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Overseas Environmental Measures of Japanese Companies (Thailand)

มาตรการดูแลจัดการสิ่งแวดล้อมที่เกี่ยวข้องกับการดำเนินธุรกิจของบริษัทญี่ปุ่นในต่างประเทศ
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Research Report on Trends in
Environmental Considerations related to
Overseas Activities of Japanese Companies
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รายงานการสำรวจแนวโน้มการให้ความสำคัญต่อสิ่งแวดล้อม
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Global Environmental Forum

Preface

A large number of Japanese companies have a presence in Southeast Asia and have built thriving businesses in the region.

On the other hand, as a legacy of its rapid economic growth, Southeast Asia is beset by serious environmental problems. Although the region is now beginning to address these issues by industrial pollution controls and other initiatives, measures are still inadequate due to the lack of financial and human resources, as well as technical expertise and experience.

Japanese companies, having overcome severe industrial pollution problems in the past on their home turf, and with greater financial backing and technical capacity than locally financed companies, are expected to play a leading role in promoting industrial pollution controls in Southeast Asia through the implementation of innovative environmental management techniques. Within Japan, too, there is mounting public pressure for Japanese companies to behave responsibly in regard to the environment of the foreign countries in which they operate.

Against this backdrop, in 1995, Global Environmental Forum, under commission by the Environment Agency of Japan, conducted a questionnaire survey on the measures being taken by Japanese companies to protect the environment in the four Southeast Asian countries of Thailand, Indonesia, the Philippines, and Malaysia. Many of the respondents expressed their wishes for the government of Japan to supply information, in the form of a handbook or guide, about environmental issues of the countries in which they operate, to assist them in carrying out more substantial environmental measures. There was also a demand for the preparation of corporate case studies describing the types of innovative environmental practices.

Following these requests, the Environment Agency in 1996 initiated a research on trends in environmental considerations related to overseas activities of Japanese companies. The research aimed at collecting information and examples useful in encouraging Japanese companies to implement environmental measures in the countries in which they operate. The results were published as research reports; the Philippines edition in 1996, and the Indonesia edition in 1997. This Thailand edition, the third in the series, reports the result of the research project commissioned by the Environment Agency in 1998.

Thailand hosts more Japanese companies than any other country in Southeast Asia. We hope that this report will help these companies improve their environmental practices, and serve as a useful resource for other Japanese companies contemplating a future move into Thailand.

We wish to take this opportunity to express our thanks and appreciation to everyone; particularly the Japanese Chamber of Commerce, Bangkok, and its Environment Committee, for their invaluable assistance in providing reference materials and in introducing companies willing to participate in the survey. We are grateful to the many Japanese companies in Thailand, and to the Ministry of Science, Technology and Environment, the Ministry of Industry, and other government agencies and the Bangkok Metropolitan Administration, who generously cooperated in information gathering. In addition, we acknowledge the help and support given within Japan, by the Japan Chamber of Commerce & Industry.

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Contents

■ How to Use This Book

This book consists of two chapters and appendices. Chapter 1 describes the environmental issues that Thailand now faces, and summarizes Thai laws and regulations on the environment. Chapter 2 presents case studies illustrating the practical measures being taken by Japanese companies in Thailand, particularly in the manufacturing industry, to safeguard the environment. The appendices provide useful information for gaining a deeper understanding of the issues raised.

Note that the term Japanese companies in Thailand as used in this book refers to corporate members of the Japanese Chamber of Commerce, Bangkok, irrespective of any special criteria such as the percentage of equity invested from Japan.

This book is designed so that each chapter, and each section within each chapter, can be read independently. Readers may select relevant information according to their particular needs.

The following describes how this book is organized.

Chapter 1 is divided into eight sections that present up-to-date information about Thailand's environmental problems, and laws and regulations:

Section 1: Thailand and Japanese Companies
Section 2: Current Environmental Issues in Thailand
Section 3: Environmental Policies in Thailand
Section 4: Industrial Pollution Controls and Regulations
Section 5: Water Pollution Management
Section 6: Air Pollution Management
Section 7: Hazardous Waste Management
Section 8: Environmental Impact Assessment in Thailand

Section 1 sketches the history of Japan's relationship with Thailand and the expansion of Japanese companies into the country. Section 2 describes specific environmental problems, such as water and air pollution, that affect Thailand at present.

The remaining sections in Chapter 1 explain and provide detailed information, categorized by topic, about the environmental laws and regulations that must be considered when formulating a corporate environmental management plan. Section 3 describes the structure of the environmental administrative system that Thailand has rapidly been putting into place in recent years. Section 4 summarizes the main features of seven laws, all related to the environment and with particular relevance to combating industrial pollution. Foremost among these laws is the Enhancement and Conservation of National Environmental Quality Act, A. D. 1992.

Sections 5, 6, and 7 outline legal mechanisms and regulatory standards in three areas – water pollution, air pollution, and hazardous waste – as essential aspects of industrial pollution control. The last section, Section 8, gives an overview of Thailand's Environmental Impact Assessment (EIA) system.

The information in Chapter 1 was mainly compiled from interviews with officials of the Ministry of Science, Technology and Environment and Ministry of Industry, and from materials published by the Thai government.

In Chapter 2, Section 1 summarizes the features and methods by which Japanese companies in Thailand, particularly in the manufacturing sector, are attempting to protect the environment. This introduction is followed by sixteen examples of innovative environmental practices being carried out by the fourteen companies studied in the on-site survey. The case studies are divided into four sections:

Section 2: Cases of Meeting Strict Wastewater Standards (five examples)
Section 3: Cases of Establishing an Environmental Management System (five examples)
Section 4: Cases of Adopting Locally Tailored Environmental Practices (three examples)
Section 5: Other Examples of Innovative Environmental Practices (three examples)

Efforts by the manufacturing sector and other industries to protect the environment in Thailand are aimed primarily at controlling water pollution, which was therefore the main focus of the cases we selected. In addition, in Section 3, we included examples of setting up an environmental management system, reflecting the strong commitment among Japanese companies in Thailand in obtaining ISO 14001 certification and building environmental management systems.

The appendices include the following information as a reference.

Appendix 1: Enhancement and Conservation of National Environmental Quality Act, B.E. 2535, A. D. 1992 (complete text)
Appendix 2: Notification of the Ministry of Industry No.6, B.E. 2540, A.D. 1997 Prescribing Treatment of Hazardous Waste Substances (excerpt)
Appendix 3: Current State of Environmental Practices of Japanese Companies in Thailand and Other Asian Countries
Appendix 4: Sources of Environmental Information in Thailand and Japan

Appendix 1 is the Enhancement and Conservation of National Environmental Quality Act, discussed in Sections 3 and 4 of Chapter 1. Its complete text is included here for better understanding of the reader. Appendix 2 contains excerpts from the Notification of the Ministry of Industry, which sets out the precise requirements for hazardous wastes treatment.

The currency conversion rate used in this book is approximately 3.3 yen to one Thai baht, a rate as of February, 1999. In Thailand, a calendar year is officially expressed by B.E., which is converted to A.D. by deducting 543. For example, B.E. 2535 becomes A.D. 1992 by deducting 543.

Chapter 1

Overview of Environmental Issues and Environmental Conservation Practices in Thailand

This chapter is divided into eight sections that encompass all the basic information required for Japanese companies to work out the most appropriate environmental measures for their particular operations in Thailand. Section 1 gives a brief account of the relationship of Japanese companies and Thailand, while Section 2 outlines Thailand's present environmental problems. Section 3 explains the environmental administrative system and the Enhancement and Conservation of National Environmental Quality Act of 1992, and Section 4 covers the principal laws relating to industrial pollution. Sections 5, 6, and 7 describe the regulatory regime and procedures for dealing with the three main environmental issues in Thailand – water pollution, air pollution, and hazardous waste. Section 8 is about environmental impact assessment (EIA), which is required for plant construction and other projects in specific industries, and explains the assessment system and the industries to which the EIA system applies. The complete text of the Enhancement and Conservation of National Environmental Quality Act is given in Appendix 1.

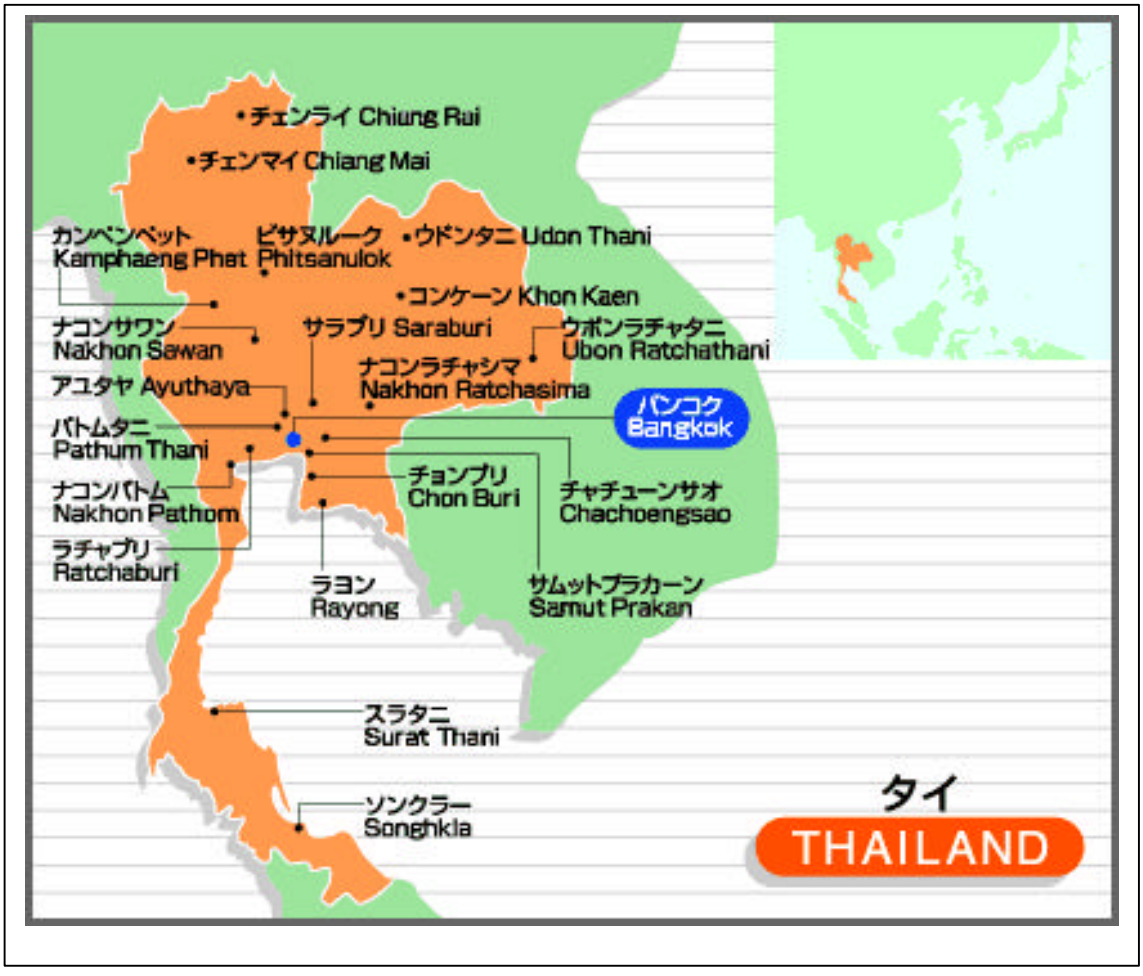
Section 1
Thailand and Japanese Companies

1. Long-Established and Ongoing Bilateral Relations

Thailand is 513,000 square kilometers in area, about 1.4 times the size of Japan (Figure 1-1-1). Shaped, so they say, like an elephant's head, Thailand has a population of 61.14 million people as of July 1998. Japan has a long, unbroken history of cultural interchange and friendship with Thailand, going back over 600 years. The Ayuthaya dynasty, which ruled for about 400 years from the end of the 14th century until the middle of the 18th century, welcomed foreign trade and the shogunate in Japan reciprocated by sending licensed merchant ships there. By the beginning of the 17th century, there was a flourishing Japanese trading community in Ayuthaya, famed as the ancient capital.

The occupation of Thailand by the Japanese army during the Second World War stands as a sad blot in the history of Japan and Thailand. However, bilateral relations are closer than ever today, particularly in the economic arena, thanks to thriving trade and Japan's expanded investment and ongoing transfer of technology into Thailand. Japan is also the largest donor of official development assistance (ODA) to Thailand. In terms of foreign direct investment, Japan still ranks as the largest foreign investor in Thailand, although the amount of capital invested fell substantially following the Asian currency and economic crisis in 1997.

Figure 1-1-1 Map of Thailand



Against this background, opportunity for contact between Japan and Thailand at the personal level has grown significantly. The number of Japanese visitors to Thailand has trended upward through the years, reaching 700,000 in 1996. Extending beyond commercial necessity, the purpose of travel to Thailand has diversified into tourism and other interests. There are now over 20,000 long-term Japanese residents in Bangkok and other places in Thailand, most of whom are staff of Japanese companies and their families. The imperial family of Japan has a close relationship with the royal family of Thailand, who commands great popular respect.

From the late 1980s Thailand maintained consistently expansive development of its economy. By the early 1990s Thailand had achieved such a rate of growth that the World Bank termed it the "Asian miracle" along with South Korea. But the currency and economic crisis, which was triggered by the floating of Thai baht in July 1997, spread rapidly to other countries in Asia. At the epicenter of this instability, Thailand fell immediately into negative economic territory, from pre-crisis growth rates of plus 8.7 percent in 1995 and plus 5.5 percent in 1996, to minus 0.4 percent in 1997. Further, the growth in fiscal 1998 is expected to be minus 7 to 8 percent. However, although Thailand is still mired in economic stagnation, some analysts are predicting that, with the assistance given by the International Monetary Fund (IMF), the country could recover to a zero growth rate in 1999.

Japanese companies in Thailand are all feeling the effects of the current crisis, to greater or lesser extent. All are taking serious steps, such as expanding their sales routes and trimming corporate structures, as they try to survive and break out of prolonged economic stress.

Thailand depends on Japan's support to recover from its economic crisis and to promote closer bilateral relations. Japanese companies, because of their long familiarity with Thailand and strong interdependency with the Thai economy, have a large part to play. In these changed economic times, Japanese companies, which contributed so much to Thailand's economic boom and industrial might in the past, now hold the key to the nation's recovery through the transfer of capital, technology and know-how across all sectors, including environmental management.

2. The Influx of Japanese Companies into Thailand

Not surprisingly, given such close bilateral relations, the expansion of Japanese companies into Thailand has been impressive. Most Japanese companies in Thailand join the Japanese Chamber of Commerce, Bangkok, whose corporate membership at the end of January 1999 stood at 1,160. This is the largest membership in Japanese chambers of commerce in Southeast Asia. Virtually all of the major corporations in Japan now have subsidiaries or joint ventures in Thailand.

Other than manufacturing, a wide spectrum of industries are represented among Japanese companies in Thailand, including finance and insurance, civil engineering and construction, distribution, and transportation. Manufacturing remains predominant, however, accounting for over half of the corporate members of the Japanese Chamber of Commerce. Most of the companies that participated in this survey were manufacturers, and all but one of the sixteen case studies discussed in Chapter 2 are taken from the manufacturing sector, the only exception being a company that develops and operates industrial estates. For this reason, the focus of

this report is on information related to environmental practices primarily in the manufacturing sector.

Japanese companies began expanding into Thailand around 1960 when prime minister Sarit Thanarat instituted an industrialization policy that included schemes to attract foreign investment. In the same year, the government set up the Board of Investment (BOI) to assist foreign companies to move into Thailand.

Expansion of Japanese industry into Thailand has occurred in three main waves. The first was prompted by the Thai government's import substitution policy and lasted from the 1960s through the early 1970s. The second extensive investment boom in the latter part of 1980s was fueled by the U.S. dollar weakening against the yen in the wake of the Plaza Accord of 1985. The third boom began in the second half of 1993, driven by the continuing appreciation of yen. Membership of the Japanese Chamber of Commerce in Bangkok has reflected the trends, more than doubling in five years from 394 companies in April 1985 to 793 companies in April 1990, and reaching over 1,000 companies in April 1995. Since then the increase has leveled off, and the number of Japanese companies in Thailand remains fairly stable at the 1,100 mark reached in 1997. The onset of the currency and economic crisis in July 1997 does not appear to have had any major effect on the membership of this organization.

A number of reasons can be cited for the large number of Japanese companies entering Thailand. The reasons include:

1. Despite changes of government, Thailand appears to be politically stable, which lends consistency to the government's economic and industrial policies.
2. There is no shortage of labor supply and the Thai people are friendly.
3. The domestic market of 60 million people is considerable and it is strategically positioned in the Asian market.
4. The Thai government encourages foreign investment.
5. Thailand has well-developed infrastructures in comparison with other Asian countries.

Japanese manufacturers that began operations in Thailand in the 1960s mostly chose to develop their own sites and build facilities in Bangkok and its environs. Since then, however, industrial estates, which offer a complete infrastructure for all sorts of services and utilities, were established by the Industrial Estate Authority of Thailand (IEAT) and by private developers. In conjunction with the tax exemptions and other incentives offered by the BOI to promote regional development, most of the recent foreign affiliates starting up in Thailand have located their operations in industrial estates, while many have set up in areas outside Bangkok and its environs. An emerging trend is for companies planning to expand their existing capacity to construct new plants in the countryside outside Bangkok because of the various environmental regulations and restrictions that govern the metropolitan area.

Over the years, the manufacturing industries operating in Thailand have changed from predominantly textiles and other raw-material processing to the electrical and electronic fields. A recent feature is the increasing number of relatively small-scale parts manufacturers moving into Thailand as their big corporate clients set up production bases there.

Rapid economic development has brought Thailand a variety of environmental pollution problems which are of major public concern. The Thai government believes that these problems must be addressed and has demonstrated its commitment to tackling environmental issues. Development used to be the main emphasis in Thailand's five-year National Economic and Social Development Plans, but since the Seventh Plan (1992-1996), environmental protection has become one of the primary objectives. Also in 1992, the government tightened all the laws related to the environment. Further, environmental non-governmental organizations (NGOs) are actively engaged in environmental work, and public awareness of the issues is growing.

Japanese companies have constituted a part of the mainstay of Thai industry. The environmental programs that they implement are therefore the subject of intense interest. Not only must Japanese companies show leadership in promoting environmentally responsible attitudes in industry, they must also, as a pre-requisite for continuing their business activities in Thailand, transfer to Thai companies the advanced environmental technologies that they have developed.

Section 2
Current Environmental Issues in Thailand

The environment in Thailand is certainly not in a healthy state. Thailand was first among the Southeast Asian nations to promote an industrialization policy based on fostering foreign investment, but the country's rapid economic growth since the latter half of the 1980s has been achieved at the cost of various environmental pollution problems. In particular, the Bangkok metropolitan area, which consists of the Bangkok Metropolitan Administration (BMA) and the four surrounding provinces (Nonthaburi, Pathum Thani, Nakhon Pathom, and Samut Prakan), and where about 20 percent of the national population and over half of the country's factories are concentrated, has serious air pollution caused by motor vehicle emissions, and grave water pollution from household and industrial wastewater. Further, due to a lack of treatment facilities, the increasing volumes of hazardous substances generated by the thriving industrial activities are mostly just dumped without proper treatment. Unless treatment facilities are built, environmental contamination caused by hazardous waste threatens to become Thailand's worst environmental problem in the future.

1. Water Pollution Problems

The most critical environmental problem facing Thailand at present is water pollution. Control of water pollution therefore has highest priority in the government's environmental programs.

Pollution of rivers from household and industrial wastewater is severe, particularly in the Bangkok metropolitan area which is most heavily populated. The government has prescribed water quality standards for some major rivers, encompassing 20 indicators such as dissolved oxygen (DO), biochemical oxygen demand (BOD), and coliform bacteria counts. The designated rivers include the Chao Phraya (Menam River), Thachin, Mae Glong, and Bang Prakong, and pollution levels are being monitored. The Chao Phraya River flows through the BMA and is most critically affected by contamination. Along the lower part of the Chao Phraya (from the river estuary in Samut Prakan Province and stretching 62 Km upstream to Nonthaburi, the provincial capital), water quality readings are extremely poor. In 1995, the lowest DO level was 0.2 mg/liter, average BOD was 3.50 mg/liter, and the total coliform count was 959,000 MPN/100ml. This level of DO is too low for fish to survive, and limits the water's acceptability even for industrial uses. Indeed, with the huge amounts of food scraps, drink containers, and other debris floating in the river, the contamination is plain to see. The situation is similar along the central and upper reaches of the Chao Phraya River, and in other rivers as well, posing problems in river water usage for either drinking water or agricultural water supply.

The heavy metals that have leached into the rivers for many years are another form of pollution that cannot be ignored. Mercury levels far exceeding the standards have been recorded in the Chao Phraya estuary, and the heavy metal concentrations on the river bed present a serious threat to ecosystems.

Of the organic pollutants entering the Chao Phraya River from the Bangkok Metropolitan Administration, it has been calculated, in terms of BOD loads, that 75 percent comes from residential and commercial facilities, while the remaining 25 percent is from industrial wastewater. The principal source of water pollution is the inflow of untreated household wastewater. As for industrial wastewater, the main polluters are the sugar, pulp and paper,

rubber, leather, and other manufacturing industries, which are mostly owned by Thai businesses.

However, because household wastewater is the prime focus of the water quality monitoring being carried out at present, sufficient information has not been accumulated yet about the current state of contamination caused by industrial wastewater. Data is scarce about heavy metals and other industrial pollutants because they can only be measured with advanced analytical techniques and equipment, and the monitoring is not systematized.

Several attempts have been made to prevent pollution of the rivers in urban Thailand. Under notifications issued by the Ministry of Science, Technology and Environment (MOSTE) and under BMA regulations, buildings over a certain size are required to have purification tanks, and sewage treatment plants are beginning to be constructed. In addition, the government in 1995 set up the Wastewater Management Authority, mandated to build efficient and economical wastewater treatment facilities and administer them. However, these government initiatives have not brought much practical benefit as yet.

Water pollution is also apparent in places other than rivers. In 1995, algae grew in an abnormal scale in the Lake of Lam Ta Khong Dam, a reservoir that supplies drinking water to Korat, a provincial capital in northeast Thailand. This abnormal algae grow, which severely disrupted Korat's water supply, was caused by inflow of wastewater from nearby households and restaurants, and by agricultural runoff.

2. Air Pollution Problems

Urban Thailand including the Bangkok metropolitan area suffers from severe air pollution. Although partly caused by industrial activities, air pollution is largely due to exhaust emissions from motor vehicles, which have increased spectacularly in Thailand. Motor vehicle pollution is particularly severe in the Bangkok metropolitan area where traffic officers and motorcycle riders wearing dust masks are a common sight.

At the end of 1998, there were 4 million registered motor vehicles, plus an estimated 2 million motorcycles on the roads in the Bangkok metropolitan area, although these numbers have probably declined slightly since the onset of the currency and economic crisis. The biggest problem caused by motor vehicles is dust, or total suspended particulate (TSP). Air quality indicators exceed the standards wherever they are measured, not only along roadsides but in residential areas too. At one location, measurements nearly seven times higher than allowable limits have been recorded. Another major cause of increased TSP levels has been the large number of public works such as highway construction carried out in preparation for the Asian Games held in Bangkok in December 1998.

Air pollutants such as nitrogen oxides generated by motor vehicle emissions have reached critical levels, posing potential risks to respiratory organs and to human health in general. The only improvement in the situation has been the continuing decline each year in the lead concentration in the air, once a major problem in Thailand. The move to unleaded gasoline, started in 1991 and completed in 1995, is beginning to pay dividends.

To control traffic pollution, new cars must undergo emission tests before leaving the factory, and periodic emission checks are compulsory for all registered vehicles (annually for buses and trucks, every five years for motorcycles, and every seven years for private vehicles). In practice, however, apart from the pre-shipment factory emission tests, checks are not being carried out as prescribed in the regulations. New vehicles with 1.6-liter or larger engines have been fitted with exhaust purifiers since 1993, but the number of motor vehicles is expected to rise again when Thailand recovers from its economic slowdown triggered by the currency and economic crisis. Traffic-related air pollution will likely be a continuing environmental problem that defies easy solution.

In regard to air pollution from industrial activities, the amount of pollutants released into the air is highest in the Bangkok metropolitan area, where about half of the 100,000 factories registered nationwide are located, and where energy consumption accounts for over 50 percent of the national total.

To ease its energy supply problems, Thailand has made a structural shift since the latter half of the 1980s from oil to coal and lignite as its industrial fuel. Because coal is more polluting than oil, air pollution is a concern in the vicinity of factories and facilities using these energy sources. For example, the Electricity Generating Authority of Thailand (EGAT) power plant located in Mae Moh in Lampang Province, north Thailand, uses lignite as its fuel, which pollutes the air with sulfur dioxide (SO_2) and other emissions. Dust collectors and taller smoke stacks have been installed, but desulfurization equipment has been installed in only two of the 13 boilers at the plant.

Factories and facilities built in recent years are mainly using natural gas and oil, but many lack any means of preventing air pollution such as dust collectors. Most of the incinerators at factory sites are not covered by the regulations at present, a failing that will need tighter control in future. Stone crushing, steelmaking, and cement plants are among the more recent sources of air pollution problems. The MOSTE is planning to set new emission standards for these industries.

Current government planning includes a nationwide network of measurement stations to monitor air pollutants in the general environment and along traffic routes. However, except for motor vehicle emissions, governmental authorities have been slow to implement air pollution controls and have given lower priority to regulating industrial pollution than to water pollution.

3. Waste Problems

Hazardous waste is the industrial waste problem that most affects the business activities of Japanese companies in Thailand. The country's industrial development has brought with it an annual increase in hazardous waste generation of close to 10 percent year-on-year. The MOSTE in 1996 estimated the total volume of hazardous waste generation for that year, including household and commercial sources, at approximately 1.6 million tons. This figure, it should be remembered, is prior to the economic crisis. Of this total, industrial sources accounted for approximately 1.2 million tons, which breaks down to about 60 percent solid waste and sludge containing heavy metals, with waste oil making up a further 20 percent.

At present, there are only two facilities in Thailand that can properly process these hazardous wastes: in Bang Khunthien in the Bangkok Metropolitan Administration (BMA), and in Mab Ta Phut in Rayong Province. Together these facilities can cope with no more than 200,000 tons annually, which suggests that most hazardous waste from factories is either stored on site, or mixed with general waste and disposed of illegally. For these reasons, the Thailand government announced plans to build seven new hazardous waste treatment facilities nationwide, but construction was stymied by intense opposition from local residents in all the planned areas, and several of the construction projects have been shelved.

Due to the slow progress in building treatment facilities, illegal dumping of hazardous wastes is increasing. In 1995, waste slag from a metal smelting plant was dumped in an old chemical refuse disposal site in Samut Prakan Province, which resulted in toxic gas generation and caused the deaths of people living in the vicinity. Hazardous waste from sources other than the industrial sector, such as car batteries and medical waste, is also on the rise. In addition, hazardous substances are being imported into Thailand for use as raw materials and are also being manufactured domestically in ever increasing quantities, with the total consumption of hazardous substances in the industrial sector reaching 1.2 million tons in 1996. As a consequence, accidents frequently occur during the manufacture, storage and transportation of hazardous substances.

Given the present situation of increasing hazardous waste resulting from Thailand's expanding economic activity, versus the lack of progress in setting up treatment facilities, the problems of hazardous wastes and toxic substances can only become more serious and difficult to eradicate in the future.

Factory wastes other than hazardous waste, such as plastics, metal, wood, and cardboard, are attractive because of their market value, and private operators willingly collect such wastes for recycling and resale.

In regard to household waste, the total generated per year was approximately 13 million tons for the whole country in 1996, but collections are carried out to quite a high level in the BMA and nationwide. Of the 2.95 million tons of household waste generated in 1996 in the BMA, accounting for about 23 percent of the national annual total, almost all (99 percent) was collected, up 12.6 percent from the collection rate in 1995. Adequate systems of garbage trucks and special barges that collect debris from canals and riverbanks, combined with regulations making it mandatory to dispose of garbage in bins in specified areas, have proved effective in cleaning up the urban environment. Collected household waste passes through either of two garbage processing sites and transit stations, and is then disposed of by landfilling, except for about 10 percent which is composted.

Even in areas outside the BMA, a high proportion of waste is collected, averaging about 80 percent. Due to low budgets for waste treatment and lack of treatment technologies, however, only about 40 percent of the waste collected in the provinces goes to landfills. The remaining waste is stored on vacant land and later incinerated outdoors, which is hardly satisfactory in view of sanitation.

4. Other Environmental Problems

Other environmental problems in Thailand include deforestation, destruction of the mangrove forests, and soil erosion resulting from development of various sorts. These many problems in the natural environment and ecosystems cannot be overlooked. From the perspective of the corporate activities of Japanese companies, however, noise and offensive odors can be cited as matters of prime concern.

In regard to noise pollution, Thailand currently has an environmental standard not exceeding 70 decibels as the average noise level over 24 hours. Standards are also prescribed for motor vehicles and motor boats, work places, and quarries. However, no regulatory standards comparable to Japan's Noise Regulation Law have been set for noise levels of general factories. Despite the lack of regulations, the number of complaints about factory noise received by government authorities is growing every year and there have been numerous calls for countermeasures.

The situation is similar with offensive odors. Although there are no regulatory standards, one Japanese company has embarked on a major odor control program at its factory because of complaints about smells from local residents. It is to be noted that many of the complaints were not about the usual nauseous substances, such as hydrogen sulfide and methyl mercaptan, but about solvent smells and burned smells that Thai people were not used to.

Section 3
Environmental Policies in Thailand

1. Development of Environmental Policies and Environmental Administration

(1) Development of Environmental Policies and Legislation of New Environmental Act

Against the backdrop of environmental problems aggravated by rapid industrialization and urbanization, Thailand in 1975 enacted the Improvement and Conservation of National Environmental Quality Act. This law established the National Environmental Board (NEB), which is headed by the deputy prime minister, and marked the first attempt at national level to address environmental issues in an organized fashion. The Office of National Environmental Board (ONEB), which was set up to develop environmental policies, embarked on planning of environmental conservation policies, prescription of air and water quality standards, and establishment of environmental monitoring systems. However, the ONEB failed to achieve anticipated results, due to budgetary constraints, shortage of human resources, and the complexities of coordination with related governmental agencies.

In 1981 the government announced a national environmental policy and planned to implement measures aimed at preserving the nature and natural resources and at harmonizing social and economic development with enhancement of the environment, but the accelerating pace of economic development and industrialization from the latter half of the 1980s further exacerbated environmental pollution.

By the 1990s, there was mounting public demand for recognition of the importance of protecting the environment. In his 1990 new year greetings, the King of Thailand, who is revered by the people, spoke of environmental issues and urged the bureaucracy and community to make a concerted effort toward improving environmental conditions. Beginning with the First National Economic and Social Development Plan covering 1961 through 1966, Thailand has drawn up a series of five-year plans that provide a framework for national policy planning. The Seventh Plan (1991-1996), which was decided in August 1990, declared the government's commitment to environmental conservation. In addition to sustainable economic development, equitable income distribution, and human resource development, the plan emphasized protection of the environment and natural resources, and better quality of life and environment as policy goals.

In 1992, partly in response to the ground-swell movement for social reforms following the military coup d'état of the previous year, the government repealed the 1975 National Environmental Quality Act and replaced it with the Enhancement and Conservation of National Environmental Quality Act, A. D. 1992 (NEQA). A number of other laws closely linked with environmental policies were substantially revised, including the Factory Act, Public Health Act, Hazardous Substances Act, and Energy Conservation Promotion Act.

A number of facts lay behind these major amendments to Thailand's environmental legislations. Among them were the rapid worsening of urban pollution, and the keen interest in environmental issues shown by the monarch and the Anand Panyarachun government of the day. In addition, events such as the 1992 incident of water contamination by a pulp and paper factory in northeastern Khon Kaen Province, which caused very costly economic damage, and environmental degradation in the international tourist resort areas such as Pattaya and Phuket, have contributed to a growing awareness within Thailand of environmental issues as social

problems.

(2) Restructuring of Environmental Administrative Organizations

The Enhancement and Conservation of National Environmental Quality Act, A. D. 1992, incorporated a number of new initiatives aimed at implementing effective environmental regulations. It established the Pollution Control Committee, introduced a system of designated pollution control areas, set up the Environmental Fund, established uniform nation-wide emission and discharge standards, encouraged the participation of environmental non-governmental organizations (NGOs) if they meet certain criteria, strengthened the "polluter-pays" principle, and beefed up penalties for non-compliance. The act also cites as a core policy the restructuring and strengthening of environmental administrative organizations.

Under the provisions of the new act, the organizations that administer environmental matters in Thailand underwent major structural reform. The previous Office of National Environmental Board (ONEB) was dismantled and its functions were integrated into the renamed Ministry of Science, Technology and Environment (MOSTE). In fact, the functions of the ONEB were split into three departments of the MOSTE (see Figure 1-3-1). These are the Office of Environmental Policy and Planning (OEPP), the Pollution Control Department (PCD), and the Environmental Quality Promotion Department (EQPD).

The OEPP, as well as taking over ONEB's function of policy coordination, is also tasked with preparing an environmental master plan based on the five-year National Economic and Social Development Plan. Other new responsibilities are to implement Environmental Impact Assessments (EIAs) for development projects and to set up regional offices. So far, regional offices have been established in twelve locations, including Ayuthaya, Saraburi, and Chon Buri, each serving as a MOSTE branch office with jurisdiction over several provinces around it.

The PCD brings pollution control functions previously dispersed over various administrative organizations under one umbrella. In addition to three environmental management divisions, each responsible for water quality, air quality and noise, and hazardous substances and solid waste, the PCD has the Law and Petition Division and other offices.

The EQPD is responsible for disseminating information about environmental administration to the public, and for gathering and administering environmental information. In addition, it acts as an intermediary between private NGOs and the MOSTE. The Environmental Research and Training Center (ERTC), built with Japanese financial assistance in Pathum Thani Province which borders the Bangkok Metropolitan Administration (BMA), also comes under the EQPD. The Japan International Cooperation Agency (JICA) carried out technical assistance projects at the ERTC until 1997.

Under the new act, the NEB was promoted to a level next to a Cabinet meeting. It is now the highest decision-making body in regard to national environmental policy. The Prime Minister is the NEB chairman, and the Deputy Prime Minister and Minister of Science, Technology and Environment are vice chairmen. NEB members include the Minister of Industry, Minister of Public Health, and other ministers of relevant ministries, the Secretary General of the Board of Investment, and no more than eight environmental specialists selected from the private sector.

Figure1－3－1 Structure of Ministry of Science, Technology and Environment

Source: brochure & pamphlet of MOSTE

The Pollution Control Committee (PCC), set up to coordinate the drafting and examination of environmental policy, previously performed by separate governmental organizations, is headed by the Vice Minister of Science, Technology and Environment. Committee members include the Director Generals of relevant ministries, the Deputy Governor of the BMA, and no more than five qualified persons appointed by the NEB. The PCC's duties include reporting to the NEB once a year on the pollution situation in Thailand. The PCC may also submit recommendations to the NEB on environmental policy changes, such as revisions to laws related to environmental regulations.

(3) Other Government Organizations Concerned with Environmental Administration

As discussed above, the 1992 National Environmental Quality Act (NEQA) was the springboard for coordinating Thailand's system of environmental administration, giving the MOSTE greater authority in the national legal framework. Historically, however, the bureaucracy in Thailand has been characterized by separate government organizations working independently from one another, which no doubt precludes any fast-track integration of the administrative and regulatory

structures concerned with environmental matters. At present, more than twenty government bodies have some involvement in environmental matters, each implementing the regulations under its own jurisdiction. Moreover, precedence among overlapping regulations is often unclear, making the overall system of environmental administration difficult to comprehend.

Main government bodies include the Ministry of Industry (MOI), Ministry of Interior, Ministry of Agriculture and Cooperatives, Ministry of Transport and Communications, Industrial Estate Authority of Thailand (IEAT), and Electricity Generating Authority of Thailand. In addition, the BMA, as a local authority, implements its own environmental regulations.

Among these, the government body that has greatest influence is the MOI, which has the power to license factory operations under the Factory Act. In particular, its Department of Industrial Works (DIW) administers wastewater, air quality, and other pollution regulations as part of the approval process for establishing and running a factory. Discharge standards identical to those prescribed by the MOSTE are issued as MOI notifications, and factories are required to submit reports on water and air quality measurements once every quarter. A similar situation applies to hazardous waste. The MOI prescribes the scope and treatment methods of hazardous waste. It also administers the country's hazardous waste treatment centers. In addition, on-site factory inspections for conformance with environmental regulations are usually performed by the MOI.

The IEAT is a state enterprise with some private-sector involvement, attached to the MOI. Under the Industrial Estate Authority of Thailand Act, the IEAT administers its own wastewater rules and other regulations in the industrial estates it operates.

Among the other government bodies involved in environmental administration, the Harbor Department of the Ministry of Transport and Communications carries out water quality surveys of rivers, and tests the quality of industrial wastewater flowing into rivers. Vehicle emission standards are overseen by the Department of Land Transport of the same ministry, and by the Royal Thai Police Department of the Ministry of Interior. The Ministry of Agriculture and Cooperatives administers irrigation canals, and its Irrigation Department is responsible for enforcing the regulations on wastewater released into irrigation canals.

There have been recent moves to rationalize the work of different government bodies, including, for example, a coordinating committee set up to coordinate the environmental regulatory functions of the MOSTE and MOI. In the future, the role of environmental control will be probably integrated into the MOSTE. But, for the time being, industries are required to comply with the regulations of all the government bodies involved in environmental control.

(4) Local Authorities' Roles in Environmental Administration

Thailand has a centralized system of government, with the Local Administration Department of the Ministry of Interior being responsible for local governance under Cabinet jurisdiction. The country is administratively divided into the BMA and 76 provinces (*changwat*). The provinces are subdivided into districts (*amphoe*), under which there are sub-districts (*tambon*) and villages (*muban*). In addition, the Municipal Act of 1953 established municipalities (*tesaban*) and sanitation districts (*sukhaphiban*) as local administrative units under provincial governance, and the self-governing city of Pattaya.

The local authorities most closely involved in environmental administration are the BMA, provinces, municipalities, and sanitation districts. However, apart from the BMA Governor who is elected by the Bangkok citizens, the provincial governors are civil servants appointed by the Ministry of Interior, and local authorities have few administrative functions in environmental matters. In terms of practical implementation of environmental controls, the BMA has special self-governing powers and is developing its own unique programs, but other local administrative bodies merely process official paperwork for the national government. The various reports and forms required to be submitted by factories based on environmental regulations are submitted to the Ministry of Industry representatives stationed in the province, and are forwarded to Bangkok.

(5) Other New Environmental Initiatives

The enactment of the National Environmental Quality Act (NEQA) was the start of several new environmental initiatives. One of particular significance to the corporate activities of Japanese companies in Thailand was the designation of pollution control areas.

A pollution control area is an area designated under NEQA provisions that is affected by, or at risk of, serious pollution, where comprehensive measures need to be implemented in accordance with an action plan to mitigate pollution. A designated pollution control area is entitled to receive fund allocation from the government budget, and loan from the Environmental Fund, for construction of a central wastewater treatment plant or central waste disposal facility. In addition, although no such cases have occurred in practice, the provincial governor of a pollution control area has the discretion to impose stricter discharge standards than the national standards. Currently, designated pollution control areas include Bangkok's four neighboring provinces (Samut Prakan, Nonthaburi, Pathum Thani, and Nakhon Pathom), as well as the cities of Pattaya and Phuket. Wastewater treatment and waste disposal facilities are being built, and environmental monitoring systems are being set up in each of these areas.

The launch of the Environmental Fund marked another new initiative. Established in the Ministry of Finance, the Environmental Fund began with initial funds of 5 billion baht, of which 4.5 billion came from the previous Fuel Oil Fund, and 500 million was drawn from the government budget. Disbursements are made to government organizations and local authorities for construction and operation of wastewater treatment or other facilities, and to private industry and environmental NGOs to support their environmental measures and environmental conservation activities. The Environmental Fund plays a similar role to the Japan Environment Corporation. Service fees and penalties collected under the NEQA are transferred into the fund.

Thailand's current environmental policies give clear voice to the "polluter-pays" principle and make the polluter strictly accountable. As well as specifically stating the obligation of the polluter to make compensation for damages, the NEQA increased the fines and introduced imprisonment for serious violation. Similarly, the Factory Act defines penalties in the form of fines and imprisonment.

Section 4
Industrial Pollution Controls and Regulations

1. Industrial Pollution Controls and Thailand's Environmental Legislation

In 1992 Thailand enacted comprehensive and systematic environmental legislation in the form of the Enhancement and Conservation of National Environmental Quality Act (NEQA). But, as mentioned in the previous section, around twenty different government bodies are concerned with environmental matters in Thailand. Working rather independently from one another within each jurisdiction, they each implement the environmental laws and regulations that fall within their realm, under a total of around one hundred different laws and regulations.

Detailed standards and regulations issued under laws are published in the Royal Thai Government Gazette as governmental or ministerial regulations, notifications and orders. These are, of course, written in the Thai language. Though laws may be officially translated into English, governmental or ministerial regulations are seldom translated by the government. The Japanese companies operating in Thailand have to go to some lengths to obtain these materials by employing Thai staff, spending vast amounts of money on translation.

The following overview of the features and contents of the seven laws most closely concerned with the implementation of industrial pollution controls in Thailand has been provided by the leading specialist in Thailand's environmental legislation, associate professor Dr. Sunee Mallikamarl of the Environmental Research Institute, Chulalongkorn University.

2. Legislations for Controlling Industrial Pollution in Thailand

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The country development of Thailand has been based upon the principles and directions of National Economic and Social Development Plans since the implementation of the First Plan (1961-1966) until present. The Plan currently in effect now is the Eight National Economic and Social Development Plan (1997-2001). The plans gradually changed Thailand’s economy from agricultural to agro-industrial and presently it has become a newly industrialized country.

Economic boom was an apparent outcome of such development but some undesirable results also occurred such as social and environmental problems which are harmful to the people until today.

In connection with environmental problems, various measures for environmental protection have been implemented against environmental destruction and pollution emission. They are technological, economic, social, and legal measures.

With regard to legal measures, 1991 saw Thailand governed by the National Peacekeeping Council and thus many laws were amended to facilitate the country’s development. Environment related laws were also amended during that period making them more beneficial to the environment than before.

Thailand’s environmental law, the Enhancement and Conservation of National Environment Quality Act, B.E. 2535 (A.D. 1992), differs from its counterparts in other countries in that it is the country’s only environmental law. Its main objective is to provide basic provisions for

environmental protection in such aspects as natural resources and pollution control and as such it is being a comprehensive environmental law. However, there are laws other than the said Act which protect the environment. Although their main objectives are not for environmental protection, certain provisions are enforceable as such and are known as environment related laws.

Environmental laws can be divided into two categories : natural resource protection and conservation laws, and pollution prevention and correction laws. Enforcement of said laws depends on the area affected by the activities.

Pollution problems arise from three major sources, namely, community pollution, agricultural pollution, and industrial pollution. This article concentrates on industrial sources that cause industrial pollution. It is a known fact that industrial sources causes water pollution, air pollution, and hazardous waste. It is therefore necessary that factories be required to manage the environment in accordance with the provisions of law in order to prevent pollution. The environmental law presented herein is cited as a guidance for industrial factories in order that they can properly comply.

(1) The Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (A.D. 1992)

The first and specific environmental law of Thailand was the Improvement and Conservation of National Environmental Quality Act, B.E. 2518 (A.D. 1975) which was proved inefficient as it was enacted to support the operation of the National Environment Board, an advisory body for the Prime Minister on environmental policy. Not being empowered to carry out any implementation on its own, the National Environment Board was required to seek co-operation from other governmental agencies which was seldomly successful. The 1991 coup d'etat saw repeals and amendments of various laws concerning country development. The Improvement and Conservation of National Environmental Quality Act, B.E. 2518 (A.D. 1975), was also repealed and re-enacted as the Enhancement and Conservation of National Environmental Quality, B.E. 2535 (A.D. 1972) with its objectives of being a basic comprehensive environmental law incorporating various aspects of environmental management.

The new Act contains 7 chapters having 111 sections and another 4 sections as interim provisions, a total of 115 sections. The agency enforcing this law is the Ministry of Science, Technology and Environment and its three offices looking after the environment are the Department of Pollution Control, the Department of Environmental Policy and Planning, and the Department of Environmental Quality Promotion. The essence of the Act is as follows:

1. The National Environment Board (NEB) which is chaired by the Prime Minister comprises political personnel being ministers from 11 environment related ministries, 4 permanent officials, and 8 specialists of which four are NGOs' representatives. It major authority is to propose to the Council of Ministers for approval the policies and plans for the enhancement of the national environmental quality. It is also empowered to prescribe ambient standards of the environment and to consider and give approval to the prescription of pollution effluent standard proposed by the minister.
2. Assurance of the people's rights and duties in the following:

2.1 The right to be informed of environmental information
2.2 The right to receive compensation from the state in the event the damage is inflicted by the dispersal of pollution or by the pollution caused by the activities or projects of government agencies or state enterprises
2.3 The right to lodge accusation against the offender as a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources
2.4 The duty to assist and cooperate with competent official in the performance of duty relating to the enhancement and conservation of environment quality
2.5 The duty to comply with this law and other laws concerning environment

3. Participation of Non-Government Organizations and Public Organization in environmental management. NGOs with Thai or foreign juristic person status are entitled to registration as environmental NGOs with the Ministry of Science, Technology and Environment. They are also entitled to certain privileges such as project grants from the Environmental Fund for their environmental activities, or to information assistance from the government sector.

4. Incentive measures promoting private sector's environmental management such as tax measures and environmental lending funds

5. Environmental Funds comprise of funds and assets from Oil Funds, annual budget, service fees and fine under the Act, subsidies from the government, contribution from the private sector, interests and other money, given as grants and soft loan or interest free loan to the government sector, the private sector and NGOs for environmentally related activities.

6. Designation of environmentally protected area aims to protect specific areas such as headwaters with specific ecological system vulnerable to destruction by human activities. Such designation is carried out by the Minister of Science, Technology and Environment with approval of the NEB.

7. Designation of pollution controlled area which is affected by serious pollution problem and needs urgent redress. In most cases the area contains large number of factories. The designation is made by the NEB. The designation of environmentally protected and pollution controlled area requires that all activities and factories located in that area be carried out under special requirements both for the environment management and the special conformity of environmental quality standards of water and air, etc. The provincial governors of the area so designated shall be required to prepare the environmental management plan.

8. Adoption of the Polluter Pays Principle (PPP) for environmental management. The customers of central wastewater treatment plant are required by this enactment to pay the fees at the rate fixed by the law. Failure to pay the fees or illegal discharge of wastewater into central wastewater treatment plant shall be punished by 4 times fine of the fees.

9. Adoption of strict civil liability principle in the victim's claim for compensation from the

polluter in that the burden of proof is shifted to the polluter and thus protecting the rights of the victim.

10. Adoption of liability to state in the event of destruction of natural resources for which the polluter or the destroyer of natural resources shall be required to pay damages and cost of rehabilitation to the state.

11. Precautions of pollution problems from activities or projects having impacts on environment by prescribing types of activities or projects for which the Environmental Impact Assessment (EIA) are required. The required EIA shall mention pollution mitigation measures and pollution monitoring system which shall be considered by the assessment committee prior to project approval. If the EIA does not pass the assessment, that activity or project will not be approved.

12. Power decentralization. This enactment provides that it is the duty and the authority of the provincial governor to prepare environmental management plan if the area designated as environmentally protected or as pollution controlled is in his jurisdiction. Although the law does not require the same for all other provinces, their environmental management plans were prepared.

The law empowers the NEB to issue NEB's announcements and authorizes the Minister of Science, Technology, and Environment to issue Ministerial Regulations and Ministerial Announcements prescribing necessary details to be complied by all concerned.

(2) The Factory Act, B.E. 2535 (A.D. 1992)

This Act controls factory operations having the Department of Industiral Works, Ministry of Industry, as an enforcement agency and its Minister is empowered to issue regulations as ancillary provisions. The law classifies factories according to their types and sizes into 3 categories.

Category 1 factory is a factory of certain type and size allowing its operation to begin immediately by the factory operator. Category 2 factory is a factory of certain type and size the operation of which can be carried out only after the licenser is notified of the operation. Category 3 factory is a factory of certain type and size which requires a setting up license prior to its setting up.

The above categorization is made in accordance with the size and type of the factory and the severity of the impact on the environment caused by the factory operation. Category 3 factory requires supervision at every stage due to its heavy impact on the environment.

The objectives of factory control under this Act are:

1. The Factory Building
   Factory of category 1 or 2 is not permitted to be set up in certain areas such as area in the vicinity of residence or within 50 metres of public area or within 100 meters of public area for category 3 factory. The building must be strong and secured and equipped with

ventilation system and storage for hazardous substance and shall not cause danger or nuisance to others or damage to their property.

2. Machinery and equipment shall be strong, safe and secure. It shall not cause vibration and meet standard requirements.

3. Factory workers shall be under supervision and there shall be permanent staff members for pollution prevention system.

4. Control of waste
   4.1 Water discharge and polluted air shall be treated to meet standard requirements prescribed by law before discharging outside the factory. Installation of treatment equipment is also required.
   4.2 Noise shall not exceed noise quality level as prescribed by law.
   4.3 Garbage, sewage and waste materials are divided into two sub-categories:
      (1) Hazardous waste is waste material contaminated with chemicals and is required to be kept in safe and closed container. Disposal thereof shall be in accordance with methods prescribed by the Minister. This type of waste must be absolutely separated from household garbage.
      (2) Household garbage means office garbage and food waste. With regard to household waste, the Ministerial Regulations No. 1, B.E. 2541 (A.D. 1998) provides that factories within 14 specified provinces requires permission from the Director General of the Department of Industiral Works prior to its transportation.
   4.4 Hazardous Substances. Hazardous substances under the Ministerial Regulations of the Ministry of Industry are explosives, inflammables, combustibles, poisonous materials, corrosives, abrasives, and health hazard substances. The law provides their storage methods and their factory use as follows:
   Storage place must be isolated and shall not be placed near living quarters, burner, storage of other goods, and other buildings. Storage place shall be maintained in good and secure condition. Material safety data sheets are required for the hazardous nature of each substance.
   Storage container shall be safe and strong in accordance with the standard and design provided by law. Concrete walls are required around the container to effectively prevent dispersal. Preventive measures shall be provided by maintaining sufficient quantity of chemicals to efficiently stop or reduce the effects of the dispersal. Lightning rods and ground wires shall be installed.
   Preventive method and equipment : air pollution prevention and elimination systems are required in storage room as well as in laboratory to prevent dangers to life, property and to prevent nuisance. Warning signs and notices are also required. Care must be taken to prevent leaking of hazardous substance. Workers are required to maintain and operate preventive equipment. The material safety data sheets are also required for the hazardous nature of the substance.
   4.5 Notes or memorandum. The Ministerial Regulations No. 3, B.E. 2535 (A.D. 1992) requires the following types of factory to submit to the Department of Industrial Works the data in the format and procedure prescribed by the Minister:
      (1) Factory with steam boiler, or boiler using liquid or gas as heat conductor

(2) Factory making or repairing steam boiler
(3) Factory with severe impact on environment as prescribed by the Minister
(4) Factory using radioactive substances
(5) Factory manufacturing, storing or using hazardous substances according to hazard substance law

Factories are required to comply with the Factory Act, B.E. 2535 (A.D. 1992). Failure to comply therewith will be punished by administrative measures and legal measures. Administrative penalty includes warning, restraining order, improvement order, machinery sealed off, temporary operation closure partially or wholly, factory closure or revocation of factory operating license. The worst case is revocation of professional license. Civil legal measures require factory causing damage to pay compensation or service fees for consulting fees. Criminal legal measures include imprisonment, fine and disqualification. More importantly, repeated offense will increase punishment for the architect or engineer working in the factory or being responsible for the work from which the offense arises and will be penalized as the factory operator if proved to have taken part in or to have had knowledge of the offense. The punishment could also be from the relevant profession control committee.

(3) Public Health Act, B.E. 2535 (A.D. 1992)

The act directly involves public health, its good living, and good quality of life of the people which is enforced by local administrative organization.

With regard to the environment, the Act could be considered as follows:

1. Management of Garbage and Sewage which include foul odour garbage, household garbage and hospital infectious garbage is under the care of local administrative organization by means of hauling, transporting and disposal thereof. The law only provides fees for hauling and transporting but not for disposing of it. However, the law is open for the same to be undertaken by private sector under the permission of local administrative administration under which arrangement the private sector will be able to collect fees at every stage of the operation. The law also provides maximum fees and service charges and that the operator will be required to follow the methods, procedures and conditions as stipulated therein. The local administrative agency is empowered to issue local requirements concerning prohibition to transfer, dump or discard garbage and sewage as well as requirements for provision of places for garbage and sewage and methods for collecting, hauling, and disposing thereof of the owner or the person in possession of any building or place.

2. Nuisance. The law provides causes of nuisance as follows:
   2.1 Any act causing water source, drainage, bathing place, latrine, excretion or ash bin or providing the same in improper place, to become dirty, over accumulation, dumping of anything causing foul odour, hazardous mist, or becoming a breeding place of disease carriers, causing health deterioration.
   2.2 Raising of animals by any means in an excessive number
   2.3 Building or factory or place of business without air ventilation, water drainage or hazardous material control or failure to control foul odour or hazardous mist emitted

therefrom

2.4 Any act causing odour, light, radiation, noise, heat, poisonous material, vibration, dust, soot, or ash

2.5 Other causes as prescribed by the Minister

The above health deteriorating nuisance carries legal punishment and the local official is empowered by the law to prohibit any person from causing any of it or to put it to stop. The local official is also empowered to issue an order in writing to cease, eliminate and control of nuisance as well as to maintain, improve, all roads, ways, waterways, drainage, moats, canals and all kind of places in his jurisdiction free from nuisance. Failure to comply with such order by the person causing such nuisance will empower the local official to eliminate it as necessary or do any necessary thing to prevent it at the expenses of the person causing it or any persons concerned.

Although the imprisonment and fine under this Act is not severe, it is applicable to factory causing impacts on environment in the event there is no environmental standard for specific case as no standard requirements to define any event as nuisance. Impact on public health and normal sensory perception are used as criteria therefor. For instance, the part dealing with nuisance under this Public Health Act is a proper tool to deal with a factory emitting foul odour to its neighborhood disturbing the peaceful living of the people residing in the area as there is no law dealing with odour in Thailand.

(4) Navigation in Thai Waters Act, B.E. 2456 (A.D. 1913) amended in B.E. 2535 (A.D. 1992)

The main objectives of this law are to regulate traffic on waterways and water usage with emphasis on preventing any activities affecting or obstructing water communication. Three Sections of this law efficiently deal with water pollution. The Harbour Officials of the Department of Harbour, Ministry of Communication, being the competent officials enforcing this Act, have taken many factories which polluted public water resources to court and won. This came as bad news to polluting factories. Several other cases are already pending in court.

The three Sections dealing with water pollution are:

> "Section 119 No person shall dump, discard or do in any way to cause any rock, gravel, earth, mud, ballast, thing or sewage except oil and chemicals into river, canal, swamp, reservoir or lake which is public passageway or used publicly or into sea in Thai waters which may shoal, silt, or contaminate it except with permission from Harbour Official. Offender shall be punished by imprisonment not exceeding 6 months or fine not exceeding ten thousand baht, or both, and shall also be required to pay compensation for expense incurred in the elimination of such thing."

> "Section 119 bis No person shall dump, discard or do in any way to cause oil and chemicals or anything into river, canal, swamp, reservoir or lake which is public passageway or used publicly or into sea in Thai waters which may become toxic to living things or the environment or become hazardous to navigation in the said river, canal, swamp, reservoir or lake. Offender shall be punished by imprisonment not

exceeding three years or fine not exceeding sixty thousand baht, or both, and shall also be required to pay compensation for expense incurred in the rectification of such toxicity or to compensate for such damages."

"Section 204 Whoever dumps, discards or leaks petroleum or petroleum contaminated water into harbour area, river, canal, lake or sea in Thai waters shall be punished with imprisonment not exceeding one year or fine from to thousand baht to twenty thousand baht, or both."

By comparison, the aforementioned Sections cover different offenses. Section 119 aims at any action which shoals, silts, or contaminates the waterways and as such it carries lighter punishment than the other two.

Section 119 bis clarifies the exception provided in Section 119, i.e., toxicity to living things or environment and hazard to navigation caused by transportation of petroleum or chemicals or anything into public water resources which is more harmful and thus carries more severe punishment than that of Section 119. These two Sections also provide for compensation for expense incurred in the elimination of the obstruction or the rectification of toxicity as well as compensatory damages. Section 204 controls the transfer of oil or the cleaning of vessel which causes contamination of public water resources by petroleum or petroleum contaminated water regardless of damage.

(5) Hazardous Materials Act, B.E. 2535 (A.D. 1992)

The objective of the said Act is to put under control all hazardous materials by providing proper control regulations and procedures as well as administrative systems among agencies concerning with supervision and control of hazardous materials. This Act empowers the Minister of Industry to prescribe area or areas within which the possession, distribution, or use of any hazardous material is prohibited in the event it is necessary to prevent danger.

More importantly, the Act defines four categories of hazardous materials and the control procedure of each category varies as follows:

1. Category 1 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which requires compliance with prescribed regulations and procedures;

2. Category 2 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which requires prior notification to competent official as well as compliance with prescribed regulations and procedures;

3. Category 3 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which requires a license. In the event a license has been issued and a law amendment has become effective or circumstances have changed or any significant event has taken place concerning safety protection, the license issuing competent official is empowered to revise the conditions under which the license has been issued as necessary. In the event the competent official refuses to issue a license or refuses

to renew a license, the applicant or the license renewal applicant is entitled to file an appeal to the responsible Minister within 30 days from the date of the receipt of the notice from the competent official. The decision of the Minister shall be final.

4. Category 4 Hazardous Material being the hazardous materials the manufacturing, importation, exportation, or possession of which is prohibited.

The Minister of Industry with the approval of the Hazardous Material Board is empowered to publish an announcement in the Government Gazette identifying the name of any of the hazardous materials in the four categories, or its property, its category, effective time, and responsible agencies for the control thereof.

An annual fee is payable according to the prescribed regulations and procedures if either Category 2 or Category 3 of Hazardous Materials is possessed for commercial purpose.

The law prohibits the possession of either Category 2 or Category 3 Hazardous Material which is an imitation, or does not meet standard requirements, or its quality becoming deteriorated, or the required registration not being effected. Such hazardous material shall be destroyed if known to be in possession, the competent official must be notified, or the material must be delivered to the competent official according to prescribed regulations and procedures.

The manufacturer shall exercise care in acquiring, determining reliable manufacturing process of such material. It shall have strong container which is safe to use, relocate, and transport. Clear and sufficient labels displaying the hazardous property of such thing must be provided. The material must be properly stored and fitness of the party to receive or anticipated to receive it must be verified.

The importer shall exercise care in selection of manufacturer, quality control, suitability and accuracy of containers and labels, means of carriage and carrier. The material must be properly stored and fitness of the party to receive or anticipated to receive it must be verified.

The carrier shall exercise care in the inspection of tools and equipment used in transportation including vehicles, containers and labels, suitable means of transportation, proper on-vehicle loading and placement, reliability of work carried out by its employees or its handlers or its co-operator.

The party in possession of hazardous material shall exercise care in verifying the reliability of the manufacturer, the importer, the provider, the accuracy of containers and labels. The material must be properly stored and the reliability of the party to receive or anticipated to receive it must be verified.

The employer or the principal or the hirer or the business owner shall be jointly liable to the wrongful act committed by the manufacturer, the importer, the carrier, the party in possession, the seller, the person making delivery to any person, who carries or carry out the work for either of them.

With regard to the building used as a place to store hazardous material, by virtue of the Building Control Act, B.E. 2522 (A.D. 1979), the Minister, by the recommendation of the Building Control Committee, had stipulated in the Ministerial Regulations No. 4 (B.E. 2526) (A.D. 1983), the characteristics of specially strong building for the storage of inflammables, explosives, or toxic dispersal or radioactive materials under the Hazardous Materials Act. Construction materials used for such buildings must be in accordance with specifications contained in the design drawings and computation permitted. In the event there is reasonable doubt that construction materials may not have met the requirements, the licensee, the operator, or the construction supervisor is required to submit to the inspector, for his inspection, the construction materials in an appropriate amount free of charge.

(6) The Enhancement of Energy Conservation Act, B.E. 2535 (A.D. 1992)

This law aims at stipulating measures for the enhancement of energy conservation or for the manufacturing of high efficiency machinery and equipment for conservation of energy. The factory operator or the owner of the building which invests and carries out energy conservation or tackling environmental problem regarding energy conservation shall be benefited from a special fee exemption or from grants from the Energy Conservation Funds, Ministry of Finance.

The law provides for factory energy conservation as follows:

1. Improvement of fuel combustion efficiency
2. Prevention of energy loss
3. Reuse of remaining used energy
4. Energy type switching
5. Improvement of electricity consumption by improving power factor. Reduction of maximum power demand during peak electricity demand of the system. Appropriate use of electrical equipment to suit loads and other means.
6. Use of maximum efficiency machinery or equipment as well as energy conserving control system and materials
7. Other means of energy conservation as provided in the Ministerial Regulations

The factory under control is required to prepare an energy conservation plan and must be the one using larger than 1000 watt/175 kiloampere power meter or using electricity from thermal power system with the energy equivalent to over 20 million megajoules.

The duty of the owner of the factory under control

1. Arrange to have at the factory one person responsible for energy with qualifications as stipulated by law.
2. Submit information on production, energy consumption and conservation to the Department of Energy Development and Enhancement.
3. Arrange to have records of energy consumption, the installation or change of machinery or equipment which affects energy consumption and energy conservation.
4. Set energy conservation targets and plan for the factory under control and submit the same to the Department of Energy Development and Enhancement.
5. Examine and analyze the achievement of the energy conservation targets and plan.

The above implementation shall follow the criteria, process and period of time as prescribed in the Ministerial Regulations issued by the Minister of Science, Technology and Environment by the advice of the National Energy Policy Board.

(7) The Industrial Estate Authority of Thailand, B.E. 2522 (A.D. 1979)

As Thailand's development policy emphasizes and relies on industrial development to generate her income, it also brings pollution harmful to the environment. It is therefore necessary that factory operation be under control and the same would be effective if factories are located in the same area. The said Act provides that, as a juristic person, the Industrial Estate Authority of Thailand (IEAT)controls and oversees all factories situated in the IEAT's industrial estate and the said factories shall enjoy certain privileges such as exemption for special fees, import/export duty or tax exemption under Investment Promotion law.

Factories located within IEAT are required to comply with IEAT's regulations issued by the Board of the Industrial Estate Authority of Thailand to regulate the operation of the industrialists.

Factory setting up within IEAT requires permission in writing from IEAT's Governor or his authorized representative.

IEAT's competent officials are empowered to enter the industrial premises during working hours to make inquiries or to inspect any document or thing related to industrial activities or other activities from any person in that premises as necessary. The factory operator is obligated to reasonably facilitate such visit.

With regard to wastewater treatment, each IEAT site will provide central wastewater treatment plant which could be joined by any factory. However, if preferred, a factory may construct its own wastewater treatment plant.

(8) Conclusion

All the above-mentioned environment related laws are major provisions factories are required to comply. Details are provided in ancillary laws such as Ministerial Regulations or Ministerial Announcements issued by virtue of their respective Acts.

Section 5
Water Pollution Management

1. Thailand's Water Pollution Regulations

As a country that has traditionally depended on rice cultivation and other forms of agriculture for its development, Thailand is particularly susceptible to problems of water pollution that affect agriculture. In addition, water shortages have occurred in recent years, particularly in urban areas, and there is growing concern about pollution of drinking water supply sources such as rivers and lakes. Government legislation accordingly gives high priority to water quality regulations, and in fact they are being most effectively implemented among all the environment-related regulations in Thailand. Pollution of rivers and lakes by household wastewater has become severe in recent years. For example, it has been estimated that 75 percent of the pollution of the Chao Phraya River is due to household wastewater and the remaining 25 percent is due to industrial wastewater. While Thailand is behind in building sewage treatment facilities and other infrastructure for dealing with domestic wastewater, its water quality legislation is focused on industrial wastewater.

In Thailand, water quality standards comparable to Japan's environmental standards have been set for surface waters (rivers and lakes; Figure 1-5-1), coastal waters and drinking water. In the surface water quality standards, water areas are categorized into five classes, according to the objectives of water usage (Figure 1-5-2). Standards are defined for each class of water body, covering 27 parameters from color, temperature, and biochemical oxygen demand (BOD) through to heavy metals. For specific rivers such as the Chao Phraya, Thachin, Bang Prakong, and Mae Glong, separate classes of water usage are defined by distance from the river estuary.

In regard to wastewater standards, apart from standards for industrial wastewater (Figure 1-5-3), Thailand has standards that apply specifically to buildings and housing estates. Standards are also set for water discharge to deep wells in order to protect the quality of groundwater.

This section explains in detail the industrial wastewater standards. Since the latter half of the 1970s, Thailand has progressively strengthened its regulations. The wastewater standards currently in force, which are based on the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA), prescribe a set of uniform nation-wide standards that cover 27 parameters including 12 types of heavy metals. In addition, with the aim of promoting realistic and feasible water quality controls in designated industries where water quality controls are difficult to implement, the government has established provisions that allow more lenient limits for three parameters: BOD, COD, and total kjeldahl nitrogen (TKN).

Each of the industrial estates needs to have its own central wastewater treatment plant as a prerequisite for its operation, and factory wastewater is never discharged directly into public water bodies. For this reason, the wastewater standards established under the Industrial Estate Authority of Thailand Act, A. D. 1979, and applied to individual factories situated within an estate, are not as restrictive as the national standards.

Depending on where it discharges its wastewater, a factory may be subject to wastewater regulations set by a government agency with specific jurisdiction over rivers, harbors, agricultural water, or other area. This means that the factory must comply with multiple wastewater regulations.

Figure 1-5-1 Surface Water Quality Standards

Parameter	Statistic	Standard Value for Class				
		1	2	3	4	5
Color, odor and Taste	-	n	n	n	n	-
Temperature(℃)	-	n	n'	n'	n'	-
pH value	-	n	5-9	5-9	5-9	-
Dissolved Oxygen	P20	n	6	4	2	-
BOD(5day, 20℃)	P80	n	1.5	2.0	4.0	-
Coliform Bacteria -Total Coliform(MPN/100ml) -Fecal Coliform(MPN/100ml)	 P80 P80	 n n	 5,000 1,000	 20,000 4,000	 - -	 - -
NO_3-N	Max.allowance	n	5.0	5.0	5.0	-
NH_3-N	〃	n	0.5	0.5	0.5	-
Phenols	〃	n	0.005	0.005	0.005	-
Cu	〃	n	0.1	0.1	0.1	-
Ni	〃	n	0.1	0.1	0.1	-
Mn	〃	n	1.0	1.0	1.0	-
Zn	〃	n	1.0	1.0	1.0	-
Cd	〃	n	0.005* 0.05**	0.005* 0.05**	0.005* 0.05**	-
Cr hexavalet	〃	n	0.05	0.05	0.05	-
Pb	〃	n	0.05	0.05	0.05	-
Total Hg	〃	n	0.002	0.002	0.002	-
As	〃	n	0.01	0.01	0.01	-
CN	〃	n	0.005	0.005	0.005	-
Radioactivity -Gross alpha(Bq./liter) -Gross beta(Bq./liter)	〃	 n n	 0.1 1.0	 0.1 1.0	 0.1 1.0	 - -
Organochlorine Pesticide(Total)	〃	n	0.05	0.05	0.05	-
DDT(μg/liter)	〃	n	1.0	1.0	1.0	-
α BHC(μg/liter)	〃	n	0.02	0.02	0.02	-
Dieldrin(μg/liter)	〃	n	0.1	0.1	0.1	-
Aldrin(μg/liter)	〃	n	0.1	0.1	0.1	-
Heptachlor & Heptachlor epoxid(μg/liter)	〃	n	0.2	0.2	0.2	-
Endrin(μg/liter)	〃	n	none	none	none	-

1) P=Percentile value
2) n = naturally
3) n'=naturally but not more than 3℃
4) * = when water hardness not more than 100 mg/liter as $CaCO_3$
5) ** = when water hardness more than 100 mg/liter as $CaCO_3$
Source: Notification of the National Environmental Board, No. 8, A.D.1994

Figure 1-5-2 Surface Water Classification and Objectives

Classification	Objectives / Condition & Beneficial Usage
Class 1	Extra clean fresh surface water resources used for: (1)conservation not necessary pass through water treatment processes require only ordinary process for pathogenic destruction (2)ecosystem conservation where basic organisms can breed naturally
Class 2	Very clean fresh surface water resources used for: (1)consumption which requires ordinary water treatment processes before use (2)aquatic organism of conservation (3)fisheries (4)recreation
Class 3	Medium clean fresh surface water resources used for: (1)consumption ,but passing through an ordinary treatment processes before using (2)agriculture
Class 4	Fairly clean fresh water resources used for: (1)consumption ,but requires special water treatment process before using (2)industry
Class 5	The resources which are not classification in class 1-4 and used for navigation

Source: Notification of the National Environmental Board, No. 8, A.D.1994

2. Water Quality Management of Industrial Wastewater

(1) Industrial Wastewater Standards Set by the Thai Government

The industrial wastewater standards set by the Thai government (Figure 1-5-3) were published in 1996 as Notification of the Ministry of Science, Technology and Environment (MOSTE) under the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA). Another notification over industrial wastewater standards has been issued by the Ministry of Industry (MOI), which has significant authority over industrial activities, and it appears to be double standards. However, these two sets of standards are identical and can be considered as one standard for practical purposes. In comparison with wastewater standards prescribed by the Japanese government (Regulation of the Prime Minister's Office), Thailand standards are stricter for BOD, COD, and heavy metals.

When setting requirements for individual factories, the government agencies that have jurisdiction over the particular factory consider the factory conditions – size, type of industry, location, wastewater characteristics, etc. – and set specific standards within the national standards. New parameters are added if applicable. For example, if the factory is situated in an area where its wastewater will be used for irrigation, the Irrigation Department of the Ministry of Agriculture and Cooperatives sets parameters that strictly regulate the wastewater salinity. Although it is possible under Thai legislation for local administrative bodies to set stricter standards as in Japan, no such local standards have been set to date, and wastewater standards are basically uniform nationwide.

Figure 1-5-4 shows the standards set by the Thai government, and examples of standards set for two different factories. Corresponding Japanese national standards are given for comparison. Under Thai government standards, BOD limits are 20-60 mg/liter, and the relevant government agencies must set standards for individual factories within this range, according to the factory conditions. This range is stricter than the Japanese standard of 160 mg/liter. For COD, Thailand uses a different method of measurement from Japan. Whereas Japan uses potassium permanganate, Thailand uses potassium dichromate as the oxidizing agent for measuring the amount of oxygen required for the oxidizing reactions. As potassium dichromate is a more powerful oxidizing agent than potassium permanganate, it yields a higher result when the same wastewater sample is analyzed by both methods. Although it depends on the sample, the potassium dichromate test gives values that are roughly three times higher than given by the potassium permanganate test. Therefore, the Thai standard of 120-400 mg/liter for COD equates to 40-130 mg/liter in Japanese terms, which is much stricter than the Japanese standard of 160 mg/liter.

For heavy metals, the Thai allowances for copper (Cu), manganese (Mn), chrome (Cr), cadmium (Cd), and other heavy metals are mostly lower than standards in Japan. In particular, Thailand's cadmium standard of 0.03 mg/liter is one third of the Japanese standard of 0.1 mg/liter.

Thailand also has a very strict selenium (Se) standard; 0.02 mg/liter in contrast to 0.1 mg/liter in Japan. Selenium is commonly found in a wide range of concentrations in the soil, from 0.1 mg/kg to as high as 1,200 mg/kg. Because selenium is widely used in industry, in cosmetics

manufacture and as a rubber additive, for example, it is likely to be present in the wastewater of factories that use this heavy metal. However, achieving this extremely low selenium standard of 0.02 mg/liter necessitates a high level of wastewater treatment, which increases processing costs for the factory.

According to an MOI official, the standards themselves are unlikely to be made any stricter in future. Rather, the government proposes to establish more rational standards based on the type of wastewater. For example, the present BOD standard is 20 mg/liter as a general rule, but that limit could be raised to 60 mg/liter for wastewater such as generated by the food industry, where the contaminants contained in the wastewater are readily decomposed by micro-organisms in the natural environment. As an example of this approach, and as mentioned above, deregulatory provisions have been set for specific industries under a 1996 notification of the Pollution Control Committee.

The introduction of a surcharge based on contaminant discharge is also under consideration. The idea is to impose a levy according to the total volume of contaminant discharge, calculated by multiplying the BOD or other concentration value by the total volume of wastewater discharged, even if the contaminant concentration is lower than the standard. This system is already being used by some industrial estates when billing factories for wastewater treatment, but there is no timetable as yet for implementation at the national level. There is no doubt, however, that factories in the future will be required not only to keep contaminant concentrations within the standards, but also to reduce their total discharge.

(2) Wastewater Standards Set for Factories

Figure 1-5-4 shows examples of wastewater standards set for a factory located in a river basin and for a factory in an industrial estate. In the river basin example, because the factory wastewater is used in agriculture for irrigation, salt concentrations in the wastewater are strictly regulated to curb salt damage. In addition to the national standard of 3,000-5,000 mg/liter for total dissolved solids (TDS), the factory is subject to a requirement set by the Irrigation Department that electric conductivity should not exceed 2,000 µS/cm. Although the type of dissolved salt is a factor, 2,000 µS/cm is equivalent to approximately 1,000 mg of dissolved salt solids per liter. Thus, this standard is additional to, and stricter than, the national standard.

In the industrial estate example, the 450 mg/liter BOD standard and the 600 mg/liter COD standard are much more lenient than the national standards set by the Thailand government. This is because industrial estates, as a legal requirement, are allowed to release wastewater to public water bodies only after final treatment by biological processing at a central wastewater treatment facility run by the estate administration. Heavy metals, which can not be treated by biological processing, are subject to standards that are equal to, or slightly less strict than, the national standards. The apparent reasoning here is that factory wastewater containing heavy metals is diluted by general domestic wastewater which is also channeled into the central wastewater treatment plant. An additional requirement in the industrial estate example is the total heavy metal concentration, calculated by putting the individual metal concentrations in a prescribed formula. Standards are also set for aluminum (Al) and titanium (Ti), although the reason for their inclusion as wastewater parameters is unknown.

A standard of 500 mg/liter is set for sulfate ions (SO_4^{2-}) in the industrial estate example, the aim being to control salinity. Factory wastewater can be strongly acidic due to the presence of sulfate (H_2SO_4). Even if caustic soda (NaOH) is added to neutralize the acidity, the SO_4^{2-} remains in the wastewater. Acidic wastewater with high sulfate content may contain several tens of grams of SO_4^{2-} when the acidity is neutralized, far exceeding the standard. Dilution with water may be one way of reducing the SO_4^{2-} concentration to an acceptable level, but dilution increases the quantity of wastewater many times. If the government introduces its proposed system of surcharges based on total contaminant discharge, it will be very disadvantageous for factories to increase wastewater volume by dilution, which will make compliance with salinity regulations a difficult problem.

(3) Water quality analysis

Water quality is analyzed using methods approved by the United States Environmental Protection Agency (EPA). Chemical oxygen demand (COD) levels are detected as COD_{Cr} by the potassium dichromate test. Either the open reflux method or closed reactor method is acceptable as the method of COD measurement. As discussed previously, COD_{Cr} shows a higher value than COD_{Mn}, the COD measurement given by the potassium permanganate test used in Japan. Therefore, a method of wastewater treatment that produces satisfactory results by Japanese standards will not necessarily meet the COD standard when applied in Thailand. A wastewater treatment facility that provides higher performance may be required.

Every factory must regularly report water analysis results to the controlling government agency at a stipulated frequency, and the analysis must be carried out by a government-approved laboratory. Currently, twenty laboratories have government approval. A laboratory seeking approval must apply to the Ministry of Industry (MOI), analyze an unknown sample and return the results, and be granted approval depending on the evaluation.

(4) Penalties for non-compliance

If a factory violates the wastewater standards, it receives a warning from the MOI, or from the Irrigation Department or other government agency with jurisdiction over its activities. If the factory fails to comply with repeated warnings, it is forced to cease operations. In fact, a pulp and paper factory has been shut down under this provision. There has also been an instance of a factory in an industrial estate having its water supply cut off and being forced to cease operations after violating standards set by the estate administration. Incidentally, neither of these two examples was a Japanese company.

Figure1-5-3 Industrial Effluent Standards

Parameter	Standard values
pH	5.5 - 9.0
Total Dissolved Solids (TDS)	Not more than 3,000 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee but not exceed 5,000 mg/liter for the following case: 1) not more than 5,000 mg/liter exceed TDS of receiving water having salinity of more than 2,000 mg/liter 2) TDS of sea if discharge to sea
Suspended Solids (SS)	Not more than 50 mg/liter depending on receiving water or type of industry or type of wastewater treatment system nude consideration of Pollution Control Committee but not exceed 150 mg/liter
Temperature(℃)	Not more than 40℃
Color and Odor	Not objectionable
Sulfide (as H_2S)	Not more than 1.0mg/liter
Cyanide (as HCN)	Not more than 0.2mg/liter
Heavy Metals	
-Zinc/Zn	Not more than 5.0mg/liter
-Chromium (Hexavalent)/Cr^{6+}	Not more than 0.25mg/liter
-Chromium (Trivalent)/Cr^{3+}	Not more than 0.75mg/liter
-Arsenic/As	Not more than 0.25mg/liter
-Copper/Cu	Not more than 2.0mg/liter
-Mercury/Hg	Not more than 0.005mg/liter
-Cadmium/Cu	Not more than 0.03mg/liter
-Barium/Ba	Not more than 1.0mg/liter
-Selenium/Se	Not more than 0.02mg/liter
-Lead/Pb	Not more than 0.2mg/liter
-Nickel/Ni	Not more than 1.0mg/liter
-Manganese/Mn	Not more than 5.0mg/liter
Fat, Oil and Grease	Not more than 5 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee but not exceed 15 mg/liter
Formaldehyde	Not more than 1.0mg/liter
Phenol	Not more than 1.0mg/liter
Free Chlorine	Not more than 1.0mg/liter
Pesticides	Not detectable

Biochemical Oxygen Demand (BOD)	Not more than 20 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee, but not exceed 60 mg/liter for the following factories: 1)animal furnishing factories 2)starch factories 3)food from starch factories 4)animal food factories 5)textile factories 6)tanning factories 7)pulp and paper factories 8)chemical factories 9)pharmaceutical factories 10)frozen food factories
Total Kjeldahl Nitrogen (TKN)	Not more than 100 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee, but not exceed 200 mg/liter for the following factories (effective after 2 year from the date published in the Royal Government Gazette of the Notification No.4): 1)food furnishing factories 2)animals food factories
Chemical Oxygen Demand (COD)	Not more than 120 mg/liter depending on receiving water or type of industry under consideration of Pollution Control Committee, but not exceed 400 mg/liter for the following factories: 1)food furnishing factories 2)animal food factories 3)textile factories 4)tanning factories 5)pulp & paper factories

Source: Notification of the Ministry of Science, Technology and Environment, No.3, A.D. 1996
Notification of the Ministry of Science, Technology and Environment, No.4, A.D. 1996
Notification of Pollution Control Committee, No.3, A.D. 1996

Figure 1-5-4 Examples of Industrial Wastewater Standards

Units are mg/liter unless otherwise specified.

Parameter	Examples of Standards for Specific Factories		Government Standards	
Product (Plant Site) / Parameter	Computer components manufacturer (situated in industrial estate)	Synthetic fiber manufacturer (situated in river basin)	Thailand[1]	Japan[2]
Temperature (℃)	45℃	40℃	40℃	-
pH	6～8	6～8	5.5 - 9.0	5.8 - 8.6
BOD	450	20	20 - 60	160
COD_{Cr}	600	60	120 - 400	160 (COD_{Mn})
Suspended Solids	500	30	50 - 150	200
Settleable Solid	1,000	-	-	-
TDS	3,000– 5,000	3,000– 5,000	3,000– 5,000	-
Electric Conductivity (μS/cm)	-	2,000	-	-
Fat, oil & grease	100	5	5 - 15	5[5]、30[6]
Tar & oil	50	-	-	-
Cu	1.0	2.0	2.0	3.0
Zn	5.0	-	5.0	5
Fe	5.0	-	-	10
Mn	5.0	5.0	5.0	10
T-Cr	1.0	-	-	2
Cr^{6+}	0.25	0.25	0.25	0.5
Cr^{3+}	0.75	0.75	0.75	2.0 (T-Cr)
Cd	1.0	0.03	0.03	0.1
Ni	1.0	1.0	1.0	-
Pb	1.0	0.2	0.2	0.1
T-Hg	0.01	0.005	0.005	0.005
Alkyl-Hg	-	-	-	ND
Heavy metals[3]	16	-	-	-
Metals[4]	30	-	-	-
Ba	1.0	1.0	1.0	-
Ag	1.0	-	-	-
Al	5.0	-	-	-
Ti	1.0	-	-	-
F	-	-	-	15
T-CN	0.2	0.2	0.2	1.0
Org. P	-	-	-	1.0

As	1.0	0.25	0.25	0.1
Color & odor	Not object	Not object	Not object	-
H_2S	1.0	1.0	1.0	-
SO_4^{2-}	500	-	-	-
SO_3^{2-}	10	-	-	-
Free Cl	100	1.0	1.0	-
Se	0.02	0.02	0.02	0.1
T-coli. Bacteria (number/100 ml)	-	-	-	3,000
T-N	100	100	100 - 200	120
P	-	-	-	16
PCB	-	-	-	0.003
Detergent	100	-	-	-
Trichloroethylene	-	-	-	0.3
Tetrachloroethylene	-	-	-	0.1
Formaldehyde	1.0	1.0	1.0	-
Phenol	10	1.0	1.0	5.0
Glucose	500	-	-	-
Ethylene Glycol	-	-	-	-
Pesticides	ND	ND	ND	-

1) The notification of the Ministry of Science, Technology and Environment, No.3, A.D. 1996 issued under the Enhancement and Conservation of the National Environment Quality Act, A.D. 1992

2) Includes only relevant parameters excerpted from the regulations of the Prime Minister' sOffice that prescribe wastewater standards (Annex 1 of Regulation No.54, 1993 and Annex 2 of Regulation No.40, 1993)

3) Sum of zinc (Zn), cadmium (Cd), two times of copper (Cu), and two times of nickel (Ni)

4) Sum of metals excluding iron and alkaline-earth metals

5) Normal-hexane extracts and mineral oils

6) Carbon-tetrachloride extracts and animal and vegetable oils

Section 6
Air Pollution Management

1. Thailand's Air Pollution Regulations

Like other developing countries, Thailand is now faced with air pollution problems brought about by rapid economic expansion. Government initiatives to tackle air pollution have been directed mainly at motor vehicle emissions, a severe form of air pollution, particularly in urban areas, and an issue that demands urgent solution. However, full-fledged regulatory measures aimed at air pollution caused by industrial activities is still a matter for future implementation, except for thermal power plants and other specific facilities.

In 1995 Thailand issued new national standards for air quality, amending and partially tightening the existing environmental standards. As shown in Figure 1-6-1, the national standards cover seven air pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), total suspended particulate (TSP), particulate matter less than 10 microns (PM-10), ozone (O_3), and lead (Pb).

Government measures directed at regulating industrial air pollution from stationary sources have traditionally concentrated on black smoke. The current industrial emission standards issued as a notification of the Ministry of Industry (MOI) define the types of sources subject to regulation, and set emission standards for fifteen air pollutants. The MOI has also prescribed SO_2 standards for factories in designated zones that use oil-firing processes. In addition, SO_2, NO_2, and TSP standards are prescribed for new thermal power plants and mixed-firing thermal power plants. The government's future plans, according to an official in the Air Quality Division of the Ministry of Science, Technology and Environment (MOSTE), are to progressively set emission standards that target specific industries where air pollution is becoming a serious concern, such as steelmaking, quarries, and cement plants. In the long term, Thailand plans to introduce emission regulations to control the total volume of pollutants that a factory releases into the atmosphere.

Regulations on air pollution by motor vehicles have been issued separately, but with basically the same content, by the MOSTE, the Royal Thai Police Department of the Ministry of Interior, and by the Department of Land Transport of the Ministry of Transport and Communications. These regulations set emission standards for individual motor vehicles and motorcycles, covering diesel smoke, CO, and hydrocarbon (HC) emissions. In addition, new vehicles must pass emission standards at shipment from factories. Since January 1993 new vehicles are required to have catalytic exhaust purifiers.

2. Factory Emission Standards

(1) Emission standards for stationary sources

Fourteen air pollutants were regulated under the industrial emission standards issued by the MOI in 1993 (Figure 1-6-2). These pollutants include arsenic (As), hydrogen chloride (HCl), hydrogen sulfide (H_2S), and SO_2. Cresol was added in 1995, bringing the total number of regulated air pollutants to fifteen. Regulations for eleven pollutants – antimony (Sb), arsenic (As), lead (Pb), chlorine (Cl), HCl, mercury (Hg), CO, sulfuric acid (H_2SO_4), H_2S, xylene, and cresol – apply to all sources, and a standard is prescribed for each pollutant. The remaining four substances are regulated for specific industries. For example, the standard for particulate

applies to boilers and furnaces, and to steel and aluminum manufacturing. In 1997 another emission standard was added, to regulate SO_2 emissions from oil-firing processes located in the Bangkok Metropolitan Administration (BMA) and in Samutprakarn Province.

However, although emission standards have been established to tackle factory-generated air pollution, and although factories are required to take measurements and submit reports on a regular basis, there are not enough laboratories capable of analyzing flue gas and Thailand has no system of verifying that measurements are accurate. Given these practical problems, it will probably be some time before air pollution control measures are implemented as provided in the regulations.

In the course of this survey, we visited a dozen or more Japanese companies in Thailand, and although all of them have instituted measures to control air pollution, most expressed concern about the lack of laboratories and about the ability of the available facilities to perform proper air quality analysis.

(2) Environmental regulations similar to air pollution regulations

Among the environmental problems in a similar category to air pollution, odor and noise may be cited as affecting the activities of Japanese companies. However, apart from the noise restrictions given in Thailand's national air quality standards, and noise standards in the workplace, there are no noise or odor regulations that apply directly to industrial activities.

Many Japanese companies operating in Thailand have received complaints about foul odors from local residents, and from temples and schools in the vicinity of their factories. In response, these companies are now making major capital investments to solve odor problems.

The ground for these corporate initiatives is found in the nuisance regulations laid down in the Public Health Act A. D. 1992. These regulations define any act causing odor, noise, vibration, light, dust, soot, etc., that impacts on the human environment as a nuisance and subject it to legal punishment. Although the Act stipulates no actual standards and gives no clear-cut definition of what constitutes a nuisance, it is often used as a means of regulating factories that disturb the peaceful living of the people residing in the neighboring area.

Figure 1-6-1 Air Quality Standards

Parameter[1)]	1-hr average		8-hrs average		24-hrs average		1-month average		1-year average[2)]		Method
	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	mg/m^3	ppm	
Carbonmonoxide/ CO	34.2	30	10.26	9							Non-Dispersive Infrared Detection
Nitrogen Dioxide/NO_2	0.32	0.17									Chemilum-inescence
Sulfur Dioxide/SO_2[3)]	0.78	0.30			0.30	0.12			0.10	0.04	UV-Fluoresce-nce
Total Suspended Particulate/TSP					0.33				0.10		Gravimetric-High Volume
Particulate Matter (<10 μ)					0.12				0.05		Gravimetric-High Volume
Ozone/O_3	0.20	0.10									Chemilum-inescence
Lead/Pb							1.5				Atomic Absorption Spectrometer

1) At 1 standard pressure and 25 deg C
2) geometric mean
3) 1-hr. SO_2 standard, 1.3 mg/m^3 for Mae Moh area and 0.78 mg/m^3 elsewhere
Source: Pollution Control Department , Ministry of Science, Technology and Environment,
Laws and Standards on Pollution Control in Thailand 4th Edition, October 1997

Figure1-6-2 Industrial Emission Standards

Substances[1)]	Sources	Standard Values
Particulate	Boiler & Furnace	
	-Heavy oil as fuel	300 mg/Nm^3
	-Coal as fuel	400 mg/Nm^3
	-Others as fuel	400 mg/Nm^3
	Steel/Aluminum manufacturing	300 mg/Nm^3
	Other source	400 mg/Nm^3
Antimony/Sb	Any source	20 mg/Nm^3
Arsenic/As	Any source	20 mg/Nm^3
Copper/Cu	Furnace or Smelter	30 mg/Nm^3
Lead/Pb	Any source	30 mg/Nm^3
Chlorine/Cl	Any source	30 mg/Nm^3
Hydrogen chloride/HCl	Any source	200 mg/Nm^3
Mercury/Hg	Any source	3 mg/Nm^3
Carbonmonoxide/CO	Any source	1,000 mg/Nm^3 or 870ppm
Sulfuric acid/H_2SO_4	Any source	100 mg/Nm^3 or 25ppm
Hydrogen Sulfide/H_2S	Any source	140 mg/Nm^3 or 100ppm
Sulfurdioxide/SO_2	H_2SO_4 production	1,300 mg/Nm^3 or 500ppm
	Combustion process-Oil as fuel [2)]	1,250ppm
Oxides of Nitrogen/NO_x	Boiler	
	-Coal as fuel	940 mg/Nm^3 or 500ppm
	-Other fuel	470 mg/Nm^3 or 250ppm
Xylene	Any source	870 mg/Nm^3 or 200ppm
Cresol	Any source	22 mg/Nm^3 or 5ppm

1) Condition is 25 degree Celsius at 1 atm
2) for the industry which settled down in BMA and Samutprakarn Province
Source: Notification of the Ministry of Industry No.2, A.D. 1993
Notification of the Ministry of Industry No.9, A.D. 1995
Notification of the Ministry of Industry No.3, A.D. 1997

Section 7
Hazardous Waste Management

1. Hazardous Waste Problems Without a Quick Fix

The ever-increasing quantities of waste generated by industrial expansion, and the problem of hazardous waste in particular, look likely to become Thailand's most serious environmental problems in the future. The Thai government has taken a constructive approach in tackling hazardous waste problems, passing a succession of laws and regulations in recent years. However, there is a desperate shortage of treatment facilities essential to properly process hazardous waste, and the construction of new treatment facilities has been blocked and delayed by community opposition in affected areas. Japanese companies in Thailand are all treating hazardous waste in accordance with the laws and regulations. In reality, though, they are seriously worried about the lack of facilities and the major expense involved in hazardous waste treatment.

It has been estimated that Thailand generated 1.6 million tons of hazardous waste in 1996, of which 1.2 million tons came from industrial sources. According to a spokesperson in the Ministry of Industry (MOI), which has jurisdiction over hazardous waste matters, no more than about 200,000 tons of this annual total was processed appropriately. The rest, it is assumed, was stored within factory sites or illegally dumped. Environmental pollution caused by illegal dumping is a serious concern.

Hazardous substances imported as raw materials or manufactured domestically reached an estimated annual total of 12 million tons in 1996, and a large number of accidents associated with the manufacture, management, and transportation of these substances have occurred. The Hazardous Substances Act A. D. 1992 regulates the manufacture, storage, and transportation of nearly 1,000 substances defined as hazardous substances, but lack of technology and the absence of an adequate monitoring system have hampered the implementation of the regulations in a manner that would have any real impact. Hazardous substances, together with hazardous waste, threaten to become major environmental problems for Thailand.

2. Hazardous Waste Legislation versus Insufficient Treatment Facilities

The Factory Act A. D. 1992 stipulates that hazardous waste must be stored in sealed and safe containers, and must be strictly separated from other types of waste. It is prescribed that the actual requirements regarding treatment methods and treatment standards for hazardous waste are to be notified under the Act by the MOI. In the past, hazardous waste was defined and the precise methods of storage, detoxification, discharge, and transportation were stipulated in Notification No. 25 and Notification No. 1 of the MOI, issued in 1988 under the old Factory Act of 1969. In 1997, however, new hazardous waste regulations were issued as Notification of the Ministry of Industry No. 6 under the provisions of the 1992 Factory Act. Current hazardous waste regulations are therefore based on this Notification of the MOI No. 6, 1997 (see Appendix 2 for details).

The new notification does not introduce any major changes to the categories of hazardous waste, but it substantially increases the range of substances subject to regulation.

(1) Description of the regulations laid down in the new notification

Entitled "Treatment of Waste or Disused Substances," Notification of the MOI No. 6, 1997 first of all prohibits any factory owner who possesses solid waste or unusable materials, in the form and with the characteristics described in the notification, from moving that waste out of the factory site except for the purpose of detoxification, treatment, disposal, or landfill in the prescribed manner. A detailed list of substances and treatment methods are laid down. The notification also specifies the standard format of the reports required when storing, treating, and transporting hazardous waste.

Under these provisions, factory owners are obliged either to treat hazardous waste themselves, following the methods prescribed in the notification, or to contract the General Environmental Conservation Public Company Limited (GENCO) to carry out treatment in compliance with the regulations. GENCO is the only hazardous waste treatment operator officially approved by the MOI.

Notification No. 6, 1997 consists of the main text, two appendixes setting out the particulars of hazardous waste treatments, and the standard forms of the required reports. Appendix 1 lists the forms and types of hazardous waste subject to regulation under four classes. Class 1 is subdivided into four categories: (1) flammable substances, (2) corrosive substances, (3) toxic substances, and (4) leachable substances. Class 2 covers hazardous waste from non-specific sources, class 3 covers acutely hazardous chemicals and toxic chemicals, and class 4 covers chemical wastes such as used lubricating oil and so on. For each of these classes and categories, the notification sets out the form, characteristics, name, and other details of the substances subject to regulation. In total, nearly 1,000 different substances are classified as hazardous waste.

Appendix 2 sets out the regulations and methods relating to detoxification, treatment, disposal, and landfill of hazardous waste. As well as giving the names of specific methods of treatment by physical, physico-chemical, chemical, and biological means, Appendix 2 also specifies test procedures to be carried out after hazardous waste has undergone stabilizing or solidifying treatment.

In short, Notification No. 6 is both detailed and extensive in content, indicating the ideal methods of treatment for a wide range of substances. It contains a large amount of complicated information, such as chemical names and analytical methods, requiring a high degree of knowledge about chemistry to fully understand it. This must make it hard even for Japanese companies to single-handedly carry out hazardous waste treatment in compliance with the regulations.

(2) Slow progress in building hazardous waste treatment facilities

At present, Thailand has only two facilities that can properly treat hazardous waste. Both were constructed by the MOI and are operated and managed by GENCO, a joint public-private sector company with partial equity investment from the MOI.

One of these facilities is the Bang Khun Thian Hazardous Waste Treatment Plant, located in the southwest of the Bangkok Metropolitan Administration (BMA). It began operating in 1988

and has a processing capacity of 1,000 cubic meters per day of wastewater containing hazardous substances from textile and electroplating factories, plus 50 tons of solid hazardous waste per day. At this plant, wastewater is treated by chemical batch-processing equipment, or continuous chemical coagulating sedimentation equipment and associated settlement ponds. Solid hazardous waste is treated by chemical solidification or cement mixing. These hazardous waste treatment technologies were supplied by Waste Management Inc. of the United States. We visited the plant during the course of this survey, and found that treatment processes were being properly conducted. There is also a landfill in Ratchaburi Province for disposal of the processed residue.

The other treatment facility, located in Map Ta Phut Industrial Estate in Rayong Province, began operation in 1997. This facility has stabilizing equipment, equipment for converting waste into fuel, and a landfill. It has the capacity to treat 70,000 tons of hazardous waste annually.

Together, these two waste treatment facilities can cope with approximately 200,000 tons of hazardous waste annually, but this falls far short of 1.6 million tons of hazardous waste generated in Thailand every year. To solve the problem, the MOI in 1996 proposed that seven more hazardous waste treatment facilities be built nationwide, but all these projects were met with fierce opposition from people living near the construction sites, and some of the projects have already been shelved. The only one that currently remains firm is a waste treatment and incinerating plant to be situated in Samutprakarn Province.

Unless additional treatment facilities are built, Thailand's hazardous waste problems will remain and it will still be a long time before any solution is found.

As far as Japanese companies are concerned, most are outsourcing hazardous waste treatment to GENCO. However, because GENCO is also collecting and transporting the waste, factories located a long way from either of GENCO's two waste treatment facilities are faced with considerable transportation costs in addition to the high treatment costs.

Apart from GENCO's two facilities for treating hazardous waste, there are MOI-approved private operators that treat used lubricating oil and used organic solvents only.

Section 8
Environmental Impact Assessment in Thailand

1. Thailand's Environmental Impact Assessment System

Thailand's environmental impact assessment (EIA) system began in 1981. It originated from a request from the World Bank for implementing an environmental impact assessment when the Electricity Generating Authority of Thailand (EGAT) proposed building a power plant with funding from the World Bank. The EIA system was incorporated into Thailand's legislation when the 1975 Improvement and Conservation of National Environmental Quality Act was partially amended in 1979. The Ministry of Science, Technology and Energy, as it was known at the time, issued a notification defining the types and sizes of projects or activities subject to an EIA.

Afterwards, under the provisions of the 1992 Enhancement and Conservation of National Environmental Quality Act (NEQA), the Ministry of Science, Technology and Environment (MOSTE) was granted the power, with the approval of the National Environmental Board (NEB), to determine the types and sizes of projects or activities that are required to file an EIA report. In addition, the Office of Environmental Policy and Planning (OEPP) under the MOSTE was made responsible for EIA procedures. The 1992 Act also defined additional types of projects or activities subject to an EIA, and reduced the term for review of submitted EIA reports.

Japanese companies are required to file an EIA report when applying for a building permit to construct a new factory, or when extending an existing factory, if the proposed construction project is subject to EIA provisions.

2. Projects Subject to Environmental Impact Assessment

As laid down in the MOSTE notification, EIA reports are currently required for 29 types and sizes of projects or activities, ranging from public works such as dam or reservoir construction to private-sector projects such as petrochemical plant construction (Figure 1-8-1).

EIA requirements for private enterprises extend to eleven types of plant construction projects in industries such as petrochemical, oil refining, iron and steel, and sugar. As a related activity, construction of an industrial estate also requires an EIA.

Brewery and distillery construction projects are likely to be added in the near future to the list of projects requiring submission of an EIA report.

3. Environmental Impact Assessment Procedure

(1) Process of reviewing environmental impact assessment reports

For private-sector development projects subject to EIA requirements, the proponent of the project must prepare two copies of an EIA report, submit one copy to the OEPP, and the other copy to the government agency that has jurisdiction over the project. Plant construction projects in which Japanese companies are likely to be involved usually require EIA reports to be filed with the OEPP and with the Department of Industrial Works in the Ministry of Industry (MOI).

On receiving an EIA report, the OEPP must examine the documents within fifteen days, and then, within the next fifteen days, refer the report together with comments based on a preliminary review to an expert review committee. This committee has forty-five days to review the referred report and to decide whether to give approval. However, if the report is deemed incomplete, the expert review committee will request the project applicant to submit a revised report. The committee then has thirty days to consider the revised EIA (Figure 1-8-2).

The government agency with jurisdiction over the project considers whether to grant a license after the EIA is approved by the expert review committee. An expert review committee is made up of a wide range of experts and authorized to approve or reject reports, and to direct an applicant to revise a report and/or submit additional information. At present, there are five such committees covering five fields: industry, water resources, mining, public works, and housing development.

For government projects that require Cabinet approval, the procedure is slightly different from private-sector projects. In this case, the proponent of the project must submit an EIA report to the National Environment Board (NEB), which then reviews the report and hears the opinions of the OEPP and expert review committee. The NEB reports its conclusions to the Cabinet. The Cabinet then considers whether to grant approval, having reviewed the project on the basis of the NEB recommendations and experts' opinions.

(2) Particulars required in environmental impact assessment reports

Among the particulars that must be included in an EIA report are:

1. A summary of the proposed project
2. Current environmental data relating to the site of the proposed project
3. Assessment of the environmental impacts of the project
4. Proposed measures and necessary expenses for preventing or minimizing environmental impacts
5. Environmental monitoring plan for air and water quality

Specifically, an EIA report must include an assessment of how the present environment contributes value to people's lives; an assessment of direct and indirect, and short- and long-term environmental impacts of the project; proposed measures for preventing adverse effects on environmental resources; measures to be implemented in the event of irreversible environmental impacts; and possible alternatives to the proposed project.

Since 1984, companies have been required to use the services of a consultant institution registered with the OEPP when preparing an EIA report. As of January 1999, there are 54 registered organizations, including private-sector environmental consultants, universities, and other institutions.

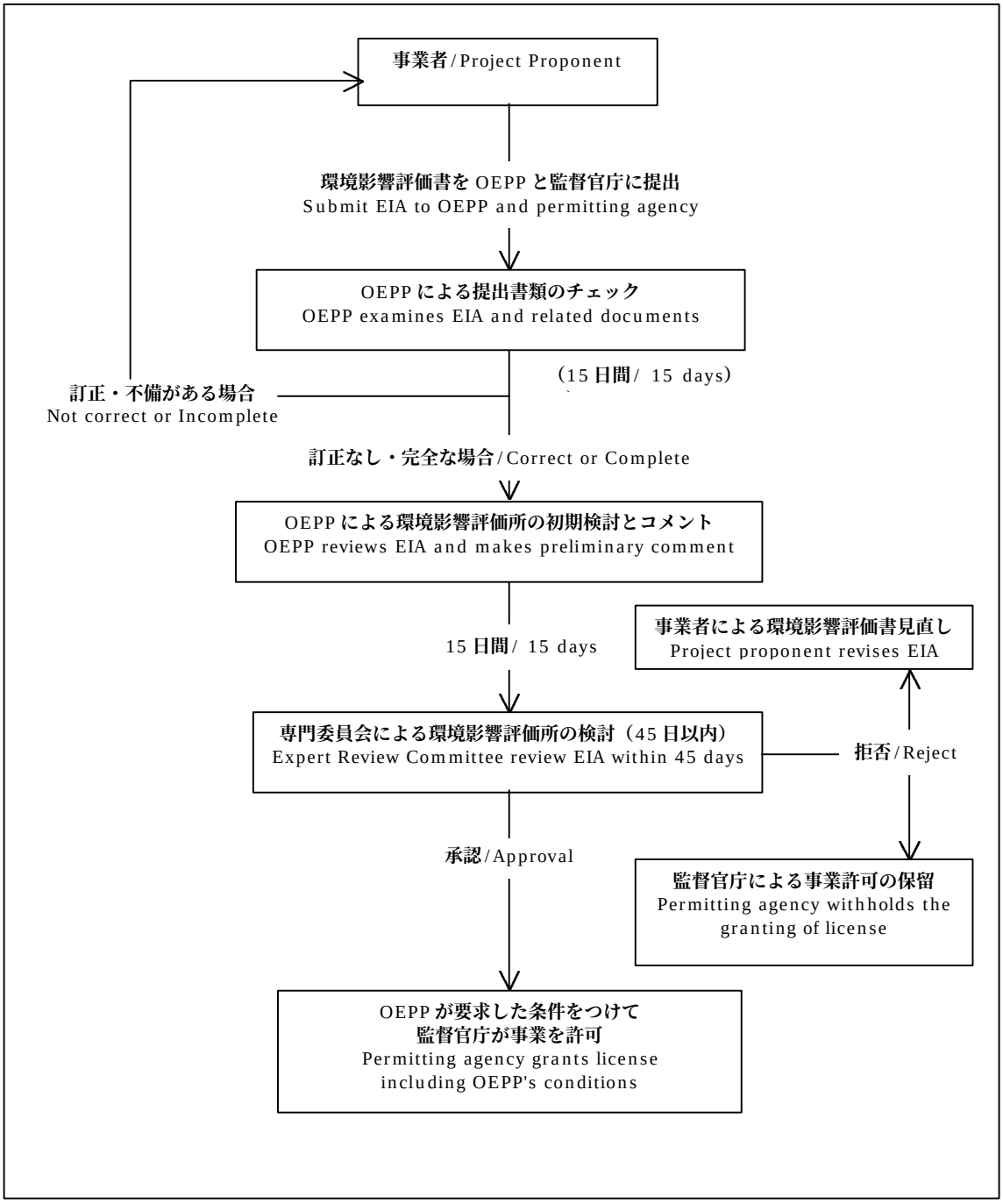
Figure1-8-1 Projects or Activities Subjected to EIA

Type of projects or Activities	Size
Dam or Reservoir	With storage volume of 100,000,000m^3 or more, or storage surface area of 15 km^2 or more
Irrigation	Irrigated area of 80,000 rails (12,800 hectares or more)
Highway or road as defined by the Highway Act, passing through following areas: 1)Wildlife sanctuaries and wildlife non-hunting areas as defined by the Wildlife Conservation and Protection Act 2)National park as defied by the National Park Act 3)Watershed area classified as class 2 by the Cabinet Resolution 4)Mangrove forests designated as the National Forest Reserve 5)Coastal area within 50 meters of high tide level	All projects with equivalents to or above the minimum standard of rural highway, including road expansion on existing route
Commercial port	With capacity for vessel of 500t or more
Commercial airport	All size
Mass transit system under the Mass Transit System and Expressway Act or project as the same characteristic or mass transit which use rail	All size
Coastal land reclamation	All size
All type of projects located in the areas approved by the Cabinet as class 1B watershed area	All size
Petrochemical industry	Using raw materials which are produced from oil refining and or natural gas separation, with production capacity of 100t/day or more
Oil refinery	All size
Natural gas separation or processing	All size
Chlor-alkaline industry requiring sodium chloride (NaCl) as raw materials for production of sodium carbonate (Na_2CO_3), sodium hydroxide (NaOH), hydro chloric acid, chlorine (Cl_2), sodium hypo-chloride (NaOCl) and bleaching power	Production capacity of each or combined productions of 100t/day or more

Irons and/or steel industry	Production capacity of 100t/day or more (production capacity shall be calculated by using ton/hour furnaces capacity multiply by 24 hours)
Cement industry	All size
Smelting industry other than iron and steel	Production capacity 50t/day or more
Pulp Industry	Production capacity 50t/day or more
Pesticide Industry producing active ingredient by chemical process	All size
Chemical fertilizes industry using chemical process	All size
Central waste treatment plant as defined by the Industry Act	All size
Sugar Industry 1)producing raw sugar, white super, refined sugar 2)producing glucose, dextrose, fructose or the like	 All size Production capacity 20t/day or more
Industrial estate as defined by the Industrial Estate Authority of Thailand Act or projects with similar feature	All size
Thermal power plant	Capacity 10MW or more
Petroleum development 1)Geophysical drilling, exploration and/or production 2)Oil and gas pipeline system	 All size All size
Mining as defined by the Mineral Act	All size
Hotel or resort facility	80 rooms or more
Residential building as defied by the Building Control Act	80 rooms or more
Building in areas adjacent to river, coastal area, lake or beach or in the vicinity of national parks or historical park which environmental quality	With Height of 23 meters or more, or total floor area or individual floor area in the building is 10,000 square meters or more
Land allocation of residential or commercial purpose	500 land pots or more or total developed area exceed 100 rails (16 hectares)
Hospital which located 1)in area adjacent to river, coastal area, lake or beach 2)in area other than 1	 1)With 30 in – patient s beds or more 2)With 60 in – patient s beds or more

Source: Technical Section of Environmental Impact Evaluation Division, Office of Environmental Policy and Planning, MOSTE, *Environmental Impact Assessment in Thailand,* January 1996

Figure1-8-2 Approval Process of Environmental Impact Assessment for Private sector projects



Source: Technical Section of Environmental Impact Evaluation Division, Office of Environmental Policy and Planning, MOSTE, *Environmental Impact Assessment in Thailand*, January 1996

Chapter 2

Environmental Conservation by Japanese Companies

:Case Studies of Corporate Practices and Policies

Japanese companies that have expanded their business to Thailand have been voluntarily and vigorously promoting their environmental practices under various conditions such as limited social infrastructure.
Chapter 2 introduces 16 cases of practical environmental measures by Japanese companies in Thailand, mainly manufacturing companies, based on the information collected by a field survey. The survey was conducted to study more than 10 member companies of the Japanese Chamber of Commerce, Bangkok. After summary of those companies' environmental practices and policies described in Section 1, 16 cases are introduced in following sections: Section2; 5 Cases of Meeting Strict Wastewater Standards, Section 3; 5 Cases of Establishing an Environmental Management System, Section 4; 3 Cases of Adopting Locally Tailored Environmental Practices, Section 5; 3 Other Examples of Innovative Environmental Practices.

Section 1
Japanese Companies in Thailand and their Environmental Conservation

This study covers field surveys conducted from November 1998 to January 1999 for more than 10 Japanese companies that have already expanded their business to Thailand. Since most of them were manufacturing companies, the survey team visited as much as possible their plant where actual measures were taken for environmental problems, and collected data for their various environmental practices while inspecting their production lines and processes. When the survey team visited Thailand, it had only passed one and half year since Asian currency and economic crisis had occurred. Thai economy was still showing no sign of recovery while Japanese newspaper was largely reporting news of recession such as production cut at Japanese automobile manufacturing companies in Thailand. From Section 2 in Chapter 2, 16 examples are introduced to explain the specific environmental practices that are taken by Japanese company in Thailand. Every Japanese company in Thailand, under severe economic situation or limited social infrastructure related environmental problem, is making sincere effort to steadily promote environmental activities by elaborating various ideas.

1. Environmental Conservation by Japanese Companies

(1) Innovation as the hallmark of corporate environmental practices

All of the Japanese companies studied during the course of this survey expressed a similar awareness that "implementing environmental measures is essential for operating successfully in Thailand; we must never cause environmental problems." The general impression gained from the survey was that Japanese companies are tackling environmental measures head on, treating them not as a special issue, but as much part and parcel of running a company as labor relations. Many of the companies that acknowledged their corporate responsibility to set up proper environmental measures also voiced the opinion that a committed approach to environmental practices has considerable cost benefits, helping to reduce production costs and to enhance the image of the company and its products.

The environmental practices of Japanese companies are focused primarily on preventing pollution from wastewater. Going beyond mere compliance with the basic standards, however, many of the companies studied in the survey are aiming to meet stringent standards of their own, and are trying to reduce their energy consumption and waste generation to target levels that they have set themselves. It was also evident that Japanese companies are strongly driven to obtain ISO 14001 certification, the international standard of environmental management. More than twenty Japanese companies in Thailand are already accredited, and many are now preparing to obtain ISO 14001 certification. There are even cases where an affiliate in Thailand has been accredited ahead of its parent company in Japan.

Among the companies investigated, some are adopting innovative activities that are difficult to implement even in Japan, such as recycling and enterprise-wide environmental programs that encompass not only subsidiaries but also Thai-based agents and local distributors across the whole country. A Japanese company has begun afforestation programs in Thailand that have no direct bearing on their business activities, and there is an observable trend toward contributing to environmental conservation in a committed, long-term way.

It should be noted, however, that the Japanese companies covered in this survey were predominantly large companies, mainly in the manufacturing sector, and many of them are subsidiaries financed by well-known parent corporations in Japan. These factors mean that the picture presented by the survey respondents does not necessarily reflect the general situation of Japanese companies operating in Thailand. We were unable to obtain precise information about the environmental activities of small companies, or of industries other than manufacturing.

(2) Wastewater treatment as the focus of industrial pollution controls

Given that water pollution is the most pressing of Thailand's environmental problems, the industrial pollution controls being used by Japanese companies are primarily focused on wastewater treatment.

As discussed in Section 5 of Chapter 1, industrial effluent standards are stricter in Thailand than in Japan for biochemical oxygen demand (BOD) and most pollution parameters, and a few of the parameters regulated in Thailand do not even exist in Japan. For this reason, many Japanese companies have installed advanced wastewater treatment facilities at enormous expense, such as

treatment plants that incorporate activated carbon adsorption, a level of processing seldom seen in Japan. In industrial estates, which have their own central treatment plant, some companies are carrying out pre-treatment, to a degree that would be considered overly cautious by Japanese standards, to eliminate heavy metals and other contaminants before discharge into the estate's treatment facility.

Another concern of Japanese companies in Thailand was the question of hazardous waste. As mentioned in Chapter 1, despite strict laws and regulations, Thailand has only two treatment facilities that can process hazardous waste appropriately. This inadequate infrastructure makes treatment in compliance with the regulations generally difficult in practice. The implication is that, in reality, a large amount of hazardous waste in Thailand is illegally dumped.

All the Japanese companies covered in this survey are going to considerable expense to carry out hazardous waste treatment as required by law. However, with only two treatment plants, one in Bangkok and the other southeast to Bangkok in Rayong province, companies located in northern Thailand or other places that are hundreds of kilometers from either treatment site are burdened with very high transportation costs in addition to the waste processing fees. Moreover, the only company authorized to run treatment facilities and to collect and carry hazardous waste is the joint public-private company, General Environmental Conservation Public Company Limited (GENCO), which is partly funded by the Ministry of Industry (MOI).

Factory wastes other than hazardous wastes have some market value in Thailand, and are mostly collected by private operators. To this end, Japanese companies tend to sort their wastes into separate and distinct stockyards within the factory, while also endeavoring to reuse and recycle each type of waste with a view to reducing waste volumes.

In regard to air pollution control, most Japanese companies in this survey had installed dust collector and other equipment for preventing air pollution, had switched to less polluting fuels, and were regularly monitoring and reporting factory emissions to the authorities. There was also one Japanese company, involved in constructing and running an industrial estate, that was carrying out regular air quality monitoring at locations both inside and outside the estate because of concerns about possible effects on the local inhabitants.

In another case, a Japanese company had implemented odor controls after complaints about foul smells from people living in the vicinity of the factory. Complaints about solvent odors and burning smells from coating processes are common in Thailand. This Japanese company, however, had installed a pyrolytic processing system and had modified its coating process, investing considerable capital in plant and equipment to completely eliminate the odor problems.

2. Cross-Corporate Initiatives to Share Environmental Information

Apart from adopting practical environmental measures, Japanese companies in Thailand are clearly making cooperative efforts to share environmental information.

The Japanese Chamber of Commerce, Bangkok, which represents many Japanese companies in

Thailand, makes environmental information readily available to its members. The Environment Committee, set up as a cross-sectoral committee separate from the Chamber's industry-specific committee structure, plays a major role in distributing environmental information. Established in October 1993, the Environment Committee consisted of 23 members, as of fiscal 1998. Its activities include presentations about new solutions being implemented by Japanese companies in Thailand, and seminars with invited speakers from the Thai government. The Environment Committee also distributes environmental information through the Chamber of Commerce newsletter and is involved in publishing such information itself. Recent publications include *Thailand's Enhancement and Conservation of National Environmental Quality Act and Related Major Legislation*, *The Factory Act and Related Ordinances*, and *The Environment of the Kingdom of Thailand*.

Other initiatives to share information were observed among Japanese affiliates. For example, a number of corporate groups have joined forces to share environmental information and to work together toward achieving ISO 14001 certification. Another corporate group is providing information outside of its own organization to Japanese affiliates in the same industrial estate.

Japanese companies have a long history of expansion into Thailand, but one in particular has worked in Thailand for about twenty years. It offers a variety of environment-related services to other Japanese companies, primarily in the design, construction, operation and management of water treatment systems, and provides companies with environment-related information as well.

Although not an example of cross-corporate information sharing, the Environmental Research and Training Center (ERTC) holds ten different training courses, including wastewater treatment technologies, water quality analysis, air pollution management and waste management, for the staff of private-sector industries. The ERTC, part of the Ministry of Science, Technology and Environment (MOSTE), was built in Pathum Thani province with funding assistance from Japan. Until 1997, the Japan International Cooperation Agency (JICA) sponsored technology assistance projects at the ERTC.

3. Thailand's Economic Crisis and its Impact on Environmental Practices

A major interest in carrying out this survey was to discover how the environmental activities of Japanese companies in Thailand were affected by the currency and economic crisis in the Asian region, which began in Thailand in July 1997.

In the course of the survey, companies mentioned that they had suffered economically from diminished revenues, for example, but there was little evidence of any impact on environmental practices. Consequently, a simple questionnaire was sent after completion of the survey to those companies that had taken part, in order to ascertain the effects of the economic crisis on their environmental policies. Of the twelve companies that responded, eleven replied that "business performance (sales and production) was affected" by the crisis, the one exception being a company that exports nearly all its products to other countries. However, all twelve respondents agreed that the crisis had "hardly any effect on corporate environmental practices."

In response to a question about the relationship between business performance and the amount

of money spent or invested in environmental measures, except for one company which checked the "Don't know" box, the other eleven companies said that they have "constant levels of expenditure and investment, regardless of business performance." A follow-up question asked about expenditure and investment adjustments, should the current economic crisis continue for a long time. To this question, only two companies said that they would reduce expenditure and investment levels "to some extent," while all the other companies answered "no change."

Although the questionnaire covered only a small sample, these findings indicate that Japanese companies in Thailand are not scaling down their environmental initiatives, regardless of economic hardships.

The questionnaire also asked companies' opinions about the effects of the currency and economic crisis on the Thai government's environmental policies. Nine companies said, "the crisis had an impact." Specifically, respondents pointed out that "the government has cut back its budget for expenditure related to environmental conservation, and policy implementation is behind schedule, especially measures that cost money." In addition, some respondents noted a tendency for the economy to take precedence over environmental conservation, and for environmental regulations to be less severely enforced. Among other responses was a concern about the increased incidence of illegal dumping of waste by Thai companies.

4. Environmental Challenges and Approaches to Workable Solutions

As indicated by this survey, Japanese companies in Thailand are not simply following environmental regulations, but are promoting innovative methods of environmental measures. However, they face a number of problems, such as access to accurate information and the lack of facilities offering environmental measurement and analysis. The companies surveyed are taking positive steps to overcome these difficulties, and have sound environmental practices and policies in place.

The main environmental challenges, and corporate efforts, can be summarized as follows:

• Access to accurate information about laws and regulations:
Many companies have set up internal systems and procedures to obtain accurate information. As well as doing their own translations to understand the laws, orders and notifications published in the Thai language in the Government Gazette, Japanese companies are now appointing graduates in environmental engineering and related disciplines to positions related to environmental management.

• Compliance with strict standards:
Because water quality and other environmental standards in Thailand are generally stricter than in Japan, Japanese companies are spending large amounts of money on equipment to control pollution and meet allowable limits. As well as taking proper care in the operation and management of such equipment, companies are providing technical training to Thai staff involved in environmental controls. In regard to the hazardous waste, Japanese companies are complying with treatment regulations, but are required to bear the high costs including transportation to Thailand's scarce treatment plants.

• Initiatives to ensure the reliability of environmental measurements:
Japanese-affiliated companies are taking various initiatives to ensure that environmental measurements are accurate and highly reliable. For example, the companies sometimes forward samples for analysis to their parent company in Japan. In such cases, there are no lab facilities in Thailand capable of measuring and analyzing a substance that is subject to regulation, or there are no means of checking the reliability of factory measurement such as emission because Thailand do not have enough organization equipped with facility to analyze the measurement.

• Closer liaison with government authorities:
To liaise more closely with environment-related government authorities and to obtain up-to-date government information, Japanese companies are making an effort to train staff who can undertake public relations roles. In addition, a growing number of companies are engaging in corporate activities that imply long-term commitment, such as participating in the activities of the Federation of Thai Industries and other organizations, and building ties with local companies.

Section 2
Cases of Meeting Strict Wastewater Standards

The Thai companies of Japanese capitals covered in this research have a corporate principle in common that they should never cause environmental problems by the effluents from their plants and are very serious in preventing such incidents. Sections 2 to 5 present summaries of their environmental measures based on the information obtained from the plant visits and associated interviews. The summaries focus on their wastewater treatment but also present their positive efforts for waste treatment, air pollution prevention and odor prevention measures. Many of the official effluent standards for wastewater in Thailand have been set after American and European Standards and some Thai standards are very stringent in terms of international comparison. This section presents cases in which Japanese companies cope with such stringent standards by installing advanced wastewater treatment facilities and operating them properly. This section also outlines treating technologies, amounts of wastewater treated, analyses of water and operating conditions of the facilities to the extent of the information provided by the plants.

Case 1 Advanced Wastewater Treatment to Remove Traces of Heavy Metals

1) Outline of the Company

Company A (Company I of Case 9)
Business line: General electric machinery manufacturing
Number of employees: 2,900
Start of operation: 1996
Location of the plant: In an industrial estate for division companies of the same group in Samut Prakan, 30 km to the east of Bangkok
Japanese equity ratio: 49%

2) Background

Company A used be a division of one general electric machinery company until the company started conducting its separation to make division companies in 1996. In 1998 eight manufacturing companies and one managing company were formed. These companies were located in the same industrial estate except for one company, and manufacture a variety of products such as color television sets, household audio-players, audio-players for automobiles, electric fans, printed circuit boards for manufacturing machines, speakers, automotive switches and other six items.

This area is close to Bangkok and therefore designated as the First Area according to the industrial classification of the Office of the Board of Investment (BOI) of the government, where the most advanced measures for environmental conservation should be taken. Very strict standards are imposed on the plant partly because of agricultural land still remaining in the vicinity. Company A has pronounced in its corporate motto environmental conservation as the first priority item. The company therefore has decided to employ the most advanced technologies in the planning of wastewater treatment facilities. The company has built advanced wastewater treatment facilities because the printed circuit board plant, in particular, produces a wastewater stream containing heavy metals.

3) Measures Taken by the Company

a. Wastewater Treatment

The printed circuit boards are manufactured by etching the thin film of copper coated on the plastic board by chemicals in forms of electric circuits. The wastewater stream from this etching process contains heavy metals. Figure 2-2-1 shows the wastewater standards set by the Ministry of Industry (MOI). The standards for Ba (barium), and Ni (nickel) are not specified by the Japanese effluent standards. The standards for Cr^{6+} (hexavalent chromium) and Cr^{3+} (trivalent chromium), 0.25 mg/liter and 0.75 mg/liter respectively, are both much lower than the Japanese standard of 2.0 mg/liter. The standard for BOD, 20 ppm, is also a very strict one. Highly advanced water treating processes are therefore required to satisfy all these standards.

The plant of company A has already replaced chlorinated organic compounds with pure water in the washing process. In the process of producing pure water by using the reverse osmosis membrane, a large amount of wastewater (RO drain) is produced. This wastewater does not contain harmful substances, though its salt concentration is relatively high.

Figure 2-2-1 Effluent Standards Set for Company A

(mg/liter)

Item	COD	BOD	SS	TDS	Tempe-rature	pH	HCN	H_2S	Oil	Tar
Standard	120	20	50	3000	40 ℃	5.5-9.0	0.2	1.0	5	ND

Item	Free-Cl	Zn	Cr^{6+}	Cr^{3+}	Hg	Cd	Mn	Pb	Cu
Standard	1.0	5.0	0.25	0.75	0.005	0.03	5.0	0.2	2.0

Item	Ni	As	Ba	Se	T-N	Formalde-hyde	Phenols	Pesticides	Color/odor
Standard	1.0	0.25	1.0	0.02	100	1.0	1.0	ND	Not object

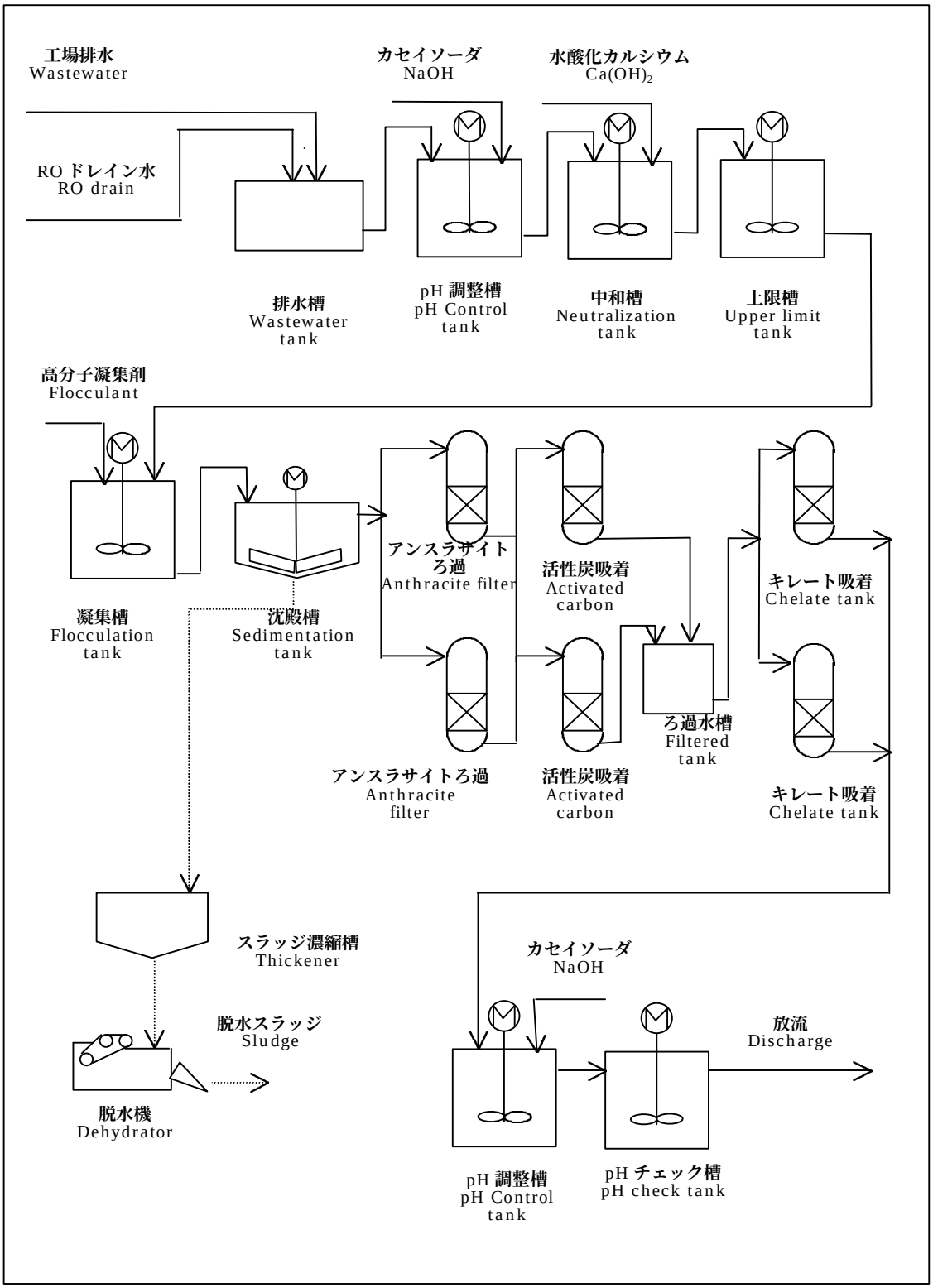
The etching process and reverse osmosis process produce nearly the same amounts of wastewater. The sum of these two streams amounts to about 40 m^3/hour. The wastewater treatment unit consisting of the facilities shown in Figure 2-2-2 has been installed to treat the wastewater to meet the standards to be dischargeable to the river. The wastewater as generated is acidic and therefore is neutralized by adding an alkali to make most of dissolved heavy metals form insoluble hydroxides. A polymer flocculant is then added to the wastewater to coagulate and settle hydroxides in the form of flocs, to be separated from the bulk of water. The upper clear water from the sedimentation tank is passed through the anthracite filter to remove suspended materials and then the activated carbon adsorption bed to remove dissolved organic compounds by adsorption to reduce BOD and COD values. The wastewater is further treated by the chelate tank to remove traces of heavy metals that have passed through the upstream facilities. The treatment by chelating agents is very effective in removing heavy metals but its operation cost is high.

The wastewater now satisfying all the items of the effluent standards by such an advanced treatment is stored in the detention pond in the industrial estate and mixed with wastewater streams from other plants to be discharged to the water channel outside the estate.

b. Solid Waste Treatment

The waste chips of the materials for printed circuit board and sludge generated at the wastewater treatment unit are consigned to General Environmental Conservation Public Company Limited (GENCO) for disposal.

Figure 2-2-2 Flow of the Wastewater Treatment of Company A



Case 2 Example of Coping with Stringent BOD Standard

1) Outline of the Company

Company B
Business line: Manufacture of synthetic thread and fabrics
Number of employees: 780
Start of operation: 1963
Location of the plant: in Nahkon Pathom 40 km to the west of Bangkok
Japanese equity ratio: 48.3%

2) Background

This plant was established in 1963, 36 years ago from now, at the present location near the River Thacin abundant in water, to secure a plentiful supply of water. At that time this plant was the only industrial installation in the midst of an agricultural land. Since then a number of plants, factories and houses have been built in this area, with associated deterioration of the environment. The government has designated this area as the First Area to restrict further construction of plants and factories. The class 4 water quality standards are applied to this area's portion of the River Thacin where the effluent water of the plant is discharged to. The quality standards call for BOD value of 4 ppm or lower.

The plant manufactures threads and fabrics from purchased polyester and rayon raw fibers. The plant consumes a large quantity of water for the dyeing process which produces a large amount of wastewater containing dyes and greases, which increase the BOD value and could contaminate the river water. The standard for BOD set by the government is a stringent one. The plant needed to install a large-scale wastewater treatment unit to clear this standard.

3) Measures Taken by the Company

a) Wastewater treatment

The plant discharges 3,800 m^3/day of waster water. Figure 2-2-3 shows the effluent standards applicable to the plant. The values of Figure 2-2-3 are basically within the limits set by the government of Thailand. The Nakhon Pathom Branch of the MOI, however, has applied the severest value of lower limit to the plant. The standard for BOD here, 20 ppm is much severer than the 160 ppm set by the Water Pollution Control Law of Japan.

Figure 2-2-3 Effluent Standards Set for Company B (mg/liter)

Item	pH	BOD	COD_{cr}	T-N	TDS	SS
Standard	5.5 – 9.0	20	120	100	3000	50

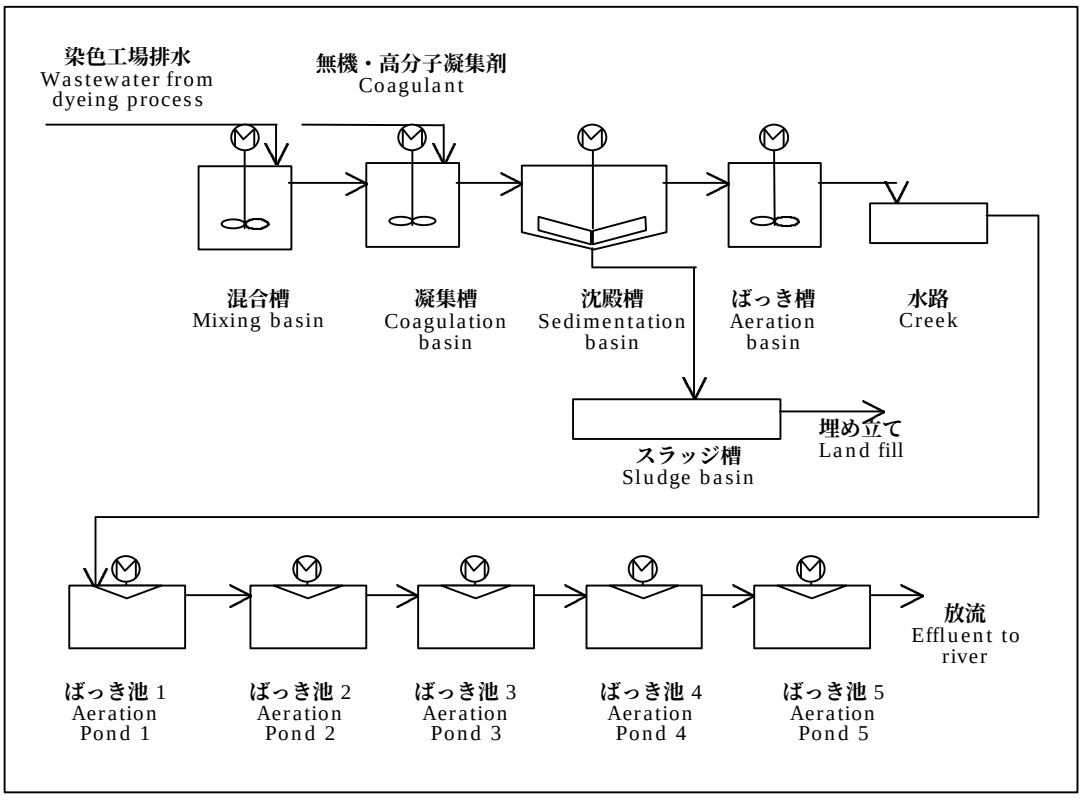
A wastewater treatment unit of the configuration shown in Figure 2-2-4 was built by contracting a Japanese water treatment facility company. A flocculant is added to the wastewater as it enters the unit to have suspended solids settle as floc. Water is then conducted through a channel to the aeration basin equipped with aeration facilities. The aeration basin consists of five ponds with surface areas ranging from 6,000 m^2 to 13,000 m^2. The water flows into these ponds in series taking a total of 13 days. During this course of time the BOD content is reduced from about 100 ppm to 20 ppm or less. Items other than BOD are also reduced to meet the standards.

The total surface area of the aeration ponds amounts to 30,000 m^2 or 25% of the plant area. The aeration ponds, though with a drawback of requiring a vast area, have advantages of being operable at stable conditions throughout the year because of the high temperatures of Thailand and low maintenance cost. The aeration ponds may be considered to be suited to Thailand.

The quality of treated water should be analyzed once in three months by a laboratory authorized by the MOI and the analytical results should be reported to the authority. In the case of this plant, the treated water is analyzed by the chemical laboratory of Chulalongkorn University. The plant also analyzes of its own treated water once a week and posts the results on the wall of the laboratory to help the operators maintain the effluent water quality within the range of standard. The analytical result by the authorized laboratory is in accord with that by the plant. The Thai managerial staffs, who also coordinate with the authorities in charge of environmental conservation, manage the operation and maintenance of the treating unit.

The Thai plant of a Japanese water treating company manufactures the flocculant used by the unit and its price has remained stable irrespective of the depreciation of Baht. The operation cost of wastewater treatment amounts to about 1.4 bahts/m^3, including the price of flocculant, electricity cost and manpower cost but excluding the maintenance cost. With the large amount of wastewater, the treating cost is a heavy financial burden on the plant.

Figure 2-2-4 Flow of Wastewater Treatment of Company B



b. Solid Waste Treatment

The sludge from the wastewater treatment (14,500 kg/month) has the largest volume of all waste categories. The sludge is landfilled in the plant premises. Plastic wastes from packing

materials, used fluorescent light tubes, waste oils and incinerator ash are now consigned to a waste treating agent. The plant has been instructed by the authority to consign disposal of the sludge and these wastes to GENCO, an authorized waste treating agent, from the next year. A small amount of metal scraps are sold to dealers. Waste paper, waste cloths and other general wastes are incinerated in the premises.

c. Exhaust Gas Treatment

Figure 2-2-5 shows the emission standards of the exhaust gas set by the government of Thailand. The exhaust gases from the boilers and incinerators are subject to these standards. The actual contents of the pollutants are much lower than the specified values and therefore the plant does not cause any air pollution problem. The plant is not obliged to report the data to the authority either. Nevertheless, the plant has a laboratory of its own that analyzes the gases several times a year to confirm that the data are below the standards.

Figure 2-2-5 Emission Standards Set for Company B

Item	Particles (heavy fuel oil)	Particles (other fuels)	SO_2	NO_2	CO
Standard	300mg/Nm^3	400 mg/Nm^3	1300 mg/Nm^3	470 mg/Nm^3	870 ppm

d. Establishment of Environmental Management System

The plant is audited and is shown the environmental management policy by the directors of the Japanese parent company once a year. The representatives of six group companies in Thailand periodically meet to exchange information on environmental matters. Company B will be required to obtain ISO14001 certification since one of the group companies in Japan obtained it in 1998.

The Environmental Conservation Committee is held in every three months participated by all executive members and representatives of the employees. The subjects discussed in the committee include quality of treated water and its trend, importance of the issue of environmental conservation, laws and regulations about environmental conservation. The minutes of the meetings are brought to all workplaces to disseminate information to all employees to enhance interest in and to provide motives for environmental conservation, reduction of wastes for example.

This plant is sometimes requested to hold seminars or to hold exhibitions as a model plant for environmental conservation. In such occasions, materials and posters are exhibited also in the plant so that every employee may be able to see them. Newly recruits have a lecture of importance of environmental conservation at the introductory course. Follow-up training is also done to impress them with the importance of environmental conservation.

As a result of these efforts the performance of this plant in environmental management is now highly evaluated. The plant was awarded three times as the best factory in environmental conservation in Nakhon Pathom in 1994, 1995 and 1998. In 1998 also, this plant was awarded by the Ministry of Labor and Social Welfare as the best plant in safety management in the nation for having achieved a record operation without accident.

Case 3 Example of Accommodating Separate Standards by Three Authorities

1) Outline of the Company

Company C
Business line: Manufacture of polyester fibers
Number of employees: 1,000
Start of operation: 1970
Location of the plant: Pathum Thani, about 15 km to the north of Bangkok
Japanese equity ratio: 45%

2) Background

The area surrounding the plant used to be an agricultural land when the plant was built 30 years ago. Since then, a number of plants, factories and houses have been built in the surroundings as the suburbs of Bangkok. As the environmental conditions deteriorated, the government has applied the stricter environmental controls. On the effluent water in particular, three different authorities, namely, the MOI, the Royal Irrigation Department of the Ministry of Agriculture and Cooperatives and the Ministry of Science, Technology and Environment (MOSTE) have set their respective standards separately for each item. This plant is therefore obliged to satisfy the strictest of all standards for each item.

The process of manufacturing polyester generates a large amount of wastewater. The treated wastewater flows through a channel to the paddy fields nearby as irrigation water. Therefore, discharging of polluted water is prohibited. The water treatment unit should be properly operated and the quality of the treated water should be properly controlled.

The Japanese parent company, on its part, laid down the following Global Environmental Conservation Charter in 1992. The parent company has also voluntarily launched a responsible care movement which closely watches the entire operation ranging from R&D, manufacturing, and sales to treatment and disposal of wastes. The parent company calls upon its overseas affiliates to act to realize the principle of the parent company. Company C positively responds to this policy and does its best in its environmental measures.

Global Environmental Conservation Charter of the Japanese Parent Company of Company C

Company C declares the following principles to realize one of its corporate ideologies, "to co-exist with the global environment and to care for nature and life."

(1)Company C always gives priority to environmental conservation and maintenance of safety in its business activity and provides the society with the products and services harmonious with the global environment.
(2)Company C promotes reduction of environmental load through effective utilization of resources and energy and through recycling of its products.
(3)Company C cooperates with the regional communities and international communities in its contribution to global environmental conservation and maintenance of sustainable development of the society through provision of knowledge and technology.

3) Measures Taken by the Company

a. Wastewater Treatment

The plant manufactures polyester raw fibers and threads from the chemicals imported from Japan and neighboring countries. The manufacturing process uses a large quantity of water. The plant takes 250 tons per hour of well water and discharges 200 tons per hour of wastewater.

The generated wastewater contains organic compounds to such an extent that its BOD and COD values are about 200 mg/liter and about 400 mg/liter, respectively. Figure 2-2-6 shows the effluent standards indicated by the MOI, the Irrigation Department and the MOSTE. The local offices of these authorities have requested the company to clear these standards. The plant has set the standards of its own taking the strictest value of each item.

The standard for CODcr, 60 mg/liter, is as strict as half the lower limit of the standard range (from 120 to 400 mg/liter) set by the government of Thailand. The standard for BOD, 20 mg/liter, is very strict compared with 160 mg/liter, the standard of the Water Pollution Control Law of Japan. The standards of the Irrigation Department include specification of electric conductivity, because the effluent water from the plant is used as agricultural water. Too high an electric conductivity indicates too high salt concentration, and shows possibility of salt damage to the agricultural crops.

Figure 2-2-6 Effluent Standards Set for Company C

		Effluent Standards			
Items	Unit	MOI	Irrigation Department	MOSTE	Standards set by the plant
pH	-	5.5 –9.0	6.5 – 8.5	5.5 – 9.0	6 – 8
Temperature	ºC	<40	-	<40	<40
COD_{Cr}	mg/liter	60	-	120	60
BOD	mg/liter	20	20	20	20
SS	mg/liter	150	30	50	30
Oil	mg/liter	5	5	15	5
Free Cl	mg/liter	1.0	-	1.0	1.0
T-N	mg/liter	-	-	100	100
Electric conductivity	µs/cm	-	2000	-	2000
Ethylene glycol	%	-	-	-	0.025

The plant has installed a wastewater treatment unit consisting of the facilities shown in Figure 2-2-7 to clear all these strict standards. The wastewater as received is stored in the reservoir to be homogenized. The water is then passed to the spray-bed pollutant decomposition tower (Trickling tower) where pollutants are bio-decomposed as the water flows down through filling with cultured microorganisms while contacting air. Then suspended particles in the water are settled in the sedimentation tank from which supernatant clear water is sent as treated water to the pond. The role of the pond is to prevent insufficiently treated water, if ever generated, from being discharged to the channel leading to the paddy fields.

The wastewater before treatment contains BOD at about 200 mg/liter. The BOD, then, is reduced to below the standard, 20 mg/liter, while passing through this unit. The values for all other items are also reduced to less than the standard values; therefore, wastewater exceeding any item of the standards will never be discharged under a proper operation management.
The sludge separated from the bulk of water in the sedimentation tank is condensed in the thickening tank and dried under direct sunlight in a storage house roofed with a transparent plastic sheet. The swift drying in this storage house prevents disagreeable odor from being generated from the sludge.

The MOI, the Irrigation Department and MOSTE check the analytical results of the wastewater. The analyses for official reporting to these authorities are consigned to a laboratory authorized

by the MOSTE. The plant analyzes the wastewater once a week at its laboratory for operation management of the wastewater treatment unit. The officials of Irrigation Department sometimes come to take samples for their own analysis. Figure 2-2-8 shows the frequencies of analyses. The pH value of the treated water, a firsthand indicator of the water quality, is measured every hour. The amperage is also checked every hour to check the operation conditions of electrical machinery such as pumps and agitators. Any abnormality is taken care of immediately after it is found. The plant laboratory analyzes the untreated wastewater entering and the treated water leaving the wastewater treatment unit at a frequency of once a week for all items to maintain the unit in normal operating conditions.

The plant now uses well water with the license, which will irrevocably expire in two years. However, the plant has been instructed by the Provincial Water Works Authority to use industrial water supplied by the authority. Use of industrial water increases the cost of water several times; however, that plant has no alternative but to switch to use the industrial water.

Figure 2-2-7 Flow of the Wastewater Treatment of Company C

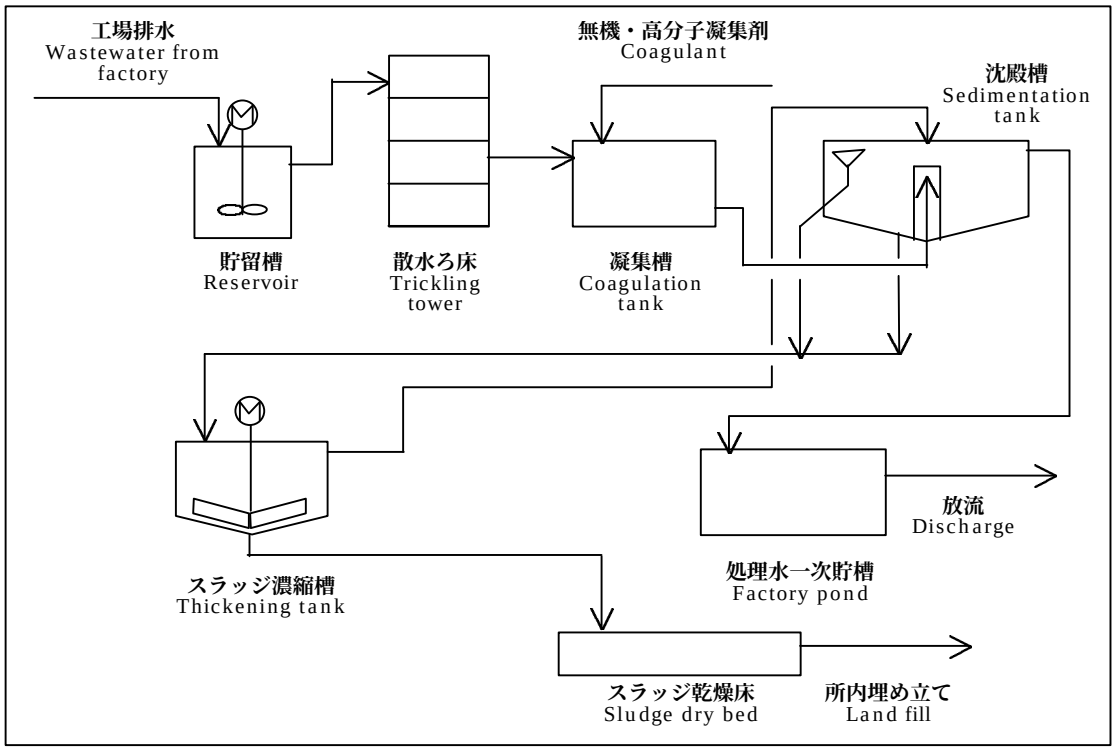


Figure 2-2-8 Frequency of Water Quality Check and Analysis

Authority or measurement provision	Subject of measurement	Frequency
Local pH meter	Wastewater at inlet	Every hour
	Recirculating water	Every hour
	Treated water	Every hour
Local ammeter	Electric power for operation of the wastewater treatment unit	Every hour
Plant laboratory	Wastewater at inlet	Once a week
	Treated water	Once a week
MOSTE	Treated water	Once a month
Irrigation Department	Treated water	Twice a month
MOI	Treated water	Once a month

b. Solid Waste Treatment

The sludge produced from the wastewater treatment unit at a rate of 2,400 tons per month constitutes the bulk of the wastes. The sludge is dried and used in the plant premises as fertilizer, or disposed of by landfilling. The next largest is the faulty fibers amounting to 220 tons per month. These faulty fibers are recycled back to the manufacturing process for reuse. The fused solid polymers before being processed into fibers are incinerated by the incinerator, with a capacity of 400 kg/hour, installed in the plant premises. Such wastes as waste paper, waste cardboard, spent oil, spent ethylene glycol are also incinerated. The kitchen garbage produced at a rate of 20 tons per month is consigned to a local treating agent for landfilling. Metal scraps are sold to dealers. The incineration ash, waste chemicals, those wastes, which may be classified as hazardous substances and the burnable wastes generated in excess of the incinerator capacity are consigned to GENCO.

c. Establishment of Environmental Management System

It is obligatory in Thailand for the designated plants to have environmental management officers. The plant of Company C is the designated one, and has two environmental management officers. These people have studied such professional areas in the universities. Environmental management officers in Thailand may be considered to correspond to the "manager in charge of pollution control" of Japan. The documents submitted to the authorities require their approval with signatures.

The safety committee, consisting of equal numbers of executive members and employees, is held once a month. This committee deals also with issues concerning environmental conservation. The Japanese parent company has already pronounced the Environment, Safety and Healthy (ESH) Policy and overseas affiliates follow suit in their activities to conserve environment, safety and health. Once a year a director of the Japanese parent company presides over the ESH committee and oversees the domestic and overseas plants conducting audit and performance evaluation and setting the next year target. The plant is scheduled to obtain the ISO9002 certification March 1999. The plant is also to obtain the ISO14001 certification following acquisition of the ISO9002 certification.

d. Others

A flood washed away a number of houses in this area two years ago. The plant, which was saved from the damage of flood, accommodated as many as 1,000 people who lost their houses in the plant laboratory and other buildings for about two months, and provided them with food. This was highly appreciated as an act of contribution to the community, and the King and the MOI awarded the plant.

Case 4 Example of Employing Advanced Treatment Including Activated Carbon Treatment

1) Outline of the Company

Company D
Business line: Manufacturing automobiles
Number of employees: 5,500 (as of end of 1997)
Start of operation: 1975 (Old plant), 1997 (New plant)
Location of the plant: Samut Prakan 30 km to the east of Bangkok (old plant) and Chachoengsao (new plant)
Japanese equity ratio: 70%

2) Background

The Japanese parent company has pronounced its global environmental conservation charter as given below. Its overseas affiliates should act basically according to this charter. In other words, the affiliates are required to strictly observe the environmental standards and to positively work for environmental conservation of each country.

The area where the old plant was located is an industrial and commercial area close to Bangkok. A number of large plants and factories have been operated since many years ago in this area. The pollution of river running near the plant has been so worsened that the government applied stringent effluent standards to prevent further pollution. The plant was obliged to install an advanced wastewater treatment unit to clear the standards. The new plant was established in Chachoengsao.

Global Environmental Conservation Charter of the Japanese Parent Company of Company D

Basic policy

1. Positive approach

Recognize that the manufacture of automobiles is deeply related to the earth's environment. Combine the strength of all groups within the Company and cooperate with suppliers and distributors worldwide to develop technologies that are gentle on the earth and serve to promote environmental measures.

2. Thorough implementation of proactive preventive measures

Evaluate the potential environmental impact at every stage in a motor vehicle's life-cycle from product development through design, manufacture, and marketing, to disposal, and take active measures to minimize that impact.

3. Social contribution

In order to realize a better environment, actively participate in diverse endeavors, in addition to those related to automotive considerations, to support environmental protection and cooperative activities within societies and regions as a good corporate citizen.

3) Measures Taken by the Company

a. Wastewater Treatment

The degreasing, chemical treatment and painting processes of steel sheets produce large quantities of wastewater. Figure 2-2-9 shows the effluent standards indicated to this plant by

the MOI. The standards are severer than those of Japan in a number of items. The value of BOD, 20 mg/liter, the value of SS, 50 mg/liter, and those of heavy metals are particularly strict. The plant installed a wastewater treatment unit consisting of the facilities shown in Figure 2-2-10 to clear all these standards. The wastewater treatment unit, with a capacity of 1,200 m^3 per day, collects all wastewater streams and subjects it to neutralization and coagulation sedimentation to remove heavy metals. These processes consist of two parallel trains to ensure steady operation even in the case of one train being in trouble. Thereafter, the wastewater is given biological treatment in the aeration tank to decompose organic substances contributing to BOD. After sludge is removed by sedimentation, the wastewater is sand filtered and subjected to activated carbon adsorption to remove BOD that has not been removed by biological treatment. The activated carbon treatment is necessary to reduce BOD to below the standard although the treatment requires very high running cost.

The plant laboratory analyzes the treated water every week for pH, TDS, SS, COD and BOD. Analysis of heavy metals is consigned to a water treating company of Japanese capital.
The sludge generated by sedimentation with flocculation is concentrated and dehydrated. The dehydrated sludge contains heavy metals and is classified as a hazardous waste. The sludge is consigned to GENCO, an authorized treating agent for disposal.

Figure 2-2-9 Effluent Standards Set for Company D

(mg/liter)

Item	COD	BOD	SS	TDS	Tempe-rature	pH	HCN	H_2S	Oil	Tar
Standard	120	20	50	3000	40℃	5.5-9.0	0.2	1.0	5	ND

Item	Free-Cl	Zn	Cr^{6+}	Cr^{3+}	Hg	Cd	Mn	Pb	Cu	Ni
Standard	1.0	5.0	0.25	0.75	0.005	0.03	5.0	0.2	2.0	1.0

Item	As	Ba	Se	T-N	Formaldehyde	Phenols	Pesticides	Color/odor
Standard	0.25	1.0	0.02	100	1.0	1.0	ND	Not object

b. Establishment of Environmental Management System

The company established the environmental management system in 1994. The vice-president in charge of production management was assigned as a head of the committee. The committee has been dealing with such issues as prevention of water pollution, prevention of air pollution, reduction of wastes, measures for global warming. The committee has several working groups in charge of wastewater treatment, energy, wastes, volatile organic compounds (VOC), and others. Environment Group was established in the Construction and Maintenance Department to coordinate these working groups. With the internal organization for environmental conservation well established as such, the company was able to obtain certification of ISO14001 rather smoothly. The new plant, which started in April 1997, and the old plant successively obtained certification respectively in December 1997 and July 1998 from a British authorized assurance organization.

c. Others

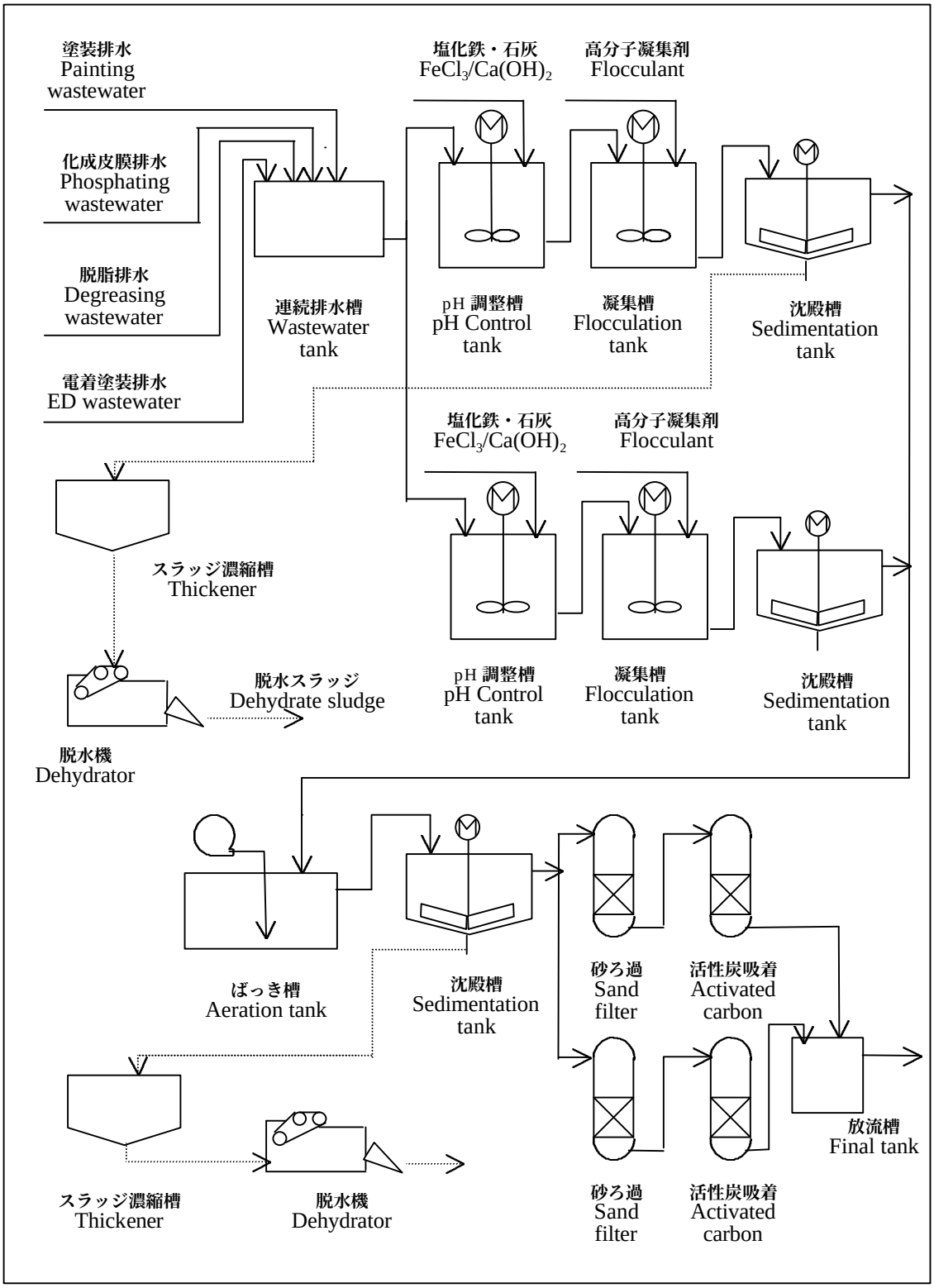
The plant is striving to reduce the emission of VOC that is now at 110 g/m^2 to the Japanese parent company's level of 80 g/m^2. The measures being tested are adoption of a minibell

automatic paining machine, recovery and regeneration of thinner, reduction of flushing time of the spray guns.

The wastes are packaging materials, sludge from the wastewater treatment unit, debris of paints. The sludge and paint debris are consigned to GENCO. The plant is now studying the ways for reducing packaging wastes such as, reducing import of components with bulky package from Japan and increasing local procurement.

New models of product line-up are subject to official inspection. The officials must approve the noxious gas levels of the exhaust gas. The plant offers a gas analyzer in the separate building to the officials in charge for their sample analysis.

Figure 2-2-10 Flow of the Wastewater Treatment of Company D



Case 5 Example of Coping with a Strict Standard for Cyanide

1) Outline of the Company

Company E
Business line: Manufacture of general electric products
Number of employees: 920
Start of operation: 1995
Location of the plant: An industrial estate in Ayuthaya 69 km to the north of Bangkok
Japanese equity ratio: 100%

2) Background

Company E produces a wide variety of products in the same plant premises ranging from desk lamps, wiring equipment, copper-plated laminates, connectors, epoxy sealing by financially independent divisions. Company E is a well-known consumer goods manufacturer and is therefore intent on environmental conservation not to damage corporate image among consumers. Company E has made public its environmental conservation policy. The company assures utmost attention to environmental conservation to protect the beautiful nature of the Ayuthaya ancient city where the company is situated, and its efforts to improve the environmental conditions with full participation of the company, including every employee, in recognition of the corporate social responsibility.

The manufacturing process includes copper and silver electric plating in a bath containing cyanides. The plant pays particular attention to the wastewater from this process. The industrial estate has a central wastewater treatment unit which gives ultimate treatment to the pooled wastewater generated in the industrial estate and discharges the treated water to the public waters. The plants in the industrial estate treat their wastewater to the specified standards before sending it to the central wastewater treatment unit of the industrial estate. The central wastewater treatment unit does not have a facility to treat cyanides; therefore, the plant has to treat cyanides before sending the wastewater to the central wastewater treatment unit. The standard indicated by the office of the industrial estate for the cyanides was much stricter than the Japanese standard. Facilities for advanced treatment and minute operation are required to satisfy this standard.

3) Measures Taken by the Company

a. Wastewater Treatment

Wastewater effluent streams containing heavy metals, cyanides, acids and alkalis are generated from different processes. Figure 2-2-11 shows the effluent standards indicated by the office of the industrial estate. The standard for cyanide (HCN), or 0.2 mg/liter, is one-tenth the Japanese standard of 2.0 mg/liter and is very strict. The standards for heavy metals, chromium (Cr), copper (Cu) and nickel (Ni) for example, are also stricter than the Japanese standards. On the other hand, the standards for COD and BOD are more lenient than the Japanese standards since the standards are defined by assuming the biological treatment for waste is done in the central wastewater treatment unit.

Figure 2-2-11 Effluent Standards Set for Company E

(mg/liter)

Item	COD	BOD	SS	TDS	Tempera-ture	pH	HCN	H_2S	Oil	Tar
Standard	1250	1000	200	2000	45℃	6.0-9.0	0.2	5.0	10.0	10.0
Item	Free-Cl	Zn	Cr	Hg	Cd	Mn	Pb	Cu	Ni	As
Standard	5.0	5.0	0.5	0.005	0.03	5.0	0.2	1.0	0.2	0.25
Item	Ba	Se	F	Free NH_3	Ammonia	Phe-nols	Pesticides	Color/ odor	Formal-dehyde	Deter-gent
Standard	1.0	0.02	5.0	50	50	1.0	ND	ND	1.0	100

The plant has installed a wastewater treatment unit consisting of the facilities shown in Figure 2-2-12. The wastewater with heavy metals is acidic and is neutralized by adding caustic soda as to precipitate heavy metals as hydroxides. The supernatant clear water is sent to the equalization tank. Sodium hypochlorite is added to the CN wastewater while its pH value is adjusted to oxidize and decompose cyanide. Then, the wastewater is sent to the equalization tank. Both acid and alkali wastewater are directly poured into the equalization tank to be mixed with other wastewater streams. The pooled wastewater homogenized in the equalization tank is sent to the reaction tank where ferric chloride and a coagulant are added while its pH value is adjusted to coagulate and settle suspended substances for separation. The supernatant water is filtered with sand, and pH adjusted and discharged as treated water.

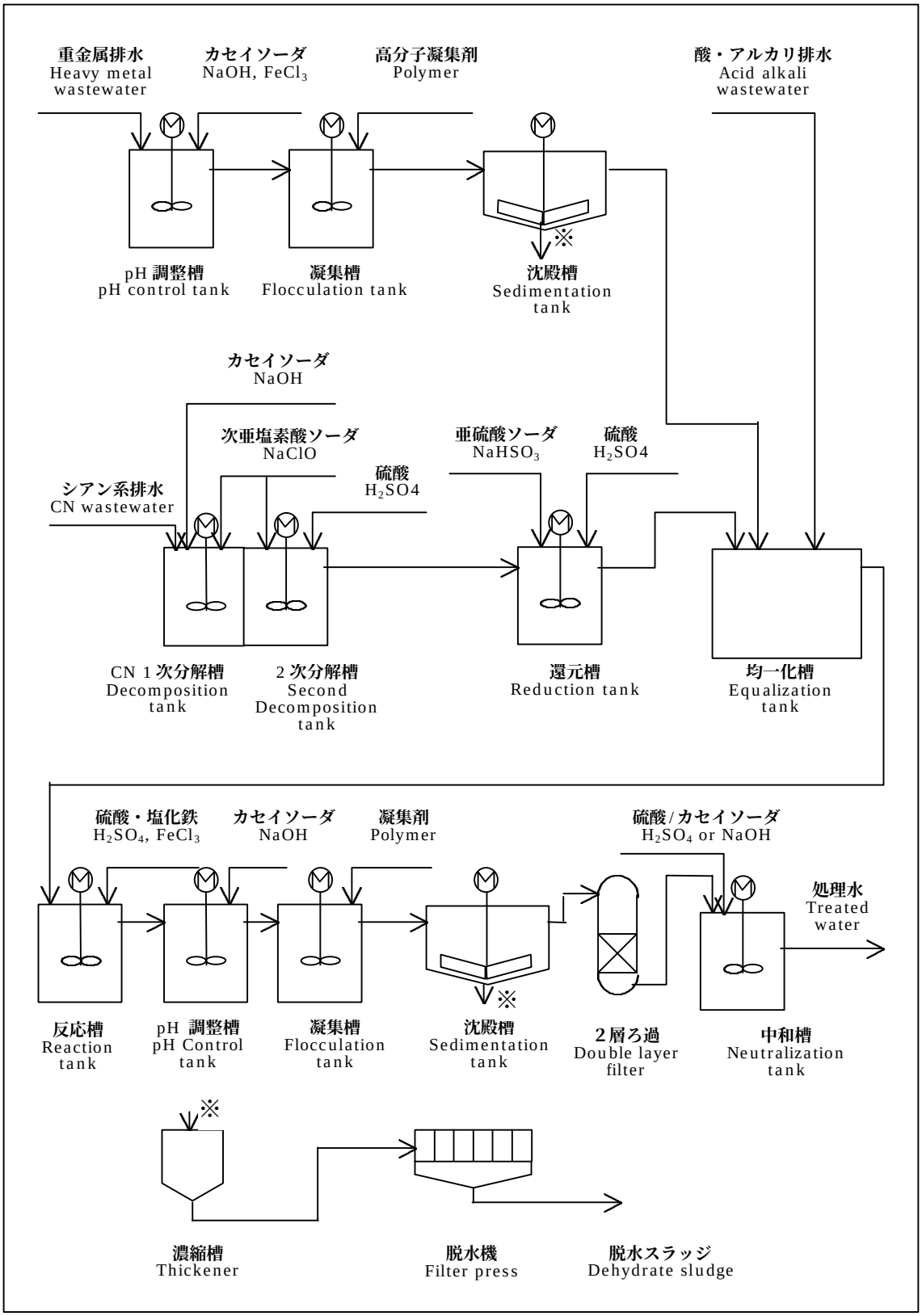
The reactions for oxidation decomposition of cyanide requires minute controls. The decomposition can easily be incomplete if not controlled well enough, and can generate poisonous hydrogen cyanide if the water is made too acidic. The treatment is carried out in two stages of the first decomposition tank and second decomposition tank, the content of the former being maintained alkaline and that of the latter neutral by pH control. The chemicals are added very carefully while watching the reduction-oxidation potentials. After oxidation decomposition is complete, the residual oxidizing agent is decomposed by a reducing agent. Thai staffs control this operation while the Japanese staff is closely instructing them.

The sand filter has double layers of different sizes of sand to remove traces of suspended heavy metals to meet the strict standards.

The wastewater after treatment by the plant is sent to the central wastewater treatment unit of the industrial estate for final treatment. The treatment cost is charged to the plant according to the following equation. Accordingly, it is necessary to reduce both the amount of wastewater and BOD value to reduce the payment of the treating cost.

Treating cost (bahts/month)
= 2.55 x Volume of water (m^3/month) + 6.1 x BOD load (kg/month)

Figure 2-2-12 Flow of the Wastewater Treatment of Company E



b. Treatment of Waste Solvents

The process to produce laminates generates wastewater and waste gas both containing solvents. The reaction between phenol and formalin to form the varnish for laminates produces condensation water that contains unreacted phenol and formalin. This water has a high value of COD and also hazardous and is therefore incinerated by being atomized in the flame of diesel fuel.

In the process of drying laminated resin papers, papers impregnated with varnish, generates waste gas containing formaldehyde. This gas is incinerated as in Japan though there is no effluent gas control in Thailand for formaldehyde. The waste heat of the effluent incinerator gas is effectively utilized for drying laminates.

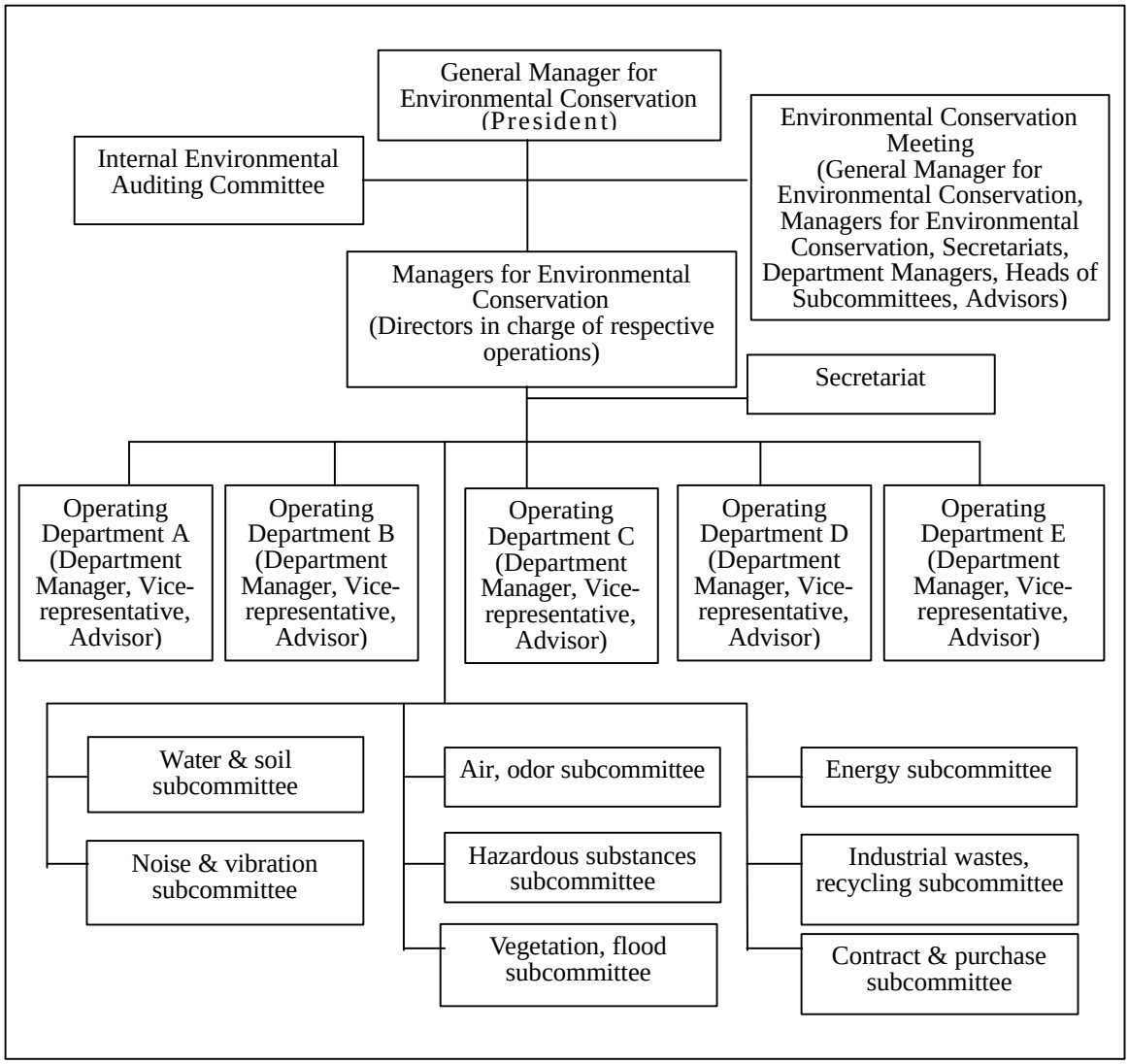
c. Solid Waste Treatment

The fines of laminates produced in the laminates processing, faulty resin paper and spent varnish are consigned to GENCO, a waste disposal agent authorized by the government of Thailand. The fines of laminates are packed in bags. The problem with the fines is dispersion to the surroundings, which must be prevented. The wastes consigned to GENCO, Ltd. amounts to about 20 tons per month. The expense paid to GENCO is rather high. Spent copper foils and faulty laminates containing copper are sold to dealers. The fine cuts of laminates are saleable in Japan; in Thailand however, these have to be handed over to disposal agents because of the lack of technology to reuse them.

d. Establishment of Environmental Management System

The plant is scheduled to obtain certification of ISO14001 in 1999 at the instruction of the Japanese parent company. The organization for promotion of ISO14001 as shown in Figure 2-2-13 has been established. Since the plant has a variety of operations, the department manager, the vice-representative and advisor are held responsible for leading each operating department. Besides, subcommittees are set up to deal with subjects common to all operating departments. The person in charge of the concerned subject of each department participates in the subcommittee. This plant's subcommittees are unique in that they cover a wide range of subjects, including measures for floods. The department deals with the problems particular to a given department and the relevant subcommittees deal with common problems. A local consulting company has been retained to identify problems concerning environmental conservation.

Figure 2-2-13 Organization for Promotion of ISO14001



Section 3
Cases of Establishing an Environmental Management System

The International Organization for Standardization (ISO) issued in September 1996 ISO14001, the international specifications for environmental management for companies and corporations. Acquisition of the ISO14001 certification not only serves as an evidence of being a company of good environmental consideration but also places the company in an advantageous position in international trades. More than 20 Japanese companies in Thailand have obtained the ISO14001 certification. The survey team visited some of these companies and obtained information on their activities through interviews. These companies are trying to manage their own ways in the formulation of environmental management organizations, enlightenment of the employees, identification of environmental problems, selection of certifying organizations. Certain companies, in addition to their own plants, require their suppliers to give environmental consideration to their manufacturing processes. The environmental management activities, enhanced throughout the companies from acquisition of ISO14001 certification, should contribute also to reduction of raw material costs through recycling and saving of electric power consumption through energy savings, in addition to environmental conservation itself, if the activities are maintained high as ever.

Case 6 Example of Obtaining the ISO14001 Certification

1) Outline of the Company

Company F
Business line: Manufacture of peripheral components of computers
Number of employees: 3,500
Start of operation: 1985
Location of the plant: An industrial estate in Pathum Thani 46 km to the north of Bangkok
Japanese equity ratio: 100%

2) Background

The plant manufactures computer interface cables, wire harnesses, flexible cables, wire assemblies for hard discs and other peripheral components. The plant exports 70 % of the products to Europe and the United States and 30 % to Japan. If a company exports 85 % or more of its production, the Board of Investment grants tax exemption for a certain fixed time period. This is one of the reasons for expanding to Thailand.

Some clients in the developed countries require acquisition of ISO14001 certification as a condition for becoming their trade partners, reflecting the enhanced recognition for global environmental conservation. Company F has regarded environmental consideration as one of the most important objectives since inauguration of the company. To comply with the requirements of such clients, furthermore, the company established an ISO14001 committee in 1996 for the purpose of obtaining the ISO14001 certification.

3) Measures Taken by the Company

a. Acquisition of the ISO14001 Certification

The plant discharges very small amounts of substances in the effluent water and effluent gas that may have impacts on the environment. The first objective was to identify the targets that may be cited as the themes of the effort to obtain the ISO14001 certification. The company selected two themes; namely, reduction of waste generation and reduction of electric power consumption. All persons in managerial positions were educated on the environmental management system. Various manuals for environmental management have been prepared. All employees have been trained for thorough execution of these manuals. The company was audited by a British certifying organization in April 1998 and the company was certified in May 1998. The company's activities are chronologically shown below.

October 1996	The president announced the environmental policy. An environment committee was established for acquisition of the ISO14001 certification. The Plant Engineering Department was entrusted with the function of environmental management. A special officer in charge of environmental conservation was appointed to assist the Manager of the Plant Engineering Department.
January 1997	The leaders of the committee received training in a course for environmental auditors. Then they educated and trained all the Thai and Japanese persons in management and supervisory positions.
April 1997	The manuals for environmental conservation are prepared. These manuals

	were combined with the manuals for quality guarantee and operation standard for the ISO9001 certification obtained in 1994.
July 1997	A preliminary environmental report was prepared summarizing all the issues concerning environmental conservation. Information on Thai laws and regulations on environment was collected.
October 1997	Important themes for environmental improvement were selected. The schedule for achieving improvement was planned and executed accordingly. The company held exhibitions to inform all the employee of the above. The concerned officers of the government and the autonomous body and persons of the concerned companies in charge were also invited to those exhibitions.
January 1998	All persons in managerial positions and representatives of all workplaces receive training for internal auditing, then they conducted internal auditing of environmental management.
March 1998	A preliminary auditing was done by a British authorized assurance organization and execution of the official audit was confirmed.
April 1998	The official audit was conducted by the certifying organization.
May 1998	The company was awarded the ISO14001 certification by the British certifying organization.

Through the above process, the internal structure for environmental management has been organized. Now, environment committee meeting is held once a month called by the president. The committee consists of managers of all departments, the environment supervisors and the manager of the Plant Engineering Department. Any activity concerned with environmental conservation is carried out through the company organization with the environment committee playing the central role.

b. Solid Waste Treatment

The processes to manufacture cables and cable assemblies produce wastes consisting of copper wire tips, debris of metals used for terminals and tin dross. About 95% of the waste is sold to a recycling agent and the rest is consigned to an authorized waste treating agent for disposal. The recycling agent has a process to separate copper and plastics from the wastes and reuses them. It was feared in view of the local conditions that the recycling agent might not effectively recycle the waste or might cause pollution in the process of recycling. The environment committee took up improvement of wastes recycling as an important subject in its effort to obtain the ISO14001 certification.

The measures taken to this subject included a study on the regenerative process, analysis of the recycling agent's operation and conversion of the process into a more efficient one.

Not recyclable wastes, such as waste paint and spent activated carbon, can not be sold to the recycling agent and therefore consigned to General Environmental Conservation Public Company Limited (GENCO), a waste treating agent authorized by the government. GENCO disposes of the waste by landfilling.

GENCO cannot handle such wastes as waste paper, sawdust and wood chips, kitchen garbage. Such wastes, constituting a small portion of the total waste, are stored in the premises of the

plant and consigned to a disposal company of the industrial estate for treatment or disposal.

c. Energy Conservation

The plant receives electricity via two oil-cooled transformers, each having a capacity of 3,500 kVA. The plant consumed a monthly average of 1.7 million kWh in 1997. Compared with the monthly average 1.54 million kWh for 1994, the consumption has gradually increased. The tariff was 1.97 Bahts/kWh on the average from April to September 1997. The breakdown of the consumption was as follows.

(1) Operation of the production machines	37%
(2) Air conditioning	23%
(3) Lighting	12%
(4) Air compressors	7%
(5) Others	21%

The plant has had an established energy management system for economizing energy consumption in which small group activities and energy conservation committee have played important roles. These efforts have implemented seven concrete and effective measures which include a change of operation hours of high-electric-load machines, modification of operating hours and set temperatures of air-conditioning, replacement of fluorescent lights to power-saving types.

The power supply and distribution facilities are periodically inspected and maintained by the Plant Engineering Department and electric work companies. The consumption of electric power is recorded. The plant continually endeavors to improve efficiency of electric power consumption by means of the above-mentioned energy management system.

The proposed measures for further conservation of energy include insulation of molds for plastic molding, reduction of idle operation time of machines, prevention of leaks of pneumatic air, turning off of unnecessary lights, recycling after purification of that portion of the exhaust gas from the soldering operation which contributes to improve air-conditioning efficiency, spreading of light-shielding films on window panes. The plant aims to achieve 4 % reduction of electric power consumption by the end of 1998 by implementing all these proposed measures.

The Energy Conservation Enhancement Act requires that from July 1999 plants consuming a large amount of electric power as this one have a person in charge of energy, keep records of energy consumption for five years, formulate plans for energy saving, report all these to the government. The plant will steadily implement all these.

d. Wastewater Treatment

The industrial water is supplied by the Province of Pathum Thani. This plant consumes about 9,000 m3/month. The industrial water is used for cooling of machines and process facilities, cooking, cleaning and sanitary purpose. The wastewater stream from the kitchen and the sanitary wastewater stream, amounting totally to 240 m3/day, are pooled in a wastewater pit of 100 m3. The plant does not produce wastewater of high pollutant concentration.

Nevertheless, the wastewater flow is arranged to facilitate inspection to guard against unlikely emergencies. The wastewater pit is equipped with a gate to block the pit to prevent the content from escaping the pit in case of emergency. The wastewater in the pit is sent to the central wastewater treatment unit of the industrial estate. Figure 2-3-1 shows the effluent standards indicated by the office of the industrial estate. The plant conducts oxidation by agitated aeration in the wastewater pit to satisfy the BOD standard. The plant satisfies all the items of the standards.

Figure 2-3-1 Effluent Standards Set for Company F by the Office of Industrial Estate

Item	COD	BOD	SS	Settleable matter	Temperature	pH	HCN	Sulfur	Oil	SO42-	SO_3^{2-}
mg/liter	600	450	500	1000	45℃	6-9	5	5	100	500	10

Item	Glucose	Free Cl	Tar oil	Detergent	Hg	Cd	Cr	Pb	Ag	Zn	Cu
mg/liter	500	100	50	100	0.01	1.0	1.0	1.0	1.0	5.0	1.0

Item	Ni	As	Ti	Fe	Ba	Se	Al	Heavy metals[1)]	Metals[2)]	Phenols
mg/liter	1.0	1.0	1.0	5.0	1.0	1.0	5.0	16	30	10

1) Sum of two times of zinc (Zn), cadmium (Cd), copper (Cu) and eight times of nickel (Ni)
2) Excluding iron and alkaline earth metals

e. Others

There are ten group companies operating in Thailand. Other group companies also strive to obtain the ISO14001 certification.

Case 7 Example of Obtaining the ISO14001 Certification and Promotes Environmental Management Including Its Business Partners

1) Outline of the Company

Company G (Company L of Case 12)
Business line: Manufacture of motor cycles and general-purpose engines
Number of employees: 2,500
Start of operation: 1992
Location of the plant: An industrial estate in the City of Bangkok
Japanese equity ratio: 83%

2) Background

The Japanese parent company maintains that its plants throughout the world, including the production centers in Japan, Europe and the Unites States, as well as its products should become more pollution free. The parent company has established the target for environmental conservation for the plant shown below called green factory plan on the basis of its own environmental standards, and promotes environmental conservation activities. The activities include acquisition of the ISO14001 certification and extension of activities to its business partners.

All the member of group companies should positively promote measures for environmental conservation, notably the following aspects.
1) Promotion of measures to make the products more pollution free
2) Promotion of measures to make the products safer
3) Promotion of measures to reduce to zero generation of wastes

3) Measures Taken by the Company

a. Acquisition of the ISO14001 Certification

A special project team consisting of eight persons was established in March 1998 specifically for acquisition of the ISO14001 certification. The members are all Thais, and three of them have majored in environment-related subjects in university. The team prepared the basic documents and studied the environmental aspects under the guidance of consultants and led the persons in charge of environmental conservation of the concerned departments and sections in preparation of their manuals. The Japanese professionals occasionally offered some advice. Reduction of wastes, achievement of effluent standards and reduction of effluent water flow were selected as targets of the environmental aspects. As a result of the concerted effort throughout the company, the company passed the audit in November 1998, eight months after the company started working for acquisition of the ISO14001 certification. The certifying organization is the Thai branch of a German certifying organization.

Since acquisition of the ISO14001 certification, Environmental Engineering Group consisting of three exclusively nominated persons has been established which has served as secretariat to promote environmental conservation. The company sometimes conducts internal audits to establish the ISO14001 movement. Three committees (Environment Committee, Energy Committee and Recycle Committee) have been formed which have done excellent jobs under the leadership of Thai leaders of department manager level. The company has provided every

employee with the cards containing basic principles for environmental consideration and manuals.

b. Solid Waste Treatment

Paint waste and kitchen garbage is the main waste generated in the plant. The plant generated 189 tons of waste in 1996 but reduced it by half, or to 43.3 tons for the first half of 1998, equivalent to 87 tons a year. The reduction of waste is attributable greatly to the reduction of paint waste achieved by modification of painting process.

The paint waste is incinerated. A portion of paint waste is sprayed with a killer agent to be made less sticky and dried. The dried paint waste is mixed with incineration ash and pressed into pebble-form solids. These solidified paint waste are used for pavement in the plant. This pavement is permeable to rain water and is expected to give a favorable effect on the environment. The plant is trying a various ways of recycling wastes.

The sludge from the wastewater treatment is consigned to GENCO. and other wastes to a local disposal company.

c. Wastewater Treatment

The process of surface treatment of steel sheets produces a large amount of wastewater. As much as 180 m^3 a day of wastewater is sent to the central wastewater treatment unit of the industrial estate after pH adjustment and heavy metal removal have been done. The central wastewater treatment unit of the industrial estate reduces BOD and COD to the government standards or less and discharges the wastewater to the river. The standards of BOD and COD indicated to the plant by the office of the industrial estate are relatively lenient, because the wastewater is further treated by the central wastewater treatment unit. The plant however has set plant's own standards more stringent than those indicated by the office of the industrial estate and operated the wastewater treatment unit to meet the plant's standards. Figure 2-3-2 compares the standards indicated by the office of the industrial estate and plant's own standards. It is one of the environmental policies of the plant to do everything the plant can do. Those are, irrespective of the standards indicated to the plant, to prepare for future tightening of the standards, to give sufficient environmental consideration for the sake of the people in the community, and to give global environmental consideration. The quality of treated water is analyzed by an authorized laboratory once a month to confirm the quality.

Figure 2-3-2 Comparison of Standards by the Office of the Industrial Estate and Company G's Standards (mg/liter)

Item	Standards by the Office of the Industrial Estate	Plant's standards
BOD	1000	200
COD	400	250
SS	500	100
Pb	1.0	0.2

d. Cooperation with the Business Partners

The company believes that the plant's products should be manufactured with due consideration given to environment at every process. In this standpoint, the company has asked its suppliers for cooperation in environmental conservation. The company has sent questionnaire to all the 106 suppliers to get hold of their environmental management. The company asked them to

implement environmental measures to the extent they can. The plant procures paints that have high pigment concentrations and low solvent content. The company asks the suppliers to treat their wastewater to the Company G's plant standards. The suppliers are classified into the following three classes: companies in which Company G has a stake or affiliates, companies of Japanese equity and companies of local capital. The company naturally asks its affiliates for more cooperation than others.

The extension of cooperation among business partners is being promoted by the initiatives of the Thai group companies, not at the instruction of the Japanese parent company. In Japan, Europe and the United States, environmental management including business partners has been accepted and established, but not sufficiently yet in Thailand. Therefore, Company G exercises its own judgment in the promotion of environmental conservation involving the suppliers. The price reduction and environmental conservation certainly add to the burden on the suppliers. Yet, Company G asks its suppliers at least to apply already established technologies to environmental conservation. Company G plans and promotes measures for environmental conservation together with the suppliers.

Case 8 Example of Obtaining the ISO14001 Certification with Other Group Companies

1) Outline of the Company

Company H
Business line: Manufacture of refrigerator parts
Number of employees: 440
Start of operation: 1988
Location of the plant: An industrial estate in Pathum Thani 50 km to the north of Bangkok
Japanese equity ratio: 100%

2) Background

The Japanese parent company has manifested the following global environmental conservation charter. The parent company requested that all the overseas affiliates should obtain the ISO14001 certification by the end of 1998.

The parent company has 12 affiliates in Thailand. Company H coordinated all group companies' efforts to obtain the ISO14001 certification, because it was considered more economical and efficient in collecting information and training employees if all the group companies worked together.

Company H has more clients of companies of Japanese capital as more Japanese companies advance to Thailand. Company H increasingly needs to exercise its own independent management policy suited to the local conditions. Similarly, initiatives by Thai staff and employees are increasingly needed to exercise measures of environmental conservation suited to the Thai local conditions.

Global Environmental Conservation Charter of Company H's Japanese Parent Company

We, human beings, live in harmony with everything in the Universe, and are entrusted with a noble mission to realize on earth a harmonious prosperity.
Our company fulfills its social responsibilities, while keeping in mind this noble mission given to us, as human beings, and, at the same time, gives full consideration and makes continuous effort to the conservation and improvement of the environment so that the earth may be maintained in a good-balanced conditions.

3) Measures Taken by the Company

a. Acquisition of the ISO14001 certification

At first the group companies separately began preparations for acquisition of the ISO14001 certification and contacted different certifying organizations. Soon the group companies realized that this was an inefficient way to obtain the certification and decided to join forces. The group companies choose one British certifying organization for the whole group. The group companies started preparation in June 1997 and all 12 group companies successfully obtained the certification July 1998. The group companies agreed that the internal audits would be done by each others in the group so that they might all receive objective audits.

Company H obtained the ISO14001 certification early among the companies of the industrial

estate. Company H therefore provides consulting services to other companies in the industrial estate. The companies of the Japanese capital tend to have consultation of Japanese companies. Company H advises that it is better to work with an organization established in Thailand because of the language barrier.

The company at first established a task force consisting of two persons exclusively in charge of environment to prepare for acquisition of the ISO14001 certification, and called a committee of seven managers with this task force as secretariat. The committee now meets once a month.

The manufacturing process of the plant does not discharge highly contaminated wastewater or exhaust gas. Therefore, the plant had difficulty identifying targets in environmental aspects in the stage of preparation of ISO14001 documents. Themes such as reduction of electric power consumption, reduction of wastewater and termination of the use of chlorinated organic compounds were selected after minute studies.

The targets set forth 5 % reduction of electric power consumption and of wastewater discharge in 1998 against the 1997 consumption. All the employees are given cards with these targets and environmental management policy. At the morning meetings, resource saving and energy saving are frequently quoted to enlighten the employees in these subjects. The employees are asked to be conscious of resource saving and energy saving even at home.

As a result of such endeavors, the employees' awareness of environmental conservation was enhanced and they became positive in submitting constructive suggestions. These suggestions include prevention of oil leaking from the machines, recycling of copper tubes and utilization of liquefied nitrogen chilliness for air conditioning. Minute attention to the lights and machines to turn off electricity when lights are not necessary and machines are running idle achieved the targeted reduction of electric power consumption. The target for wastewater reduction was also achieved by increasing the recycling of washing water. Use of chlorinated organic compounds for rinsing precision devices was terminated July 1998. These measures not merely contribute to environmental consideration but also reduce expenses, thereby increasing the profit of the company. The company accordingly promotes environmental conservation measure in the philosophy that good environmental conservation ultimately pays.

c. Others

The Thai society typically has a top-down structure. Thais normally work under the instruction of the superiors and seldom voluntarily propose their ideas. The company promotes various committee activities to break such traditional behaviors and encourage employees' voluntary activities. Kitchen and Canteen Committee, for example, made a suggestion that the burnt deposit of rice on the bottom of the rice cooking pot represented wasting of resource and energy. Responding to this suggestion, the plant installed a gas burner controller to achieve better temperature control.

The plant's wastewater is not highly contaminated; therefore, it is directly sent to the central wastewater treatment unit of the industrial estate. The exhaust gas is only emitted from the soldering process in the plant.

Case 9 Example of Jointly Obtaining the ISO14001 Certification with Division Companies of a Corporate Group

1) Outline of the Company

Company I (Company A of Case 1)
Business line: General electric machinery manufacturing
Number of employees: 2,900
Start of operation: 1996
Location of the plant: In an industrial estate for division companies of the same group in Samut Prakan, 30 km to the east of Bangkok
Japanese equity ratio: 49%

2) Background

The Japanese parent company of Company I has pronounced its environmental policy that the company gives continuous consideration to the environment and make a sincere effort to maintain and improve the environment. The parent company requires that its affiliates, both in Japan and abroad, obtain the ISO14001 certification by the end of March 1998.

Company I used to be a general electric machinery company manufacturing various electric products. Company I had a scope to strengthen its management structure and to expand business in preparation of the ASEAN Free Trade Area (AFTA) scheduled to become effective after 2000. Then, it planned to divide itself by each operating division, formed eight financially independent operating companies and one managing company in 1996 and has completed it August 1998. All these companies are situated in this industrial estate to form a group of companies except one and manage themselves in a financially independent manner.

The managing company coordinates and promotes subjects, like acquisition of the ISO14001 certification, that are common to all member companies of the group.

3) Measures Taken by the Company

a. Acquisition of the ISO14001 Certification

As shown in the following record, the group member companies obtained the certification a year after they started working for acquisition of the certification.

April 1997	Environmental Office was established to coordinate the member companies.
May 1997	Restructuring of the environmental management organizations
July 1997	Start of activities for acquisition of certification
August 1997	Selection of logotype and slogans, holding of ISO14001 exhibitions and seminars
September 1997	Distribution of brochures on environment issues to all the employees and issuance of environment news for educational purpose
October 1997	Start of audio programs on environment and ISO14001 at the employee's cafeteria / Start of preparation for education and necessary document preparation for acquisition of the ISO14001 certification / Education of all employees on ISO14001
November 1997	Exhibition on Energy Conservation was held

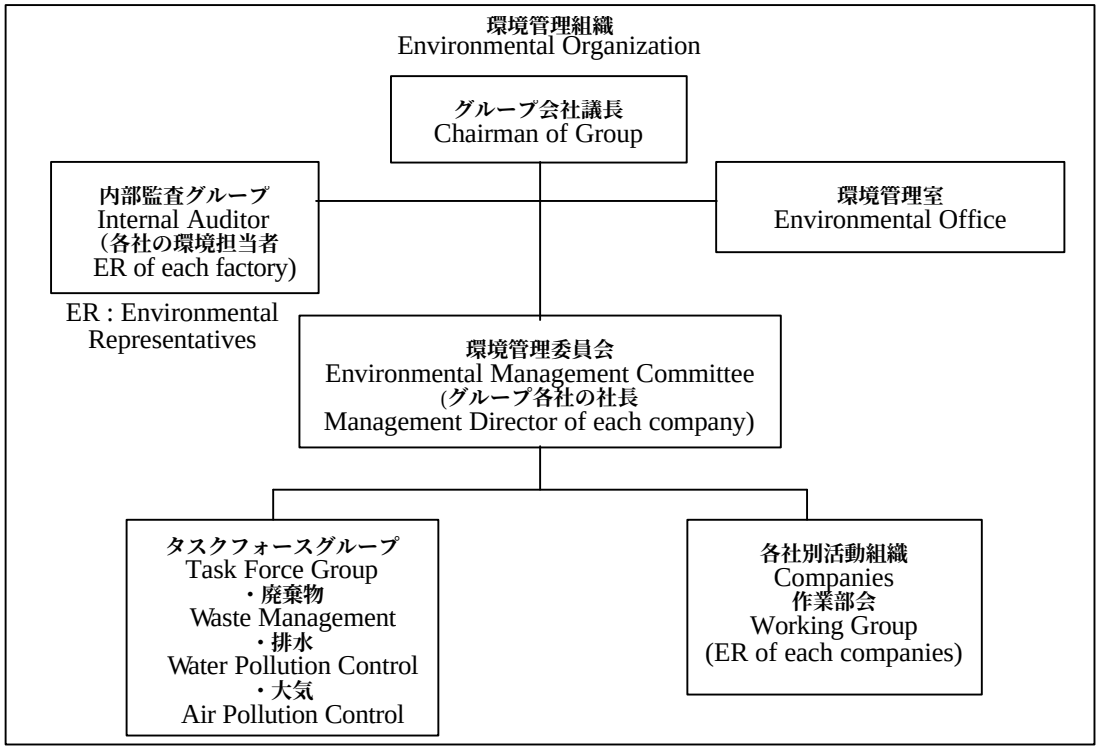
January 1998	Completion of documents for ISO14001 and starting of execution of the ISO14001 activities
February 1998	First internal audit by members of the Association of the Group Companies
June 1998	Audit by the Thai certifying organization
July 1998	Acquisition of certification
December 1997	First surveillance

b. Cooperation with Other Companies

In May 1997, the group companies agreed to reform environmental management organization as shown in Figure 2-3-3 so that the groups companies may be able to deal with environmental problems more rationally. Environmental Management Committee meets once a month to decide on common subjects and exchange information. Implementation of the measures for improvements is consigned to three task force groups. Waste Management Task Force achieved a 25 % reduction of waste treating cost in one year of the group companies by conglomerating the packaging materials of expanded polystyrene through heating, fusing and pressing and letting the dealers to take them. Waste Management Task Force also promoted waste paper recycling. Water Pollution Control Task Force applied right maintenance to the wastewater treatment units that had not functioned well to clear the effluent standards. Air Pollution Control Task Force replaced carbon tetrachloride with pure water for cleaning devices and parts and thus decreased emission of pollutants to the atmosphere and reduced inhalation of organic compounds by improving the paining process.

The cooperative works among the group companies not only facilitated acquisition of the ISO14001 certification and helped solve various problems by drawing upon the combined capabilities of the group companies.

Figure 2-3-3 Environmental Management Organization of Inter-Companies of Company I Group



Case 10 Example of Obtaining the ISO14001 Certification with Little Environmental Impact

1) Outline of the Company

Company J
Business line: Manufacture of printers, hard disc drives, cameras, data-processing devices, precision parts of optical instruments
Number of employees: 9,000
Start of operation: 1988
Location of the plant: In an industrial estate in Pathum Thani, 50 km to the north of Bangkok
Japanese equity ratio: 100%

2) Background

The Japanese parent company has guided all overseas plants in environmental consideration. The parent company has taken care of this company very minutely since inauguration. The parent company decided that Company J should obtain the ISO14001 certification as an evidence of good environmental conservation.

Two years ago the Japanese parent company requested this plant to obtain the ISO14001 certification by the end of March 1999. The plant rallied all forces and prepared for acquisition of the certificate. As a result, the plant successfully obtained certificate in May 1998, about one year earlier than expected. Since the plant obtained certification, some European clients have begun asking whether this plant has obtained ISO14001 certification.

3) Measures Taken by the Company

a. Acquisition of the ISO14001 Certification

Environment Committee, the supreme organization, with the president heading the committee and all department managers of the operating departments being the members, holds a meeting twice a year. Under Environment Committee are Promotion Groups, which have various committees each in charge of particular subject such as waste, chemicals, beautification of the plant, energy. These committees prepared documents for ISO14001 with participation by the representative of each department.

Basic materials and guidance were provided by the Japanese parent company. The company obtained certification from a Thai certifying organization rooted firmly in Thailand, because the company operates in Thailand. The operation of the plant consists mainly of assembling precision devices and parts and therefore does not discharge highly contaminated effluent water or effluent gas. Therefore the company carefully sorted out environmental aspects and devised methods for evaluation in preparation of the audit documents.

Under the motto of “harmony with the environment”, the company established the targets for reduction of electric power consumption, reduction of water consumption and reduction of waste generation as shown in Figure 2-3-4. Other targets include review and improvement of the environmental aspects of the soldering process and thorough maintenance of wastewater pits.

The plant is now reducing electric power consumption by modification of the power distribution system and setting of right voltage and is reducing water consumption by increasing the use of recycled water.

Figure 2-3-4 Targets for Reduction of Environmental Impact of Company J

Item	Target
Electric power consumption	Reduction of electric power consumption per unit sales value by 5 % from the previous year's performance
Water consumption	Same as above
Waste generation	Reduction of waste generation per unit sales value by 10 % from the previous year's performance

b. Wastewater Treatment

The office of the industrial estate provides water from a well in the estate, and this plant receives about 400,000 m^3 a year. The received water is partly purified by reverse osmosis and used for washing precision devises and parts and is partly used for cooling purpose. The spent water from the washing process and used cooling water constitute the wastewater. Since the degree of contamination is very low, the wastewater is sent directly to the central wastewater treatment unit of the industrial estate after pH value is checked.

Effective from 1999, use of well water will be prohibited by the instruction of the Ministry of Industry (MOI). The plant will then have to purchase industrial water from the Provincial Water Works Authority. The cost of water, 8 Bahts/m^3 as of the end of 1998, will increase to 21 Bahts/m^3. The reduction of water consumption will be economically more important and must be implemented also from the viewpoint of cost reduction.

c. Solid Waste Treatment

The packaging materials -- wood frames, expanded polystyrene, and cardboard -- constitute the bulk of wastes. The boxes used by the Thai parts suppliers are designed for repeated use; therefore, the plant sends them back to the suppliers. The plant is now studying the methods for using the boxes coming from Japan as containers for export products to Japan so as to send them back to Japan. Two 8-ton truckloads of expanded polystyrene is generated a day, which is sold to a local agent.

About 250 tons of faulty products are generated per half a year. These are crushed and consigned to a dealer authorized by the MOI for treatment and disposal. The dealer extracts metals and other valuables for reuse, incinerates the combustibles and disposed of incombustibles by landfilling. Since the company receives tax incentive from the Board of Investment specially for manufacturing export products, the company is strictly forbidden to channel to the domestic market even a faulty product. The toner for the printer is harmful for the health if inhaled; therefore, utmost care is exercised for its disposal. The plant sees to it that a disposal company consigned for the treatment rightly disposes of it by visiting the company and watching their work.

Waste oils and hazardous substances such as waste chemicals are consigned to GENCO, an authorized disposal company by the government. Company J pays the cost for treatment and

disposal.

d. Others

This plant has been promoting High Reliability (HR) program since 1991. This program aims to improve the reliability of the company's products involving all employees from manufacturing to product delivery. The program consists of group activities and a suggestion system. Every employee participates in one of the group activities where group members discuss the problem and finds solution to a problem. The leader is selected from the group members, and the group holds a meeting every week. The suggestion system is open to everyone. Anyone who submits a suggestion is responded from plant managers within a week or two. The HR program has been established among the employees and helps encourage them and contributes to enhancing reliability of the company's products.

This program contains issues concerning environment. Accordingly, this movement promotes enhancement of employee's awareness of environmental conservation and encourages their voluntary actions.

Section 4
Cases of Adopting Locally Tailored Environmental Practices

The most of Japanese companies in Thailand have established corporate principle for environmental conservation. Many of their products are well-known consumers' goods; therefore, their good environmental conservation measures are important to enhance their corporate images. These companies attach particular importance to maintaining good relations with the people in their local communities. This prompts them to take thorough measures to odor, wastewater and wastes so that the local people would not have any complaints against them. Some of them open the plant to the local people to let them see the facilities and operation, thereby establishing friendly relationship with the local people. The environmental conservation measures based on mutual acceptance and mutual benefits between the plants and the local people are expected to be very effective.

Case 11 Example of Converting Byproducts into Soil Conditioners to be Returned to Farmland

1) Outline of the Company

Company K Business line: Manufacturing chemical seasonings Number of employees: 320 Start of operation: 1998 Location of the plant: In Kamphaeng Phet about 160 km to the north of Bangkok Japanese equity ratio: 70%

2) Background

Company K is one of the early comers to Thailand. Its No.1 plant in the suburbs of Bangkok has been operating for 37 years. The No.1 plant manufactures chemical seasonings from starch extracted from cassava, a root crop. The company decided to build the new plant to meet the growing demand. The company planned to use spent molasses with starch as raw material. This location was selected because of this area's availability of both starch and molasses. Besides, the No.1 plant has a problem with transportation and distribution of a liquid byproduct of chemical seasonings, which contains organic substances at high concentrations. The No.2 plant reported in this case, being situated in the midst of a stretch of farmland, has an advantage of being able to returning the byproduct to the farmland as organic fertilizer.

3) Measures Taken by the Company

a. Measures for the Byproducts

The plant produces as much as 45,000 tons of byproduct liquor consisting mainly of waste cells of microorganisms. This byproduct contains nitrogen and minerals and is therefore effective as fertilizer. A significant difference has been noticed in growth between the seedlings of sugar canes given this liquor and those not given it. As this information spreads, an increasing number of farmers growing sugar canes in the vicinity of the plant are requesting the plant to spray this liquor on their farms. This liquor is becoming famous also as effective fertilizer to corn and cassava.

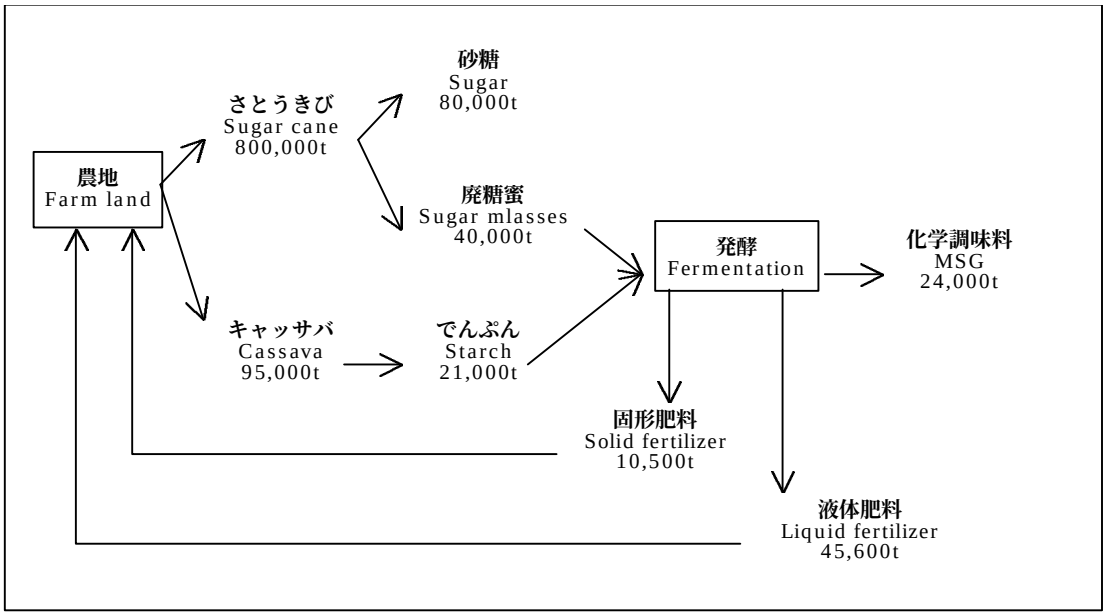
The plant now treats the liquor and sends a tank-truck to spray it on the nearby farmlands. This liquor, a nuisance in the No.1 plant in the suburbs of Bangkok, is effectively utilized as a resource in the agricultural area of the No.2 plant, thereby reducing the transportation cost needed for disposal in the case of the No.1 plant.

This plant also produces as much as 10,500 tons of a solid waste consisting of the waste activated carbon used for decolorization and the excess sludge from the activated sludge process. These solid wastes contains nitrogen and potassium, effective ingredients as fertilizer, and is sold to a fertilizer company, which adds phosphorus to it and sells as a fertilizer for strawberries, litchi trees and longan trees.

Neither the byproduct liquor nor the solid wastes can be officially called fertilizer because of their nitrogen and potassium contents being lower than the standards specified by the Thai law.

The company therefore has to call them soil conditioners. Figure 2-4-1 indicates the routes through which these byproducts are recycled back to the farmland as soil conditioners.

Figure 2-4-1 Byproducts Agricultural Recycling Flow of Company K



b. Wastewater Treatment

The river to which the plant discharges wastewater flows to Bangkok. Therefore, the plant is voluntarily conducting the strict control of wastewater quality. The plant has set the standards for BOD and total Kjeldahl nitrogen (TKN) to be 20 mg/liter maximum and 200 mg/liter maximum, respectively, equivalent to the standards the government of Thailand has set for the effluent water for chemical seasoning plants. The plant has installed a wastewater treating unit consisting of the facilities shown in Figure 2-4-2.

The government prohibits plants or factories from being constructed within one to three kilometers from river banks, the distance depending upon the kind of industries. The manufactures of chemical seasonings are not subject to this restriction. However, the company made a large pond to keep wastewater from the activated sludge process when the plant was built, in compliance with the request which the Ministry of Industry (MOI) made in view of the recent industrial pollution problems.

The wastewater treatment unit receives 1,500 tons per day of water from the processing facilities. The incoming water is adjusted for pH and subjected to biological decomposition in the aeration tank. The water is then sent to the sedimentation tank to be separated from the sludge by sedimentation. The upper clear water is called treated water. The treated water is sent to the pond with a holdup capacity of 20 days. Fish and shrimps inhabit the pond. There is more in environmental conservation effect to the pond than the mere holdup capacity required by the MOI, including good impressions the visitors may have on this plant.

The plant measures COD_{Mn}, TKN and color of the treated water quality every day, items relatively easy to measure, for controlling the operation of the wastewater treatment unit. If

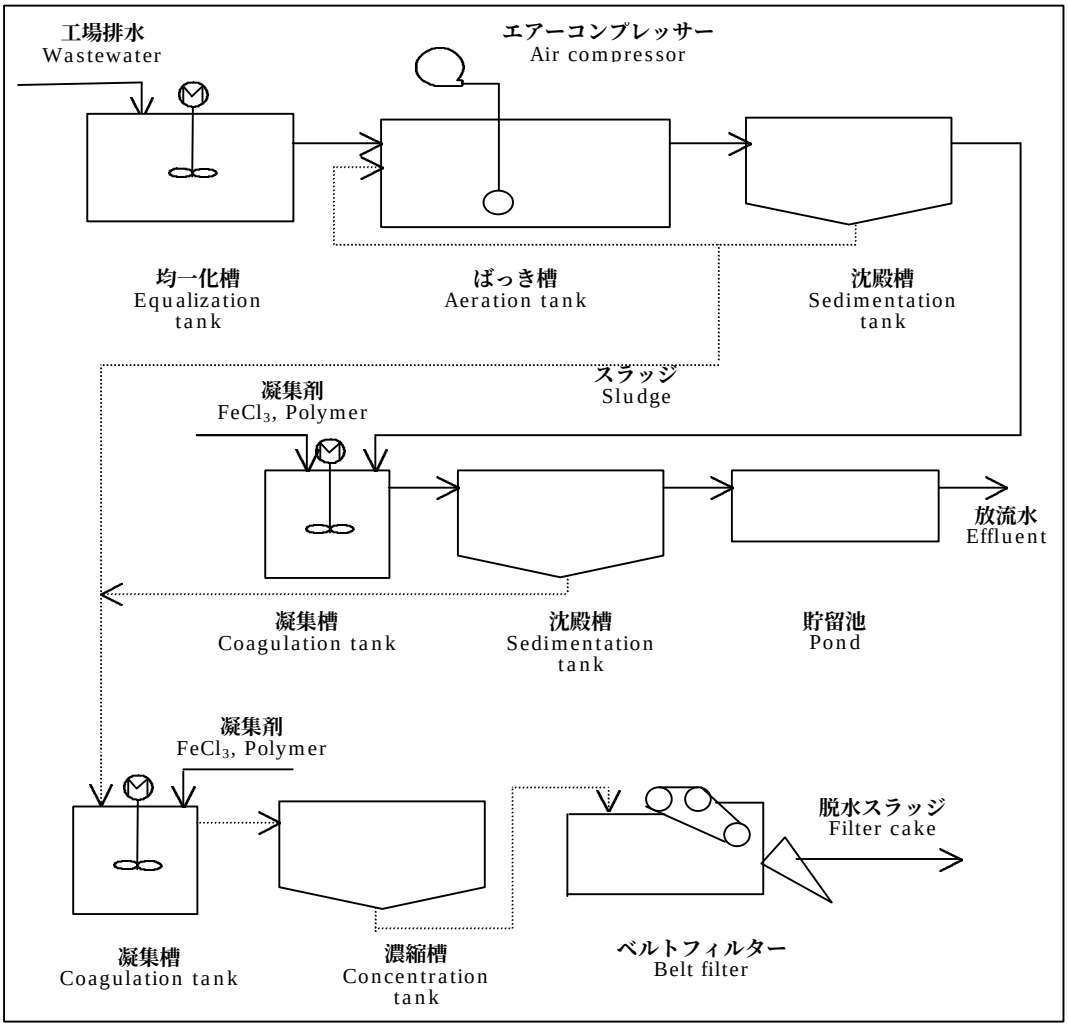
any abnormality is found in these measurements, corrective measures are taken immediately. The treated water is analyzed for BOD and CODcr by the No.1 plant once a week. The analytical results of the main items (BOD, CODcr, pH and T-N) are reported once a month to the officer of the MOI stationed in the Provincial Office.

During the harvest season the farmers burn the leaves of cane sugar on the farmlands. The ash from the burning falls on the pond and raises the pH value of the water. During this season, the pH value of the water from the activated sludge process is so adjusted that pH of the water discharged from the pond may fall within the controlled range, taking into consideration of the effect of the falling ash.

c. Others

Company K has established a fund to extend financial aids to schools and restoration of historical buildings. Company K presents awards to the school athletic meetings, and extends cooperation to the local industrial promotion society in the campaign for safety training and 5S movement (named after the Romanized Japanese terms all starting with S meaning tidying up, cleanup, and others for organized plant environment). The company normally avoids donating money but offers cooperation in activity.

Figure 2-4-2 Flow of Wastewater Treatment of Company K



Case 12 Example of Taking Thorough Measures for Disagreeable Odors as Environmental Consideration to the Community People

1) Outline of the Company

Company L (Company G of Case 7) Business line: Manufacture of motor cycles and general-purpose engines Number of employees: 2,500 Start of operation: 1992 Location of the plant: An industrial estate in the City of Bangkok Japanese equity ratio: 83%

2) Background

The company has been in operation for 34 years since 1965. The company used to have a plant located in another place in the suburbs of Bangkok, which has become too small for the present operation. The company therefore built a new plant in this place in 1992. This industrial estate was managed by the Industrial Estate Authority of Thailand (IEAT), a joint public-private company; therefore, the company considered that procedures for applications and granting of permission would proceed smoothly in this industrial estate. The industrial estate is conveniently located for transportation of the parts and products and for supply of labor. These were the reasons for selecting this industrial estate as location of the new plant.

This plant is located in the outermost side of the industrial estate and is adjacent to a residential area across the fence. The plant would receive complaints from the residents about any odor if the plant might emit. The plant's products are reputed in Thailand; therefore, the plant aims to maintain a good impression of the products all the more by taking thorough environmental conservation measures, thereby reducing occurrence of odor claims to zero.

3) Measures Taken by the Company

a. Odor Prevention

The odor is generated in the processes of spraying paints and subsequent drying. Since 1993, the plant has consecutively taken the following measures.

(1) Installation of an exhaust gas scrubbing chamber
(2) Replace the spray guns with low-pressure ones
(3) Increase of the height of stack to 40 meters and installation of a filter unit in stack
(4) Increase of pigment concentrations and reduction of solvent concentration
(5) Adoption of micro bells to improve transfer efficiency of the gun

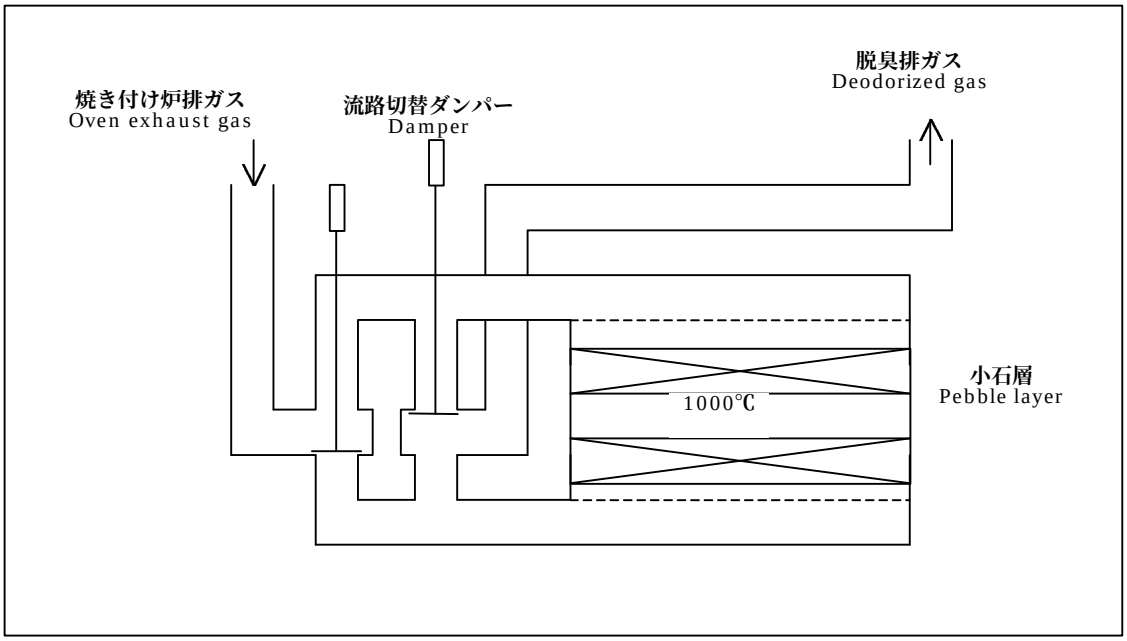
These measures resulted in a reduction of xylene content in the air from 200 ppm, the standard, to 45 ppm. However, this did not provide a complete solution of the odor problem because the odor caused complaints if it was felt even for a short period of time.

The plant took an additional measure by installing a facility to decompose the odorants effluent from the oven for baking process of the paint. This facility, as shown in Figure 2-4-3, allows the exhaust gas to flow alternately upward and downward through pebble layers heated to 1,000ºC to oxidize and decompose the odorants. The gas is flown at first downward. When the lower pebble layers become hot by heat of combustion, the flow is reversed from downward

to upward to perfect oxidation decomposition. The switching of the flow is done by intermittent damper operations to ensure continuous decomposition of the odorants. Gas is burned to heat the unit when the facility is started up. Through these measures the concentration of xylene has been reduced to 25 ppm, a level low enough not to be perceived by human sense. The plant analyzes the odorants to confirm the decomposition. The company also periodically sends the gas sample to the parent company in Japan for gas chromatographic analysis.

The above measures have resolved the problem of complaints. Nevertheless, the employees conduct monitoring of odor in the surrounding of the plant when the plant is in operation and the plant takes corrective measures if odor is ever detected before the plant receives complaints.

Figure 2-4-3 Flow of the Odorants Combustion System of Company L



Case 13 Example of an Industrial Estate Where the Community People are Allowed to Watch Environmental Conservation Measures

1) Outline of the Company

Company M Business line: Development, sales in lots and management of an industrial estate Number of employees: 200 Start of operation: 1990 Location of the plant: Ayuthaya 69 km to the north of Bangkok Japanese equity ratio: Not disclosed

2) Background

The US-educated general manager of this industrial estate has a keen interest in environmental conservation. Of the 92 tenants of this industrial estate, companies of Japanese capital represent the majority, or 62 to be exact. Ten of these companies of Japanese capital have already obtained the ISO14001 certification. These companies lead the entire industrial estate in the environmental conservation activities. In the City of Ayuthaya where the industrial estate is situated, restoration of the historical relics has been underway. The awareness of the local people for environmental conservation is very high. Under such circumstances, environmental measures open to the community are required. The industrial estate monitors not only effluent waters and wastes from the plants but also the quality of air surrounding the industrial estate, thus the industrial estate gives utmost consideration to environmental conservation. The results of the monitoring are disclosed to the people of the community. The company considers good relationship with the community people very important.

3) Measures Taken by the Company

a. Wastewater Treatment

The industrial estate takes water from 16 deep wells and supplies it as industrial water to the plants and factories in the estate. The wastewater generated by the plants and factories are fist treated by them to the specified quality and then collected in the central wastewater treatment unit of the industrial estate where water is given final treatment to be discharged to the channel outside the industrial estate. The maximum capacity of the central wastewater treatment unit is 15,000 m^3 a day.

Figure 2-4-4 shows the effluent standards set for the plants and factories in the estate. The standards presume biological treatment by the central wastewater treatment unit and are therefore relatively lenient for COD and BOD. The plants are individually required to satisfy the strict specifications for heavy metals, which are not amenable to biological treatment. The industrial estate takes samples of water from each plant and factory twice a month, and has them analyzed by a laboratory authorized by the government at the tenant's expense. A warning is issued to the tenant not complying with the standards of the industrial estate. If the tenant does not correct the quality of wastewater to comply with the standards, the supply of industrial water may be suspended. The Japanese companies take an immediate measurement for any problems they may cause after they are warned.

Figure 2-4-4 Effluent Standards Company M Has Set for the Tenant Plants and Factories

(mg/liter)

Item	COD	BOD	SS	TDS	Tempe-rature	pH	HCN	H_2S	Oil	Tar
Standard	1250	1000	200	2000	45℃	6.0-9.0	0.2	5.0	10.0	10.0
Item	Free-Cl	Zn	Cr	Hg	Cd	Mn	Pb	Cu	Ni	As
Standard	5.0	5.0	0.5	0.005	0.03	5.0	0.2	1.0	0.2	0.25
Item	Ba	Se	F	Free NH_3	Ammo-nia	Phenols	Pestici-des	Color/ odor	Formal-dehyde	Deter-gent
Standard	1.0	0.02	5.0	50	50	1.0	ND	ND	1.0	100

The central wastewater treatment unit of the industrial estate must comply with the effluent standards set by the government for all items. For this purpose, the industrial estate installed a central wastewater treatment unit shown in Figure 2-4-5. The central wastewater treatment unit receives wastewater streams from the plants and factories in the equalization tank. Then the treatment unit neutralizes the wastewater and subjects it to biological treatment to decompose the pollutants. The formed sludge is separated by settling in the sedimentation tank. The upper clear water is discharged as treated water after chlorine disinfection. The sludge is concentrated by the thickener followed by dewatering by filter press. The dewatered sludge was disposed of by landfilling.

The environmental impact assessment prepared at the time of industrial estate construction set the items for routine checking and standards as shown in Figure 2-4-6. The company consigns once a month analysis for these items to a laboratory authorized by the MOI. The past records indicate that BOD of the water received ranges from 60 to 300 mg/liter and that of the discharged water ranges from 9 to 47 mg/liter which satisfies the standard for BOD. The company summarizes the results of these analyses and reports to the Ministry of Science, Technology and Environment (MOSTE) every six months.

Formerly, the company had to analyze the treated water for all the 30 items of the effluent standards set by the government. The rule was revised afterward, and now only 11 items shown in the figure should be analyzed for ordinary testing.

Figure 2-4-5 Flow of the Central Wastewater Treatment of Company M

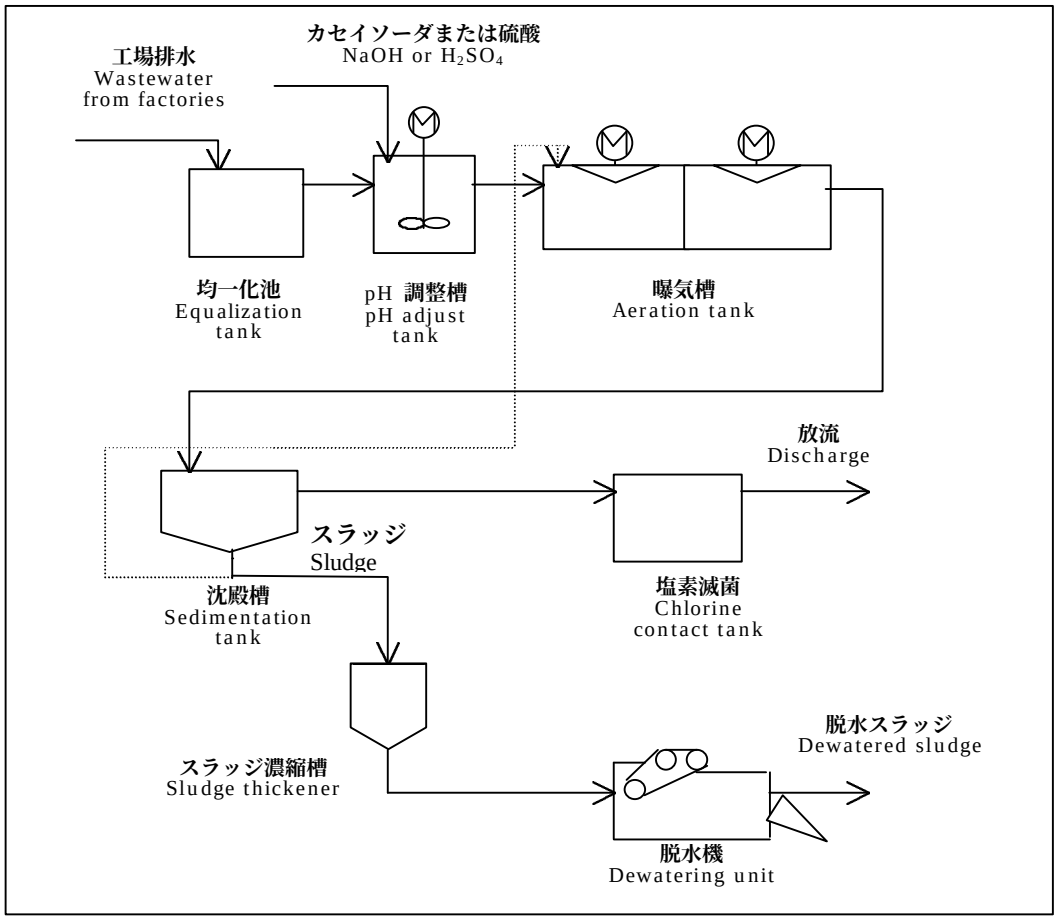


Figure 2-4-6 Effluent Standards Set for Company M

(mg/liter)

Item	pH	BOD	COD	SS	DS	Oil
Standard	5.5-9.0	60	400	150	5000	5
Item	Zn	Cr	Cu	Pb	Ni	—
Standard	5	0.5	2	0.2	1.0	—

b. Solid Waste Treatment

The industrial estate collects about 7 to 8 tons of general wastes such as kitchen garbage and waste paper from the plants, and incinerates the waste in the incinerator inside the estate with a capacity of 5 tons per day. Cost of 45 Bahts per drum is chargeable to the tenants. The company calls a disposal company to sell them such salable wastes as recyclable paper and metals and incinerates the remaining wastes by a five-tons-a-day incinerator in the premises of the industrial estate. The incinerator ash is landfilled.

Each plant and factory individually consign a treatment and disposal of hazardous wastes to a disposal company authorized by the government. On the other hand, the industrial estate collects record on the treatment and disposal of hazardous wastes from each tenant, and compiles them to report to the MOSTE in every six months.

c. Measures Taken for Air Pollution and Noise

One of the environmental policies of this industrial estate is to prevent air pollution and to contain noises. The company monitors air quality and noise at one point in the premises and at three points outside the premises. Figure 2-4-7 shows environmental standards for this area and the monitoring results. The figure indicates that the monitored quality of air both inside and outside the premises satisfies the standards by big margins, indicating that the plants and factories in this industrial estate do not cause air pollution. The maximum noise levels measured outside the premises are close to the standards; this is presumably attributable to the location of the industrial estate being close to a trunk road.

Figure 2-4-7 Environmental Standards for Air and Noise and Company M's Measurements

		Locations and measured values			
Item	Standards	Outside 1	Outside 2	Outside 3	Inside
TSP	0.33 mg/m^3 24 hr	0.025 - 0.085	0.24 - 0.13	0.032 - 0.072	0.025 - 0.095
PM 10	0.12 mg/m^3 24 hr	0.013 - 0.051	0.019 - 0.083	0.022 - 0.052	0.016 - 0.041
SO_2	0.30 mg/m^3 24 hr	Less than0.001	Less than0.001	Less than0.001	less than 0.001
NO_2	0.32 mg/m^3 1 hr	0.006 - 0.12	Less than0.001	Less than0.001	0.006 - 0.025
CO	34.4 mg/m^3 1 hr	1.75 - 3.25	2.50 - 3.00	2.25 - 3.25	2.75 - 3.75
Noise	70dB 24 hr	6.46 - 68.0	57.4 - 62.3	-	-

d. Others

The company submits an environmental impact assessment (EIA) report in every six months to the MOSTE. The report contains amount of water discharged, treated water quality, treatment and disposal of wastes, results of monitoring of air quality and noise level, discharges of hazardous wastes from individual plants and factories. The report volume is as thick as several centimeters.

The company discloses to the local residents the environment-related facilities and their operation conditions upon request by the residents. They come to the plant several times a year. They appreciate that the water discharged from the estate is cleaner than the water in the channels in the local community.

Section 5
Other Examples of Innovative Environmental Practices

The Japanese companies in Thailand encounter various challenges in their efforts for environmental conservation. Some companies have set up strict self-imposed effluent standards in anticipation of the official standards becoming tighter in future. Others have modified their manufacturing process itself so that they do not generate wastewater or hazardous wastes. There are still others conducting effective treatment of their wastewater linked with the central wastewater treatment units of the industrial estates. Each activity effectively reduced their environmental impacts in its own way.

Case 14 Example of Working Closely with the Central Wastewater Treating Unit of the Industrial Estate

1) Outline of the Company

Company N Business line: Manufacture of polyester fibers Number of employees: 450 Start of operation: 1993 Location of the plant: Ayuthaya 20 km to the north of Bangkok Japanese equity ratio: 75%

2) Background

In 1993 when the company was looking for an industrial estate for locating a plant, they knew that different environmental measures were required for different places in Thailand. In convenient places near Bangkok, construction of a plant was not allowed within 1 km from riverbanks and strict effluent standards were regulated. Requiring a large quantity of water, the polyester fiber plant is desirably located in a place where water is sufficiently available. Places far apart from Bangkok have more generous effluent standards but are inconvenient for transportation of raw materials and products.

The company therefore chose this industrial estate as the plant site, being located not far from the City of Bangkok and having utility supply, industrial water in particular, and central wastewater treatment unit. This industrial estate is managed by a public-private joint corporation participated by the Industrial Estate Authority of Thailand (IEAT) and private firms.

Company N manufactures polyester staples and filaments from the chemicals imported from Japan and the Middle East, generating a large quantity of wastewater highly containing BOD contents. The company has adopted a useful system that both its own wastewater treatment process and the central wastewater treatment unit in the estate compensate each other effectively to meet the strict effluent water standards set by the government of Thailand.

3) Measures Taken by the Company

a. Wastewater Treatment

The plant produces wastewater at a rate of about 40 m^3 per hour. Figure 2-5-1 shows the standards for the water acceptable to the central wastewater treatment unit of the industrial estate. At the beginning, the plant used to send its wastewater to the central unit without treatment, then the wastewater sometimes failed to meet the BOD standard. Therefore, in 1996, the plant made a pond equipped with an aeration facility. The purposes of the pond were emergency holdup, equalization of the quality of wastewater, and reduction of BOD by aeration. The aeration pond had a capacity of 1,000 m^3 and a surface area of 600m^2 and holdup capacity of one day. Since this aeration pond was made, the plant's wastewater has never failed to meet the standards of the industrial estate. The office of the industrial estate checks every month the quality of the sample of effluent water streams from each tenant. This plant contracts out analysis of the treated water to the supplier of the water treating chemicals every week. The both tests at the estate and at the plant show same results.

The central wastewater treatment unit collects wastewater streams from the tenants and gives the water activated sludge treatment to reduce BOD to 60 ppm or less and discharges it. If a tenant sends wastewater exceeding the standards to the central wastewater treatment unit, the tenant is given a penalty by the rule of this industrial estate. Figure 2-5-2 shows price of industrial water supplied to the tenant. The water prices are decided based on the BOD content of the wastewater of each tenant. If the BOD content of the wastewater exceeds 500 mg/liter, the price of the industrial water increases threefold. In a case of the plant receiving 1.5 times as much water as wastewater it discharges, it is economically effective to hold down the BOD content to less than 500 mg/liter.

Figure 2-5-1 Effluent Standards Set for Company N by the Industrial Estate

(mg/liter)

Item	pH	BOD	SS	Temperature ℃
Standard	5.5 to 9.0	500	50	45

Figure 2-5-2 Water Price Set for Company N by the Industrial Estate

BOD of wastewater (mg/liter)	Water price (Bahts/m^3)
200 max.	4.5
200 to 300	5.5
300 to 500	6.4
500 or more	18.2

b. Solid Waste Treatment

The off-specification fibers produced from the manufacturing processes are thoroughly recycled as raw material. However, those stained or stiffened in a lump end up being a waste. The plastic materials for packaging and cardboard become wastes. Easily combustible wastes amounting to from 100 to 200 kg a day are incinerated in the incinerator inside the plant. The wastes amounting 12 tons a month that are not easily combustible and general wastes like kitchen garbage, are burned by the incinerator of the industrial estate. The hazardous wastes specified by ordinances are consigned to General Environmental Conservation Public Company Limited (GENCO) for treatment and disposal at a price of 3.6 Bahts per kg. The plant generates hazardous wastes at a rate of about two tons a month. The restriction on the waste is becoming ever stricter. When a waste is brought out of the industrial estate, the guard checks the destinations of transportation.

c. Exhaust Gas Treatment

The standards set by the government are applied to the plants in the industrial estate. This plant operates two 500 kW diesel-powered generators on a low-sulfur diesel fuel; therefore, they do not cause any problem. This plant consigns analysis of exhaust gas to an authorized laboratory once in six months. The company reports the results of analysis to the Ministry of Industry (MOI) through the IEAT.

d. Others

The Power and Utility Section is in charge of wastewater treatment and water supply. The Personnel Section, also in charge of general affairs, is in charge of waste management because

of this work requiring frequent meetings and negotiations with the outside organizations. The manger of the Personnel Department closely keeps in touch with the Provincial and District offices of the IEAT. Through such contacts with outside organizations the company is able to obtain direct information on such themes as revisions of laws and regulations about environmental conservation. The Bangkok Japanese Chamber of Commerce also provides various pieces of information.

The safety committee consisting of 15 members in executive positions and representatives of workplaces meets once a month to discuss the means of giving due environmental consideration and thorough execution of operation standards in the execution of the 5S movement. This was named after the Romanized Japanese terms all starting with S meaning tidying up, cleanup, and others for organized plant environment. Performances of such endeavors were highly evaluated and the Ministry of Public Health awarded the company for the activities of safety, environmental conservation and sanitation.

The company will soon need to obtain certification for ISO14000 series, because this certification is inevitable when exporting products to the United States and European countries.

Case 15 Example of Setting Strict Company Standards in Anticipation for Tightening of Official Standards

1) Outline of the Company

Company O
Business line: Manufacture of polyester raw materials
Number of employees: 136
Start of operation: 1999 (planned)
Location of the plant: An industrial estate in Rayong about 160 km to the southeast of Bangkok
Japanese equity ratio: 50%

2) Background

Company O's Japanese parent company has an excellent manufacturing process of polyester. Now it has become more difficult to build a plant in Japan for various reasons. The parent company has decided to build a most advanced plant in Thailand, which has an advantage of good raw material supply and a good market. The design of the new plant was reflected on the future aspect of environmental conservation including measures against the global warming.

The local partner also fully understands corporate social responsibility and has announced the corporate principle to the group companies. The corporate principle states, among others, that the group companies should take pride in environmental conservation. A booklet containing this corporate principle is distributed to all employees to enhance their awareness in environmental conservation.

The location is close to a chemical complex producing a variety of chemical derivatives from the natural gas produced close to this area. Raw materials such as Para-xylene are supplied from the complex.

3) Measures Taken by the Company

a. Wastewater Treatment

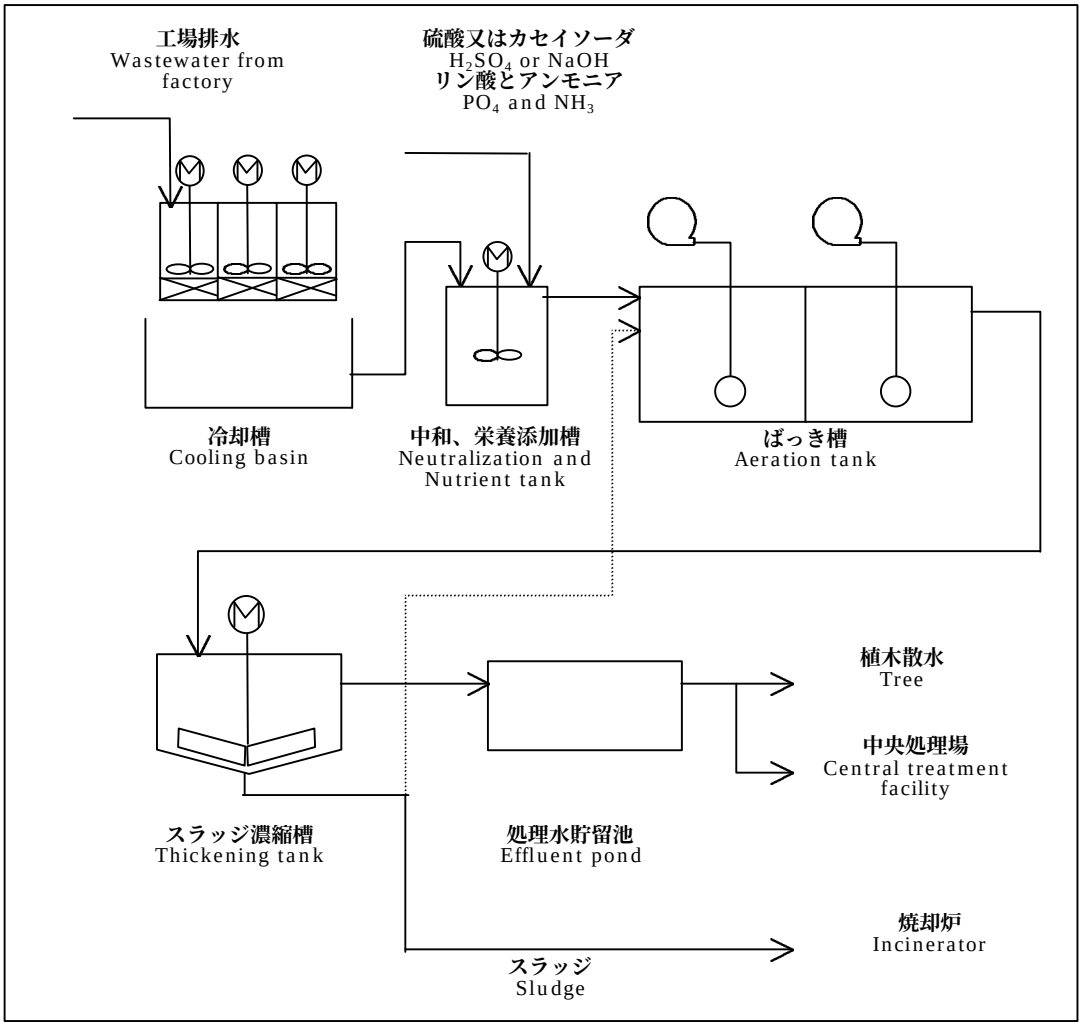
The company prepared an environmental assessment report on the construction of the plant with the cooperation of a local consulting company. The company first obtained approval on the environmental assessment report from the Ministry of Science, Technology and Environment (MOSTE) and then submitted the environmental impact assessment report, together with other documents, to the MOI and obtained permission for operation of the plant. The MOSTE and the MOI indicated effluent water standards; however, the company has set up its own company's standards, stricter than the official one in certain items, in anticipation of future tightening of the standards. Figure 2-5-3 compares the official standards and the company's standards. The company's standards specify more stringent values for pH and suspended solids (SS). The company considers it important that the treated water always satisfy the stricter standards for these items. The company has installed the wastewater treatment unit consisting of the facilities shown in Figure 2-5-4.

Figure 2-5-3 Comparison of Official and Company O's Standards for Wastewater

(mg/liter)

Item	Official standards	Company's standards
pH	5.5 – 9.0	6.0 – 8.0
TDS	3000	3000
SS	50	30
Oil	5	5
BOD	20	20
COD	120	120

Figure 2-5-4 Flow of Wastewater Treatment of Company O



The hot wastewater streams from the manufacturing processes are received in the cooling basin where the water is cooled. The pH values of the wastewater are adjusted and nutrients are added in preparation for biological treatment. Organic compounds in the wastewater are decomposed by the action of microorganisms in the two aeration tanks arranged in series to ensure reduction of BOD. The water is then sent to the thickening tank to settle the sludge of

micro-biological flocs. The supernatant clear water is sent to the effluent pond for holdup as treated water which is sent to the central wastewater treatment unit of the industrial estate, with a portion of water used for spraying on trees. The purpose of the effluent pond is to hold the treated water so that the treated water not meeting the standards, if ever produced, may not be allowed to flow out of the plant. A part of the sludge is recycled from the thickening tank to the aeration tanks and the rest is taken out for incineration.

The plant is charged with the treating fee of the central wastewater treatment unit according to the following unique formula.

Treating fee (Bahts/month)
= 2.55 x effluent water volume (m^3/month) + 6 x BOD load (kg/month)

This equation consists of two elements, one proportional to the effluent water volume and the other proportional to the BOD load. Reduction of either element leads to reduction of the treating fee.

b. Solid Waste Treatment

The waste consists mainly of the solid wastes produced from the manufacturing processes, sludge from wastewater treatment and waste paper from the office. These wastes are burned in incinerator with a capacity of 43 tons/day in the premises. The MOSTE and the MOI have set the standards for the effluent gas from incinerator. The company has set more stringent company's standards in anticipation of tightening of the official standards in future. Figure 2-5-5 compares these two standards.

The company's standards specify more stringent values for TSP (total suspended particulates) and NOx (nitrogen oxides) than the official standards. The design of the stack incorporates a cyclone and a dust collector to attain the standard for TSP and injection of urea into the cyclone to reduce NOx. In addition, a secondary combustion chamber is installed at the outlet of the stack to decompose the excess urea.

Figure 2-5-5 Comparison Official and Company O's Standards for Exhaust Gas from Incinerator

Item	Official standards	Company's standards
TSP (mg/Nm^3)	400	300
SO_2 (ppm)	30	
NOx (ppm)	250	155
Transparency (%) [1)]	20	
HCl (ppm)	136	
Dioxins (ng/Nm^3)	30	

Note 1) The method of the U. S. Environmental Protection Agency is used for measurement.

c. Measures Taken for Noise

The MOI has issued an ordinance on the noise level and tolerable exposure time of workers as shown in Figure 2-5-6.

Figure 2-5-6 Noise Level and Exposure Time

Tolerable exposure time per day	Noise level (db(A))
Less than 7 hours	Over 91
Over 7 hours & less than 8 hours	Below 90
Over 8 hours	Below 80
No exposure	Over 140

d. Environmental Monitoring

The environmental assessment calls for environmental monitoring. The company plans to conduct environmental monitoring more frequently than required by the assessment. Figure 2-5-7 shows the schedule of the environmental monitoring.

Figure 2-5-7 Schedule of Environmental Monitoring of Company O

Item	Location of measurements	Frequency required by the environmental assessment		Company O's own standards	
		Frequency	Measuring organization	Frequency	Measuring method
Wastewater	Outlet of the effluent pond	Once a month	Authorized laboratory	Every minute Once a month	Automatic measurement Manual analysis
Exhaust gas	Stack	Once a month	Authorized laboratory	Every minute	Automatic measurement
Air	Surroundings of the plant	Once a month	Authorized laboratory	-	-
Noise	Plant border Compressor	Once in every six months Four times a year	Authorized laboratory Authorized laboratory	- -	- -

An automatic pH meter was installed at the outlet of the effluent pond to continuously record pH. If an abnormality is found, measures will be taken immediately. Automatic measuring instruments continuously monitor SO_2 and NOx contents of the combustion effluent gas to maintain the operation in normal conditions.

e. Others

The company's business is regarded as one of the fashion industry because the company manufactures a raw material for fibers. Therefore, if the plant is not kept clean, the company will not be able to give a good public impression. The company therefore stresses the importance of sorting-out, tidying-up and cleanup. The plant executes a big cleanup campaign twice a year. The Thai people are well disciplined and cooperative to the company's policy.

The company makes financial contributions to the temple and the activities of community. The Thai have very strong feelings of attachment to their temples. This helps the company to maintain a strong tie with the community.

Case 16 Example of a Salt Manufacturing Process with Minimum Environmental Impact

1) Outline of the Company

Company P Business line: Manufacture of table salt and industrial salt Number of employees: 87 Start of operation: 1989 Location of the plant: Nakhon Ratchasima 300 km to the northeast of Bangkok Japanese equity ratio: 20%

2) Background

In the northeastern part of Thailand, there is a high-quality rock salt formation with purity as high as 98%. There has been salt manufacturing industry in this area since long time ago. Traditionally, nearly saturated brine was pumped up from underground to be poured to salt pans where salt crystals were formed by solar evaporation of water. Such a method of manufacturing salt involves the following environmental problems.

- In the process of concentration of the brine, a portion of mother liquor is discarded to remove undesired impurities. If this mother liquor is discharged to rivers, it would cause damages on the agriculture which uses the river water for irrigation.

- The salt water could unintentionally spill over to give damages to the nearby farms and paddy fields in case of a heavy rain.

- Fresh water is pumped down to the salt formation to be recovered as a rich brine. Since they do not have technology to control degree of dissolution of rock salt, they could excessively dissolve the rock salt to form too big an underground cavity. Naturally, the cavity could collapse and create a cave-in on the ground.

- When the climate is abnormal, they burn firewood to heat the brine to concentrate it by forced evaporation without using salt pans. This requires a large amount of firewood and could lead to forest destruction.

This company used to apply the above method of manufacturing salt; however, the company found it difficult to meet the growing demand for industrial salt as the Thai economic has been growing. The company has decided to construct a plant equipped with a modern salt manufacturing technology, which is environmental-friendly and is not affected by the climatic conditions.

3) Measures Taken by the Company

Since Japan does not have a technology to produce salt from rock salt, the technology was introduced from Europe. Figure 2-5-8 shows the flow of the overall manufacturing process. The plant has expanded four times since 1989 to reach the present capacity of one million tons a year. The pipe wells reaching to the rock salt formation about 200m deep inject water to dissolve the rock salt to form concentrated brine, which is pumped to the ground by other pipes.

To the brine thus brought to the ground are added chemicals for refining to precipitate such impurities as magnesium chloride and calcium chloride in the form of water-insoluble solid compounds. The solid compounds are removed and the remaining refined liquor is condensed by evaporation of water. As the liquor is concentrated, slurry containing crystalline salt is precipitated. The precipitated slurry is dehydrated by centrifuge to obtain the industrial salt. This industrial salt contains moisture at about 2%. Further drying of the industrial salt produces table salt of 99.9 % purity.

The removed solid consists mainly of calcium sulfate and magnesium hydroxide. These are insoluble in water and not harmful to human bodies. The solid waste is generated at a rate of 20 kg per ton of refined salt. The waste is landfilled in a pit, 100m long 50m wide and 3m deep, in a clay formation.

The steam generated from brine evaporation is reheated through adiabatic compression by a compressor as shown in Figure 2-5-9 to be used for heating the brine. The condensate generated from the steam after heating the brine is pumped underground to dissolve the rock salt. This plant does not burn fuel to generate heat but uses heat of compression generated by electric-power driven compressors. Accordingly, this plant does not cause air pollution.

Figure 2-5-8 Flow of the Overall Manufacturing Process of Company P

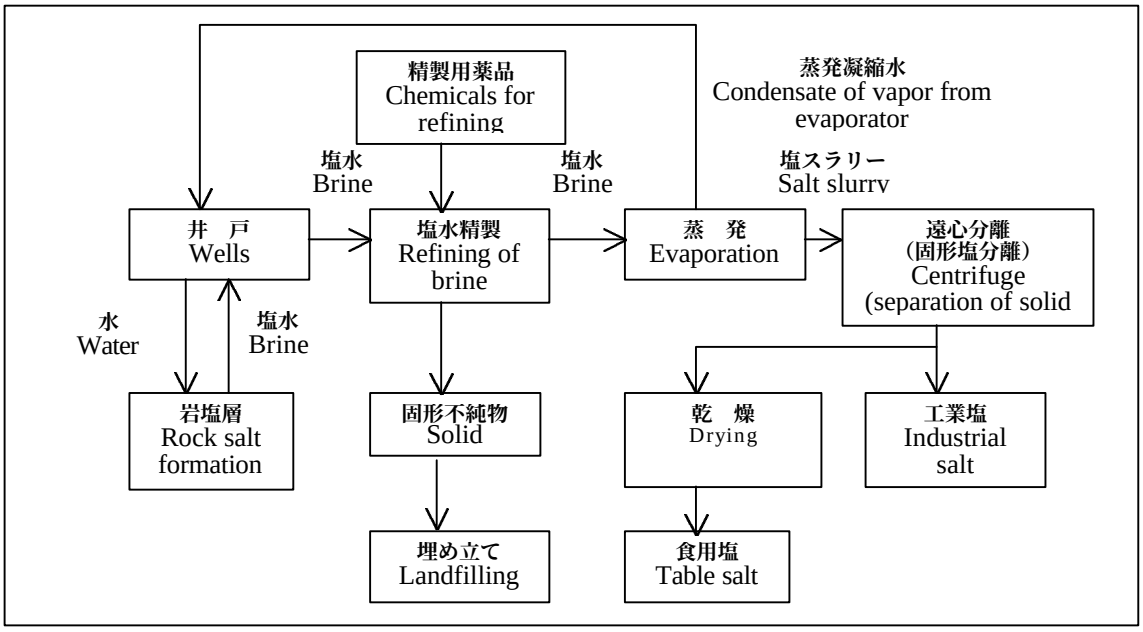
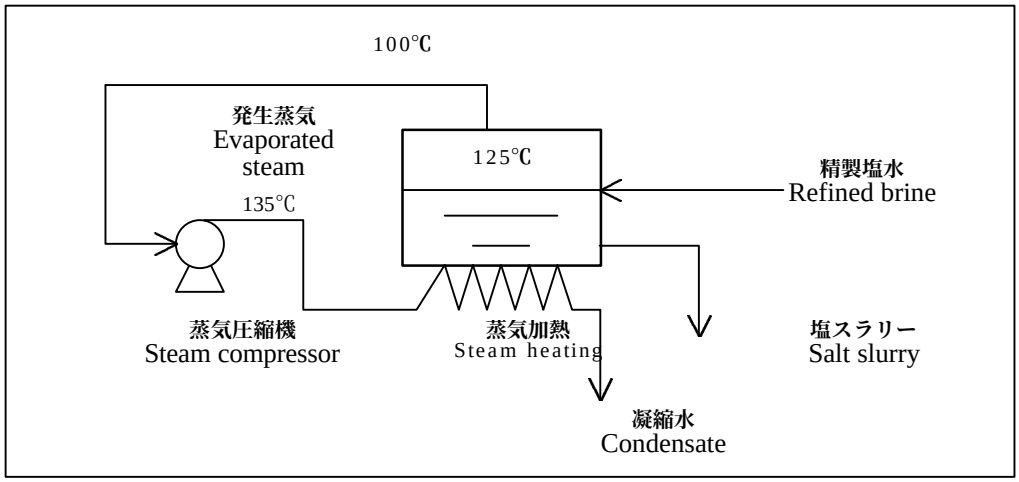


Figure 2-5-9 Process to Evaporate Brine of Company P



Cavities are created in the rock formation where rock salt has been dissolved. If a cavity becomes too large, it could cause a collapse to create a cave-in on the ground. The size of the cavity is measured by an ultrasonic instrument while the brine is pumped up. The pumping is terminated when the diameter of the cavity reaches 80 meters, the maximum tolerable size for not causing collapse.

The water used for dissolving salt is reused and therefore this plant does not discharge wastewater. The plant receives 30 m^3 per hour of river water as a whole including kitchen and sanitary uses. The used river water is filled in the underground cavities and is not discharged. The company plans to plant trees on the land where there was a pit used for disposing of the solid waste, and develop a recreation park there to demonstrate that the solid waste does not have adverse environmental impacts.

The company reports once a year the locations and sizes of the underground cavities to the Department of Mineral Resources of the MOI. The company also reports once a month the analytical results of the solid waste to be buried and water to be used for sealing the cavities to the MOSTE.

The company operates the plant without discharging the mother liquor containing the impurities to the agricultural land, without burning firewood that could cause forest destruction, and without causing collapse on the ground. Such operation of the company has been highly evaluated as non-pollution plant operation. In 1994 the plant was selected by the MOI as a model plant and was awarded a citation of the Prime Minister.

<Appendices>

Appendix 1
Enhancement and Conservation of National Environmental Quality Act, B.E. 2535, A.D. 1992

Enhancement and Conservation of National Environmental Quality Act B.E. 2535, A.D.1992

BHUMIBOL ADULYADEJ, REX.Given on the 29th Day of March B.E. 2535, Being the 47th Year of the Present Reign

His Majesty King Bhumibol Adulyadej is graciously pleased to proclaim that：
Whereas it is deem expedient to reform and improve the law on enhancement and conservation of national environmental quality. Be it, therefore, enacted by the King, by and with the advice and consent of the National Legislative Assembly, acting as the National Assembly, as follows：

Section 1 This Act shall be called "The Enhancement and Conservation of National Environmental Quality Act, B.E. 2535"

Section 2 This Act shall come into effect after the elapse of a period of sixty days from the date following its publication in the Government Gazette.

Section 3 The following Acts shall be repealed ：

(1)The Enhancement and Conservation of National Environmental Quality Act, B.E. 2518.

(2)The Enhancement and Conservation of National Environmental Quality Act (No. 2), B.E.2521.

(3)The Enhancement and Conservation of National Environmental Quality Act (No. 3), B.E. 2522

Section 4 In this Act,

"Environment" means natural things which form the physical and biological conditions surrounding man and man-made things.

"Environmental Quality" means the balance of nature, being composed of animals, plants, natural resources and man-made objects which is for the benefit of subsistence of mankind and the sustenance of human-being and nature.

"Environmental Quality Standards" means the parameters of quality standards for water, air, noise and other conditions of the environment which are determined as the general criteria for enhancement and conservation of environmental quality.

"Fund" means the Environmental Fund.

"Pollutant" means wastes, hazardous substances and other polluting substances as well as residues, sediments or remainders of such matters, which are discharged from point sources of pollution or naturally occur in the environment, that have or are likely to have impacts on environmental quality or to cause conditions poisonous or harmful to the health and hygiene of the public, and shall mean to include radiation, heat, light, noise, odor, vibration or other nuisances emanated or discharged from point sources of pollution.

"Pollution" means the state or environment that has been affected, changed or contaminated by pollutants, resulting in deterioration of environmental quality, such as water pollution, air pollution, soil pollution.

"Point Source of Pollution" means any community, factory, building, structure, vehicle, place of business or activity or any other thing from which pollution is generated.

"Waste" means refuse, garbage, filth, dirt, wastewater, polluted air, polluting substances or any other hazardous substances which are discharged or originated from point sources of pollution, including residues, sediments or remainders of such matters, either in the state of solid, liquid or gas.

"Wastewater" means waste in liquid state including polluting or contaminating substances contained in such liquid.

"Polluted Air" means waste in gaseous state in the form of vapor, steam, exhaust, fume, odour, smoke, gas, dust, soot, ash or other polluting substances in the form of particulate matters that can be suspended in the atmospheric air.

"Hazardous Substance" means explosive substances, inflammable substances, oxidizing and peroxiding substances, toxic substances, pathogenic substances, radioactive substances, genetic transforming substances, corrosive substances, irritating substances, or other substances whether chemical or not, which may cause danger to human-being, animal, plant, property or the environment.

"Nuisance" means nuisance according to the law on public health.

"Factory" means factories according to the law on industrial plants.

"Building" means buildings according to the law on building control.

"Vehicle" means automobiles or motorcycles according to the law on automobiles, vessels according to the law on Thai vessels and aircrafts according to the law on aviation.

"Monitoring Control Operator" means the person licensed to monitor, control, assess, operate and maintain wastewater treatment or waste disposal facility, or equipment, instrument, tools, appliances for control, treatment or disposal of any other pollution, which the owner or possessor of point source of pollution manages to construct and bring into operation by his own investment and expenses for the treatment of wastewaters or disposal of wastes or any other pollutants.
"Service Contractor" means the person licensed to render for hire the services of wastewater treatment or waste disposal or monitoring of environmental quality.
"Conservation Area" means the areas designated as national parks, wildlife reserves, tourism preserve and other protected areas pursuant to the governing laws related thereto.
"Local Official" means
(1)President of the Municipal Council within a municipality.
(2)President of the Sanitary District Board within a sanitary district.
(3)Changwat Governor within a local administration organization.
(4)Governor of the Bangkok Metropolitan Administration within Bangkok Metropolis.
(5)Permanent Secretary of Pattaya City Administration within the City of Pattaya.
(6)Head of local administrator in the administration of the local administration organization other than (1) to (5) above, established by specific law governing thereof, within such local administration organization.
"Pollution Control Official" means the person appointed by the Minister to perform the functions concerning pollution control under this Act.
"Competent Official" means the person appointed by the Minister to have power and duty to take action under this Act.
"Minister" means the Minister of Science, Technology and Environment.

Section 5 In case any provision under this Act refers to Changwat or mandates the power and duty of the Changwat Governor, such reference or mandate shall denote the inclusion of Bangkok Metropolitan Administration or the power and duty of the Governor of Bangkok Metropolitan Administration, as may be the case.

Section 6 For the purpose of public participation in the enhancement and conservation of national environmental quality, the following rights and duties may be accorded to individual person as provided by this Act or governing law related thereto:

(1) To be informed and obtain information and data from the government service in matters concerning the enhancement and conservation of environmental quality, except the information or data that are officially classified as secret intelligence pertaining to national security, or secrets pertaining to the right to privacy, property rights, or the rights in trade or business of any person which are duly protected by law.
(2) To be remedied or compensated by the State in case damage or injury is sustained as a consequence of dangers arisen from contamination by pollutants or spread of pollution, and such incident is caused by any activity or project initiated, supported or undertaken by government agency or state enterprise.
(3) To petition or lodge complaint against the offender in case of being a witness to any act committed in violation or infringement of the laws relating to pollution control or conservation of natural resources.
(4) To co-operate and assist government officials in the performance of duty relating to the enhancement and conservation of environmental quality.
(5) To strictly observe the provisions of this Act or other laws concerning the enhancement and conservation of environmental quality.

Section 7 In order to encourage public participation in the promotion and conservation of environmental quality, non-governmental organizations (NGOs) having the status of a juristic person under Thai law or foreign law which are directly engaged in activities concerning environmental protection or conservation of natural resources without any objective to be involved in politics or to make profits from the engagement in such activities, shall be entitled to register with the Ministry of Science, Technology and Environment as the NGOs for environmental protection and conservation of natural resources in accordance with the rules, procedures and conditions prescribed by ministerial regulation.

Section 8 The NGOs that have been registered pursuant to section 7 may request for government assistance or support in the following matters :

(1) The organization of volunteers to assist in the performance of duty of government officials under this Act or other laws concerning the enhancement and conservation of environmental quality.
(2) Public relations campaign and dissemination of information or data to promote public awareness and

proper understanding and knowledge about environmental protection and conservation of nature and natural resources.

(3) Providing assistance to people in certain areas of the country to initiate projects or activities for environmental protection and conservation of natural resources in such areas.

(4) Conducting study and research in respect of environmental protection and conservation of natural resources and bringing to the attention of the Government or agencies concerned on what are the viewpoints and suggestions based upon the outcome of such study and research.

(5) Providing legal aid to people who are in jeopardy of or afflicted by pollution damage caused by leakage of pollutants or contamination as well as acting as representative of such pollution victims to bring lawsuit and litigate claim in court for compensation or damages to which they are entitled as legal remedies.

In case any registered NGOs, in the carrying out of activities indicated in the first paragraph, encounter problems or difficulties and request for help from the National Environment Board, the Prime Minister shall, with the recommendation of the National Environment board, have the power to direct for appropriate recourse or order the government agency or state enterprise concerned to render assistance or facilitation as seen fit under the circumstances.

The Fund Committee, with the approval of the National Environment Board, may consider to allocate grants or loans in support of any activity of the registered NGOs as deemed appropriate.

The registered NGOs may propose for nomination of candidates as representatives of the private sector to be appointed by the cabinet as qualified members of the National Environment Board.

In case any registered NGO's activities are undertaken by causing disturbances or contrary to public order or unsuitable, the Minister shall have the power to revoke the registration of the NGO involving in such activities.

Section 9 In case there is an emergency or public danger arising from natural disaster or pollution caused by contamination and spread of pollutants which will, if left without any remedial actions, seriously endanger the safety of life, body or health of the people, or aggravatedly cause damage to the properties of the people or the State, the Prime Minister shall have the power to order, as deemed appropriate, government agencies, state enterprises or any persons, including the persons who are or may be the victims of such danger or damage, to take prompt action, individually or jointly, in order to be able to control, extinguish or mitigate the adverse effects of such danger or damage. In case any polluters are known and can be identified, the Prime Minister shall be empowered to enjoin such persons from any acts which may aggravate the adverse effects of pollution during the occurrence of such endangering incident.

The Prime Minister may delegate the power to give orders pursuant to the first paragraph to the Changwat Governor to exercise such power and act on his behalf within the territorial jurisdiction of that Changwat. The said delegation of power shall be made by a written order and published in the Government Gazette.

When any order is given by the Prime Minister by virtue of the first paragraph, or by the Changwat Governor acting on behalf of the Prime Minister by virtue of the second paragraph, such order shall be published in the Government Gazette without delay.

Section 10 In order to prevent, remedy, extinguish or mitigate the emergency or danger of pollution envisaged by section 9, the Minister shall determine preventive measures and prepare a contingency plan to rectify the situation in advance.

Section 11 The Prime Minister and the Minister of Science, Technology and Environment shall have charge and control of the execution of this Act, insofar as it is concerned with their respective powers and duties conferred upon them under this Act.

The Minister of Science, Technology and Environment shall have the power to appoint pollution control officials and other competent officials, issue ministerial regulations prescribing fees not exceeding the rates attached hereto and prescribing other activities for the execution of this Act.

The Ministerial Regulations shall come into force upon their publication in the Government Gazette.

Chapter I National Environment Board

Section 12 There shall be a National Environment Board consisting of the Prime Minister as the Chairman, a Deputy Prime Minister designated by the Prime Minister as the first Vice Chairman, the Minister of Science, Technology and Environment as the second Vice Chairman, the Minister of Defense, the Minister of Finance, the Minister of Agriculture and Cooperatives, the Minister of Transport and Communications, the Minister of Interior, the Minister of Education, the Minister of Public Health, the Minister of Industry, the Secretary-General of the National Economic and Social Development Board, the Secretary-General of the Board of Investment, the Director of the Bureau of the Budget as members ex officio and members qualified in environmental matters not more than eight persons of which no less than half shall be representatives from the private sector and the Permanent Secretary of the Ministry of Science, Technology and Environment as member and secretary.

The appointment of qualified members shall be made by drawing from persons who are knowledgeable and known for their expertises, contributions and experiences in the matters concerning the enhancement and conservation of environmental quality.

Section 13 The National Environment Board shall have the power and duty as follows:

(1) To submit policy and plan for enhancement and conservation of national environmental quality to the cabinet for approval.

(2) To prescribe environmental quality standards pursuant to section 32.

(3) To consider and give approval to the Environmental Quality Management Plan proposed by the Minister according to section 35.

(4) To consider and give approval to the Changwat Action Plan for environmental quality management according to section 37.

(5) To make recommendations to the cabinet in respect of financial, fiscal, taxation and investment promotion measures for the implementation of the policy and plan for enhancement and conservation of national environmental quality.

(6) To propose for amendment or improvement of laws relating to the enhancement and conservation of environmental quality to the cabinet.

(7) To consider and give approval to the action plan for prevention and remedy of danger caused by contamination of pollutants or spread of pollution proposed by the Pollution Control Committee pursuant to section 53 (1).

(8) To consider and give approval to the setting of emission or effluent standards proposed by the Minister pursuant to section 55.

(9) To supervise, oversee and expedite the enactment of royal decrees and issuance of ministerial regulations, rules, local ordinances, notifications, bye-laws and orders which are necessary to ensure systematic operation of the laws relating to enhancement and conservation of environmental quality to the fullest extent possible.

(10) To submit opinion to the Prime Minister for his directions in case it appears that any government agency or state enterprise infringes or refrains from complying with the laws and regulations for environmental protection which may cause extensive damage to the environment.

(11) To specify measures for the strengthening and fostering of co-operation and co-ordination among government agencies, state enterprises and the private sector in matters concerning the promotion and conservation of environmental quality.

(12) To supervise the Fund management and administration.

(13) To submit reports on national environmental quality situation to the cabinet at least once a year.

(14) To perform other functions as may be provided by this Act or other laws to be within the authority of the National Environment Board.

Section 14 A qualified member appointed by the cabinet shall hold office for a term of three years and may be re-appointed for a period of not more than one consecutive term.

In case an additional appointment of qualified member is made during the term of those members who have already been appointed to hold office, the term of additional membership shall be equal to the remainder of the term of those members who have already been appointed before.

Section 15 In addition to the expiration of the term of office according to section 14, a qualified member appointed by the cabinet shall vacate office upon:

(1) Death;
(2) Resignation;
(3) Being a bankrupt;
(4) Being an incompetent or quasi-incompetent person;
(5) Being punished by a final judgment to a term of imprisonment except for an offence committed through negligence or a petty offence.
(6) Being dismissed by the cabinet for incompetence or misconduct or having vested interests in any activity or business that may have a direct impact on or adversely affect the environmental quality.

When a qualified member vacates office before the expiration of his term of office, the cabinet may appoint another person to fill the vacancy and such person shall hold office only for the remaining term of his predecessor.

Section 16 In convening the National Environment Board meeting, if the Chairman is absent or unable to perform the function, the first Vice Chairman shall act as the Chairman. If the Chairman and the first Vice Chairman are both absent or unable to perform the function, the second Vice Chairman shall act as the Chairman. If the Chairman and both the two Vice Chairmen are all absent or unable to perform the function, the members who attend the meeting shall elect one of the attending members to act as the chairman of the meeting.

Section 17 A meeting of the National Environment Board requires the presence of not less than one-half of the total member of its members to constitute a quorum.

The decision of a meeting shall be made by a majority of votes. In casting votes, each member shall have one vote. In case of an equality of votes, the Chairman of the meeting shall have an additional vote as a casting vote.

Section 18 The National Environment Board may appoint an expert committee or subcommittee to consider or carry out any matter as may be entrusted by the National Environment Board.

Section 16and section 17 shall apply mutatis mutandis to the meeting of the expert committee or subcommittee.

Section 19 The National Environment Board shall have the power to require government agencies, state enterprises and other persons to deliver documents relating to the examination of impacts on environmental quality and documents or data concerning the projects or workplans of such government agencies, state enterprises and persons for its consideration. For this purpose, the Board may, summon persons concerned to give explanation. If the Board is of the opinion that any project or workplan may seriously affect the environmental quality, it shall recommend remedial measures to the cabinet.

In case the documents or data required to be delivered to the National Environment Board pursuant to the first paragraph are relevant to trade secrets in the nature of a patent and protected by the law on. patent rights, the National Environment Board shall specify suitable measures and methods for preventing such documents or data from being disclosed to anyone to ensure that they shall only be used strictly for the purpose of this section.

Section 20 In the performance of its function, the National Environment Board, the expert committee or the sub-committee may invite any person to present facts, explanation, opinion or technical advice as it deems fit and may request co-operation from any person with a view to ascertaining any fact or surveying any activity which may have an adverse effect on environmental quality.

Section 21 In the performance of its duties under this Act, the National Environment Board may entrust the Office of Environmental Policy and Planning, the Pollution Control Department or the Environmental Quality Promotion Department under the Ministry of Science, Technology and Environment with the operation or preparation of propositions to be made to the National Environment Board for further actions.

Chapter II Environmental Fund

Section 22 There shall be established a fund called the "Environmental Fund" in the Ministry of Finance with the following moneys and properties :
(1) Money from the Fuel Oil Fund in the amount determined by the Prime Minister.
(2) Money transferred from the Revolving Fund for Environmental Development and Quality of Life established by the Annual Budget for the Fiscal Year of B.E. 2535 Act, B.E. 2535.
(3) Service fees and penalties collected by virtue of this Act.

(4) Grants from the Government from time to time.
(5) Moneys or properties donated by donors in the private sector both domestic and foreign, by foreign governments or by international organizations.
(6) Interest and benefits accrued from this Fund.
(7) Other moneys received for the operation of this Fund.

The Comptroller-General's Department, Ministry of Finance, shall keep the moneys and properties of the Environmental Fund and make disbursements from the fund in accordance with this Act.

Section 23 Fund disbursements shall be made for the following activities and purposes:
(1) As grants to government agency or local administration for investment in and operation of the central wastewater treatment plant or central waste disposal facility, including the acquisition and procurement of land, materials, equipment, instrument, tools and appliances necessary for the operation and maintenance of such facility.
(2) As loans to local administration or state enterprise for making available of air pollution control system, wastewater treatment or waste disposal facilities to be used specifically in the activities of such local administration or state enterprise.
(3) As loans to private person in case such person has the legal duty to make available and install an on-site facility of his own for the treatment of polluted air, wastewater or waste disposal or any other equipment for the control, treatment or eliminate pollutants that are generated by his activity or business undertaking, or such person is licensed to undertake business as a Service Contractor to render services of wastewater treatment or waste disposal under this Act.
(4) As aids or grants to support any activity concerning the promotion and conservation of environmental quality as the Fund Committee sees fit and with the approval of the National Environment Board.
(5) As expenditures for administering the Fund.

Section 24 There shall be a Fund Committee consisting of the Permanent Secretary of the Ministry of Science, Technology and Environment as the Chairman, the Permanent Secretary of the Ministry of Agriculture and Cooperatives, the Secretary-General of the National Economic and Social Development Board, the Director of the Bureau of the Budget, the Director-General of the Department of Local Administration, the Comptroller-General of the Comptroller-General's Department, the Director-General of the Department of Public Works, the Director-General of the Department of Industrial Works, the Director-General of the Department of Mineral Resources, the Director-General of the Pollution Control Department, the Director-General of the Environmental Quality Promotion Department and not more than five qualified persons appointed by the National Environment Board as members and the Secretary-General of the Office of Environmental Policy and Planning as member and secretary.

Section 14 and section 15 shall apply mutatis mutandis to the holding office of the qualified members of the Fund Committee.

Section 25 The Fund Committee shall have the power and duty as follows
(1) To consider on Fund allocation for use in the activities prescribed by section 23.
(2) To prescribe rules, conditions, procedures and methods concerning application for allocation or loan from the Fund.
(3) To lay down administrative rules and procedures concerning the power, duties and working methods of the Fund managers according to section 29 and section 30 as well as mechanisms for co-ordination among the Fund Committee, the Comptroller-General's Department and the Fund managers according to section 29 and section 30.
(4) To lay down rules and procedures for the receipt and disbursement of moneys from the Fund.
(5) To fix durations for repayment of loans from the Fund according to section 23 (2) or (3) as well as interest rates and securities as necessary and appropriate.
(6) To determine the ratio and criteria for deduction of service fees and penalties that are required by section 93 to be remitted to the Fund.
(7) To perform any other functions provided under this Act.

The prescription of rules according to sub-section (2), (3) or (4) and guidelines for action under sub-section (1) or (5) shall be approved by the National Environment Board.

The Fund Committee may appoint a subcommittee to consider or carry out any matter as may be entrusted by the Fund Committee.

Section 26 Section 16, section 17 and section 20 shall apply mutatis mutandis to the performance of

functions of the Fund Committee and the subcommittee appointed by the Fund Committee.

Section 27 In consideration to allocate money from the Fund for the purpose of section 23 (1), the Fund Committee shall give first priority to the request for allocation under the Changwat Action Plan for environmental quality management according to section 39 to construct or operate the wastewater treatment plant or waste disposal facility, for which certain amount of government budget has been earmarked or revenues of the local administration have been allocated as additional contributions to the Fund allocation.

The proportion between the government budget or contributions from the local revenues and the Fund allocation to be determined by the Fund Committee according to the first paragraph shall be determined in accordance with the rules laid down by the National Environment Board.

Section 28 The Fund allocation as loans to the local administration, state enterprise or private person pursuant to section 23 (2) or (3) shall be determined by the Fund Committee in accordance with the rules and conditions stipulated by the National Environment Board.

In order to encourage compliance with this Act, the Fund Committee may, with the approval of the National Environment Board, allocate from the Fund as an exceptional long-term loan to any local administration, state enterprise, or private person and may determine to reduce the interest rates or make exemption to the payment of such interest as deemed appropriate.

Section 29 The Comptroller-General of the Comptroller-General's Department, Ministry of Finance, shall be the Fund manager in relation to such portion of the Fund to be allocated as grants to the government agency or the local administration for investment in and operation of the central facility for wastewater treatment or waste disposal according to section 23 (1) and those portions of the Fund to be allocated for the purposes other than those provided by section 23 (2) and (3).

Section 30 The Fund Committee may authorize an appropriate financial institution owned by the State or the Industrial Financing Corporation of Thailand to be the Fund manager in relation to such portion of the Fund that will be allocated as loans to the local administration, state enterprise or private person pursuant to section 23 (2) or (3).

In carrying out the management of Fund according to the First paragraph, the Fund manager has the duty to study and analyze the investment and technical feasibility of the project and shall be empowered to enter the loan agreement on behalf of the Fund Committee in the capacity as the lender, to keep and disburse moneys to the borrowers from this portion of the Fund in accordance with the terms and conditions of the loan agreement, to pursue, demand and receive repayments and interest from the borrowers in order to pay back to the Fund, and shall be empowered to lay down rules and procedures, with the approval of the Fund Committee, for such matters.

Under the loan agreement to be entered into according to the second paragraph, there must be a condition stipulated as an essential element of the agreement that the borrower shall have the duty to make use of the loan specifically for the purpose of meeting the requirements with which the borrower has the legal duty to comply under this Act or other related laws.

Section 31 The moneys received into the Fund and kept by the Comptroller-General's Department, Ministry of Finance, shall be managed by deposit in saving or fixed accounts with State owned financial institutions in order to earn accrued interest.

All moneys earned by the Fund according to section 22 shall be paid into its account for the purpose of uses in the activities indicated in section 23 and shall not be remitted to the Treasury as revenues of the Government.

Chapter III Environmental Protection

Part 1 Environmental Quality Standards

Section 32 For the purpose of environmental quality enhancement and conservation, the National Environment Board shall have the power to prescribe by notifications published in the Government Gazette the following environmental quality standards:

(1) Water quality standards for river, canal, swamp, marsh, lake, reservoir and other public inland water sources according to their use classifications in each river basin or water catchment.

(2) Water quality standards for coastal and estuarine water areas.
(3) Groundwater quality standards.
(4) Atmospheric ambient air standards.
(5) Ambient standards for noise and vibration.
(6) Environmental quality standards for other matters.

The prescription of environmental quality standards pursuant to the foregoing paragraph shall be based upon scientific knowledge, principles, criteria and evidence related thereto and shall also take into account the practicability of such standards from the viewpoint of economic, social and technological considerations.

Section 33 The National Environment Board shall, if deemed reasonable, have the power to prescribe special standards, which are higher than the environmental quality standards prescribed pursuant to section 31, for the protection of areas designated as conservation or environmentally protected area according to section 42, or areas designated according to section 44, or pollution control areas designated pursuant to section 58.

Section 34 The National Environment Board shall have the power to make appropriate modifications and improvements to the prescribed environmental quality standards in the light of scientific and technological progresses and changes in economic and social conditions of the country.

Part 2 Environmental Quality Management Planning

Section 35 The Minister shall, with the approval of the National Environment Board, formulate an action plan called "Environmental Quality Management Plan" for implementation of the national policy and plan for enhancement and conservation of environmental quality determined by virtue of section 13 (1).

The Environmental Quality Management Plan pursuant to the first paragraph shall be published in the Government Gazette.

It shall be the duty of all government agencies concerned to take actions within their powers and functions that are necessary for effective implementation of the Environmental Quality Management Plan and in order to ensure that actions are taken to achieve the objectives and goals as prescribed, it shall be the duty of the Ministry of Science, Technology and Environment to give advice to government agencies and state enterprises which are concerned with the formulation of workplans or the taking of any actions with a view to implementing the Environmental Quality Management Plan.

Section 36 The Environmental Quality Management Plan pursuant to section 35 may be a short, intermediate or long-term plan, as appropriate, and should contain workplans and guidances for action in the following matters:

(1) Management of air, water and environmental quality in any other area of concerns.
(2) Pollution control from point sources.
(3) Conservation of natural environment, natural resources or cultural environment pertaining to aesthetic values.
(4) Estimation of financing to be appropriated from government budget and allocated from the Fund which is necessary for implementation of the Plan.
(5) Scheme for institutional arrangements and administrative orders by which co-operation and co-ordination among government agencies concerned and between the public service and private sector could be further promoted and strengthened, including the determination of a manpower allocation scheme which is required for implementation of the Plan.
(6) Enactment of laws and issuance of regulations, local ordinances, rules, orders and notifications necessary for implementation of the Plan.
(7) Scheme for inspection, monitoring and assessment of environmental quality by which the results of implementation of the Plan and enforcement of law related thereto can be evaluated objectively.

Section 37 After the Environmental Quality Management Plan has been published in the Government Gazette, it shall be the duty of the Governor of the Changwat, in which there is a locality designated as environmentally protected area according to section 43, or as pollution control area according to section 59, to formulate an action plan for environmental quality management at Changwat level and submit it to the National Environment Board for approval within one hundred and twenty days from the date on which the Governor of that Changwat is directed by the National Environment Board to prepare the Changwat action

plan for environmental quality management. If, however, there is a reasonable ground, the said duration may be extended as appropriate by the National Environment Board.

In preparing a Changwat Action Plan for the pollution control area according to section 59, the Governor shall incorporate into it the action plan for mitigation and elimination of pollution prepared by the local authority pursuant to section 60 and the local action plan shall form an integral part of the Changwat Action Plan.

In case there is any Changwat, in which no locality is designated as an environmentally protected area according to section 43, or as pollution control area according to section 59, that is nevertheless desirous to enhance and conserve the environmental quality within the limits of its territorial jurisdiction, the Governor of that Changwat may prepare a Changwat Action Plan, within the framework of and in conformity with the requirements of the Environmental Quality Management Plan, and submit it to the National Environment Board for approval.

Section 38 The Changwat Action Plan to be submitted to the National Environment Board shall be an action plan which proposes a system of integrated management of environmental quality in conformity with the guidance specified in the Environmental Quality Management Plan, taking into account the severity of the problems and economic, social and environmental conditions of that Changwat, and should address and contain essential elements in the following matters:

(1) Plan for control of pollution from point sources.

(2) Plan for procurement and acquisition of land, materials, equipment, tools and appliances which are essential for the construction, installation, improvement, modification, repair, maintenance and operation of central wastewater treatment plants or central waste disposal facilities belonging to government agency or local administration concerned.

(3) Plan for collection of taxes, duties and service fees for operation and maintenance of central wastewater treatment plants or central waste disposal facilities referred to in sub-section (2) above.

(4) Plan for inspection, monitoring and control of wastewaters and other waste matters which are discharged from point sources of pollution.

(5) Law enforcement plan for the prevention and suppression of violation or infringement of laws and regulations pertaining to pollution control and conservation of nature, natural resources and cultural environment pertaining to aesthetic values.

Section 39 The Changwat Action Plan for environmental quality management to be given first priority for the consideration of the National Environment Board must propose an estimate of budgetary appropriation and allocation from the Fund for the construction or procurement for the acquisition of a central wastewater treatment plant or a central waste disposal facility pursuant to section 38 (2). In case any Changwat is not ready to take steps for the procurement and acquisition of the central wastewater treatment plant or the central waste disposal facility, it may instead propose a plan to promote private investment in the construction and operation of wastewater treatment or waste disposal facilities in order to make available of such services within its jurisdiction.

The Changwat Action Plan to be prepared according to the first paragraph with a request for budgetary appropriation and allocation from the Fund shall be accompanied by drawings, plans, specifications and an estimated price of the project for construction, installation, improvement, modification, repair, maintenance as well as the process and method for operation of the proposed central wastewater treatment plant or central waste disposal facility.

For the purpose of approving the Changwat Action Plan with a request for budgetary appropriation in accordance with the first paragraph, the Office of Environmental Policy and Planning shall be responsible for the gathering and analysis of the Changwat Action Plans for environmental quality management in order to make a proposal for annual budgets of the Office to be earmarked specifically for this purpose.

Section 40 In case the management of environmental quality in any matters will have to be carried out in an area adjoining the territorial jurisdictions of two or more provinces due to the geographical conditions or the characteristics of the natural ecosystems of that area, or for the purpose of a sound, systematic and proper management in accordance with the principle of integrated management of environmental quality and natural resources, the Governors of the relevant provinces shall jointly prepare the action plan mandatory required by section

37.

Section 41 In case any Changwat, which is mandatory required to prepare the action plan according to section 37, fails or is incapable to evolve such a plan, or has prepared and submitted the plan as required but failed to get the approval of the National Environment Board for any reason, the National Environment Board shall consider the nature of the problems encountered by that Changwat and evaluate whether its environmental quality is adversely affected to such an extent that any action is warrant to rectify the situation. If action is deemed necessary, the National Environment Board shall propose to the Prime Minister to issue an order directing the Ministry of Science, Technology and Environment to prepare the Changwat Action Plan on behalf of the Changwat in question.

Part 3 Conservation and Environmentally Protected Areas

Section 42 Protection and management of areas within the limits of national parks and wildlife reserves shall be in accordance with the Environmental Quality Management Plan effective by virtue of section 35 and governed by the laws related thereto.

Section 43 In case it appears that any area is characterized as watershed area, or characterized by unique natural ecosystems which are different from other areas in general, or naturally composed of fragile ecosystems which are sensitive and vulnerable to destruction or impacts of human activities, or worthy of being conserved due to its natural or aesthetic values or amenities, and such area is yet to be designated as a conservation area, the Minister shall, with the advice of the National Environment Board, be empowered to issue ministerial regulation designating such area as an environmentally protected area.

Section 44 In issuing the ministerial regulation pursuant to section 43, any one or more of the following protective measures shall be prescribed thereunder:

(1) Land use prescriptions for preserving the natural conditions of such area or for preventing its natural ecosystems or its aesthetic values or amenities from being adversely impacted.

(2) Prohibition of any acts or activities that may be harmful or adversely affect or change the pristine state of the ecosystems of such area.

(3) Specifying types and sizes of projects or activities undertaken by government agencies, state enterprises or private entities, to be constructed or operated in such area, which shall have the legal duty to submit reports of environmental impact assessment.

(4) Determination of management approach and method specific to the management of such area including the scope of functions and responsibilities of relevant government agencies for the purpose of co-operation and co-ordination that are conducive to efficient performance of work towards the preservation of natural conditions or ecosystems or aesthetic values and amenities in such area.

(5) Prescriptions of any other protective measures which are deemed proper and suitable to the conditions of such area.

Section 45 In any area, despite having been designated as a conservation area, a master town and country plan area, a specific town and country plan area, a building control area, an industrial estate area pursuant to the governing laws related thereto, or designated as a pollution control area pursuant to this Act, but which nevertheless appears to have been adversely affected by environmental problems which assume a critical proportion to such an extent that an immediate action has become imperative and yet no action is taken by government agencies concerned to rectify the situation due to a lack of clear legal authorization or otherwise failure to do so, the Minister shall, with the approval of the National Environment Board, propose for a cabinet authorization to take any one or several protective measures provided by section 44, as necessary and appropriate, in order to control and solve the problems in such area.

When cabinet authorization is obtained as provided in the first paragraph, the Minister shall, by notification published in the Government Gazette, determine the limits of such area and prescribe in detail the protective measures and the duration for which such measures shall be effectively taken therein.

With the approval of the National Environment Board and the cabinet, the duration of effectiveness specified according to the second paragraph may be extended by notification published in the Government Gazette.

Part 4 Environmental Impact Assessment

Section 46 For the purpose of environmental quality promotion and conservation, the Minister shall, with the approval of the National Environment Board, have the power to specify, by notification published in the Government Gazette types and sizes of projects or activities, likely to have environmental impact, of any government agency, state enterprise or private person, which are required to prepare reports on environmental assessment for submission to seek approval in accordance with section 47, section 48 and section 49.

In the notification issued according to the first paragraph, procedures, rules, methods and guidelines shall be laid down for the preparation of environmental impact assessment report for each type and size of project or activity, including related documents that are required to be filed together with the report.

In case there has been an environmental impact assessment concerning project or activity of any particular type or size, or site selection for such project or activity in any particular area and such assessment can be used as a standard assessment applicable to the project or activity of the same type or size or to the site selection of such project or activity in the area of similar nature, the Minister may, with the approval of the National Environment Board, issue a notification in the Government Gazette exempting such project or activity of the same or similar nature from the requirement of environmental impact assessment, provided that the proponent of such project or activity shall express its consent to comply with various measures prescribed in the environmental impact assessment report which is applicable as the standard for assessment of such project or activity in accordance with the rules and methods specified by the Minister.

Section 47 In case the project or activity which is required to prepare the environmental impact assessment according to section 46 is the project or activity of a government agency or of a state enterprise or to be jointly undertaken with private enterprise which is required the approval of the cabinet in accordance with official rules and regulations, the government agency or state enterprise responsible for such project or activity shall have the duty to prepare the environmental impact assessment report at the stage of conducting a feasibility study for such project, such report shall be filed with the National Environment Board for its review and comments and then submitted to the cabinet for consideration.

In considering to give approval to the environmental impact assessment report filed according to the first paragraph, the cabinet may as well request any person or institution, being an expert or specialized in environmental impact assessment, to study and submit report or opinion for its consideration thereof.

For project or activity of government agency or state enterprise which is not required to be approved by the cabinet according to the first paragraph, the government agency or state enterprise responsible for such project or activity shall prepare and file the environmental impact assessment report in order to obtain approval prior to the initiation of such project or activity in accordance with the rules and procedures as provided by section 48 and 49.

Section 48 In case the project or activity which is required by section 46 to prepare the environmental impact assessment report is the project or activity which is required by law to obtain permission prior to construction or operation, the person applying for the permission shall have the duty to file the environmental impact assessment report with the permitting authority under such law and with the Office of Environmental Policy and Planning simultaneously. The report to be filed as aforesaid may be made in the form of an initial environmental examination (I.E.E.) in accordance with the rules and procedures determined by the Minister pursuant to section 46, second paragraph.

The official who is legally authorized to grant permission shall withhold the granting of permission for the project or activity referred to in the first paragraph until having been notified by the Office of Environmental Policy and Planning of the result of consideration pertaining to the review of the environmental impact assessment report in accordance with section 49.

The Office of Environmental Policy and Planning shall examine the environmental impact assessment report and related documents filed therewith. If it is found that the report as filed is not correctly made in accordance with the rules and procedures specified by virtue of section 46, second paragraph, or the accompanied documents and data are incomplete, the Office of Environmental Policy and Planning shall notify the person applying for permission who files the report within fifteen days from the date of receiving such report.

In case the Office of Environmental Policy and Planning finds that the environmental impact assessment report together with related documents as filed is duly made and completed with the data as required, or has been duly amended or modified in accordance with the foregoing third paragraph, it shall review and make preliminary comments on the report within thirty days from the date of receiving such report in order that the report together with the preliminary comments shall be referred to the committee of experts for further consideration.

The appointment of the committee of experts according to the foregoing fourth paragraph shall be in accordance with the rules and procedures determined by the National Environment Board. The committee shall be composed of expert members who are qualified or specialized in various fields of related disciplines and the authority legally competent to grant permission for the given project or activity under review, or its representative, shall be included in its membership.

Section 49 The review and consideration by the committee of experts according to section 48 shall be carried out within forty-five days from the date of receiving the environmental impact assessment report from the Office of Environmental Policy and Planning. If the committee of experts fails to conclude its review and consideration within the said period, the report shall be deemed to have been approved by it.

In case the committee of experts approves or is deemed to have given approval to the report, the official legally empowered to grant permission shall accordingly order that the permission be granted to the person who applies for it.

In case approval of the report is denied by the committee of experts, the permitting authority shall withhold the granting of permission to the person applying for it until such person will resubmit the environmental impact assessment report that has been amended or entirely redone in conformity with the guidelines and detailed requirements determined by the order of the committee of experts.

When such person has resubmitted the environmental impact assessment report that has been amended or entirely redone, the committee of experts shall review and conclude its consideration within thirty days from the date of receiving the resubmitted report, If the committee of experts fails to conclude its review and consideration within the said period, it shall be deemed that the committee has approved the report and the permitting authority shall accordingly grant permission to the person who applies for it.

In case it is deemed reasonable the Minister may issue notification in the Government Gazette requiring that the project or activity of the type and size specified by the notification issued by virtue of section 46 also file the environmental impact assessment report when the application is made for renewal of permission for such project or activity in accordance with the same procedures as applicable to the application for the permission.

Section 50 For the purpose of review and consideration of the environmental impact assessment report pursuant to section 48 and section 49 and site inspection is deemed appropriate, the committee of experts or the competent official assigned by the committee shall be authorized to inspect the site of the project or activity identified in the report for which approval thereof is sought.

When the committee of experts has approved the environmental impact assessment report pursuant to section 49, the official who is legally competent to grant permission or the renewal of permission shall stipulate as the conditions of permission or renewal thereof all the mitigation measures proposed in the environment impact assessment report and all such conditions shall be deemed the conditions prescribed by virtue of the governing laws on the subject matter.

Section 51 For the purpose of compliance with section 47 and section 48, the Minister may, with the approval of the National Environment Board, require that the environmental impact assessment report as required by section 46 be prepared or certified by the person who is licensed to be a specialist in environmental impact assessment.

Application and issuance of license, qualifications of specialists who will be eligible to prepare environmental impact assessment reports, control of the licensee's performance, renewal of license, issuance of certificate in lieu of the license, suspension or revocation of the license and fee payments for the application and issuance of license shall be in accordance with the rules, procedures and conditions stipulated by ministerial regulation.

Chapter IV Pollution Control

Part 1 Pollution Control Committee

Section 52 For the purpose of pollution control under this Act, there shall be a committee called the "Pollution Control Committee" (PCC) which consists of the Permanent Secretary of the Ministry of Science, Technology and Environment as the Chairman, the Director-General of the Department of Local Administration, the Director-General of the Police Department, the Director-General of the Department of Land Transport, the Director-General of the Harbor Department, the Director-General of the Department of Public Works, the Director-General of the Department of Mineral Resources, the Director-General of the Department of Industrial Works ' the Director-General of the Health Department, the Director-General of the Department of Agriculture, the Director-General of the Department of Environmental Quality Promotion, the Secretary-General of the Office of Environmental Policy and Planning, the Permanent Secretary for the Bangkok Metropolitan Administration and not more than five qualified persons appointed by the National Environmental Board as members and the Director-General of the Department of Pollution Control as member and secretary.

Section 14 and section 15 shall apply mutatis mutandis to the holding office of the qualified members in the Pollution Control Committee.

Section 53 The Pollution Control Committee shall have the power and duty as follows:

(1)To submit an action plan for prevention or remedy of pollution hazards or contamination to the National Environment Board.

(2)To give opinion and recommend the National Environment Board on proposed amendments to or improvement of any laws concerning the control, prevention, reduction or eradication of pollution.

(3)To propose incentive measures regarding taxation and private, investment promotion in relation to pollution control and promotion and conservation of environmental quality to the National Environment Board.

(4)To recommend the National Environment Board on the determination of service fee rates for the central waste water treatment or central waste disposal services of the government.

(5)To give advice to the Minister on the setting of emission or effluent standards under section 55.

(6)To give advice to the Minister concerning the types of point sources of pollution that will be required to comply with section 68 and section 69.

(7)To make recommendation on the issuing of ministerial regulations specifying the types and categories of hazardous wastes under section 79.

(8)To coordinate government agencies, state enterprises and the private sector in their actions to control, prevent, mitigate or eradicate pollution.

(9)To prepare and submit the report on pollution situation to the National Environment Board once a year.

(10)To consider and resolve on the challenge to the order of the pollution control official under this Act.

(11)To perform other functions designated by this Act or other law to be the power and duty of the Pollution Control Committee.

(12)To carry out other matters assigned by the National Environment Board.

The Pollution Control Committee may appoint a subcommittee to consider or carry out any matter as may be assigned by the Pollution Control Committee.

Section 54 Section 16, section 17 and section 20 shall apply mutatis mutandis to the performance of functions of the Pollution Control Committee and subcommittee.

Part 2 Emission or Effluent Standards

Section 55 The Minister shall, with the advice of the Pollution Control Committee and the approval of the National Environment Board, have the power to publish notification in the Government Gazette prescribing emission or effluent standards for the control of wastewater discharge, polluted air emissions, or discharge of other wastes or pollutants from point sources into the environment, in order to meet the environmental quality standards set by virtue of this Act for the conservation of national environmental quality.

Section 56 In case there have been standards prescribed by virtue of the other laws concerning wastewater discharges, polluted air emissions, or discharge of other wastes or pollutants

from point sources of pollution into the environment and such standards are no less stringent than the emission or effluent standards set by the Minister by virtue of section 55, such standards shall continue to be effective by virtue of the laws related thereto. If however, such standards are less stringent than the emission or effluent standards set by the Minister pursuant to section 55, the government agencies empowered by such laws shall amend such standards in conformity with the emission or effluent standards under this Act. If there is any obstacle preventing from doing so, the National Environment Board shall resolve on such matter and the government agencies concerned shall act in accordance with such resolution.

Section 57 In case any government agency is empowered by the other law to prescribe emission or effluent standards in any matter, but that government agency fails to exercise its power, the Minister shall, with the recommendation of the Pollution Control Committee and with the approval of the National Environment Board, publish notification in the Government Gazette prescribing the emission or effluent standards in question and such standards shall be deemed to have been set by the governing law on such matter.

Section 58 If it is deemed reasonable, the Changwat Governor shall have the power to publish notification in the Government Gazette prescribing a special set of emission or effluent standards applicable to the pollution control area designated by section 59, higher than the standards set pursuant to section 55 or the standards set by virtue of other law which remain in force according to section 56.

Part 3 Pollution Control Area

Section 59 In case it appears that any locality is affected by pollution problems and there is a tendency that such problems may be aggravated to cause health hazards to the public or adverse impact on the environmental quality, the National Environment Board shall have power to publish notification in the Government Gazette designating such locality as a pollution control area in order to control, reduce and eliminate pollution.

Section 60 For the purpose of the Changwat Action Plan for environmental quality management to be prepared according to section 37, the local official in the locality designated as the pollution control area pursuant to section 59, shall prepare and submit an action plan for reduction and eradication of pollution in such area to the Changwat Governor in order to incorporate such plan into the Changwat Action Plan for environment quality management.

In preparing the action plan for reduction and eradication of pollution, steps shall be taken as follows：

(1) to survey and collect data concerning point sources of pollution located within the limits of that pollution control area.

(2) to make an inventory showing the number, type and size of point sources of pollution under survey and collection of data according to (1) above.

(3) to study, analyze and assess the state of pollution, as well as the scope, nature, severity of the problem and impacts on environmental quality in order to specify suitable and necessary measures for mitigation and eradication of pollution in that pollution control area.

The pollution control official shall give advice and assistance to the local official necessary for the preparation of the action plan to reduce and eradicate pollution according to the first and second paragraphs.

Section 61 The action plan for reduction and eradication of pollution in the pollution control area under section 60 shall propose the estimation and request for government budget and Fund allocations for construction or operation of the central wastewater treatment plant or the central waste disposal facility necessary to reduce and eradicate pollution in that pollution control area.

Section 62 In case it is necessary to acquire a piece of land to be used as the site of the central wastewater treatment or central waste disposal facility for any pollution control area but state-owned land is not available, steps shall be taken to select and acquire land for the siting purpose. If there are expenses, the estimate and request for government budget and Fund allocation shall be made in the Changwat Action Plan.

If it is unable to proceed under the first paragraph, suitable land shall be selected and proposed to the Minister in order to take steps to expropriate such land in accordance with the law on expropriation of immovable property.

Section 63 The Changwat Governor shall supervise and oversee the local official's actions under section 59. If no action is taken by the local official within a reasonable time, the Changwat Governor shall have the power to take action on behalf of the local authority upon notification to such local authority and the National Environment Board.

Part 4 Air and Noise Pollution

Section 64 Usable vehicle shall conform to the emission standards prescribed for such vehicle pursuant to section 55.

Section 65 If it is found that the use of any vehicle is in violation of section 64, the competent official shall have the power to prohibit the use of such vehicle permanently or until it will have been modified or improved to meet the emission standard requirements prescribed pursuant to section 55.

Section 66 In issuing the order prohibiting to use of vehicle according to section 65, the competent official shall make the sign clearly shown by the words "Use Prohibited Permanently" or "Use Prohibited temporarily" or any other sign, known and understood by the general public to have the same meaning, on any part of such vehicle.

The making or removal of the sign under the first paragraph, or the use of vehicle while the said sign is on, shall be in accordance with the rules, methods and conditions specified in the ministerial regulation.

Section 67 In performing his duty under section 65, the competent official has the power to stop and inspect the vehicle, enter into the vehicle or to do any act necessary to check and test the engine and equipment of such vehicle.

Section 68 The Minister shall, with the advice of the Pollution Control Committee, have the power to publish notification in the Government Gazette specifying the types of point sources of pollution that shall be controlled in regard to the emission of polluted air, ray, or other pollutants, in the form of smoke, fume, gas, soot, dust, ash, particle or any other form of air pollutant, to the atmosphere, in conformity with the emission standards prescribed under section 55, or standards prescribed by any government agency by virtue of the other law which remain in force according to section 56, or standards set by the Changwat Governor in special case for the pollution control area according to section 58.

The owner or possessor of the point source of pollution under the first paragraph has the duty to install or bring into operation an on-site facility for air pollution control, equipment or other instrument as determined by the pollution control official in order to control, dispose, reduce or eliminate pollutants which may affect the air quality, unless such facility, equipment or instrument has already been in place and still in a working condition upon the inspection and test by the pollution control official. For the purpose of this section, the pollution control official may also require that the operation of such facility, equipment or instrument be controlled by the Monitoring Control Operator.

The provisions of the first and second paragraphs shall apply mutatis mutandis to the point source of pollution which emit or generate noise or vibration in excess of the emission standards set pursuant to section 55, or the standards set by any government agency by virtue the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Part 5 Water Pollution

Section 69 The Minister shall, with the advice of the Pollution Control Committee, have the power to publish notification in the Government Gazette specifying the types of point sources of pollution that shall be controlled in regard to the discharge of wastewaters or wastes into public water sources or into the environment outside the limits of such point sources, in conformity with the effluent standards set pursuant to section 55, or the standards set by any government agency by virtue of the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Section 70 The owner or possessor of the point source of pollution under section 69 has the duty to construct, install or bring into operation an on-site facility for wastewater treatment or waste disposal as determined by the pollution control official. For this purpose, the

pollution control official may also require that such owner or possessor commission a Monitoring Control Operator to control the wastewater treatment or waste disposal facility that shall be constructed, installed or brought into operation accordingly.

If any point source of pollution has had an on-site facility for wastewater treatment or waste disposal before the date of notification of the Minister under section 69, the owner or possessor of such point source of pollution shall inform the pollution control official to check the functioning system of the facility. If its capability to treat wastewaters or dispose of wastes fails to meet the applicable standards, the owner or possessor has the duty to modify or improve it in conformity with the pollution control official's directions.

Section 71 In any pollution control area or locality where a central wastewater treatment plant or a central waste disposal facility has been brought into operation by the administration concerned, the owner or possessor of the point source of pollution according to section 70, first paragraph, who has not yet constructed, installed or brought into operation the on-site facility for wastewater treatment or waste disposal according to the prescription of the pollution control official, or may not want to construct or make arrangements for such a system, shall have the duty to send the wastewaters or wastes generated by his activities to the central wastewater treatment plant or central waste disposal facility in the pollution control area or in that locality for treatment or disposal and shall have the duty to pay the service fees at the rates fixed by virtue of this Act or the other related laws.

Section 72 In any pollution control area or locality where the central waste water treatment plant or central waste disposal facility has been brought into operation by the administration concerned, the owner or possessor of any point source of pollution, except those under section 69, shall have the duty to send wastewaters or wastes from his source of pollution to the central waste water treatment plant or the central waste disposal facility in that pollution control area or locality for treatment or disposal and shall have the duty to pay service fees at the rates fixed by virtue of this Act or the other related laws, except such point source of pollution has already had its own wastewater treatment or waste disposal facility which is capable to meet the standards prescribed under this Act.

Section 73 No person shall be employed as a Monitoring Control Operator or as a Service Contractor, who renders for hire the services of wastewater treatment or waste disposal, without obtaining the license from the local official.

Application and issuance of license, qualifications of the applicant, control of the licensee's performance, renewal of license, issuance of certificate in lieu of the license, suspension or revocation of the license and fee payments for the application and issuance of license shall be in accordance with the rules, procedures and conditions stipulated by ministerial regulation.

The person who has obtained a license to be a Service Contractor shall also be deemed to have obtained a license to be a Monitoring Control Operator.

In rendering the services of wastewater treatment or waste disposal by the Service Contractor according to the first paragraph, the service charges shall not exceed the rates fixed by the ministerial regulation.

Section 74 In any pollution control area or locality where the central wastewater treatment or central waste disposal facility of the public service is yet to be put into operation, but there is nonetheless a Service Contractor who is licensed to render such services within that area, the owner or possessor of the point source of pollution according to section 70 and section 71 shall be required to send the wastewaters or wastes from his point source for treatment or disposal by such Service Contractor in accordance with the rules, regulations, methods and conditions prescribed by the local official, with the advice of the pollution control official.

Section 75 In any pollution control area or locality where the central wastewater treatment or central waste disposal facility is yet to be put into service by the government and there is no licensed Service Contractor rendering services therein, the local official may, with the advice of the pollution control official, determine a temporary method necessary for the treatment of wastewaters or disposal of wastes from point sources of pollution under section 70 and section 71 until the central wastewater treatment or central waste disposal facility will have been constructed, installed and put into operation within such pollution control area or locality.

The temporary method for wastewater treatment or waste disposal according to the first paragraph shall mean to include the collection, transport or conveyance of wastewaters or wastes by whatever appropriate means to be treated or disposed by the central wastewater treatment plant or central waste disposal facility of the government in the other area; or to allow the licensed Service Contractor rendering services in the other area to render the same services in that pollution control area or locality temporarily; or to allow such licensed Service Contractor to collect and transport wastewaters or wastes to treat or dispose by his own wastewater treatment or waste disposal facility located outside that pollution control area or locality.

Section 76 Wastewaters treated by either the central wastewaters treatment plant of the government or by the wastewater treatment facility of the Service Contractor must also have the properties which meet the requirements of the effluent standards prescribed by virtue of section 55, or the standards prescribed by virtue of the other law which remain in force according to section 56, or the standards set by the Changwat Governor in special case for the pollution control area according to section 58.

Section 77 The government agency or the local authority which makes provision for the services of central wastewater treatment or central waste disposal facilities by using government budget, or revenues of the local authority, and Fund allocations under this Act shall be responsible for the management and control of such facilities. In this respect, the responsible agency or local authority may employ a licensed Service Contractor under this Act to manage and control the operation of such facilities.

Regulations, rules and methods for conveyance, collection and transport of wastewaters or wastes from the point sources of pollution to the central wastewater treatment plant or central waste disposal facility as well as prescriptions, prohibitions, restrictions and other conditions for discharging and draining of wastewaters or wastes from factories and other point sources of pollution under section 72 into the systems of central wastewater treatment or central waste disposal facilities shall be prescribed by the ministerial regulation.

Part 6 Other Pollution and Hazardous Waste

Section 78 The collection, transport and other arrangements for the treatment and disposal of garbage and other solid wastes; the prevention and control of pollution from mining both on land and in the sea; the prevention and control of pollution from the exploration and drilling for oil, natural gas and all kinds of hydrocarbon both on land and in the sea; and the prevention and control of pollution resulting or originated from the discharge of oil and the dumping of wastes and other matters from sea-going vessels, tankers, and other types of vessel, shall be in accordance with the governing laws related thereto.

Section 79 In case there is no specific law applicable thereto, the Minister shall, with the advice of the Pollution Control Committee, have the power to issue ministerial regulation specifying the types and categories of hazardous wastes generated from the production and usage of chemicals or hazardous substances in the production process of industry, agriculture, sanitation and other activities which shall be brought under control. For this purpose, rules, regulations, measures and methods must also be prescribed for the control of collection, storage, safety measures, transportation, import into the Kingdom, export out of the Kingdom, and for proper and technically sound management, treatment and disposal of such hazardous wastes.

Part 7 Monitoring, Inspection and Control

Section 80 The owner or possessor of the point source of pollution, required by virtue of section 68 or section 70, to have his own facility for treatment of polluted air, equipment or instrument for control of the discharge of polluted air or other pollutants or the wastewater treatment or waste disposal facility, shall have the duty to collect statistics and data showing the daily functioning of the said facility or equipment and instrument, and make detailed notes thereof to be kept as recorded evidence at the site of that point source of pollution, and shall submit report summarizing the functioning results of the facility, equipment or instrument to the local official of the locality where such point source is situate at least once a month.

The collection of statistics and data, the making of notes and reports shall be in accordance with the rules, procedures, methods and format specified by ministerial regulation.

In case the facility for treatment of polluted air, wastewaters or waste disposal or equipment and instrument indicated in the first paragraph requires a Monitoring Control Operator as determined by the pollution control official, the Monitoring Control Operator shall have the duty to act under the first paragraph on behalf of the owner or possessor.

The Service Contractor licensed to render wastewater treatment or waste disposal services shall have the duty to do the same as the owner or possessor of the point source of pollution is required under the first paragraph.

Section 81 The local official shall gather the reports received according to section 80 and send them to the pollution control official, who has jurisdiction over that locality, on a regular basis at least once a month. In doing so, the local official may make comments for consideration of the pollution control official.

Section 82 In order to perform his functions under this Act, the pollution control official is empowered as follows:

(1) To enter into the building, place and site of the factory or point source of pollution or the site of wastewater treatment or waste disposal facility which belongs to any person, between the sun rise and sun set or during the working hours, to inspect the functioning process of wastewater treatment or waste disposal facility, air pollution control system or equipment and other instrument for the control of polluted air or other pollutants, as well as to examine the notes, statistics or data on the functioning of the said facility, equipment and instrument, or when there is a reasonable suspicion that there is a non-compliance with this Act.

(2) To issue an order in writing directing the owner or possessor, the Monitoring Control Operator, or the licensed Service Contractor rendering the services of wastewater treatment or waste disposal, to correct, change, improve or repair the air pollution control, wastewater treatment or waste disposal facility or other equipment and instrument for the control of polluted air or other pollutants. If however, the point source of pollution is a factory, the official under the law on industrial plants shall be notified to take action within his power and duty. If such official fails to do so, the pollution control official shall have the power to take action in accordance with this Act.

(3) To issue a written order directing the owner or possessor of the point source of pollution which is not a factory to pay penalties as provided under section 90, section 91 or section 92. If the point source of pollution is a factory the official under the law on industrial plants shall be notified to order the owner or possessor of such factory to pay the penalties and, in doing so, such official under the law on industrial plants shall be deemed to be the pollution control official under this Act. If, however, such official fails to issue the penalty order within a reasonable time, the pollution control official shall then have the power to issue the order directing the owner or possessor of such factory to pay the penalties.

(4) To issue a written order directing the Service Contractor licensed to render the services of wastewater treatment or waste disposal to stop or shut down his services, or revoking his license in case such Service Contractor violates or does not comply with this Act, or any ministerial regulation, local ordinance, rule, notification or condition issued or stipulated by virtue of this Act, or does not comply with the order of the pollution control official issued by virtue of this Act.

(5) To issue a written order suspending the Monitoring Control Operator under section 68 or section 70 in case such Monitoring Control Operator violates or does not comply with this Act, or any ministerial regulation, local ordinance, rule, notification, or condition issued or stipulated by virtue of this Act, or does not comply with the order of the pollution control official issued by virtue of this Act.

Section 83 In case it is deemed reasonable in the interest of co-ordination of action among agencies concerned, the pollution control official may:

(1) Recommend the official who has the legal power to control the point source of pollution, to close down its operation, to suspend or revoke the license of its owner or operator, or to bar its use or utilization in any way, especially in connection with the point source of pollution under section 68, section 69 or section 74 which has no intention to treat the polluted air, wastewaters or other wastes and illegally discharges the untreated wastes into the environment outside the limits of its site and premise.

(2) Recommend the local official to take legal action against the owner or possessor of the point source of pollution under section 71 or section 72 in order to coerce him to send wastewaters or wastes to be treated or disposed in accordance with this Act.

(3) Give advice and suggestions to the local official or the government agency concerned in connection with the operation and maintenance of the central wastewater treatment plant or the central waste disposal facility under the responsibility of such local official or government agency.

Section 84 In the performance of duty under this Act, the competent official or the pollution control

official must produce his identity card at the request of the person concerned.

The identity card of the competent official and pollution control official shall be in such a form as prescribed in the ministerial regulation.

Section 85 The owner or occupier of premises, vehicles or any person concerned shall facilitate the performance of duty under this Act by the competent official or the pollution control official who shall be official under the Penal Code.

Section 86 The performance of duty by the competent official under section 50, first paragraph, or section 65 and the performance of duty by the pollution control official under section 82 (1) shall be done in the presence of the owner or occupier of the premise or vehicles; if such person cannot be found, it shall be done in the presence of at least two other persons requested by the competent official or the pollution control official to attend as witnesses.

Section 87 The owner or possessor of the point source of pollution, the Service Contractor licensed to render services of wastewater treatment or waste disposal, the Monitoring Control Operator or any other person who is not satisfied with the order of the pollution control official under section 82 (2), (3), (4) or (5), is entitled to challenge such order by petition to the Pollution Control Committee within thirty days form the date of receiving the order of the pollution control official.

If the petitioner does not agree with the decision of the Pollution Control Committee, he shall appeal to the Minister within thirty days from the date of receiving notification of the Pollution Control Committee's decision.

The decision of the Minister shall be final.

Part 8 Service Fee and Penalty

Section 88 In any pollution control area or locality where a central wastewater treatment plant of a central waste disposal facility has been constructed and brought into operation as a public utility service, funded by government budget or revenue of the local administration and money allocated from the Fund as provided in this Act, the National Environment Board shall, with the advice of the Pollution Control Committee, fix the rates of service fee to be applicable within the limits of each pollution control area or locality, being the site of and served by the operation of such facility.

The service fee rates fixed according to the foregoing first paragraph shall be notified and published in the Government Gazette.

Section 89 The rates of service fee fixed according to section 88 for treatment of wastewaters or for disposal of wastes emanated from point sources pursuant to section 71 and section 72 may be varied as appropriate.

The owner or possessor of the point source of pollution governed by the provision of section 72, in the category of domestic household, that can be classified as a small-scale user is entitled to be exempted from the payment of service fees in accordance with the rules and conditions stipulated by the National Environment Board, with the advice of the Pollution Control Committee.

Section 90 Any owner or possessor of point source of pollution who avowedly refrains from sending wastewaters or wastes to the central wastewater treatment plant or the central waste disposal facility as required by section 71 or section 72 and illegally discharges such wastewaters or wastes into the environment outside the limits of the site of the point source owned or possessed by him, or does send the wastewaters or wastes to the central wastewater treatment plant or the central waste disposal facility of the public service for treatment but fails or refuses to make payment for the service fees without being entitled to the exemption as provided by section 89, second paragraph, shall be liable to pay as a penalty four time as much the amount of service fee that he is liable to pay at the rate fixed in accordance with section 88 until the provision of this Act is observed by him.

Section 91 Any owner or possessor of the point source of pollution, required by section 70 to have an on-site facility for wastewater treatment or waste disposal, who illegally discharges wastewaters or wastes into the central wastewater treatment plant or the central waste disposal facility of the public service, shall be liable to pay as a daily penalty four time as much the amount of daily expenses for the normal operation of his on-site facility for wastewater treatment or waste disposal throughout the duration of such illegal discharge and shall also be liable to pay damages if such illegal discharge has caused any damage or

defection to the central wastewater treatment plant or the central waste disposal facility of the public service.

Section 92 Any owner or possessor of the point source of pollution subject to the requirements of section 68 or section 70, who refrains from using his on-site facilities or equipment for the control of air pollution, noise pollution and vibrations, or refrains from operating his on-site facilities for the treatment of wastewaters or disposal of wastes and illegally discharges such untreated wastewaters or wastes into the environment outside the limits of the site of the point source of pollution, shall be liable to pay as a daily penalty four time as much the amount of daily expenses for the normal operation of his facilities, equipment or process for wastewater treatment or waste disposal throughout the duration of such illegal discharge.

Section 93 The local authority or the competent official of the government agency responsible for the operation of the public wastewater treatment plant or waste disposal facility shall have the power and duty to collect service fees, penalties and claim for damages as provided in this Part, particularly in connection with the operation of the central wastewater treatment plant or the central waste disposal facility of the public service which is made available by such local authority or government agency.

The service fees and penalties collectable in accordance with the foregoing first paragraph shall be exempted from being remitted to the Treasury as government revenues, but shall be deducted and remitted to the Fund at the ratio specified by the Fund Committee, whereas the balance therefrom shall be used as expenditures for operation and maintenance of the central wastewater treatment plant or the central waste disposal facility of the local authority or government agency which is responsible to collect such service fees and penalties.

Chapter V Promotional Measures

Section 94 The owner or possessor of any point source of pollution, who has the duty according to this Act or other related laws to install an on-site facility for treatment of polluted air or wastewaters or for disposal of any other wastes, including the procurement of equipment, instrument, tools, appliances or materials necessary for control of pollution from such point source, or the Service Contractor licensed pursuant to this Act, is entitled to request for promotional supports and assistance from the government service in the following matters:

(1) Request for assistance regarding import duties for the import into the Kingdom of necessary machinery, equipment, instrument, tools, appliances or materials which are not available in the Kingdom.

(2) Application for permission to bring foreign experts or specialists into the country to carry out works concerning the installation, monitoring, control or operation of air pollution control systems, wastewater treatment works or waste disposal facilities in case qualified persons within the Kingdom are not available for recruitment and commissioning to supervise and control machinery, equipment, instrument or tools imported into the Kingdom pursuant to sub-section (1), including application for exemption of income tax that will incur from the performance of work as a supervisor of such person within the Kingdom.

The owner or possessor of the point source of pollution who has no legal duty as referred to in the foregoing first paragraph, but nonetheless wishes to install an on-site facility with his own equipment, instrument, tools or appliances for air pollution control, wastewater treatment or for disposal of other wastes emanated from his activities or business undertakings, is also entitled to request for promotional supports and assistance from the government service in accordance with the foregoing first paragraph.

Section 95 The request for promotional supports and assistance according to section 94 shall be made to the National Environment Board in accordance with the rules, procedures, methods and formats prescribed by ministerial regulation.

The National Environment Board shall consider and proceed with the request for promotional supports and assistance according to the foregoing first paragraph as it sees fit, taking into account the economic, financial and investment necessities of each individual applicant. In case it is considered appropriate to give assistance to the applicant, the National Environment Board shall recommend the government agencies concerned to act within their powers and functions to render promotional supports and assistance to the

applicant accordingly.

Chapter VI Civil Liability

Section 96 If leakage or contamination caused by or originated from any point source of pollution is the cause of death, bodily harm or health injury of any person or has caused damage in any manner to the property of any private person or of the State, the owner or possessor of such point source shall be liable to pay compensation or damages therefor, regardless of whether such leakage or contamination is the result of a willful or negligent act of the owner or possessor thereof, except in case it can be proved that such pollution leakage or contamination is the result of:

(1) Force majure or war.

(2) An act done in compliance with the order of the Government or State authorities.

(3) An act or omission of the person who sustains injury or damage, or of any third party who is directly or indirectly responsible for the leakage or contamination.

The compensation or damages to which the owner or possessor of the point source of pollution shall be liable according to the foregoing first paragraph shall mean to include all the expenses actually incurred by the government service for the clean-up of pollution arisen from such incident of leakage or contamination.

Section 97 Any person who commits an unlawful act or omission by whatever means resulting in the destruction, loss or damage to natural resources owned by the State or belonging to the public domain shall be liable to make compensation to the State representing the total value of natural resources so destroyed, lost or damaged by such an unlawful act or omission.

Chapter VII Penal Provisions

Section 98 Any person who violates or refuses to observe the order issued by virtue of section 8 or obstructs any act done in compliance with such order shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

In case the person who violates or refuses to observe the order or obstructs any act done in compliance with such order is the person who has caused danger or damage arisen from pollution, such person shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 99 Any person who illegally encroaches upon, occupies, or enters into public land to act in any manner which results in the destruction, loss or damage to natural resources or treasures worthy of being conserved, or causes the occurrence of pollution having impact on the environment within the limits of environmentally protected area designated by virtue of section 43 shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 100 Any person who violates or refrains from observing the restrictions stipulated by ministerial regulation issued according to section 44 or by notification given by the Minister according to section 45 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 101 Any person who spreads or disseminates false information about the danger from any point source of pollution with the intention to destroy its reputation or to undermine public trust on the lawful operation of its business or activity shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

If the spread or dissemination of information according to the foregoing first paragraph is done by means of publication, announcement, advertisement or reports through newspaper, radio, television or other forms of mass media, the person who commits such act shall be punished by imprisonment not exceeding five years or fine not exceeding five hundred thousand baht, or both.

Section 102 Any person who violates the order of competent official forbidding the use of vehicle according to section 65 shall be punished by fine not exceeding five thousand baht.

Section 103 Any person who refuses to observe the order given by competent official according to section 67 shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 104 Any owner or possessor of the point source of pollution who refrains from observing the provision of section 71, or any person who refrains from observing the provision of section 72, or the rules laid down by the local authority by virtue of section 74 or section 75, first paragraph, or the ministerial regulation issued by virtue of section 80 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 105 Any person who renders services as a Monitoring Control Operator or as a Service Contractor for wastewater treatment or waste disposal without the license granted according to section 73 shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 106 Any owner or possessor of the point source of pollution or any Monitoring Control Operator or any Service Contractor rendering the services of wastewater treatment or waste disposal, who refrains from collecting statistics or data or from making notes or reports as required by Section 80 shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 107 Any Monitoring Control Operator or Service Contractor having the duty to make notes or reports according to this Act, who intentionally makes such notes or reports showing false information or statements shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 108 Any person who obstructs or refuses to comply with the order of the pollution control official given in the performance of his duty according to Section 82 (2) shall be punished by imprisonment not exceeding one month or fine not exceeding ten thousand baht, or both.

Section 109 Any Service Contractor rendering services for wastewater treatment or waste disposal ordered by the pollution control official to stop or close down his services pursuant to Section 82 (5), or any Monitoring Control Operator whose license has been revoked by the order of the pollution control official pursuant to Section 82 (6), who violates or refuses to comply with such order of the pollution control official or continues to carry on his service in violation of such order shall be punished by imprisonment not exceeding one year or fine not exceeding one hundred thousand baht, or both.

Section 110 Any owner or possessor of the point source of pollution who employs the person, whose license to be a Monitoring Control Operator has been revoked, to supervise and monitor the operation of air pollution control, wastewater treatment or waste disposal facility that he has the duty install and operate according to this Act, shall be punished by fine not exceeding fifty thousand baht.

Section 111 In case the offender who is liable to be punished according to this Act is a juristic person, the directors or managers of such juristic person, or any person who is responsible for the business operation of such juristic person, shall also be punishable by the same penalties prescribed by law for such offence, unless it can be proved that they have no part to play in the commission of such offence.

Interim Provisions

Section 112 In the period during which the National Environment Board is yet to be appointed in accordance with section 12 of this Act, the National Environment Board appointed prior to the date of effectiveness of this Act shall continue to hold office in order to perform its function until the new Board shall be appointed and take over the office.

Section 113 All ministerial regulations, rules, procedures, notifications or orders, issued by, virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518 which remain in force on the date of effectiveness of this Act, shall continue to be effective, insofar as they are not in conflict with or contrary to this Act, unless and until ministerial regulations, rules, procedures, notifications or orders will have been issued in accordance with this Act.

Section 114 The person, who has been holding a license as an eligible person to prepare reports concerning the study and measures for the prevention of and remedy for the adverse effect on environmental quality by virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518, shall continue to be eligible to prepare the environmental impact assessment report provided by this Act, until such person is required

by the Minister to apply for license in accordance with this Act.

Section 115 For all the reports concerning the study and measures for the prevention of and remedy for the adverse effect on environmental quality required for any project or activity pursuant to the Enhancement and Conservation of the National Environmental Quality Act, B.E. 2518, that have been filed prior to the date on which this Act shall come into effect and still pending review by the Office of National Environment Board, the review and approval of such reports shall be further proceeded with in accordance with the rules and procedures laid down by virtue of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2518. For this purpose, the power and duty of the Office of National Environment Board in become the power and duty of the Office of Environmental Policy and Planning.

Appendix 2
Notification of Ministry of Industry No. 6, B.E. 2540, A.D. 1997 Prescribing Treatment of Hazardous Waste Substances

Notification of Ministry of Industry No. 6, B.E. 2540, A.D. 1997
Prescribed Pursuant to the Factory Acts B.E. 2535
Treatment of waste or disused substances

Notified on 29 October, B.E. 2540
Published in the Government Gazette, Volume 114, Special Part 106 (Ngo) dated 13th November B.E. 2540

Under Section 13(3), 13(3)(Kor) and 13(3)(Khor) of Decree law Ref. 2/2535 prescribed pursuant to the Factory Act B.E. 2535, the minister of industry has proclaimed the following.

1 A person engaging in a factory business, who possesses waste or disused substances of which properties and characteristics defined in the appendix 1 at the end of this notification, has to manage to treat the waste or disused substances as defined in 2 and 3.

2 Prohibit to take the waste or disused substances as indicated in 1 out of the factories. With the exception that there was a permission from the minister of industry or a person entrusted by the minister of industry for detoxification, disposal, discharge or landfill according to the standards and methods defined in the appendix 2 at the end of this notification.

3 Report details regarding types, quantities, properties, characteristics and storage sites of the waste or disused substances including the methods of preservation, detoxification, disposal, discard, transfer and transportation using the forms Ro-Ngo 6 attached at the end of this notification to the Department of Industrial Work within 60 days counting from the date this notification comes into force. With the exception that a person engaging in a factory business who operates a factory after this notification comes into force, shall report the details within 90 days counting from the start of operation and shall report the detail next time within 30 December of each year. The report can be sent by the registered mail presuming that the postal delivering day is the reporting day.

This notification shall come into force as from the day following the day of its publication in the government Gazette.

Appendix 1
A list of properties and characteristics of waste or disused substances
Attached to the Notification of Ministry of Industry No.6, B.E. 2540

Part 1
Waste or disused substances in the forms of ignitable substances, corrosive substances, reactive substances, toxic substances and leachable substances.

Section 1 Ignitable substances, which have the following properties and characteristics.

1.1 A liquid substance of which flash point is lower than 60 °C (140 °F) excluding aqueous solution containing alcohol less than 24% by volume. The testing or analytical method is done by using the apparatus, Pensky Martens Closed Cup Tester according to the standard testing method of ASTM D-93-79 or D-93-80 or by using the apparatus Setaflash Closed Cup Tester according to the standard testing method of ASTM D-3278-78.

1.2 Non liquid substances, which can cause ignition when undergone friction, moisture, spontaneous chemical changes. Once ignited. it burns intensively and continuously causing severe danger under standard temperature and pressure. (pressure at 1 atm and temperature at 0 °C).

1.3 Ignitable compressed gas which is any substance or mixture contained in vessels at the absolute pressure more than 2.81 kg/cm2 (40 psi) and at the temperature of 21 °C (70°F) or at the absolute pressure more than 7.31 kg/cm2 (104 psi) and at the temperature of 55 °C (130°F). The testing or analytical method follows the standard testing method of ASTM D-323.

1.4 Oxidizer, which can oxidize rapidly and stimulate the combustion of organic compounds

for example, the compounds of chlorate permanganate inorganic peroxide and nitrate.

Section 2 Corrosive substances, which have the following properties and characteristics.

2.1 Aqueous compound of which acidity or the pH value is equal to or lower than 2 and of which alkalinity or the pH value is equal or higher than 12.5. Testing or analyzing methods are done by using pH-meter according to US EPA Method 9040.

2.2 Liquid solution which erodes steel SAE 1020 more than 6.35 mm (0.250 in) per year at the temperature of 55°C (130°F). Testing or analyzing methods are followed NACE (National Association of Corrosion Engineers) Standard TM-01-69.

Section 3 Reactive substances, which have the following properties and characteristics.

3.1 The substance that is not stable reacts rapidly and violently but without explosion.

3.2 The substance that reacts explosively with water.

3.3 The substance that forms an explosive mixture when mixed with water.

3.4 The substance that generates toxic gases, vapors or fumes when mixed with water in an amount that may cause hazards to human health and environment.

3.5 The substance that is composed of cyanide or sulfide. When the acidity or pH values are between 2 to 11.5 then it generates toxic gases, vapors or fumes when mixed with water in an amount that may cause hazards to human health and environment.

3.6 The substance that explodes when heated in the limited volume or reacts explosively and rapidly and may cause explosion when exposed to the standard temperature and pressure (pressure at 1 atm and temperature at 0°C.

Section 4 Toxic substances, which have the following properties and characteristics.

4.1 The substance that is hazardous to human health and causes lethality with small amount. Testing or analyzing methods are done by EPA toxicity test methods.

4.2 The substance of which toxicity is described as follows:
When rats were used in animal tests, LD50 (Oral LD50) is lower than 50 mg per kg-body weight or LC50 (Inhalation LC50) is lower than 100 ppm in the form of vapor or gas. When rabbits were used in animal tests, LD50 (Dermal Rabbit LD50) is lower than 43 mg per kg-body weight. Here LD50 means the average (amount) of medium lethal dosage that causes mortality in 50% of a group of animals. The unit of LD50 is mg of toxic substance per 1 kg of animal body weight. LC50 means the average (concentration) of medium lethal concentration that causes mortality in 50% of a group of animals. The unit of LC50 unit is part (by volume or by weight) of toxic substance per million parts of media (by volume of by weight).

4.3 The substance that is generated by production processes in which carcinogenic chemicals as listed in Group 1, Group 2A and Group 2B by International Agency for Research on Cancer were included or contaminated.

4.4 The substance that is toxic to aquatic (Aquatic LC50) lower than 5 mg/L in 96 hours.

4.5 The substance that is diluted lower than 20% in concentration but is still toxic as LC50 to aquatic in 96 hours.

Section 5 Leachable substances that were extracted by the Leachate extraction procedures and leachate analysis as defined in Section 3 of the Appendix 2 in the end of this notification. The amount of heavy metal or the toxic substances in leachate are equal to or more than any of the following values.

Arsenic (total)	5.0 milligram /liter
Barium	100.0 milligram /liter
Benzene	0.5 milligram /liter
Cadmium (total)	1.0milligram /liter
Carbon tetrachloride	0.5 milligram /liter
Chlordane	0.03milligram /liter
Chlorobenzene	100.0milligram /liter
Chloroform	6.0milligram /liter
Chromium (total)	5.0milligram /liter
ortho-Cresol	200.0milligram /liter

meta-Cresol	200.0milligram /liter
para-Cresol	200.0 milligram /liter
Cresol (total)	200.0 milligram /liter
2-4 D	10.0milligram /liter
1,4-Dichlorobenzene	7.5 milligram /liter
1,2-Dichloroethane	0.5 milligram /liter
1,1-Dichloroethylene	0.7milligram /liter
Endrin	0.02milligram /liter
Heptachlor and its epoxide	0.008milligram /liter
Hexachlorobenzene	0.13milligram /liter
Hexachlorobutadiene	0.5 milligram /liter
Hexachloroethane	3.0 milligram /liter
Lead (total)	5.0 milligram /liter
Lindane	0.4 milligram /liter
Mercury (total)	0.2 milligram /liter
Methoxychlor	10.0milligram /liter
Methyl ethyl ketone	200.0milligram /liter
Nitrobenzene	2.0milligram /liter
2,4-Nitrotoluene	0.13milligram /liter
Pentachlorophenol	100.0milligram /liter
Pyridine	5.0 milligram /liter
Selenium	1.0 milligram /liter
Silver	5.0 milligram /liter
Tetrachloroethylene	0.7 milligram /liter
Toxaphene	0.5 milligram /liter
Trichloroethylene	0.5 milligram /liter
2,4,5-Trichlorophenol	400.0 milligram /liter
2,4,6-Trichlorophenol	2.0milligram /liter
2,4,5-TP (Silvex)	1.0 milligram /liter
Vinyl chloride	0.2milligram /liter

Part 2
Waste or disused substances from non-specific sources and specific sources.

Section 6 Waste or disused substances from non-specific sources which have the following properties and characteristics.

6.1 Spent halogenated solvents used in the degreasing processes such as tetrachloroethylene, trichloro ethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, chlorinated fluorocarbon. Including those mixtures with other solvents used in the degreasing processes. The mixture prior to use contained one or more types of the above mentioned chemicals in the concentration of 10% by volume or more. Also the still bottoms from the solvent recovery process of the mentioned mixture are included.

6.2 Spent halogenated solvents such as tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chloro benzene, 1,1,2-trichloro-1,2,2-trifluoroethane, Ortho-dichlorobenzene, trichlorofluoro methane, 1,1,2-trichloroethane. Including those mixtures with other solvents used in the degreasing processes. The mixture prior to use contained one or more types of the above mentioned chemicals in the concentration of 10% by volume or more. Also the still bottoms from the solvent recovery process of the mentioned mixture are included.

6.3 Spent non-halogenated solvents, group 1 such as xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutylketone, n-butyl alcohol, cyclo hexanone and methanol. Including those mixtures with other solvents used in the degreasing processes. The mixture prior to use contained one or more types of the above mentioned chemicals in the concentration of 10% by volume or more. Also the still bottoms from the solvent recovery process of the mentioned mixture are included.

6.4 Spent non-halogenated solvents, group 2 such as cresols, cresylic acid and nitrobenzene. Including those mixtures with other solvents used in the degreasing processes. The mixture

prior to use contained one or more types of the above mentioned chemicals in the concentration of 10% by volume or more. Also the still bottoms from the solvent recovery process of the mentioned mixture are included.

6.5 Spent non-halogenated solvents, group 3 such as toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol and 2-nitropropane. Including those mixtures with other solvents used in the degreasing processes. The mixture prior to use contained one or more types of the above mentioned chemicals in the concentration of 10% by volume or more. Also the still bottoms from the solvent recovery process of the mentioned mixture are included.

6.6 Wastewater treatment sludges from electroplating operations, with the exception of those sludges from aluminium anodizing processes with sulfuric acid, steel plating processes with aluminium or zinc, cleaning/stripping solution from steel plating processes with tin, zinc and aluminium, and chemicals from aluminium etching and milling processes.

6.7 Used solution from cyanide plating bath in metal plating processes.

6.8 Sludge from metal plating bath in which cyanide is used in the plating process.

6.9 Cleaning/ stripping solution from metal plating processes in which cyanide is used.

6.10 Waste materials in quenching bath and oil bath from the metal heat treating operations in which cyanide is used in the process.

6.11 Used cyanide solution from salt bath pot cleaning in metal heat treating operations.

6.12 Sludge from wastewater treatment in the quenching process of metal heat treating operations in which cyanide is used.

6.13 Sludge from wastewater treatment in the aluminium chemical conversion coating with the exception of zirconium phosphating in aluminium can washing process.

6.14 Wastes from the production or industrial application of tri-or tetrachlorophenol or the intermediates used in the production of chloro-phenol derivatives used as reactants or chemical intermediate or components in the formulating processes. However wastes from the production processes of hexachlorophene, purified 2,4,5-trichloro phenol and wastewater and used carbon in the hydrogen chloride purification process are excluded.

6.15 Wastes from the production or industrial application of pentachloro phenol or intermediates as derivatives of pentachloro phenol used as reactant or chemical intermediate or component in the formulating process, except wastewater and used carbon in the purification of hydrogen chloride.

6.16 Wastes from the production and industrial application of Tetra-, penta-, or hexachlorobenzenes in the alkaline condition used as reactant or chemical intermediate or component on formulating process, except wastewater and used carbon in the purification of hydrogen chloride.

6.17 Wastes from the production of any substances or compounds by the equipment for producing tri- and tetrachlorophenols, provided that wastes from the specific equipment used for producing (or operating) hexachlorophene from purified 2,4,5-trichlorophenol are not included, except wastewater and used carbon in the purification of hydrogen chloride.

6.18 Wastes from the production process of chlorinated aliphatic hydrocarbons by free radical catalyzed including distillation residues of heavy ends and tars, wastes from washes of reactors in the production process of chlorinated aliphatic hyfdrocarbons by free radical catalyzed. The carbon chain in these chlorinated aliphatic hydrocarbons may be from1 to 5 unrelated with the number or position of chlorine substitute, provided that wastewater, sludge from wastewater treatment and spent catalysts are not included.

6.19 Used Condensed light ends, filter aids and desiccant in the production process of chlorinated aliphatic hydrocarbons by free radical catalyzed. The carbon chain in these chlorinated aliphatic hydrocarbons may be from 1 to 5 unrelated with the number or position of chlorine substitute.

6.20 Wastes from the production of any substances or compounds by the equipment for producing tetra-, penta-, hexa-chlorobenzene in the alkaline condition used as reactant or chemical intermediate or component on formulating process, except wastewater and used carbon in the purification of hydrogen chloride.

6.21 Discarded unused formulations that contain the components of, or contain the components of compound from tri-, tetra-,or penta chlorophenol, provided that disused substances that contain the components of hexachlorpphenol derived from the synthesis of purified 2,4,5-

trichlorophenol are not included.

6.22 Residues from incineration or thermal treatment of contaminated soil with waste or disused substances as indicated in Section 6.14, Section 6.15, Section 6.16, Section 6.17, Section 6.20 and Section 6.21.

6.23 Wastewater and residues from wood preserving process including used preservative drippage and formulations generated in the plants using chlorophenolic except wastewater that is not contaminated with chemicals in the process.

6.24 Wastewater and residues from the preserving process by using creosote formulation including used preservative drippage and formulations, provided that sludge of wastewater treatment from the preserving process using creosote or pentachlorophenol is not included, except wastewater that is not contaminated with chemicals in the process.

6.25 Wastewater and residues from the preserving process by using inorganic preservatives which contain arsenic, chromium including used preservative drippage and formulations, provided that sludge of wastewater treatment from the preserving process using creosote or pentachlorophenol is not included, except wastewater that is not contaminated with chemicals in the process.

6.26 Primary sludge from petroleum refinery generated in the oil waste solid separation process including sludge of oil, water or solids from the gravitational separator during the storage or wastewater treatment or wastes from oil cooling, sludge generated in oil/water/solids separators in tanks and impoundments, in ditches, in conveyances, in sumps and in stormwater units both from the those accepted or unaccepted, dry weather flow, sludge generated by the separation of cooling water and oil contaminated cooling water, activated sludge from biological treatment including sludge from other units after the biological treatment.

6.27 Emulsified secondary sludge from petroleum refinery generated by the separation of oil/water/solids, including sludge or any float generated by physical or chemical separation of oil/water/solid in the wastewater treatment (including waste from cooling units). Sludge includes sludge and float generated in the induced air flotation, sludge in tanks and impoundments and sludge in dissolved air flotation process (DAF), sludge generated in stormwater united both accepted or unaccepted, dry weather flow, sludge generated by the separation of cooling water and oil contaminated cooling water, activated sludge from biological treatment including sludge from other units after the biological treatment.

Section 7 Hazardous wastes from specific sources which have the following properties and characteristics.

7.1 Waste substances from wood preservation such as: sludge from wastewater treatment in the preservative process using creosote or pentachloro phenol.

7.2 Waste substances from inorganic pigments manufacturing industries such as: sludge from wastewater treatment in the production process of chrome yellow and orange, molybdate orange, zinc yellow, chrome green, chrome oxide green both in anhydrous and hydrated forms, iron blue including residues from oven of chrome oxide green production process.

7.3 Waste substances from organic chemicals manufacturing industries such as:

7.3.1 Distillation bottoms generated in the production process of acetaldehyde from ethylene.

7.3.2 Distillation side cuts generated in the production process of acetaldehyde from ethylene.

7.3.3 Bottom stream from wastewater strippers in the production process of acrylonitrile.

7.3.4 Bottom stream fromacrylonitrile column in the production process of acrylonitrile.

7.3.5 Bottoms from acrylonitrile purification column in the production process of acrylonitrile.

7.3.6 Still bottoms in the distillation of benzyl chloride.

7.3.7 Distillation residues or heavy ends in the production process of carbon tetrachloride.

7.3.8 Heavy ends or still bottoms) from purification column in the production process of epichlorohydrin.

7.3.9 Heavy ends from fractionation column in the production process of ethyl chloride.

7.3.10 Heavy ends from the distillation of ethylene dichloride in the production process of ethylene dichloride.

7.3.11 Heavy ends from the distillation of vinyl chloride in the production process of vinyl chloride monomers.

7.3.12 Antimony catalyst in the production process of fluoromethane.

7.3.13 Distillation bottom tars in the production process of phenol/acetone from cumene.
7.3.14 Distillation light ends in the production process of phthalic anhydride from naphthalene.
7.3.15 Distillation bottoms) from the production process of phthalic anhydride from naphthalene.
7.3.16 Distillation bottoms from the production process of nitrobenzene by the nitration of benzene.
7.3.17 Stripping still tails from the production process of methyl ethyl pyridine.
7.3.18 Waste substances from centrifugation) and distillation in the production process of toluene diisocyanate.
7.3.19 Spent catalyst from the hydrochlorinator in the production process of 1,1,1-trichloroethane.
7.3.20 Product stream stripper in the production process of 1,1, 1-trichloroethane.
7.3.21 Column bottoms or heavy ends in the production process of tichloroethylene and prchloroethylene.
7.3.22 Distillation bottoms in the production process of aniline.
7.3.23 Distillation bottoms or fractionation column bottoms in the production process of chlorobenzene.
7.3.24 Distillation light ends in the production process of phthalic anhydride from ortho-xylene.
7.3.25 Distillation bottoms in the production process of phthalic anhydride from ortho-xylene.
7.3.26 Distillation bottoms in the production process of 1, 1, 1-trichloroethane.
7.3.27 Heavy ends from heavy ends column in the production process of 1, 1, 1-trichloroethane.
7.3.28 Waste substances from the distillation of aniline in the production process of aniline.
7.3.29 Wastewater from the production process of nitrobenzene and aniline.
7.3.30 Waste water separated from the stage of reactor product washing) in the production process of chlorobenzene.
7.3.31 Column bottoms from the separation process in the production of 1, 1-dimethyl hydrazine or UDMH from carboxylic acid hydrazine.
7.3.32 Condensed column overheads from the production separation process and the condensed of vent gases from reactor in the production of 1, 1-dimethyl hydrazine or UDMH from carboxylic acid hydrazine.
7.3.33 Filter cartridges from the product purification process in the production of 1, 1-dimethyl hydrazine or UDMH from carboxylic acid hydrazine.
7.3.34 Condensed column overheads from the intermediates separation process in the production of 1, 1-dimethyl hydrazine or UDMH from carboxylic acid hydrazine.
7.3.35 Wastewater in the production process of dinitrotoluene by the nitration of toluene.
7.3.36 Wastewater as reaction by-product from drying column in the production process of toluenediamine by hydrogenation of dinitrotoluene.
7.3.37 Condensed liquid light ends in the purification of toluene diamine in the production process of toluenediamine by hydrogenation of dinitrotoluene.
7.3.38 Vicinals in the purification of toluene diamine in the production process of toluene diamine by hydrogenation of dinitrotoluene.
7.3.39 Heavy ends in the purification of toluene diamine in the production process of toluenediamine by hydrogenation of dinitrotoluene.
7.3.40 Organic condensate from solvent recovery column in the production process of toluene diisocyanate by phosphogenation of toluene diamine.
7.3.41 Wastewater from reactor vent gas scrubber in the production process of ethylene dibromide by bromination of ethene.
7.3.42 Used absorbent solids in the purification of ethylene dibromide for the production of ethylene dibromide by bromination of ethylene.
7.3.43 Still bottoms from the purification of ethylene dibromide for the production of ethylene dibromide by bromination of ethylene.
7.3.44 Distillation bottoms in the production process of alpha-/methyl-/ring-chlorinated toluene, benzoyl chlorides and other compounds containing these functional groups with the exception of still bottoms from the distillation of benzyl chloride.
7.3.45 Organic residuals from the spent chlorine gas and hydrochloric acid recovery in the production process of alpha-/methyl-/ring-chlorinated toluene, benzoyl chlorides and other compounds containing these functional groups with the exception of used carbon absorbent.
7.3.46 Sludge generated from wastewater treatment in the production process of alpha-/methyl-/ring-chlorinated toluene, benzoyl chlorides and other compounds containing these

functional groups with the exception of sludges subjected to neutralization and biological sludge.

7.4 Waste from inorganic chemicals manufacture industries such as:

7.4.1 Brine purification muds from the production of chlorine by mercury cell, provided that separated brine prior to this process was not used.

7.4.2 Waste substances of chlorinated hydrocarbon from the purification process of chlorine by diaphragm cell.

7.4.3 Sludge of wastewater treatment from the production process of chlorine by mercury cell.

7.5 Waste substances from the production industries of plant or animal pesticides such as:

7.5.1 By-products of salts in the production process of MSMA and cacodylic acid.

7.5.2 Sludge of wastewater treatment in the production process of chlordane.

7.5.3 Wastewater and scrub) by the chlorination of cyclopentadiene in the production process of chlordane.

7.5.4 Filter solids from filtration of hexachlorocyclopentadiene in the production process of chlordane.

7.5.5 Sludge of wastewater treatment from the production process of creosote.

7.5.6 Still bottoms from the distillation of toluene for reuse in the production of disulfoton.

7.5.7 Sludge of wastewater treatment in the production process of disulfoton.

7.5.8 Cleaning/stripping from the production process of phorate.

7.5.9 Filter cake from the filtration of diethylphosphorodithioic acid in the production process of phorate.

7.5.10 Sludge of wastewater treatment in the production process of phorate.

7.5.11 Sludge of wastewater treatment in the production process of toxaphene.

7.5.12 Residues or heavy ends from the distillation of tetrachlorobenzene in the production of 2, 4, 5-T.

7.5.13 Residues of 2, 6-dichlorophenol in the production of 2, 4-D.

7.5.14 Wastewater from vacuum stripper in chlorinator of chlordane in the production of chlordane.

7.5.15 Wastewater that was not treated in the production process of toxaphene.

7.5.16 Wastewater that was not treated in the production process of 2, 4-D.

7.5.17 Wastewater, including salts, wash water, supermates and filtrates from the production process of ethylenebisdithio carbamic acid.

7.5.18 Wastewater from reactor vent scrubber in the production process of ethylenebisdithiocarbamic acid and salts.

7.5.19 Waste residues from filtration, evaporation and centrifugation in the production process of ethylenebisdithiocarbamic acid and salts.

7.5.20 Bag house dust and floor sweeping from the milling and packaging in the production or formulation process of ethylenebisdithiocarbamic acid and salts.

7.5.21 Wastewater from reactor and used sulfuric acid from acid dryer in the production process of methyl bromide.

7.5.22 Residues separated from wastewater and used absorbent in the production process of methyl bromide.

7.6 Waste substances from explosives manufacturing industries such as: sludges of wastewater treatment from the explosive production process, explosive contaminated carbon, sludges from the production, formulation or loading of initiating lead-based compounds and pink/red solution from the TNT preparation process.

7.7 Waste substances from petroleum refining industries such as: float from dissolved air flotation (DAF), slop oil emulsion, tank bottoms contaminated with zinc, sludge from API separator and sludge from heat exchanger bundle.

7.8 Waste substances from iron and steel industries such as: residues and dust from emission control in primary steel production by electric furnace and used solution for pickle from the steel finishing processes in each operation.

7.9 Waste substances from primary copper production industries such as: sludge and slurry blowdown from the thickening process in acid plant.

7.10 Waste substances from the primary lead production industries such as: residues from surface impoundment in each operation.

7.11 Waste substances from primary zinc production industries such as: sludge and slurry

blowdown from acid plant.

7.12 Waste substances from primary aluminium production industries such as: used potliners.

7.13 Waste substances from secondary lead production industries such as: waste and dust from production process and used solution in leaching waste and dust from emission control with acid.

7.14 Waste substances from veterinary pharmaceuticals such as: sludge of wastewater treatment, residues from distillation tar, or aniline-based compounds and residues from the utilization of activated carbon in decolorizaton in the production process of arsenic or organo-arsenic.

7.15 Waste substances from the ink formulation industries such as: sludge, washes with caustic soda solvents or water from cleaning tubs and equipment in ink formulation process using pigments, driers, soaps and stabilizers in which chromium and lead are added as components.

7.16 Waste substances from coking industries such as:

7.16.1 Sludge of ammonia still lime from coking.

7.16.2 Tar sludges in decanter tank.

7.16.3 Residues from coal tar recovery process such as collecting sump residues in the production of cokes from coals or in the recovery of coke by-products.

7.16.4 Tar storage tank residues in the production of cokes from coals or in the recovery of coke by-products.

7.16.5 Residues from the recovery of light oil such as residues in stills, decanters and wash oil recovery units which is included in the recovery of coke by-products.

7.16.6 Residues in the wastewater sump from the distillation light oil including sludge from interception or contamination in the recovery of coke by-products.

7.16.7 Residues from naphthalene collection and recovery in the recovery of coke by-products.

7.16.8 Tar storage tank residues in the coal tar refining.

7.16.9 Coal tar distillation residues including still bottoms.

7.17 Waste substances from petrochemical industries such as residues of products contaminated with solvents, plastic residues from the incomplete polymerization or contaminated with solvents, sludge from wastewater treatment contaminated with solvents or plastic of incomplete polymerization and all kind of disused or used catalyst and intermediates.

Part 3
Waste or disused substances which have the properties and characteristics of disused or discarded or off-specification or waste chemicals in containers or any residues used for cleaning and contaminated with spilt chemicals.

Section 8 Acute hazardous chemicals as follows:
202 substances such as Aldrin (the other chemicals not listed here)

Section 9 Toxic hazardous chemicals as follows:
45 substances such as Acetaldehyde (the other chemicals not listed here)

Part 4
Waste or disused substances which have the properties and characteristics chemical wastes.

Section 10 Residues arising from industrial waste disposal operations.

Section 11 Wastes from the manufacture, formulation and use of wood preserving chemicals in industrial production processess.

Section 12 Wastes from the production, formulation and use of organic solvents in industrial production processess.

Section 13 Used lubricating oil.

Section 14 Waste mineral oils unfit for their originally intended use in which the content of petroleum oil is more than 70%.

Section 15 Waste oils/ water, hydrocarbons/ water mixture emulsions in industrial production processess.

Section 16 Waste substances and articles containing or contaminated with polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)

Section 17 Waste tarry residues arising from refining, distillation, and any pyrolytic treatment.
Section 18 Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish in industrial production processess.
Section 19 Wastes from production, formulation and use of resins, latex, plasticizers, glues/adhesives) in industrial production processess.
Section 20 Wastes from production and formulation of photographic chemicals and processing substances.
Section 21 Wastes resulting from surface treatment and plastics in industrial production processess.
Section 22 Wastes having the following as constituents:
22.1 Metal carbonyls
22.2 Beryllium; beryllium compounds
22.3 Hexavalent chromium compounds
22.4 Copper compounds
22.5 Zinc Compounds
22.6 Arsenic; arsenic compounds
22.7 Selenium; selenium compounds
22.8 Cadmium; cadmium compounds
22.9 Antimony; antimony compounds
22.10 Tellurium; tellurium compounds
22.11 Mercury; mercury compounds
22.12 Thallium; thallium compounds
22.13 Lead; lead compounds
22.14 Inorganic fluorine compounds excluding calcium fluoride
22.15 Organic or inorganic cyanides
22.16 Acidic solutions or acids in solid form
22.17 Basic solutions or base in solid form
22.18 Asbestos (dust and fibres)
22.19 Organic phosphorus compounds
22.20 Phenols; phenol compounds including chlorophenols
22.21 Ethers
22.22 Halogenated organic solvents
22.23 Organic solvents excluding halogenated solvents
22.24 Any congenor of polychlorinated dibenzo-furan
22.25 Any congenor of polychlorinated dibenzo -p-dioxin

Appendix 2
Standards and methods for detoxification, disposal, discharge or landfill of waste or disused substances, attached to Notification No.6, B.E. 2540

Section 1 For detoxification, disposal, discharge or landfill of waste or disused substances as indicated in Appendix 1, a person engaging in a factory business shall take effect of either treatment or disposal or chain treatments as follows based on the characteristics and properties of the waste or disused substances with an approval from the Director of Department of Industrial Works or a person entrusted by the Director.
1.1 Physical treatment such as follows:
1.1.1 Centrifugation
1.1.2 Steam distillation and Steam stripping
1.1.3 Multi-media filtration
1.1.4 Reverse osmosis, micro-/Ultra-filtration
1.1.5 Evaporation
1.1.6 Air flotation
1.1.7 Gravity thickening
1.1.8 Oil/water separator or coalescence separator
1.2 Physical/chemical treatment such as follows:
1.2.1 Soil washing
1.2.2 Air stripping
1.2.3 Activated carbon adsorption

1.2.4 Precipitation/Flocculation
1.2.5 Dissolved air flotation
1.2.6 Ion exchange
1.2.7 Liquid/liquid extraction
1.2.8 Filter press, dewatering, vacuum filtration and belt-press filtration
1.3 Chemical treatment such as follows:
1.3.1 Neutralizaion and pH adjustment
1.3.2 Oxidation/reduction reactions
1.3.3 Ozonation and UV/ozonation
1.3.4 Electrodialysis
1.3.5 Precipitation
1.3.6 Dechlorination
1.3.7 Dehalogenation
1.4 Biological treatment such as follows:
1.4.1 Attached film reactors
1.4.2 Activated sludge
1.4.3 Anaerobic digestion
1.4.4 Composting
1.4.5 Stabilization ponds
1.4.6 In situ biological decomposition
1.4.7 Biological detoxification
1.5 Thermal processes for treatment and/or disposal such as follows:
1.5.1 Wet-air oxidation
1.5.2 Liquid injection incineration
1.5.3 Cement kiln incineration and Rotary kiln incineration
1.5.4 Fluidized bed incineration
1.5.5 Solar evaporation
1.6 Stabilization/fixation/solidification processes such as follows:
1.6.1 Molten glass
1.6.2 Chemical fixation
1.6.3 Pozzolanic and cement based solidification
1.6.4 Thermoplastic encapsulation
1.6.5 Polymer encapsulation
1.7 Land treatment and/or disposal such as follows:
1.7.1 Land farming
1.7.2 Spray irrigation
1.7.3 Engineered, secured landfill
1.7.4 Above ground long-term storage
1.7.5 Deepwell injection
1.8 A person engaging in a factory business can employ the other methods besides those indicated in Section 1.1 to Section 1.7 or other methods that can be verified that the treated results are equivalent or superior to the indicated methods for detoxification, dispose, discard or landfill of the waste or disused substances. Or the other methods that can reduce the waste or disused substances subjected to safety reuse and recycle such as solvent recovery, oil recovery. acid regeneration and metal recovery or that can be used as fuels blending for Co-incineration in industrial kilns/furnaces or wastes exchange for the application in production process as well as the employment of other parties' service activities in each operation.

Section 2 Waste or disused substances that passed through the stabilization and solidification processed shall have the following properties.
2.1 The unconfined compressive strength tested by ASTM D-1633 and D-2166 shall not lower than 3.5 kg/cm2. The treated waste or disused substance shall bear the load from upper when discarded in the secured landfill.
2.2 The density shall not lower than 1.15 ton/m3.
2.3 The concentration of the toxic substance in leachant or extraction fluid is corresponding to the leachate extraction procedure for the verification of the detoxification and completed

stabilization of the waste or disused substances as indicated in Section 3 prior to secured landfill.

Section 3 Leachate extraction procedure and the analyzing method for the concentration of the hazardous leachant or extraction fluid are as follows:

3.1 Extraction for the quantitative analysis of leachable from waste and disused substance and testing whether the waste and disused substances have undergone the detoxification or stabilization completely by employing the following procedures.

3.1.1 If the sample of waste or disused substances is solution or the content of dry solids is lower than 0.5%, filter the solution with glass fiber filter of which pore diameter is around 0.6 to 0.8 micrometer, then analysis the filtrate by the method indicated in Section 3.2.

3.1.2 If the sample of waste or disused substances contains dry solids more than 0.5% then operate the following procedures.

(1) Grind the sample of waste or disused substances into powder and then screen through the sieve of which pore diameter is 9.5 mm.

(2) To the 100 g sample obtained from (1), add leachant or synthetic acid rain extraction fluid comprised of distilled water and sulfuric acid and nitric acid (in the ratio of 80 to 20 by weight) until the pH of the mixture is constant at 5. Then adjust the volume of the mixture to make the ratio of leachant to sample weight equal to 20.

(3) Shake the mixture with a rotary agitator at the rotation rate of 30 rpm at 25°C for 18 hours.

(4) Filter the leachate with a fiber glass filter of which pore diameter is 0.6 to 0.8 micron.

(5) Analyze the filtrate as indicated in Section 3.2.

3.2 The analysis for toxic substances in filtrate from Section 3.1.1 or Section 3.1.2 follows the standard method US EPA SW 846 or the standard method indicated in Notification of Ministry of Industry Ref 2/2539, date 14 June B.E. 2539 for wastewater analysis. In the case the analysis of solution in leachate higher than standard as indicated in Section 5 Part 1 of the Appendix 1, it has to conduct the detoxification again to acquire the definite properties.

Attached to the Notification of Ministry of Industry No.6, B.E. 2540 (A.D. 1997)
(Format RO－GO9)

Report on the details of waste or disused substances

Date: Day, Month, Year

I (name) a person engaging in a factory business. The office is located on the _____Village_____Side street _____Road_____- _____Tambon_____District_____ Province_____Telephone_____ FAX_____ factory registration No._____. The factory is located on the ____ Village_____Side street _____ Road_____ Tambon _____ District _____Province_____Telephone_____FAX_____. I would like to report the details of the waste or disused substances as follows:

Section 1 The details of waste or disused substances and the methods of disposal (indicated in the document serial No. 1)
Section 2 Layouts indicating sites of storage, detoxification, disposal, discard, or landfill in outline (indicated in the document serial No. 2)
Section 3 Transfer and transportation (indicated in the document serial No. 3)
Section 4 Landfill and monitoring plans (indicated in the document serial No. 4)
Section 5 Emergency response in the case of accident during storage, detoxification, disposal, discard, or landfill (indicated in the document serial No. 5)

Signature _____
a person engaging in factory business
( )

(Document serial No.1)

The details of waste or disused substances and the methods of disposal

Order	As inicated in Appendix 1		Names of waste or disused substances	Amount	Disposal	Remarks
	Part	Section				

Signature _____
a person engaging in factory business
( )

(Document serial No.2)

Layouts indicating sites of storage, detoxification, disposal, discard, or landfill in outline

Signature _____
a person engaging in factory business
( )

(Document serial No.3)

Transfer and transportation

1. Methods of Transfer and transportation

2. Packaging, vehicle, vehicle registration

3. Route of transportation for storage, detoxification, disposal, discard or landfill.

4. Transporter (if any)
4.1 Name：_____
Address／Office_____
4.2 Name：_____
Address／Office_____

5. Uniform Industrial Hazardous Waste Manifest

Signature _____
a person engaging in factory business
( )

(Document serial No.4)

Landfill and monitoring plans (if any)

1. Landfill step

2. Monitoring step

Signature _____
a person engaging in factory business
( )

(Document serial No.5)

Emergency response in the case of accident during storage, detoxification, disposal, discard, or landfill

1. During storage

2. During transfer or transportation

3. During detoxification, disposal, discard or landfill

Signature _____
a person engaging in factory business
( )

Appendix 3
Current State of Environmental Practices of Japanese Companies in Thailand and Other Asian Countries
(from the 1995 Research on Trends in Environmental Considerations related to Overseas Activities of Japanese Companies)

1. Summary of the Survey

In order to assess the environmental practices of Japanese companies engaged in business in four Asian countries; the Philippines, Thailand, Indonesia and Malaysia, a survey consisting of a questionnaire and on-site interviews was conducted in 1995 with the cooperation of the respective local Japanese Chamber of Commerce and Industry. The questionnaire was distributed to all 2,070 companies (including non-manufacturers and small local offices) on the Japanese Chambers of Commerce and Industry's list of members for each of the four host countries (individual and nonprofit corporate members were excluded from the survey). Of these, 425 companies responded. (The return rate was 20.5%). For the survey in Thailand, the questionnaire was sent to 1,028 companies, of which 133 responded. The return rate was 12.9%.

The breakdown of the companies that responded by type of industry was: 69.2% by those in manufacturing (compared to 63.7% - the average of the other three Asian countries. Likewise, the figures in the parentheses hereafter show the average of the other three Asian countries.) and 25.6% (33.9%) by those in the non-manufacturing sector (construction, wholesale, finance, insurance, etc.). As for the number of employees, companies with less than 100 were 24.1% (34.6%), those with 100 through 500 were 33.8% (31.2%), and those with 1,000 or more were 19.5% (20.2%).

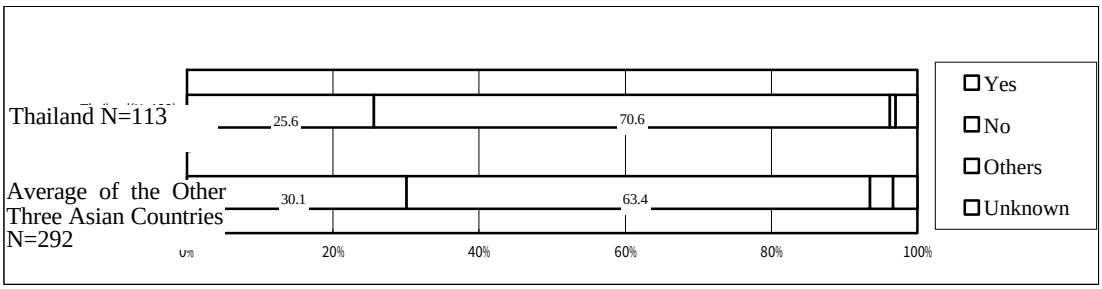
The current state of environmental practices of the Japanese companies in Thailand is summarized hereunder in comparison with the average of the other three Asian countries (292 returns).

2. Results of the Survey

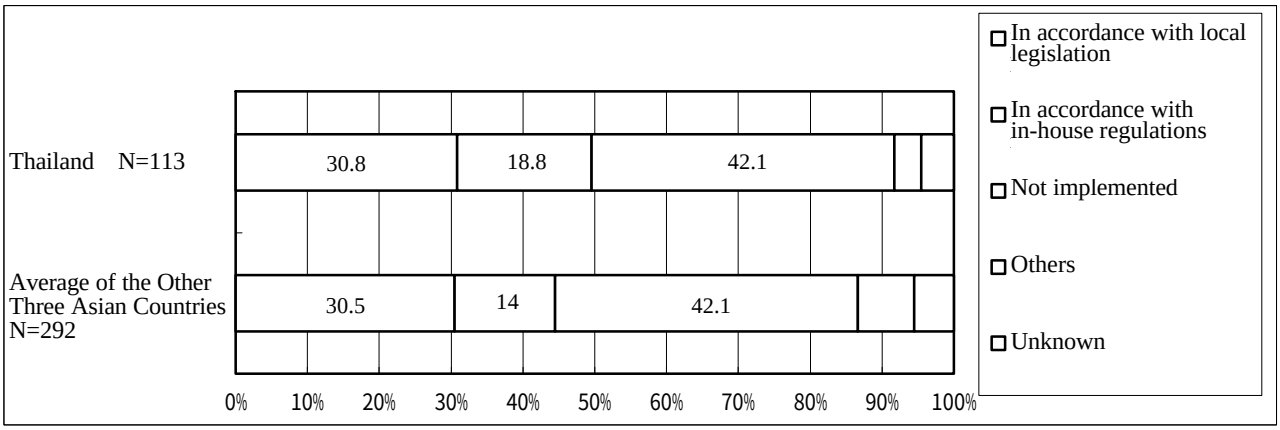
(1) Environmental considerations before establishing business overseas

In Thailand, the companies legally obliged to carry out environmental assessments accounted for 25.6% (30.1%) as shown in App3-Figure 1. However, the survey showed that, in fact, a far larger percentage of 49.6% (44.5%) of all companies that responded conducted environmental assessments (refer to App3-Figure 2). [30.8% (30.5%) did so in accordance with the local legislation of the host countries while 18.8% (14.0%) did so based on in-house regulations.]

App3-Figure 1 Was Environmental Assessment Legally Obligatory?



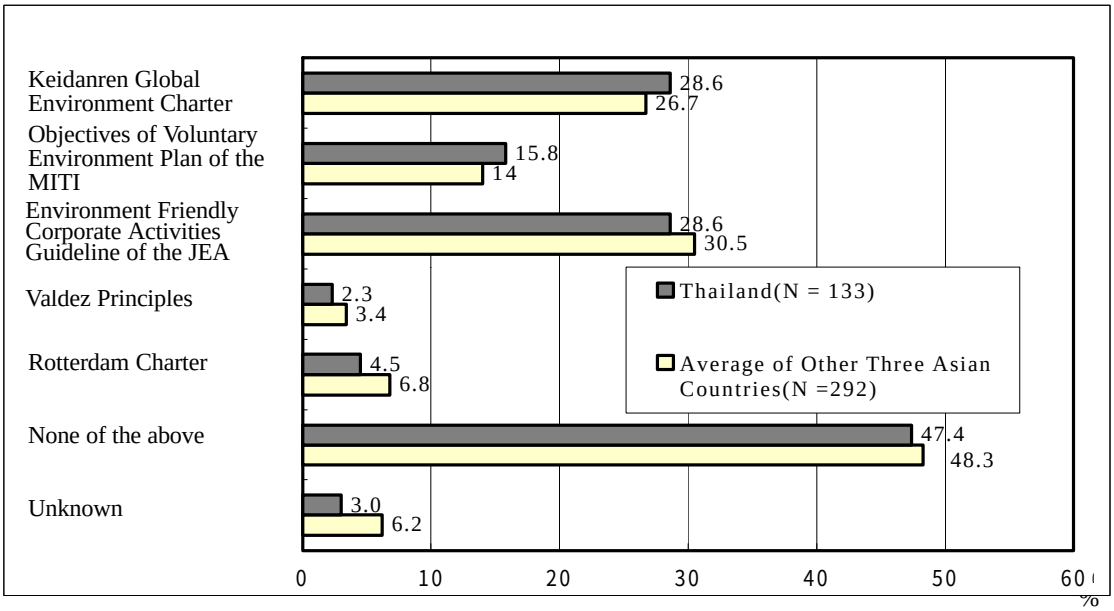
App3-Figure 2 Implementation of Environmental Assessment



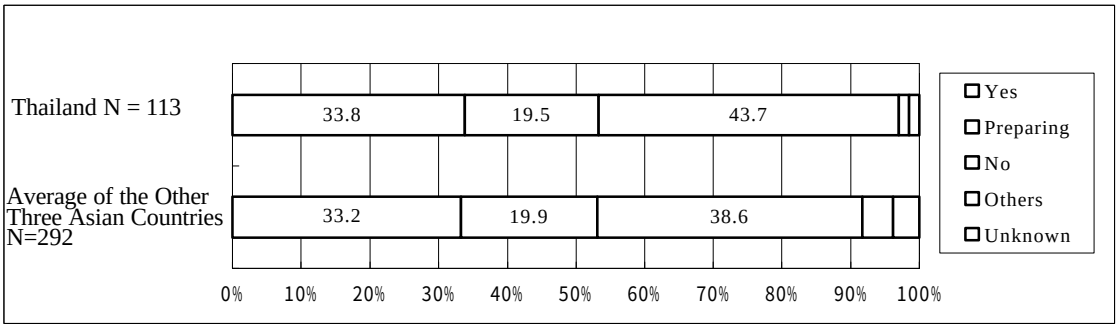
(2) In-house system and organization for promoting environmental measures

While 28.6% (30.5%) of the companies were acquainted with "Environment Friendly Corporate Activities Guideline" as published by the Japanese Environment Agency, 28.6% (26.7%) were aware of "Keidanren Global Environment Charter" by the Federation of Economic Organizations (Keidanren)(cf. App3-Figure 3, where multiple answers permitted). 53.3% (53.1%) had already established or were in the process of establishing corporate environmental policies (cf. App3-Figure 4). 52.6% (50.8%) said that they had some kind of section or personnel engaged in environmental management (cf. App3-Figure 5). [11.3% (11.0%) had a section exclusively designated for that purpose, 3.8% (4.5%) had exclusively designated staff, and 37.5% (35.3%) had staff assigned for environmental management with additional responsibilities.]

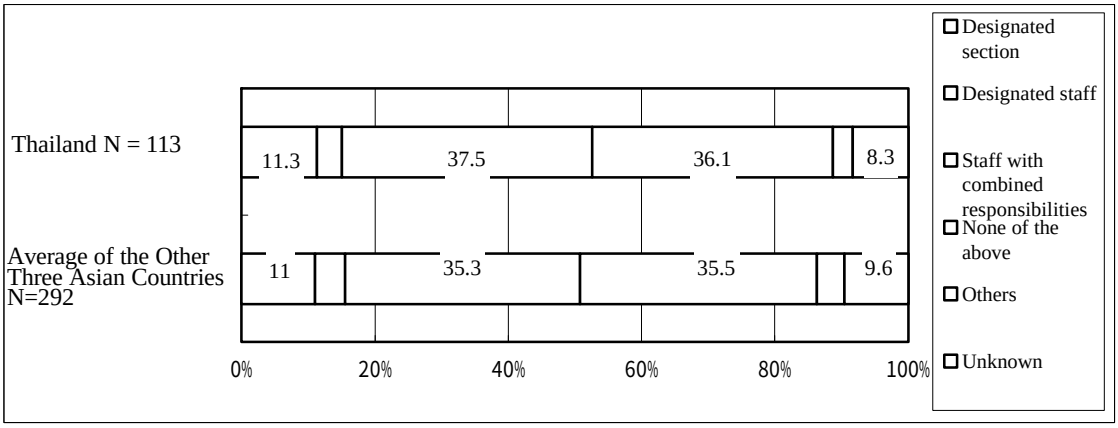
App3-Figure 3 Level of Awareness of Established Guidelines and Charters (Multiple answers permitted)



App3-Figure 4 Does Your Company Have Environmental Policies?



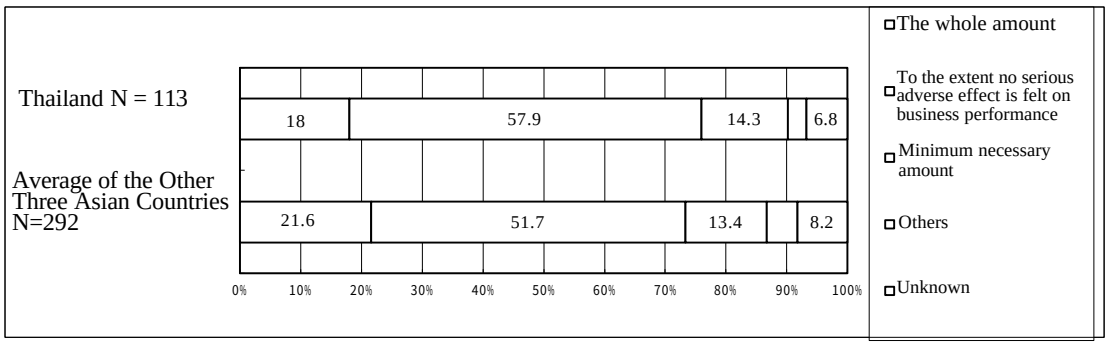
App3-Figure 5 Does Your Company Have Sections or Personnel Assigned to Environmental Management?



(3) Attitudes of companies toward environmental issues

Regarding the expenditures or investments for environmental conservation, 75.9% (73.3%) of those responded were willing to do more than the minimum requirements to satisfy the current regulations (cf. App3-Figure 6). [18.0% (21.6%) of these were willing to bear the necessary cost regardless of the company's business performance and 57.9% (51.7%) were willing to do so to the best of their ability so long as it had no serious effect on the business performance.]

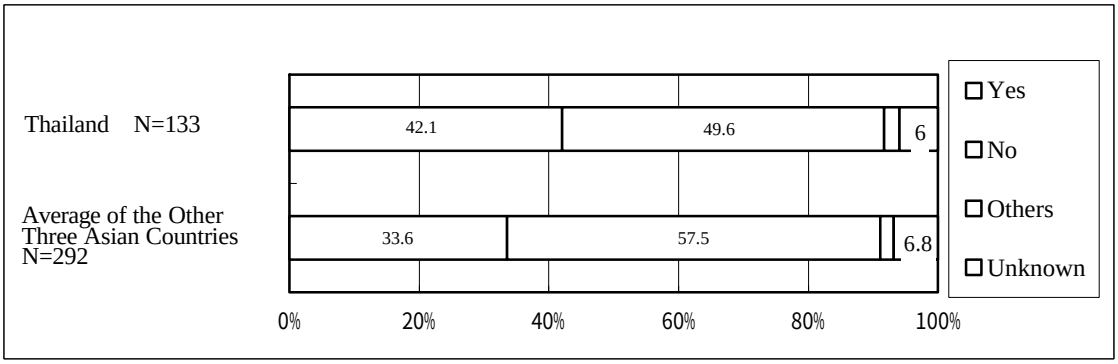
App3-Figure 6 Attitude toward Environmental Conservation in Relation to Expense



(4) Environmental issues surrounding operations in the host countries.

Of all those that responded, 42.1% (33.6%) were subject to the regulations of the local governmental bodies in terms of air and water pollution, etc. (cf. App3-Figure 7).

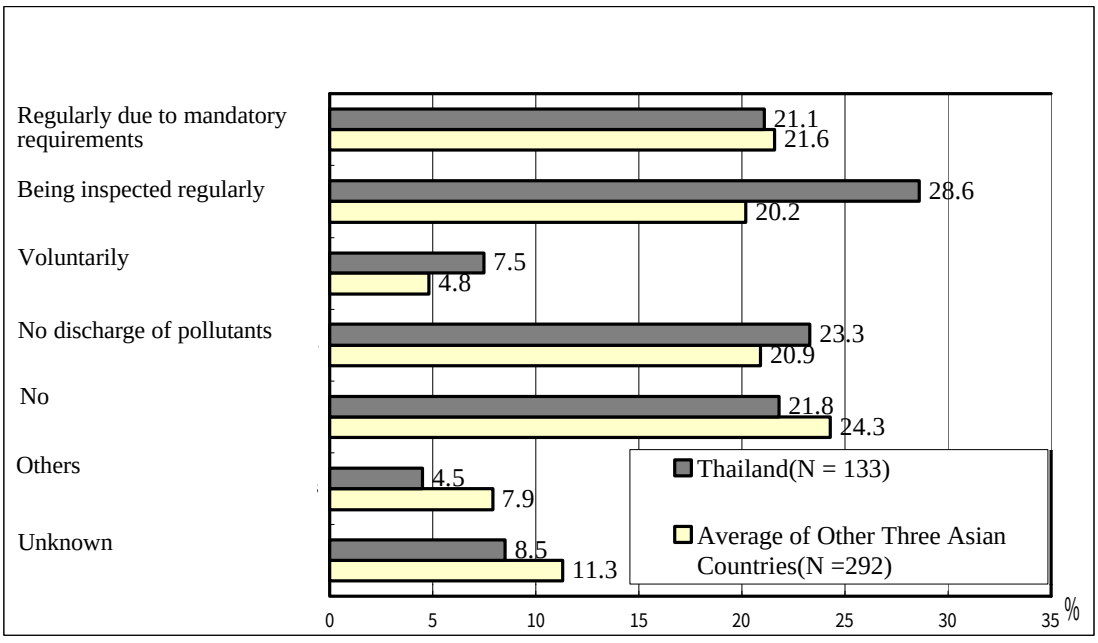
App3-Figure 7 Is Your Company Subject to Environmental Regulations?



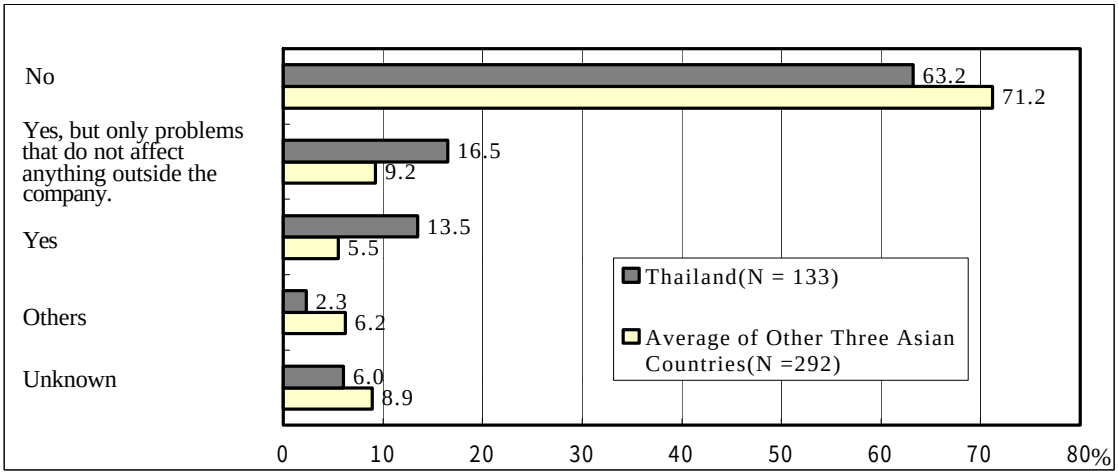
The questionnaire revealed that 28.6% (26.4%) reported the results of measurements of air and water pollution to the local authorities (cf. App3-Figure 8). [21.1% (21.6%) filed the reports on a regular basis because of mandatory requirements, while 7.5% (4.8%) reported on a voluntary basis. 28.6% (20.2%) were subject to mandatory periodic inspections.]

30.0% (14.7%) of the companies had encountered some environmental problems in the course of operation, including minor ones such as those with little or no significant effects outside the company premises (cf. App3-Figure 9).

App3-Figure 8 Does Your Company Report Measurement Results on Air and Water Quality? (multiple answers permitted)

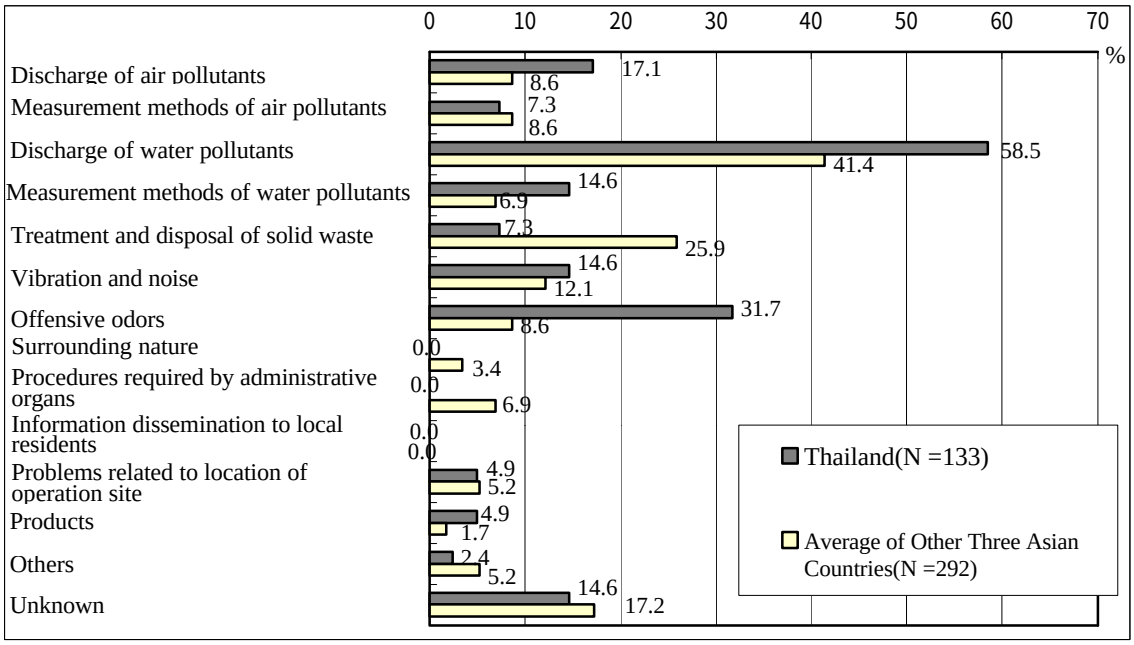


App3-Figure 9 Has Your Company Encountered any Environmental Problems and What Kinds of Problems ?



Among the environmental problems encountered, the issue related to discharge of pollutants into water showed the highest, accounting for 58.5% (41.4%), followed by issues related to odors accounting for 31.7% (8.6%), air pollutants 17.1% (8.6%), and vibration and noise 14.6% (12.1%). 14.6%(6.9%) had problems with measurement methods of water pollutants discharged into pollutants. Compared with the average of the other three Asian countries, Indonesia reported fewer problems with the treatment and disposal of the solid waste but reported higher figures for odor problems (cf. App3-Figure 10, where multiple answers permitted).

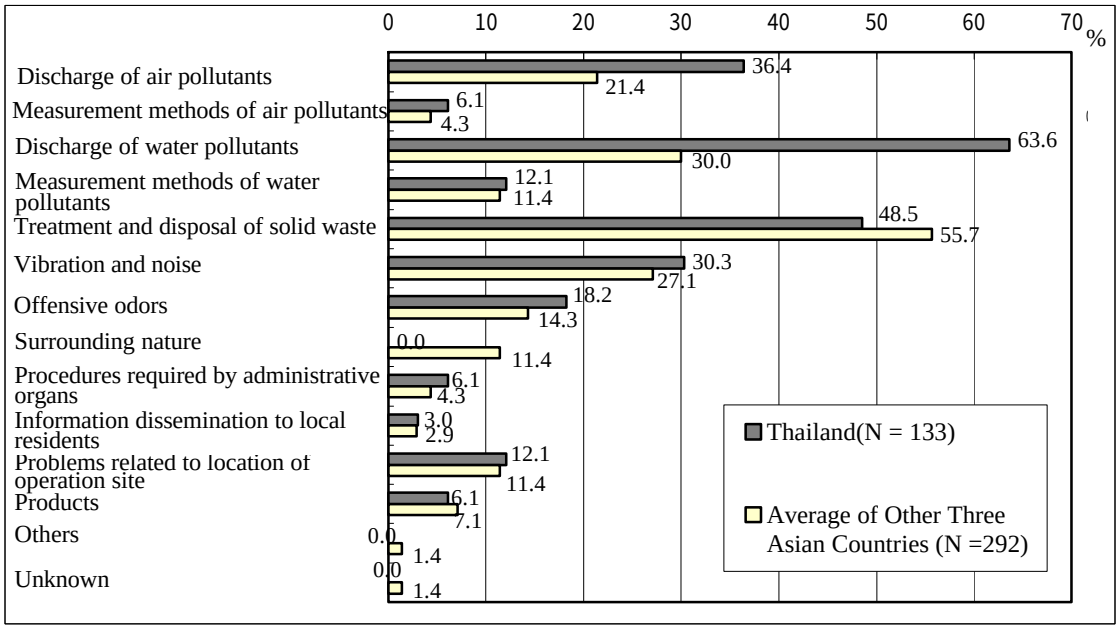
App3-Figure 10 Past Environmental Problems and Issues (multiple answers permitted)



According to the on-site interviews in all of the four Asian countries surveyed, the most advanced measures available in the host countries are employed in the treatment of waste water from the manufacturing operations; however some companies did not properly treat human daily waste water within the operation site. The on-site interviews also revealed that, some companies, unable to find proper disposal sites, kept the solid waste within the premises. This issue need to be tackled because it may lead to environmental problems in the future unless some appropriate measures are taken.

24.8% (24.0%) of the companies anticipate the possibility of some environmental problems arising. Among the issues anticipated, issues related to discharge of water pollutants reached 63.6% (30.0%), treatment and disposal of solid waste 48.5% (55.7%), and emission of air pollutants 36.4% (21.4%) (cf. App3-Figure 11, where multiple answers permitted).

App3-Figure 11 Anticipated Environmental Problems and Issues (multiple answers permitted)

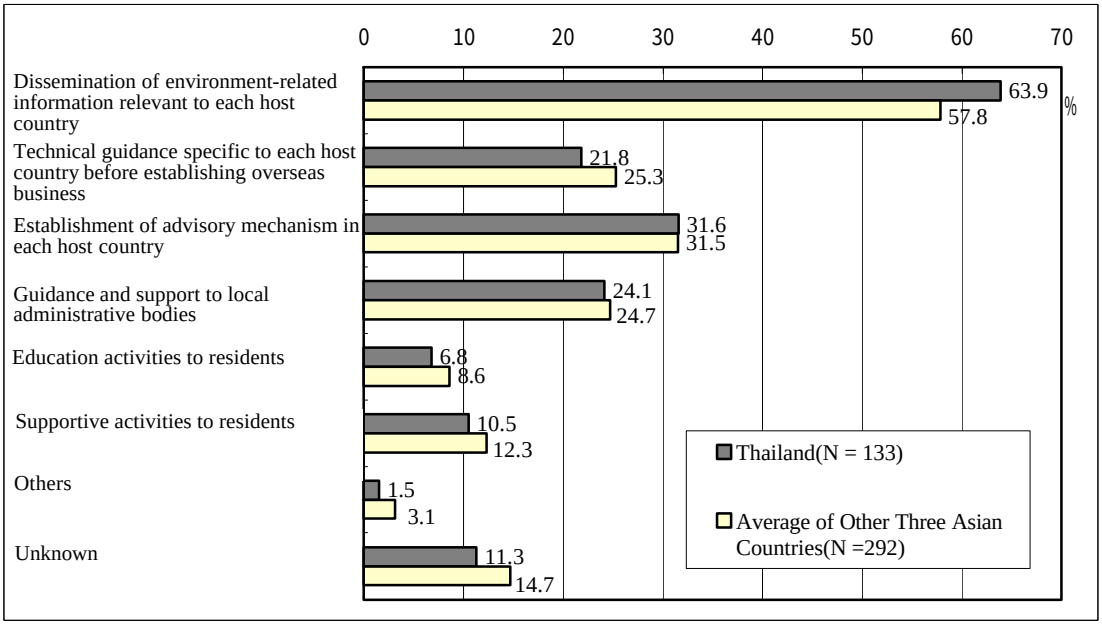


(5) Actions expected from the Japanese government

The questionnaire revealed that the Japanese government is expected to take the following actions for the furtherance of environmental measures by Japanese companies engaged in business operation overseas. Dissemination of environment-related information relevant to each host country (i.e. preparation of manuals); 63.9% (57.8%), establishment of an advisory mechanism in each host country; 31.6% (31.5%), provision of guidance and support and the acceptance of trainees by local administrative bodies of each host country for improvement of environmental and measurement technologies; 24.1% (24.7%), and provision of environmental technical guidance on measurement methods, for example, specific to each host country, in advance, to companies about to set up branches overseas; 21.8% (25.3%) (cf. App3-Figure 12, where multiple answers permitted).

Also during the on-site interviews, there were requests for the preparation of manuals summarizing environmental laws and regulations, and the current environmental problems and issues for each country. A compilation of the case studies about environmental measures from previous experiences of the companies already established there was also requested.

App3-Figure 12 What Do You Expect from the Japanese Government?



Appendix 4
Sources of Environmental Information in Thailand and Japan

1. タイ / in Thailand

⑴ タイ政府機関及びその他機関 / Thailand government agencies and other institutions

1) 科学技術環境省 / MOSTE: Ministry of Science,Technology and Enivironment
・公害管理局水質管理部 / Water Quality Management Division,Pollution Control Department
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404 Phahonyothin Center Bldg. Phahon Yothin Rd.,Phayathai,Bangkok 10400,Thailand
phone+66-2-619-2214
・公害管理局固形廃棄物・有害廃棄物管理部 / Hazadous Substance and Waste Management Division, Pollution Control Department
404 Phahonyothin Center Bldg. Phahon Yothin Rd.,Phayathai,Bangkok 10400, Thailand
phone+66-2-619-2300～2305
・環境政策・環境計画事務室環境影響評価部 / Environmental Impact Evaluation Division, Office of Environmental Policy and Planning
60/1 Soi Pibulwatana 7, Rama 6 Road, Bangkok 10400,Thailand
phone+66-2-279-7180～7189
・環境研究研修センター / ERTC:Environmental Research and Training Center
Technopolis, Amphone Klong Luang, Pathumthani 12120, Thailand
phone+66-2-577-1136～1140

2) 工業省 / MOI:Ministry of Industry
・工業局 / Department of Industrial Works, Ministry of Industry
75/6 Rama 6 Road, Rajthevee, Bangkok 10400, Thailand
phone+66-2-202-4000/202-3967
・工業局有害物質管理部 / Hazardous Substances Control Bureau
75/6 Rama 6 Road, Rajthevee, Bangkok 10400, Thailand
phone+66-2-202-4227/202-4229

3) タイ投資委員会 / BOI:The Board of Investment
555 Vipawadee Rangsit Road,Chatuchak, Bangkok 10900, Thailand
Phone+66-2-537-8111

4) タイ工業団地公社 / IEAT:Industrial Estate Authority of Thailand
618 Thanon Nikhom Makkasan, Phayathai,Bangkok 10400, Thailand
phone +66-2-253-0561

5) バンコク都環境政策推進部 / Environmental Policy and Promotion Division, Bangkok Metropolitan Administration
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6) タイ環境研究所/ TEI:Thailand Environment Institute
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phone +66-2-252-6151～6159
fax +66-2-255-6999

2) 日本貿易振興会バンコクセンター / JETRO, Bangkok Center
JETRO Building., 159 Rajadamri Road, Lumpini, Bangkok 10330,Thailand
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3) 国際協力事業団タイ事務所 / JICA: Japan International Cooperation Agency, Thailand Office
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4) 盤谷日本人商工会議所 / Japanese Chamber of Commerce,Bangkok
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5) 海外経済協力基金 / OECF: Overseas Economic Cooperation Fund
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6) 国際交流基金バンコク日本文化センター / Japan Foundation, Japan Cultural Center,Bangkok
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⑴ 日本政府及びその他日本機関 / Japanese government agencies and other institutions

1) 環境庁企画調整局地球環境部環境協力室 / Office of Overseas Environmental Cooperation, Global Environment Department, Environment Agency
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phone(03)3581-3351(代)
fax(03) 3581-3423

2) 日本貿易振興会 (ジェトロ) / JETRO
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6) 日本貿易振興会アジア経済研究所 / Institute of Developing Economies
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42 Ichigayahonmuracho, Shinjuku-ku Tokyo 162-0845 Japan
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7) 経済団体連合会 / Keidanren, Japan Federation of Economic Organizations
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1-9-4 Otemachi, Chiyoda-ku Tokyo 100-0004 Japan
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8) 日本商工会議所国際部中小企業国際化推進室 / International Division, Japan Chamber of Commerce & Industry
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9) 東京商工会議所産業政策部 / Tokyo Chamber of Commerce and Industry
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② タイ政府機関 / Thailand government agencies

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fax(03) 3589-5176

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（2）英語 / in English

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