as shown in Table 10.1

Table 10.1 Turnover and Number of Employees of the Enterprises Visited

Number of Employees	Turnover (billion VND)				
	＜10	10-100	100-1,000	1,000＜	Uncertain
＜200	SOE 2	SOE 1			
200-500		SOE 2	SOE 2		SOE 2
500-1,000		SOE 2	SOE 1		JV 1
1,000＜			SOE 3	SOE 2	SOE 1
Uncertain					SOE 2

10.1.2 Industrial Wastewater in the Targeted Enterprises

(1) Sources of Wastewater

Wastewater from the food processing industry sub-sector is classified into the following four categories:

Category 1: Wash water that is generated intermittently through washing vessels, piping, machine parts and/or the floor after batch production. This water usually contains organic pollutants.

Category 2: Wash water that is generated continuously in seafood processing lines from product and equipment washing, from instant noodle production lines during equipment washing, or in beverage packaging units when drums or bottles for beer, liquor or soft drinks are washed.

Category 3: Process wastewater that is generated from processes, e.g. wastewater from a neutralization unit in the vegetable oil refining process; The primary distiller bottom blow down wastewater from the liquor production process; Cooling wastewater from the vacuum evaporation unit in the glucose syrup process or vegetable oil process also belongs to this category.

Category 4: Cooling wastewater that is continuously discharged at high temperature from cooking and distillation units in the liquor production process, decolorization and deodorization units in the vegetable oil refining process, or the candy production unit.

With regard to Category 1 wastewater, which accounts for a large portion of industrial wastewater from the sub-sector, it is inevitable that some amount of pollutants will be discharged out of production systems in order to maintain product quality, as well as sanitary hygiene. Even if it were possible to reduce the amount of wastewater by improving the washing method, the absolute quantity of the pollutants discharged would probably not decrease. Therefore, the only way to reduce the environmental impact caused by Category 1 wastewater is to enlarge the batch size of production; i.e. to expand the physical dimensions of the production system.

The volume of Category 2 wastewater is basically in proportion to the amount of production.

As for Category 3 wastewater, the amount of pollutants depends on the process and equipment applied. It is understood that process improvement projects are underway in oil producing enterprises in Viet Nam.

Category 4 wastewater is clean, the only problem is its high temperature. At present, this wastewater is discharged together with dirty wastewater. However, there are some projects underway in some companies in the sub-sector to recover and recycle the cooling wastewater by installing a cooling tower or cooling unit.

(2) Current Status of Industrial Wastewater Treatment

Few enterprises have installed effective wastewater treatment systems in the sub-sector. Wastewater from most factories is discharged in canals or in the surrounding environment without treatment. Enterprises in the sub-sector are now surveying adequate wastewater treatment systems. Most of the projects for wastewater treatment in the sub-sector, however, are neither finalized, nor being implemented due to a shortage of financial resources.

The main pollutants found in wastewater from food processing factories are organic. Organic pollutants can generally be treated by biological systems which, in order to operate the systems effectively, requires a definite employee training period and operational know-how. In one enterprise it was discovered that their wastewater treatment system, which utilizes biological technology, does not function effectively.

In the case of one joint venture with a Japanese company, it took them more than half a year to establish suitable operating conditions for a wastewater treatment system which consisted of pH adjustment, biological treatment, including anaerobic treatment, coagulation, sedimentation and filtration.

Technology transfer of wastewater treatment system operations will be a big issue in Viet Nam, although wastewater treatment systems could be designed and constructed by certain organizations in Viet Nam.

(3) Environmental Impact Caused by Industrial Wastewater from the Sub-sector

The environmental impact of wastewater from the enterprises visited in this Study was estimated based on an analysis of their wastewater.

Table 10.2 shows the results of the analysis of the wastewater samples collected at the final discharge points out of the factories. The amount of wastewater discharged was estimated according to the water balance reported by factory representatives because no flow meters were provided for measurement.

Figures shown in Table 10.2 include domestic wastewater, which is discharged together with industrial wastewater in most enterprises. The enterprise F12 was not in operation during the field survey.

Table 10.2 Wastewater Quality of Enterprises Visited

Enterprise Number	Quantity (m^3/day)	Quality Parameter (mg/l)			
		COD	BOD	SS	Oil
F01	740	2,993	2,371	778	1.15
F02	1,080	638	501	75	0.37
F03	1,139	662	389	144	0.24
F04	2,400	360	225	129	20.0
F05	290	346	162	87	0.22
F06	600	589	458	256	8.45
F07	260	10,923	7,462	1,228	0.55
F08	240	1,807	1,337	414	0.41
F09	300	557	424	330	0.38
F10	810	91	62	106	0.67
F11	400	3,231	2,357	797	4.64
F12					
F13	4,000	405	245	662	0.16
F14	20,000	11	7	22	0.12
F15	450	300	184	211	0.23
F16	250	372	224	565	0.26
F17	345	352	220	88	0.20
F18	850	5,116	3,412	3,320	0.48
F19	1,008	545	343	102	0.14
F20	300	272	158	148	0.18
F21	305	585	388	777	0.24
Total	35,767				
TCVN 5945		100	50	100	10

The wastewater from the sub-sector is characterized by high organic pollutant content, except enterprise F10 and F14. The wastewater of the former is composed of only household waste, in the latter, a wastewater treatment system is operating effectively.

Table 10.3 shows the absolute amount of all contaminants, calculated by multiplying the amount of wastewater by its respective, pollutant concentrations, in all the enterprises visited. The lowest row shows figures calculated by multiplying the total amount of wastewater, 35,767 m^3/day, by the respective national standard, TCVN 5945. Absolute COD and BOD discharged from the sub-sector as a whole are 5 and 6 times higher respectively, than the standard.

Table 10.3 Pollutants Discharged from Enterprises Visited

Enterprise Number	Quantity (m^3/day)	Pollutant Discharged (kg/day)			
		COD	BOD	SS	Oil
F01	740	2,171	1,755	575	0.85
F02	1,080	688	541	81	0.40
F03	1,139	754	443	164	0.28
F04	2,400	864	540	310	48.00
F05	290	69	32	17	0.05
F06	600	353	275	154	5.07
F07	260	2,840	1,940	319	0.14
F08	240	434	321	99	0.10
F09	300	167	127	99	0.11
F10	810	74	50	86	0.54
F11	400	1,292	943	319	1.86
F12					
F13	4,000	1,621	978	2,649	0.63
F14	20,000	226	140	440	2.40
F15	450	135	82	95	0.10
F16	250	93	56	141	0.06
F17	345	121	76	30	0.07
F18	850	4,349	2,900	2,822	0.41
F19	1,008	549	345	103	0.14
F20	300	82	47	44	0.06
F21	305	178	118	237	0.07
Total	35,767	16,744	11,509	8,668	61.34
TCVN 5945		3,577	1,788	3,577	357.6

In Japan, uniform discharge standards for both COD and BOD are set at 160 mg/l under the Water Pollution Control Law, a level milder than in Viet Nam. However, as a practical matter, they are controlled at 20 or 25 mg/l, depending on the wastewater amount, by stringent regulation standards under prefectural ordinances. Considering that enterprises in Japan are satisfying the stringent standard, COD and BOD discharged from Japanese factories at the equivalent wastewater amount of 35,767 m^3/day of the enterprises studied, are estimated at 720 and 890 kg/day at the maximum. It is estimated that environmental impact caused by wastewater in Viet Nam is 15 or 20 times higher than Japanese factories of equivalent scale.

Assuming that employees spend half of their active hours in the factories, the contribution of domestic wastewater to BOD discharged is calculated by multiplying the total number of employees of the enterprises visited, 14,805, by 1/2 of the population equivalent BOD, 50 g/day. BOD discharged with domestic wastewater is estimated to be approximately 370 kg/day, which accounts for 3.2 % of total BOD discharged from the enterprises visited.

10.1.3 Current Status of Productivity in the Food Processing Sub-sector

In general, the productivity of enterprises is relatively low in this field that belongs to a process intensive industry. Table 10.4 shows beer production and unit water consumption in the enterprises visited compared with a typical Japanese beer factory. Even the largest beer factory in Viet Nam, Factory D in Table 10.4, is much smaller than a typical Japanese beer factory. In addition, unit water consumption in Viet Nam is larger than 10 m^3/m^3-Beer, which is generally the amount in beer production factories around the world.

Table 10.4 Beer Production and Unit Water Consumption

		Production (m^3/year)	Unit Water Consumption (m^3/m^3-Beer)
Viet Nam	Factory A	4,800	22
	Factory B	3,600	26
	Factory C	5,800	12
	Factory D	200,000	-
Typical Japanese Factory		2,000,000	5-10

Table 10.5 shows the production capacities and wastewater amounts of the vegetable oil producing enterprises visited compared to an average size Japanese factory. Although the factories studied rank with average scale Japanese factories in terms of production capacity, their wastewater amounts are much larger. The wastewater amount of an average scale Japanese factory, 1.7 m3/t-product oil, shown in Table 10.5, is the 1984 figure, which was improved from 14 m3/t-product oil in 1974. The 1974 figure is equivalent to that of present Vietnamese factories.

Table 10.5 Production Capacity and Wastewater Amount of Vegetable Oil Producing Factories

		Production Capacity (t/day)	Wastewater Amount (m^3/t-Product Oil)
Viet Nam (1998)	Factory A	45	6.4
	Factory B	60	14.2
Average Japanese Factory		85	1.7

It should be noted that modern facilities have been introduced in the field, such as in the dairy products industry, where severe competition exists between Vietnamese enterprises and foreign invested enterprises. Also, a relatively high level of production management has been observed in enterprises that are exporting their products.

10.2 Causal Analysis for the Current State of the Food Processing Sub-sector

10.2.1 Current Status and Problematic Issues Concerning Production Technology in the Food Processing Sub-sector

(1) Current Status of Production Technology in the Food Processing Sub-sector

In general, most food processing enterprises in Viet Nam possess outdated equipment imported in the 1960's or 1970's from Germany, Japan, the former USSR, China or Taiwan. Modernization of production equipment is a common issue for the food processing sub-sector in Viet Nam, although projects utilizing new production lines are partly underway in some enterprises.

It should be pointed out that another issue in the sub-sector is a marked lack of skilled workers. If modernized equipment is introduced, most food processing enterprises will be in need of engineers or workers who can cope with new technologies. Training of employees is one of the most important issues in the food processing industry in Viet Nam.

Supported by the cheap cost of labor, packaging processes are completely manually operated in most enterprises, except for a few cases.

Examples of food processing technologies that are currently being applied in Viet Nam are mentioned below.

1) Beverage

The beverage sub-sector is one of the rapidly growing industries in Viet Nam. The beer industry, which produces more than 500 million l/year, is an important national industry in Viet Nam.

(a) Beer

More than 2,500 domestic beer-producing companies exist, most of which are small in size with production capacities of 1,000-25,000 l/day. The beer production technology applied in most companies is classified as "cold fermentation." A technology developed by the Food Industry Research Institute (FIRI) under MOI has been licensed to a few small beer-producing companies. Several joint ventures produce foreign brand beer by importing technologies and equipment from Europe.

Figure 10.1 shows a conceptual block flow diagram of the beer production process in Viet Nam.

Malt is not usually produced inside factories, but is purchased instead. Production processes are being operated batch wise.

After being pulverized in a milling section, malt is sent to a cooker and mixed with rice powder. The ratio of rice to malt is mostly set at between 40 and 60 %. After a saccharification operation in a cooker, hops are added and boiled. The temperature of the main fermentation reaction is set at approximately 5 ℃.

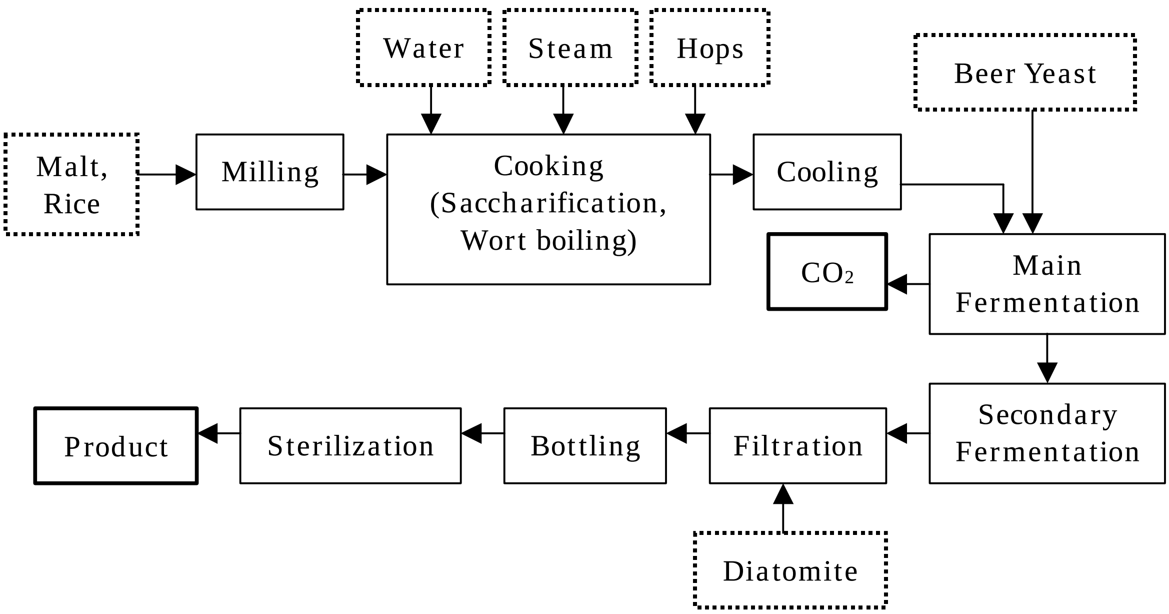


Figure 10.1 Block Flow Diagram of the Beer Production Process

Carbon dioxide (CO_2) generated during fermentation is recovered and sold after liquefaction. After several weeks of aging through secondary fermentation at 0 ℃, beer is filtered with a diatomite filter, poured into drums as draught beer or bottled for heat sterilization.

Except for joint ventures and a few other enterprises, the packaging process, which is composed of bottle filling and crown-capping, is operated manually.

(b) Liquor

The liquor industry, as well as the beer industry, is growing in Viet Nam. Figure 10.2 shows a conceptual block flow diagram of the liquor production process.

Cassava starch or molasses is used as a raw material for liquor. After pretreatment (e.g. molasses dilution), the raw material is sent to the cooking process, which is composed of a liquefaction unit and a saccharification unit. Enzymes tend to be used in the cooking process instead of acids in order to reduce environmental impact. Carbon dioxide (CO_2) from the fermentation unit is recovered and sold after liquefaction, as it is in the beer process. After fermentation, ethanol is purified with three distillers in the distillation process.

Adding specified ingredients to ethanol in mixing tanks produces various kinds of liquor.

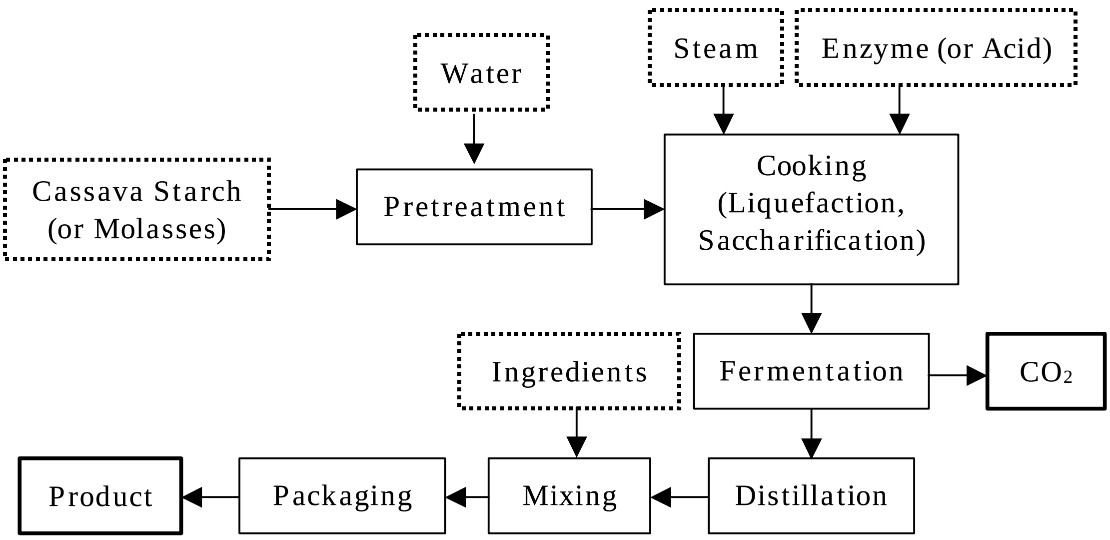


Figure 10.2 Block Flow Diagram of the Liquor Production Process

Most production units are batch-wise and manually operated. Few measuring instruments are provided for the process. For example, distillers are equipped with only two pressure gauges which indicate the pressures of the distiller top and the reboiler.

The packaging unit is also operated manually, including bottle filling, capping and labeling. Even if an automated filling machine is in operation, manual labor is still required due to the fluctuation of the quantity of bottles being filled.

(c) Soft Drinks

Soft drink production is conducted using a mixing process. Figure 10.3 shows a conceptual block flow diagram of a typical soft drink production process.

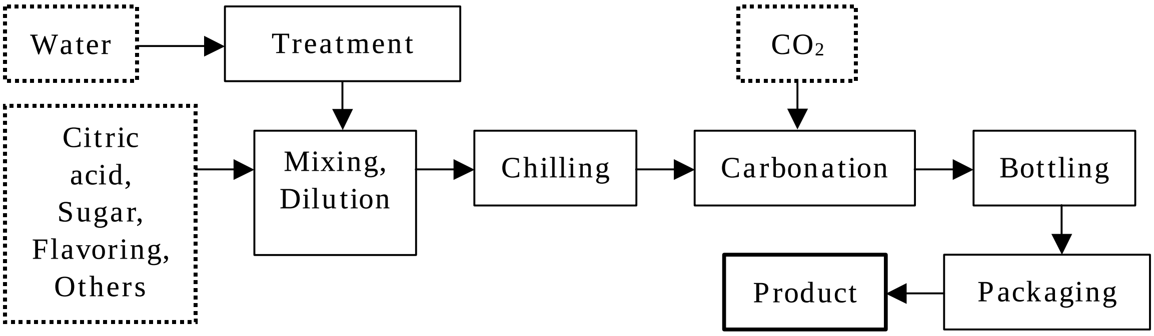


Figure 10.3 Block Flow Diagram of the Soft Drink Production Process

The supply water treatment unit plays an important role in soft drink production. One factory in Ho Chi Minh City uses 200 m depth well water by treating it in a two stage treatment system, which is composed of a primary system where lime treatment and sand filtration take place, and a secondary system where the water is coagulated, sterilized and goes through a diatomite filtration process.

2) Glucose Syrup and Confectioneries

Many manual operations remain in the confectionery production process in Viet Nam, where equipment with limited functions is utilized.

(a) Glucose Syrup

Figure 10.4 shows a conceptual block flow diagram of a typical glucose syrup production process.

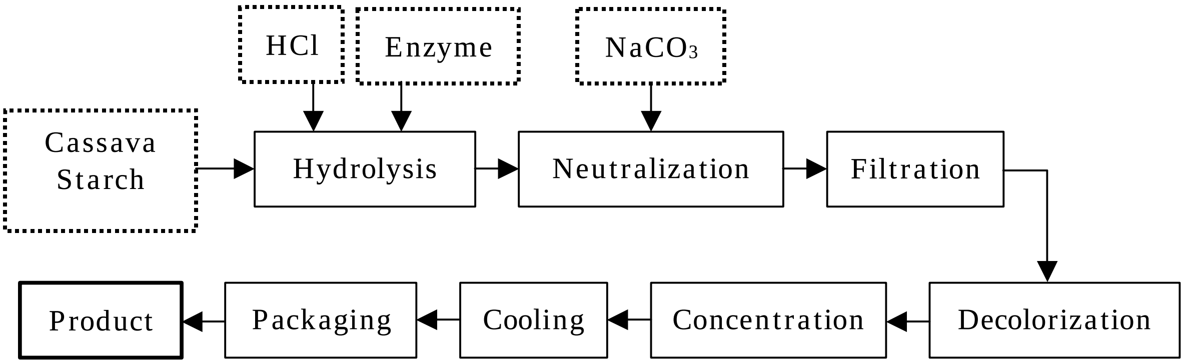


Figure 10.4 Block Flow Diagram of the Glucose Syrup Production Process

Cassava starch is used as a raw material. Saccharification of cassava starch occurs through hydrolysis with acids or an enzyme. A technology developed by the Food Industry Research Institute (FIRI) is being applied in one factory. By using enzymes (e.g. amylase) instead of acids, a high-maltose-syrup is produced.

After neutralization with soda ash, filtration, activated carbon decolorization, concentration through vacuum evaporation and cooling, glucose syrup, the final product, is produced.

(b) Confectioneries

Figure 10.5 shows a conceptual block flow diagram of a candy production process.

The main raw materials are sugar and glucose syrup. The ratio of sugar and glucose syrup is controlled depending on the product specifications. After dissolving the raw materials, additive mixing, cooking (boiling down), and cooling through vacuum evaporation follow. Wastewater from the vacuum evaporator contains a small amount of the product. After the rolling and cutting processes, individual wrapping of the product, candy, follows. In one factory, wrapping work is carried out manually by workers. According to sources at the factory, an introduction of an automated wrapping machine will cause a social problem because of loss of employment opportunities for workers.

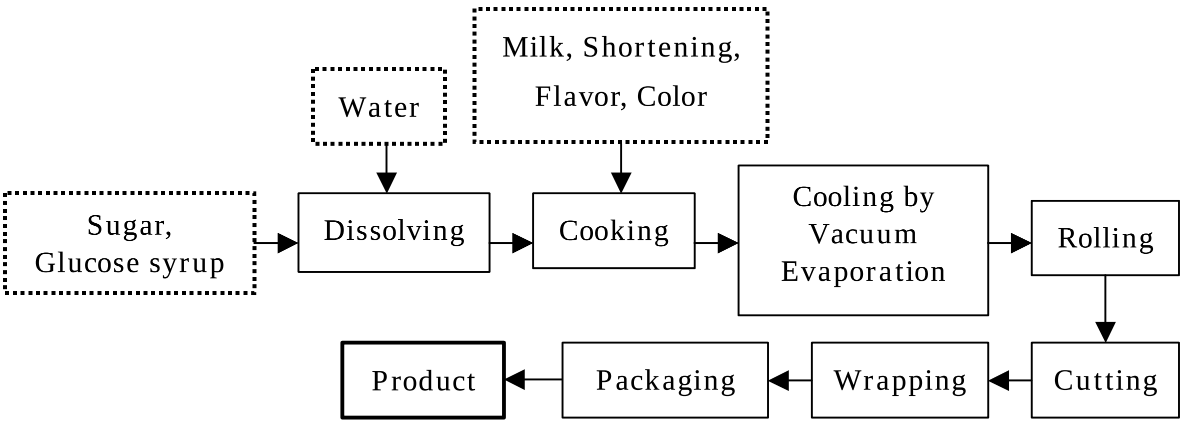


Figure 10.5 Block Flow Diagram of the Candy Production Process

3) Dairy Products

Severe competition exists between SOEs and foreign invested enterprises in the dairy product market in Viet Nam. Dairy product production technologies in

Viet Nam are mostly imported from Europe. Compared with other food processing industries, more modern technologies have been introduced into the dairy product sub-sector.

(a) Condensed Milk

Condensed milk or UHT (Ultra High Temperature) milk is produced by mixing raw milk with butter and sugar. Key technologies in this process are hygiene maintenance and cleaning. In these processes in one of the factories visited during the Study, stainless steel equipment and a CIP (Cleaning In Place) system with an automatic sequence controller is utilized.

(b) Milk Powder

There is only one factory in Viet Nam that is producing milk powder. Figure 10.6 shows a conceptual block flow diagram of a milk powder production process

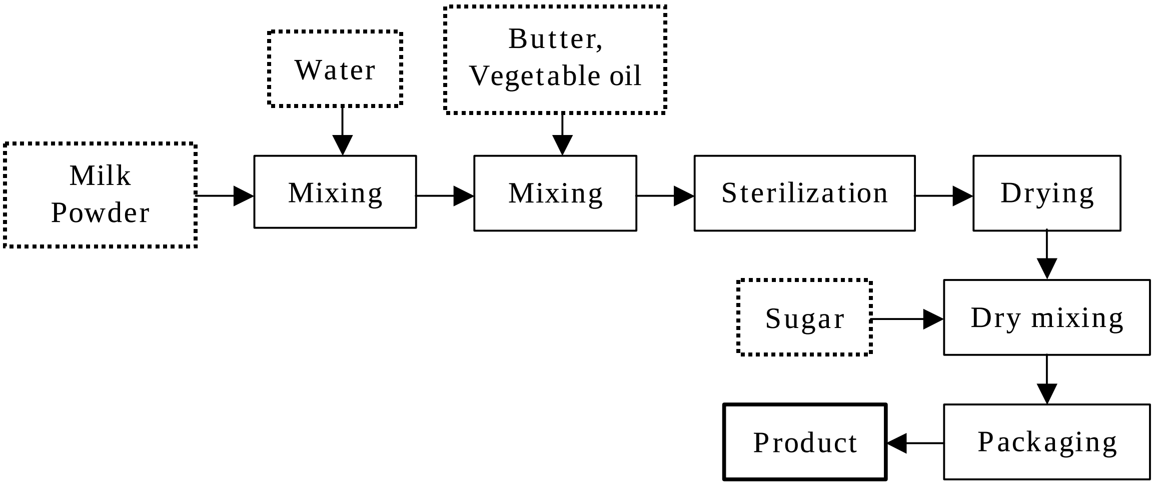


Figure 10.6 Block Flow Diagram of the Milk Powder Production Process

The raw material, milk powder, is mixed with water, butter and vegetable oil and then dried in a spray dryer. After dry mixing with sugar, the product is packaged.

4) Vegetable Oil

The production of vegetable oil in Viet Nam showed a remarkable 154 % increase over the three years since 1995, as shown in Table 10.A.1 in Appendix 10.

The vegetable oil production process is composed of two sections, expelling and refining. Figure 10.7 shows a general block flow diagram of the vegetable oil production process.

Basically, crude oil is obtained in the expelling section by milling and pressing oil seed, such as coconut, sesame, peanuts, or soybeans. The expelling process creates a small amount of wastewater due to the washing of equipment.

In the refining section, crude oil is neutralized with sodium ash, decolored with activated clay, and deodorized through vacuum evaporation. Contaminated wastewater is generated mainly from the neutralization unit. The vacuum evaporation unit generates wastewater that contains oil.

Through the hydrogenation of refined oil with Ni catalyzer, margarine or shortening is produced.

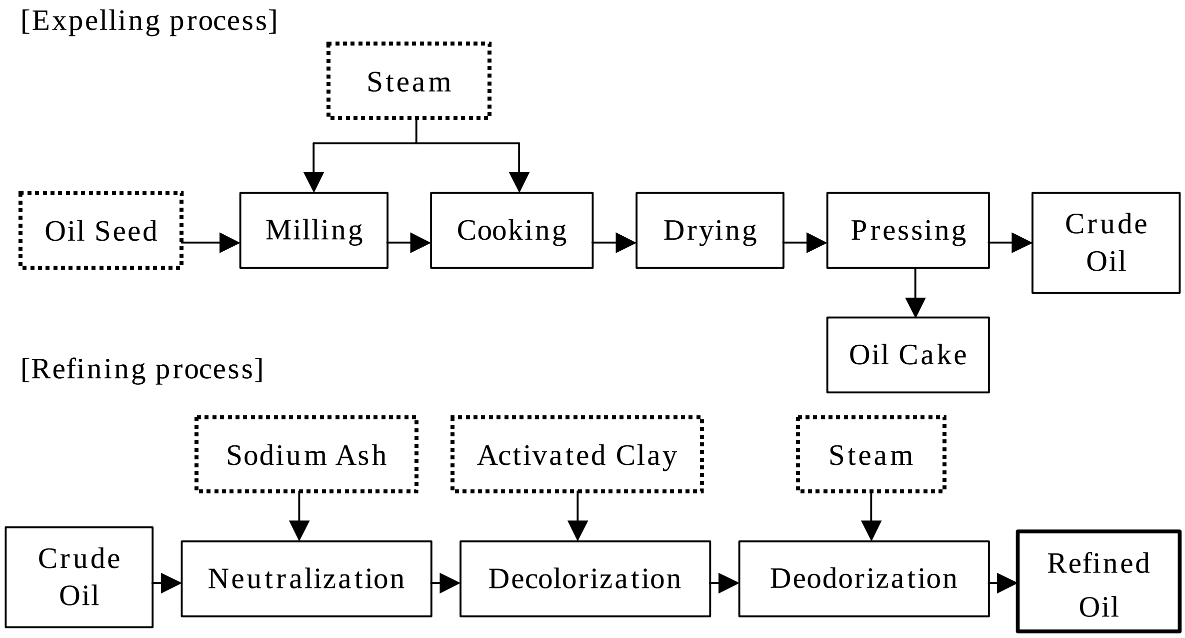


Figure 10.7 Block Flow Diagram of the Vegetable Oil Production Process

In order to cope with rapidly increasing product demand and to improve outdated technologies, expansion projects are underway in some of the factories visited in the Study.

5) Seafood Processing

Seafood processing is one of the main sources of cash income in Viet Nam. Processed seafood is exported to Asian countries and to Japan, its most stable market. It is also exported to the EU, a new, potentially big market for the Seafood Processing industry in Viet Nam.

The main products of this industrial area are frozen shrimp, crab, cuttlefish and squid, clams and other marine products produced based on the IQF (Individual Quick Freeze) method.

Figure 10.8 shows an example of a block flow diagram of IQF sole fish fillet production.

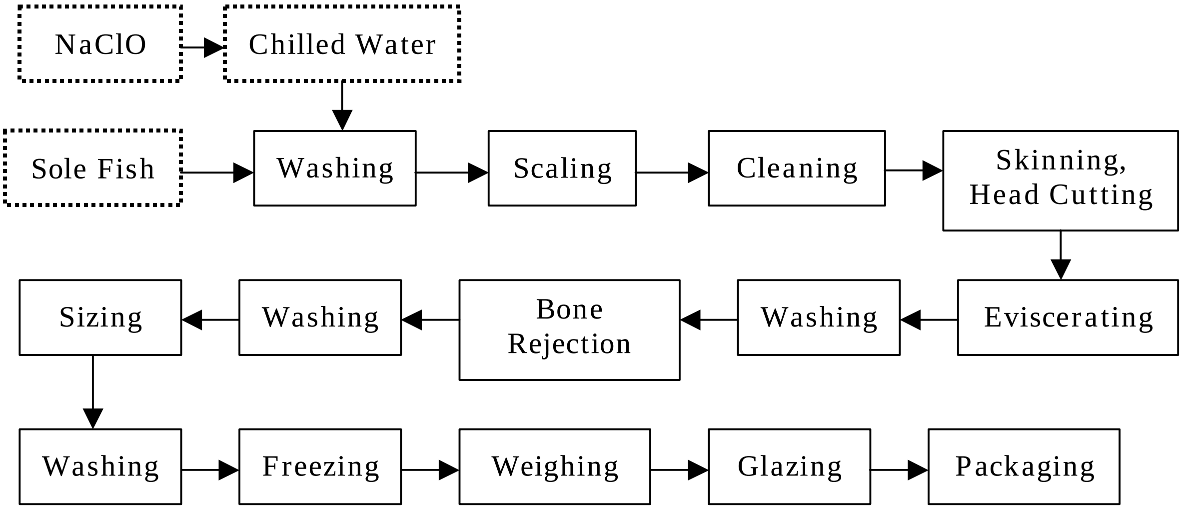


Figure 10.8 Block Flow Diagram of the IQF Sole Fish Fillet Production Process

In one factory visited in the Study, standard manuals which describe the treatment conditions for each unit operation are prepared for every product in order to meet a foreign buyers' strict requirements.

6) Instant Noodles

It is said that the demand for instant noodles in Viet Nam has steadily increased and will reach 160,000 t/year by 2000.

Figure 10.9 shows a block flow diagram of the instant noodle production process.

Wheat flour is mixed with water and additives, and then kneaded. After rolling and cutting, the raw material is made into wavy noodles, which are then converted into alpha-starch by steaming. After passing through a broth bath of salt and seasoning additives, the noodles are fried, either by direct frying or indirect frying. Steam is used for heating in the frying unit. The fried product is then packaged together with an instant noodle soup pack.

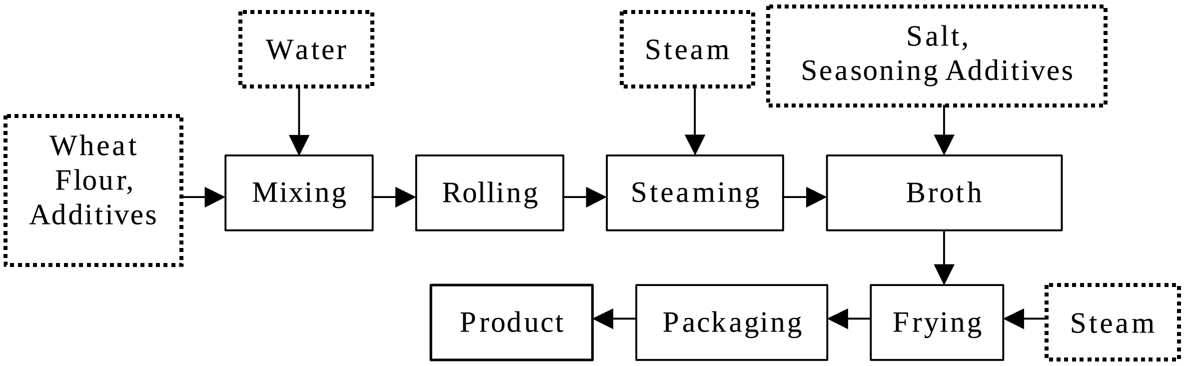


Figure 10.9 Block Flow Diagram of the Instant Noodles Production Process

(2) Problematic Issues Concerning Production Technology in the Food Processing Sub-sector

Although projects for process improvement are underway in some companies in the sub-sector, most enterprises are faced with the following problematic issues concerning production technology:

1. Outdated production facilities;
2. Small scale production by batch-wise operations;
3. Outdated production processes;
4. Incomplete countermeasures for resource conservation, such as steam condensate or cooling wastewater recovery;
5. Leakage of liquid from glands on pumps and valves, which are left as they are due to an insufficient facility maintenance scheme;
6. Unrestricted utilization of large amounts of water, including pumping up of a large amount of groundwater;
7. Lack of engineers and skilled laborers;
8. Manual packaging processes;
9. Facilities that are unable to conform to the GMP standard, e.g.:
   (1) Inefficient floor drainage of washing wastewater in the production area due to leveled or uneven structures;
   (2) Lack of measures to prevent the product or equipment from being contaminated with foreign matter;

10.2.2 Current Status and Problematic Issues of Production Management Technology in the Food Processing Sub-sector

(1) Quality Control

The level of production control in companies doing business with foreign countries is relatively high. For example, companies producing processed seafood are making every effort to meet the severe requirements raised by foreign buyers based on GMP or HACCP standards.

In general, however, there is room for improvement in most companies in the sub-sector for production control that adheres to GMP for food processing factories. Most factories should pay more attention to countermeasures for preventing food products from being contaminated by foreign matter such as dust, insects and the like.

(2) Standardization

One factory visited in the Study already obtained ISO-9002 certification in November, 1999. Likewise, similar projects for obtaining ISO-9002 certification are being undertaken in some other companies. As a matter of course, it is understood that standard manuals are prepared and revised as needed in those companies that intend to get ISO-9002 certification.

In other companies, it is noted that drawings of production processes are not provided and standardization, such as manual preparation which is essential for transferring technology to employees over the long term, is not being proceeded with.

(3) Productivity Improvement

It was observed that a “5S Movement” had been introduced in one of the factories visited. The “5S Movement” was widely practiced in Japan in the past, and proved effective for improving morale and productivity.

However, positive measures for productivity improvement, like the “5S Movement”, are not being practiced commonly in Viet Nam. In most companies, productivity data is gathered only for reporting purposes. Very rarely are production losses calculated and analyzed in a short management cycle, e.g. daily, in order to study and establish countermeasures for reducing losses.

(4) Waste Reduction

Most factories the Study Team visited are making efforts to reduce waste:

1. CO_2 from the fermentation processes is recovered as product;
2. Solid waste is recovered and sold as animal feed or fertilizer to the extent possible.

One remaining task for factories in the Food Processing sub-sector is to minimize leakage from processes in order to reduce the amount of wastewater generated by floor, equipment and machine parts washing.

(5) Problematic Issues of Production Management in the Food Processing Sub-sector

Common problematic issues in production management found in most enterprises in the food processing sub-sector are summarized as follows:

1. Lack of basic data to control unit consumption; and
2. Lack of positive action to reduce production losses.

10.2.3 Problematic Issues of Wastewater Treatment in the Food Processing Sub-sector

The food processing sub-sector has the following problems concerning wastewater treatment:

1. No treatment adopted;
2. No wastewater quality analysis;
3. No separation of dirty wastewater and clean wastewater, or rainwater;
4. Lack of information on the latest wastewater treatment technologies;
5. Insufficient operational know-how of wastewater treatment systems, especially for biological treatment.

10.2.4 Summary of Causal Analysis of the Current State

Figure 10.10 shows the relation between factors causing the current problematic issues in the food processing sub-sector. The sub-sector has the following problematic issues that are the same as the common issues described in Chapter 6:

1. Imperfect infrastructure for industrial pollution prevention such as:
   (a) Lack of educational and training organizations for environmental pollution prevention engineers; and
   (b) Lack of wastewater quality analysis organizations and engineers

2. The administrative organizations responsible for Industrial Pollution

Prevention are urged to give enterprises direction for environmental protection and to promote effective measures.

3. Small-scale factories are dispersed over the country. Imperfect industrial infrastructure, such as logistics and/or an efficient transfer system for raw materials and utilities, is causing low profitability in enterprises, which consequently restricts investment for improvement and modernization due to a chronic lack of financing.

4. Low level of production management in most enterprises:

In most enterprises, due to an insufficient analysis of production processes, production losses and problematic issues in production processes are not sufficiently grasped. In addition, it is pointed out that the wastewater amount is large in most factories because cheap industrial water is readily consumed and dirty wastewater is mixed with clean wastewater and rainwater due to the lack of a policy for classifying wastewater for recovery and re-use. One of the reasons why the progress of the installation of wastewater treatment systems in the sub-sector is slow, as well as in other sub-sectors, is that a large investment is required due to a large volume of wastewater.

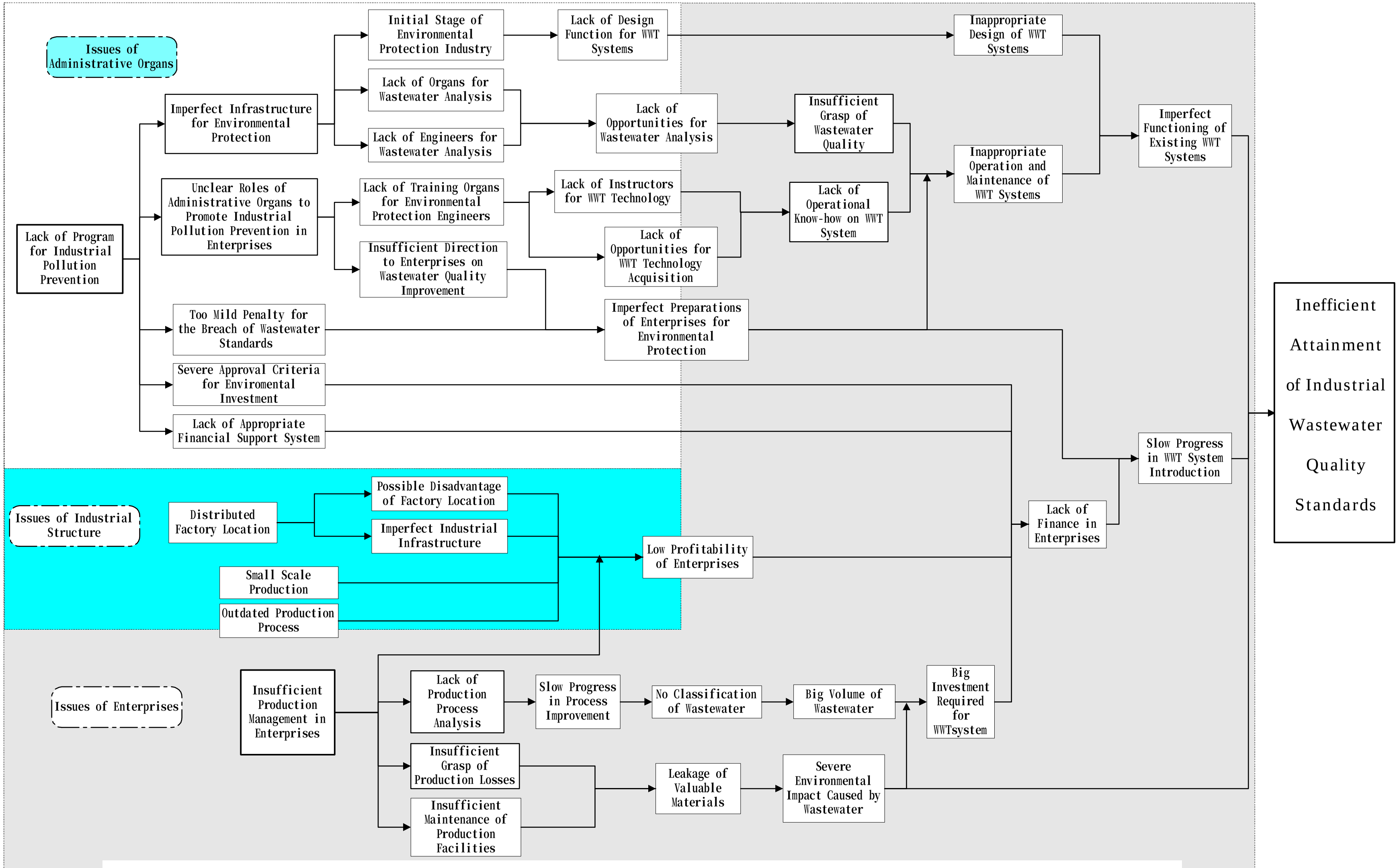


Figure 10.10 Relation Between Factors Causing Problematic Issues in Enterprises

10.3 Countermeasures for Technology Improvement in the Food Processing Sub-sector

10.3.1 Countermeasures for Promoting Cleaner Production Technology

In order to cope with the fundamental problem of small scale production in most enterprises in the sub-sector, it is urged that new factories of sufficient scale be created by putting several enterprises together in the same business. Such drastic countermeasures, however, would have trouble being accepted under the current circumstances and should be discussed on a different level of industry promotion policy in Viet Nam. Therefore, countermeasures should be adopted in this section only on the basis that they improve the existing enterprises.

Other than the expansion projects currently being undertaken in several enterprises visited, there is also, room for improvement in production technology, not only by renewing equipment, but also through better, more detailed management.

(1) Process and Facility Improvement

Examples of production process or facility improvements are listed as follows:

1. Recovery and reuse of cooling wastewater: In general, cooling wastewater is clean. The only problem is its high temperature. Cooling wastewater can be reused by utilizing a cooling tower or cooling unit. Recovering cooling wastewater is an effective way to decrease the total amount of wastewater and to reduce the cost required for the installation of wastewater treatment systems. Therefore, before enterprises study the installation of a wastewater treatment system, it is recommended that they study the possibility of separating dirty and clean wastewater and also investigate the possibility of reusing cooling wastewater.
2. Recovery of steam condensate: Just as it is for cooling wastewater, the recovery of steam condensate is effective for decreasing the amount of wastewater, although it does not contribute to a reduction in environmental impact.
3. Recovery of distiller bottom components in liquor producing factories as fuel or animal feed.
4. Process change from acidic hydrolysis to enzymatic hydrolysis in the starch saccharification process.

5. Floor drainage improvement by sloping floors with a slight gradient in the production area.
6. Sealing up windows to prevent possible invasion of foreign matter into the production area.

(2) Production Management Improvement

1. Introduction of the concept of unit consumption and a reduction of production losses; More concretely:
   (a) confirm what losses are compared to theoretical or standard unit consumption,
   (b) compare the unit consumption of main materials regularly (e.g. monthly, weekly or for every batch),
   (c) work out ways to minimize losses
2. Initiate improvement activities that require the participation of all employees, like the "5S Movement".

The "5S Movement" in item No. 2 might be more closely associated with the term "Clean Production" rather than "Cleaner Production". "Clean Production," however, is an important and an effective, fundamental goal of production activities. The "5S Movement" was widely practiced in Japan, and proved effective in improving morale and productivity. It consists of the following five principles:

(1) Clear out all unnecessary things. Keep only necessary objects and information in the work place;

(2) Put things in order. Organize items systematically. Think of the lay-out as a very important production factor. Use visual communication;

(3) Clean up the work place. Find and eliminate sources of dirt. Initiate regular cleaning inspections. Create good house keeping habits;

(4) Be concerned about workers' personal appearance; and

(5) Discipline. Follow proper procedures. Follow rules and regulations.

By executing the "5S Movement" the following improvements are expected:

a. Space utilization improvement;
b. Quick access to materials and goods;
c. Maintain workers' morale;
d. Nice work environment;
e. Better impression on clients;
f. Accident prevention; and

g. Personal well-being of employees.

In order to enable the enterprises to smoothly implement the countermeasures related to management activities, like the items mentioned above, it is urged that public or private institutions be established and function to provide necessary advice to the enterprises.

10.3.2 Countermeasures Utilizing End of Pipe Technology

It is impossible to reduce the environmental impact caused by industrial wastewater only by improving production technologies. In order to satisfy the wastewater regulation standards, the introduction of wastewater treatment systems is essential. On a mid-term basis, wastewater treatment systems should be installed in every enterprise incorporating the following factors:

1. Introduction of biological treatment systems;
2. Appropriate sizing of oil separators with sufficient retention time in the oil refining factories;
3. Preparation of wastewater analysis devices at the same time wastewater treatment facilities are introduced;
4. Training of personnel in charge of wastewater treatment and analysis.

10.4 Conclusion and Recommendations for Industrial Pollution Prevention in the Food Processing Sub-Sector

10.4.1 Recommendations for Enterprises in the Food Processing Sub-Sector

Summarizing the discussion in the previous section, the following are proposed countermeasures urged to be taken by the enterprises in the sub-sector.

(1) Short Term Countermeasures

A reinforcement of management technology that starts with the recognition of the present status of production management and an adoption of countermeasures which do not require a big investment are recommended on a short term basis:

1. Promote production loss reduction activities by setting up a project team (ref. to 10.3.1(2) 1.)
2. Promote a productivity improvement movement that incorporates the participation of all employees ((ref. to 10.3.1(2) 2.)
3. Separate dirty wastewater and clean wastewater (ref. to 10.3.1(1) 1.)
4. Get a better, more accurate grasp of water balance and the volume and quality of wastewater

5. Begin training engineers on wastewater quality analysis and wastewater treatment methods.

(2) Mid and Long-Term Countermeasures

It is recommended that the following countermeasures that require investment be promoted on a mid and long term basis.

1. Recovery and reuse of cooling wastewater (ref. to 10.3.1(1) 1.)
2. Recovery and reuse of steam condensate (ref. to 10.3.1(1) 2.)
3. Installation of wastewater treatment systems (ref. to 10.3.2)
   It is recommended that wastewater treatment experts be invited to test the operations of wastewater treatment systems in order to establish optimal operating conditions.
4. Improvement of floor drainage by sloping floors in the production area (ref. to 10.3.1(1) 5.)
5. Prevention of possible invasion of foreign matter into the production area by sealing up windows (ref. to 10.3.1(1) 6.)

10.4.2 Measures to be Taken by Administrative Organizations

In order to promote the implementation of industrial pollution prevention countermeasures in individual enterprises, MOI, as the key administrative organization, is urged to take the following core measures:

(1) Draw up a Policy for Industrial Pollution Prevention (Wastewater)

Under existing circumstances it is impossible, and may prevent the sound development of the economy, to force enterprises in Viet Nam to comply with the wastewater quality standard, TCVN5945, without delay. It is recommended that MOI set up a phased attainment plan for TCVN5945 and direct and administer enterprises based on it.

(2) Guidelines for Industrial Pollution Prevention

It is important to promote both Cleaner Production technologies and End of Pipe technologies in order to prevent industrial pollution. It is recommended that MOI direct enterprises by working out guidelines for Cleaner Production and End of Pipe technologies. The guidelines are to be composed of the following:

1. Grasping the present state of production and wastewater;
2. Production process improvement;

3. Recovery of valuable material;
4. Separation of dirty wastewater, clean wastewater and rainwater;
5. Recovery and reuse of cooling wastewater and steam condensate;
6. Installation of wastewater treatment systems;
7. Operation and maintenance of wastewater treatment systems.

It is recommended that items 1 through 5 mentioned above, which do not require a large investment, be promoted as short term targets. It is recommended that the installation of wastewater treatment systems be aimed for by most enterprises on a mid-term basis.

(3) Incentive Measures

In order to resolve the fact that most enterprises are unable to invest in environmental countermeasures due to financial difficulties, it is recommended that a system where enterprises can be provided with long-term, low interest loans or tax preferences, as mentioned in Chapter 5, be enforced.

(4) Infrastructural Provisions for Industrial Pollution Prevention

It is recommended that MOI put the Industrial Energy and Environment Office in charge of setting up the infrastructure necessary for enterprises to take countermeasures for industrial pollution prevention. This office should work to set up:

1. Agencies to provide training services for production management;
2. Agencies to provide services for wastewater quality analysis or wastewater diagnosis;
3. Agencies to provide training services for wastewater treatment;
4. Agencies to provide services for technology transfer concerning wastewater treatment.

10.4.3 Investment Demand for Industrial Pollution Prevention in the Food Processing Sub-Sector

The sum of the funds required by the targeted enterprises in the food processing sub-sector in this Study for industrial pollution prevention is estimated to be over 100 billion VND, as shown in Table 10.6.

Table 10.6 Investment Demand for Industrial Pollution Prevention (Food Processing Sub-sector)

Unit: million VND

Type of Study	No. of Companies	Cleaner Production		End of Pipe		Total
		No.	Amount	No.	Amount	
Detailed study	5	5	15,000	5	25,000	40,000
Simplified study	16	0	0	14	61,000	61,000
Total	21	5	15,000	19	86,000	101,000

References

1) Statistical Yearbook-1998; General Statistical Office

2) Vietnam Socio-Economy: the period 1996-1998 and Forecast for the year 2000

Appendix 10

Overview of the Food Processing Sub-sector

1. General

The food processing industry in Viet Nam possesses high potential because of the plentiful agricultural and marine products the country is blessed with. Agriculture is supported by fertile lands ideal for production, represented by the Red River Delta and the Mekong Delta, and marine products are dependent on the rich fishing ground which spreads to the east of the Indochina Peninsula. The main food products in Viet Nam are sugar, seafood products, meat products, instant noodles, soy sauce, beer, soft drinks and cigarettes. Table 10.A.1 shows production trends of the main products in the Food Processing Industrial Sub-sector.

Table 10.A.1 Main Products in the Food Processing Industrial Sub-sector

	Unit	1995	1996	1997	1998
Fish sauce	million l	149	167	170	180
Canned fruits	t	12,784	16,318	21,422	23,550
Vegetable oils	t	38,612	78,076	87,717	98,163
Tinned milk	million tins	173	169	188	191
Milling rice, maize	1,000 t	15,582	16,116	18,839	19,140
Sugar, sugar syrup	1,000 t	517	637	649	657
Tea	t	24,239	32,930	44,974	49,022
Liquor	1,000 l	51,379	67,112	93,600	95,200
Beer	million l	465	533	581	656]
Sodium glutamate	1,000 t	65	87	91	105
Cigarettes	million packet	2,147	2,160	2,123	2,178

The General Statistical Office (GSO) annually publishes statistics, including statistics on the food processing industry, which is categorized into “Food and Beverage”, and “Cigarettes and Tobacco” by the GSO. Table 10.A.2 and Figure 10.A.1 show the gross output of the food processing sub-sector compared with the whole manufacturing sector for four years since 1995. It is understood that the absolute increase of the gross output of the whole manufacturing sector was greater in the following year than the previous year, although the growth rate tended to slow down. Compared with the whole manufacturing sector, the growth rate of the food processing sub-sector has gradually decreased.

Table 10.A.2 Gross Output of the Food Processing Industrial Sub-sector (at the Constant Price of 1994)

Unit: billion VND

	1995	1996	1997	Preliminary 1998
Food & Beverage	27,008.2	30,886.7	34,015.2	36,932.4
		(+14.4%)	(+10.1%)	(+ 8.6%)
Cigarettes & Tobacco	3,976.7	4,195.6	4,399.9	4,531.9
		(5.5%)	(+ 4.9%)	(+ 3.0%)
Manufacturing Total	83,260.6	94,787.8	107,662.4	119,476.5
		(+13.8%)	(+13.6%)	(+11.0%)

Source: Statistical Yearbook-1998, Socialist Republic of Vietnam, General Statistical Office

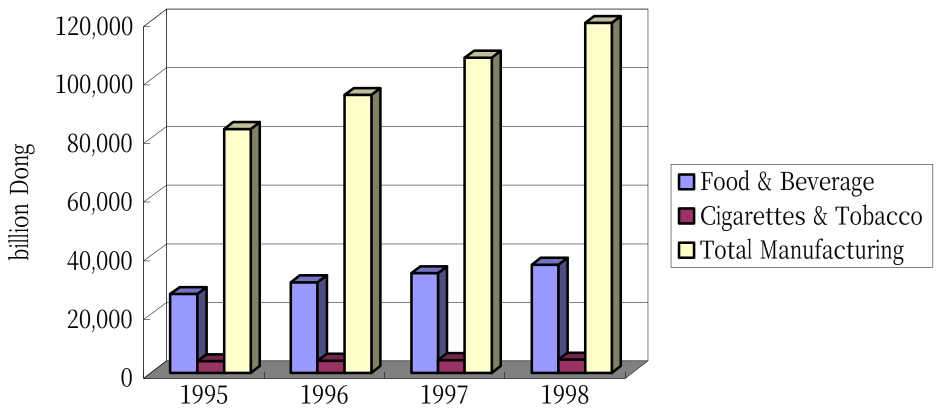


Figure 10.A.1 Gross Output of the Food Processing Industrial Sub-sector

According to "Vietnam Socio-Economy: the Period 1996-1998 and Forecast for the Year 2000", however, the growth rate of light industry exceeded that of heavy industry during this period which resulted in an imbalance of the industrial structure.

In recent years, food product exports have showed steady growth. Table 10.A.3 shows the main food products for exportation. The big four export products of Viet Nam in 1994 were oil, coffee, rice and seafood products.

Table 10.A.3 Main Food Products for Exportation

	Unit	1995	1996	1997	1998
Shelled ground nuts	1,000 t	111.0	127.0	83.3	87.0
Coffee	1,000 t	248.1	283.7	391.6	382.0
Tea	1,000 t	18.8	20.8	32.0	33.0
Rice	million t	2.0	3.0	3.6	3.7
Cashew nuts	1,000 t	19.8	16.5	33.3	25.6
Pepper	1,000 t	17.9	25.3	23.0	15.3
Vegetable & fruit, fresh	million US$	56.1	90.2	68.0	53.0
Marine products	million US$	621.4	696.5	782.0	858.0

2. Structure of the Food Processing Industrial Sub-sector

The food processing industrial sub-sector in Viet Nam is characterized by having a number of non-SOEs. Table 10.A.4 shows the number of enterprises in the sub-sector. Non-state owned enterprises accounted for more than 99.7% and 85.4% of the number of enterprises in the food & beverage sub-sector and in the cigarettes & tobacco sub-sector, respectively.

Table 10.A.4 Number of Enterprises in the Food Processing Industrial Sub-sector

	Ownership	1995		1996	
		Number	%	Number	%
Food & Beverage	(1) State owned	358	0.2	328	02
	(2) Non-State owned	167,514	99.7	182,501	99.8
	(3) Foreign investment	63	0.04	74	0.04
	Total	167,935	100.	182,803	100
Cigarettes & Tobacco	(1) State owned	21	13.4	22	4.2
	(2) Non-State owned	134	85.4	501	95.4
	(3) Foreign investment	2	1.3	2	0.4
	Total	157	100	525	100

Table 10.A.5 and Figure 10.A.2 show the gross output of the food & beverage sub-sector at the constant price of 1994 by economic sector.

The state-owned enterprises accounted for more than 47 % of the sub-sector in gross output through the period surveyed, while the non-state owned enterprises gradually fell in total percentage of gross output of the sub-sector. The foreign invested sector constantly showed the largest growth rate, which however, tended to decrease over time.

It can be said that the growth of the sub-sector was dependent on the state-owned enterprises.

Table 10.A.5 Gross Output of the Food & Beverage Industry by Economic Sectors (at constant 1994 Prices)

Unit: billion VND

Ownership		1995	1996	1997	1998
State-owned	Central	5,894.8	6,592.4	7,235.2	7,875.6
	Local	6,982.4	7,956.7	8,925.8	9,706.4
	Total	12,877.2	14,549.1	16,161.0	17,582.0
	(Growth rate %)		(13.0)	(11.1)	(8.8)
Non-state	Collective owned	21.7	41.9	43.3	
	Private owned	1,265.2	1,528.1	1,735.2	
	Mixed ownership	1,472.0	2,097.0	2,116.1	
	Households	6,214.2	6,482.8	6,826.6	
	Total	8,973.1	10,149.8	10,721.3	11,447.6
	(Growth rate %)		(13.1)	(5.6)	(6.8)
Domestic Total		21,850.3	24,698.9	26,882.3	29,029.6
	(Growth rate %)		(13.0)	(8.8)	(8.0)
Foreign invested		5,157.9	6,187.8	7,132.9	7,902.9
	(Growth rate %)		(20.0)	(15.3)	(10.8)
Grand Total		27,008.2	30,886.7	34,015.2	36,932.5
	(Growth rate %)		(14.4)	(10.1)	(8.6)

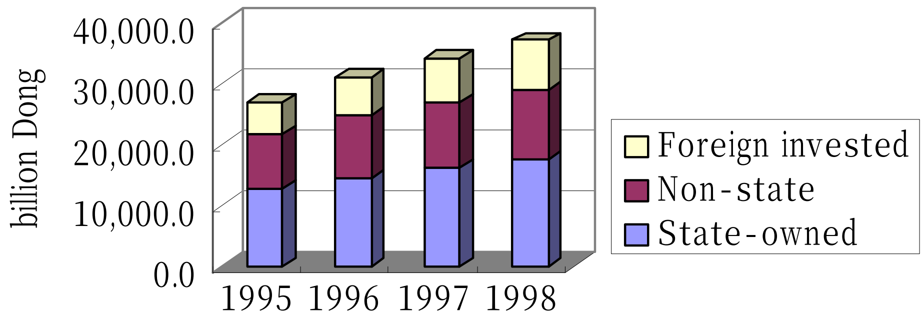


Figure 10.A.2 Gross Output of the Food & Beverage Sub-sector

Table 10.A.6 shows average output of enterprises in the food and beverage sub-sector calculated using the figures in Tables 10.A.4 and 10.A.5. The average output of the SOEs was less than one half of the foreign invested enterprises, although they showed a relatively steady growth rate. The average output of non-state owned enterprises remained extremely small.

Table 10.A.6 Average Output of Enterprises in the Food and Beverage Sub-sector (at the Constant 1994 Price)

Unit: billion VND per Enterprise

	Ownership	1995	1996
Food & Beverage	(1) State owned	35.970	44.357
	(2) Non-State owned	0.054	0.056
	(3) Foreign invested	81.871	83.619
	Total	0.161	0.169

References

1) Statistical Yearbook-1998; General Statistical Office

2) Vietnam Socio-Economy: the Period 1996-1998 and Forecast for the Year 2000