

Unit 3105 Introduction of my environmentally sustainable business 1

- Environmental regulations and conditions in Thailand-

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Executive Summary

As the concern for the environmental preservation and sustainable development of businesses become a major concern of companies in the 21st century, I began to think of the necessity of creating the best business model, which would enable the development of a business and preservation of the natural environment at the same time. In previous studies, I have shown frameworks and strategies for environmentally sustainable business (UNIT 3103, 3014). In the coming series of studies I will show how my companies, Ajinomoto and FDG, are applying those frameworks and strategies to enable rapid business growth in an environmentally sustainable way. In this paper, I will give a brief explanation of the environmental condition in my home country, Thailand, where Ajinomoto and FDG conduct business.

1. INTRODUCTION

In previous papers, I have shown today's environmental situations from a global point of view. In this paper, I will explain local environmental conditions and regulations in Thailand to introduce the local environmental background of Thailand, where Ajinomoto and FDG conduct business. Ajinomoto is a global amino acids and foods company, originally from Tokyo. FDG is an environmentally sustainable waste management company of the Ajinomoto group, which is growing rapidly by extending its business regions.

In this series of studies I am going to explain how Ajinomoto and FDG, especially FDG company, are adopting the best business models for an environmentally sustainable business. We need to know the environmental background information in Thailand, before starting to discuss the environmental strategy, because local environmental conditions affect the way environmental problems need to be handled. For example, where there is a big forest, fumes coming from a camping fire may not be any environmental problem, unless the fire burns the forests, while in big cities the fumes from a fire will annoy surrounding people, therefore it would be an environmental problem. Environmental solutions require local application and adaptation as well. For example, under the energy crises, one location may

want to use solar batteries to cover the electricity shortage, while the other location may want to use wind generation, or plant biomass or birds' excrement to generate steam and electricity. The environmentally sustainable business should try to adopt its best business mode, however local adaptation is always necessary. Local economic conditions, such as whether it is a money economy or a traditional economy, will also affect the environmentally sustainable business's strategies, as I showed in the previous paper (Unit 3103). This means that the global environmental problem needs locally developed and locally adopted solutions, which are backed up with the best environmentally sustainable business strategy (Unit 3103, 3014).

2. THE COUNTRY BRIEF OF THAILAND

Ajinomoto has many factories in Thailand. This is because Thailand is located at the center of South East Asia, where natural resources are abundant, the economy is developing rapidly and a well educated labor force is available. I have summarized the basic characteristics of Thailand below:

- Country area: Thailand has a country area of 514 thousand square kilometers, with a population of 65,444,371 people (July, 2005).¹
- Weather: tropical; rainy, warm, cloudy southwest monsoon (mid-May to September); dry, cool northeast monsoon (November to mid-March); southern isthmus always hot and humid.
- Industry: tourism, textiles and garments, agricultural processing, beverages, tobacco, cement, light manufacturing such as jewelry, electric appliances and components, computers and parts, integrated circuits, furniture, plastics, world's second-largest tungsten producer, and third-largest tin producer.
- Agriculture: rice, cassava (tapioca), rubber, corn, sugarcane, coconuts, soybeans.

- Economy: Thailand's economy has slowed slightly over the past year, but real GDP growth was still strong at 6.1% for 2004, down from 6.8% in 2003. During 2004, slower growth in Thai exports was partially offset by a strong year in the tourism sector. Real GDP growth for 2005 is projected at 5.7%. Longer-term annual growth rates are projected in the range of 5-6%.
- Environmental current issues: air pollution from vehicle emissions; water pollution from organic and factory wastes; deforestation; soil erosion; wildlife populations threatened by illegal hunting.
- Environmental international agreement; party to: Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Hazardous Wastes, Marine Life Conservation, Ozone Layer Protection, Tropical Timber 83, Tropical Timber 94, Wetlands signed, but not ratified: Law of the Sea.

3. ENVIRONMENTAL REGULATIONS AND AUTHORITIES IN THAILAND

In this paper, I refer to information on environmental regulations, mostly from Overseas Environmental Measures of Japanese Companies (Thailand), Research Report on Trends in Environmental Considerations related to Overseas Activities of Japanese Companies FY 1998², which was carried out by the Ministry of the Environment. The data and tables of the environmental regulations were updated from Internet information sources³.

Companies should follow the national and local environmental regulations. In my opinion, only complying with the regulation is not enough; an excellent environmentally sustainable company should lead the environmental policy of the government by showing better countermeasures and environmentally sustainable business models. I summarized Thailand's regulations and authorities briefly to provide a better understanding of the environmental authorities and policies in Thailand.

There is only one environmental regulation and six related regulations which do not intend to protect the environment as the main purpose, but intend to control the environmental aspect of the regulations². In Thailand, there are three major environmental pollution concerns: the regional pollution problems, agricultural pollution and industrial pollution. I have summarized the environmental regulation and six supplemental regulations:

- Enhancement and Conservation of National Environment Quality Act , 1992
 - Ministry: Ministry of Science, Technology and Environment (MOISTE) controls the environmental policies based on the regulation.
Three departments: Pollution Control Department (PCD), Office of Environmental Policy and Planning (OEPP), and Environmental Quality Promotion Department.
 - Purpose: This authorizes the committee of the National Environmental Board (NEB) to issue the environmental bulletin and authorizes the Minister of MOISTE to issue ministerial ordinance and notices.

- Factory Act 1992
 - Ministry : Ministry of Industry (MOI)
 - Purpose: Control the operation of factories. Factories are categorized into three groups.
 - Category One: Operation is immediately approved after claim.
 - Category Two: Operation is approved after getting permits from authorities.
 - Category Three: Operation is approved after assessment of the environmental impacts.

- Public Health Act, 1992
 - Ministry : Food and Drug Administration (FDA)
 - Purpose : Control any conduct which has an adverse effect on health, or the healthy life of the public.

- Navigation in Thai Water Act, 1913
 - Ministry : Ministry of Transportation and communication, Department of Harbor.
 - Purpose : Controls water quality.

- Hazardous Substance Act, 1992
 - Ministry of Industry (MOI)
 - Purpose : Controls toxic substances by building appropriate systems and policies. There are four categories of toxic substances.
 - Category one: Handles substances with appropriate procedures.
 - Category two: Notification to authorities is required to handle toxic substances.
 - Category three: Permits are required to handle toxic substances.
 - Category four: Production, importation/exportation, handling of these toxic substances are forbidden.

- Energy Conservation Promotion Act, 1992
 - Ministry : MOISTE, National Energy Policy Board
 - Purpose : Promote energy efficient operation by issuing regulations and giving investment supports and tax relaxation.

- Industrial Estate Authority of Thailand Act, 1979
 - Ministry : Industrial Estate Authority of Thailand (IEAT)
 - Purpose: Controls factories operating in the industrial parks, which is

under the control of IEAT.

4. The Environmental Problems in Thailand

Unfortunately, Thailand's environment is not maintained well, especially so in the urban areas². Thailand has invited industries from developed countries, and was the earliest among the South East Asian countries to industrialize the country as a national policy. The industrialization succeeded in increasing Thailand's gross domestic production (GDP), however many environmental problems have occurred instead. In Metropolitan Bangkok Area (BMA), which consists of Bangkok Metropolitan Administration and four surrounding provinces (Nonthaburi, Phatumthani, Nakhonphatom and Samut Prakan), its suburban area, especially where approximately twenty percent of the national population concentrates and half of the factories of the country exist, pollution of air and water are becoming problems. Further, due to a lack of treatment facilities, the increasing volume of hazardous wastes produced by the industrial activities is dumped into the environment untreated. If the situation is unchanged, the environmental problems will become even worse. In this chapter, the environmental problems of Today's Thailand are summarized in three categories: water pollution, air pollution and industrial hazardous wastes. I will explain these problems to provide environmental background information on the country where Ajinomoto and FDG conduct business so that readers can have a better understanding of the environmental background.

4-1 Water pollution

4-1-1 Water pollution in Thailand

Among three problems in the environment – water, air and the hazardous wastes – water pollution is the most serious problem in Thailand. Therefore, the government gives prevention of water pollution the highest priority among the three environmental problems. This recognition of the environmental problem coincides

with the problems of the fermentation industry. In BMA especially, the water pollution problem is serious because there are many pollution sources of wastewater from citizens and industrial sources. The governmental authority monitors pollution indicators such as Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), and Total E. Coli Counts (TEC), 20 items in total for the big rivers such as the Chao Phraya, Thachin, Mae Kong, and Bang Parking (Figure 1). In 1995, the downstream of the Chao Phraya river recorded the worst data for water quality; the lowest dissolved oxygen is 0.2 mg/liter, BOD is 3.50 mg/liter, TEC is 959,000 Most Probable Number (MPM)/100 milliliter. Under this DO level, fish cannot survive. The Chao Praya river has a lot of garbage drafting on the surface of the water; the contamination is plain to see. Accumulation of heavy metals is not at a significantly high level. A high level of mercury is observed in the bottom sand of the Chao Phraya river. Of the organic contaminants entering the Chao Phraya river, 75 percent of the organic contaminants originate from residential and commercial sources and 25 percent are from industrial wastewater. The wastewater from households is released into the Chyao Phraya river without any treatment and this is the major source of the organic environmental problem. Domestic pulp, sugar, paper, rubber and leather companies, which are mostly owned by home country Thai businesses, are the major sources of industrial source pollution. Now the government is monitoring wastewater from citizens' homes only and analysis of the water from manufacturing plants is not yet being done, because contaminants can be measured only with techniques and equipment, and the monitoring is not systemized.

In this sense, industries operating in Thailand have relaxed regulations compared to developed countries. However, foreign industries operating in Thailand should set strict self control policies so that industry itself can validate the quality of the industrial wastewater and try to lead the Thai government and Thai home country industries to ensure a higher level of clean production technology and less pollution to the environment. Several attempts have been made to prevent pollution of the rivers in urban Thailand. To prevent pollution of river water, the Ministry of Science, Technology and Environment (MOSTE) issued a notification to require purification tanks for buildings over a certain size and sewage treatment plans are beginning to be constructed. The same kind of water pollution is happening in other places than in the river. In 1995 in Korat, the biggest city in north east Thailand, there was an incident of abnormal amounts of algae in Lam Ta Khong Dam, which is the source of the tap water in Korat.

Figure 1 River Map in Thailand



Source: MAPWORLD⁴,

<http://www.mapsofworld.com/thailand/thailand-river-map.html>

4-1-2 Water pollution control

Thailand has a big agricultural industry, therefore the country is susceptible to problems of water pollution that affect agriculture. In recent years, water resources have been dwindling, particularly in urban areas, and concern for the quality of the drinking water reservoirs such as ponds and lakes is rising. Among the

environmental regulations, the water regulations for water quality are the highest priority, in fact these regulations are the most effectively implemented of all the environmental regulations in Thailand. It is evident that the construction of municipal sewage plants is behind schedule. Even though wastewater from households and commercial sources accounts for 75 percent of the pollution of water and wastewater, pollution from industries is 25 percent, the focus of the governmental control for the water quality has been the wastewater from industries. To maintain better water environment, the government's leadership is necessary. The government should provide sewage treatment plants for household wastewater, however industries, especially global companies operating in Thailand, should show leadership by applying the most advanced environmental treatment systems and environmental policies so that they can demonstrate the best business practice, which the government of Thailand and Thai home country business should aim for as the advanced industrial standard. Ajinomoto has a Zero Emission Policy as the company's global commitment to social responsibility, which purports to minimize the environmental burden⁵. The BOD level of the industrial wastewater in Thailand is 60 ppm (Appendix-1) and there are special relaxation rules up to 100 ppm for fermentation industries, however Ajinomoto is committed to keeping it below 10 ppm.

The Thai government sets the environmental standards for the water quality of surface river and ponds in five ranks, where twenty seven parameters are listed as the environmental standard. For specific rivers such as Chyao Phraya, Tachin, Bang Prakong and Mae Klong, separate classes of water usage are defined according to the distance from the river estuary. There are industrial waste standards (Appendix-1), drafted effluent standards for buildings and houses (Appendix-2) and water characteristic discharge into deep wells (Appendix-3). From the late 1970s, stricter wastewater standards have been applied and in 1992 the Improvement and Conservation of National Environment Quality Act was promulgated to control 27 items and 12 kinds of metals. In the industrial zone, the final treatment of the wastewater from factories is done by the shared common final treatment system. The standard for the water quality for this is controlled by the Industrial Estate Authority of Thailand (1979). Multiple regulations have to be met when the treated water is released into the river, harbor and agricultural water.

4-1- 3 Waster quality control of industrial water

The Ministry of Industry (MOI) and the Ministry of Science Technology and Environment (MOSTE), have issued the industrial wastewater standard. Each factory has to ask the MOI for an operational permit. 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 – and set specific standards within the national standards. The government agencies decide additional requirement to the release of water upon approval. For example, where the released water is used for irrigation of agricultural land, the irrigation department of the Ministry of Agriculture and Cooperatives set the level of salinity very strictly. The nationwide regulation states only Total Dissolved Substance (TDS) 3,000 to 5,000 ppm, however for the wastewater to be used for Agriculture, the value of the electrical conductivity is restricted to below 2,000 micro S/cm, which is equivalent to 1,000 mg/liter TDS.

BOD control is allowed within the range of 20 to 60 mg/liter and the controlling office in the district will determine the allowance. For example, Ajinomoto is allowed to release BOD as high as 200 ppm. Such a waiver is given after considering the economic advantage of inviting foreign capital investment into Thailand and also considering the ease of the decomposition of BOD included in the wastewater. However, Ajinomoto has a much stricter internal environmental policy so that Ajinomoto's factories are releasing wastewater which contains less than 10 ppm, as explained already. Generally, wastewater from the food industries, for example, has organic substances that decompose more easily than BOD from chemical industries, so a maximum allowance of BOD 60 ppm is allowed.

Factories located in the industrial zone have a relaxed wastewater standard, for example BOD 450 mg/liter, Chemical Oxygen Demand (COD) 600 mg/liter, which are much looser than the wastewater standard of Thailand. This is because there is a common final wastewater treatment facility in the industrial park. The standards for heavy metals are looser than the national standards, this is assuming that the industrial wastewater could be diluted by the civil and other sources of wastewater in the industrial park. Separated from the BOD allowance to minimize the environmental burden of BOD, the Thai government is preparing to have a charging system for BOD in the wastewater from industries, even if it is within the control range of the BOD regulation. This can be said to be an aggressive

movement of the government to internalize the social environmental cost to industries. This year Ajinomoto's factories were asked to set inline BOD meters which have BOD sensors and emit BOD data directly to the MOI office so that the MOI can always monitor the value of BOD released from Ajinomoto. This is one of the cooperative programs among the government and private companies to make the water quality better. Once this is successful, the government will promulgate this system as a part of the Factory Law of Thailand. Foreign industries should cooperate proactively with the Thai government to establish better industrial environmental standards and pursue environmentally friendly and sustainable business development.

4-1-4 Water analysis

Thai government approves the analytical method developed by the Environmental Protection Agency (EPA), USA. For example, Chemical Oxygen Demand (COD) is done by oxidation using the CODcr by potassium dichromate test. Factories need to submit the analytical results of tests done by government-approved laboratories.

4-1-5 Penalties

Factories that exceed the control limits will receive a warning from the MOI or from the Irrigation Department or other governmental agency with jurisdiction over its activities. If a factory fails to comply with repeated warnings, the authority will order the factory to stop operations. There was an incident in which a pulp factory owned by a Thai home country business was ordered to stop operation.

4-2 Air pollution in Thailand

Urban Thailand, including BMA, suffers from severe air pollution. The government's emphasis on air pollution control focuses on the car exhaust

problems. The control of industrial air pollution is the second biggest concern and a plan is going to be prepared from now. Current air pollution regulations are issued in 1995(Appendix-4-1, 4-2), which includes the control limit on Carbon Oxide (CO), Nitrogen Dioxide (NO₂), Sulfate Dioxide (SO₂), Total Suspended Particulate (TSP), Micro Particles Less than 10 Microns (PM-10), and Lead (Pb). For the industrial air pollution, there has been a history of control of black particles in the emissions from stationary sources, such as factories. Current industrial emission standards proposed in a notification from the MOI define the types of sources subject to regulation, and set emission standards for 31 air pollutants (Appendix 4-2). According to the information of MOSTE, there will be new air pollution standards for such industries as stones, industrial stones and pebble production facilities, steel making, quarries and cement industries, where air pollution is becoming a serious concern. In the near future there will be regulations controlling the total emission quantity. Smell problems and noise problem are not precisely described by the air pollution regulations, however these can be problems for neighbors and therefore they are controlled by the Public Health Act. For cars, there are individual exhaust gas regulations (Appendix-5), for Black Particles, Carbon Mono Oxide, and Hydro Carbons. From 1993, car manufacturers have been obligated to fit catalytic air cleaners. Thailand is one of the developing countries which does not ratify the Kyoto Proposal, therefore there are no orders from the government to control CO₂ gas emissions. Thailand is suffering from many pollutants, such as car exhausts and toxic pollutants from industries, and it is beginning to improve the level of those pollutants. Companies aiming for environmentally sustainable development should, no matter how low the regulation requirements are for the air pollution control, apply the best process to reduce the environmental pollutants in Thailand so that those companies can show the standard of the next generation's environmentally friendly manufacturing system. Ajinomoto applies its global zero emission policy to the plant operation in Thailand, it aims to reduce CO₂ emissions per annual sales by 20 % by the year 2010(Bench mark is 2004).

4-3 Toxic wastes

4-3-1 Situation in Thailand

Industrial wastes, especially toxic substances, are becoming big social environmental problems. The lack of treatment facility capacity is becoming a headache to the government. Citizens are resisting the construction of new landfill or treatment facilities nearby their homes, therefore the progress of the construction project is very slow. The lack of industrial waste treatment capacity tends to result in illegal dumping problems. For example, in 1996, 1.6 million metric tons of industrial wastes were generated nationally and 1.2 million metric tons of these were from industries. However, the MOI estimated that only about 0.2 million metric tons of the industrial wastes were properly treated. The rest of the waste was kept as waste inventory or might have been dumped illegally. Imported and domestically produced toxic chemicals were around 12 million metric tons in 1996 and there were many accidents related with those toxic chemicals. In 1992, the Hazardous Substance Act was promulgated and about 1,000 kinds of chemicals were registered as controlled toxic chemicals.

4-2-2 The lacking capacity of treatment facility

The Factory Act (1992) states that toxic industrial wastes shall be put in closed vessels, and kept in the specified places to avoid contamination problems. Factories which emit hazardous industrial waste have to either treat hazardous wastes by themselves or ask for treatment by the General Environmental Conservation Public Company Limited (GENCO), which is the sole company to have an official permit for treating hazardous industrial wastes in Thailand. There are only two facilities which can handle hazardous industrial wastes in Thailand, both of which were built by the MOI and controlled and operated by GENCO. In the BMA, there is one treatment facility. It started its service in 1988 and has a capacity for handling 1,000 metric tons per a day of toxic industrial water, and processes 50 metric tons per a day of hazardous industrial solid wastes. The technology is licensed from MWI (USA). The other facility is located in the Rayon area and its capacity is 70 thousand metric tons of hazardous industrial wastes.

The two facilities can therefore handle a total of 0.2 million metric tons of industrial hazardous wastes per year. The lack of capacity is obvious therefore the MOI, as the responsible authority, planned to build seven more treatment facilities in Thailand. However, many of them have been severely opposed by citizens. The generation and treatment capacity of hazardous industrial wastes in Thailand is not balanced, and environmental problems may occur. Companies aiming for sustainable development in an environmentally friendly way should show examples of reducing hazardous wastes to zero by changing the process, raising the efficiency of the process dramatically, and recycling and converting toxic wastes to no toxic substances. Ajinomoto is committing to a reduction in wastes of more than 99.9%, eventually down to zero, by its zero emission policy⁵. Ajinomoto established FDG, an independent environmentally sustainable waste management company, in 2001. This has made Ajinomoto's zero emission target possible⁵. FDG is becoming the fermentation industry's excellent business model of how to develop a sustainable but environmentally friendly business.

5. What global companies should aim at in Thailand

Thailand is one of South East Asia's emerging economies. Global companies come to Thailand to supply the demand for their products in the country and to export products from Thailand. Rich natural resources, a cheaper and capable labor force and the government's incentive policies to invite foreign industries make Thailand one of the most attractive South East Asian countries to invest in. Thailand is still rapidly growing its GDP and therefore there are many problems related to the environment. The government of Thailand tries to provide sufficient environmental countermeasures and social infrastructure to treat polluted substances, however it does not keep up with the speed of the industrial development. Leading companies in industries, especially those global companies from developed countries, should therefore show leadership in introducing the most advanced production technology and environmental solutions to reduce and hopefully improve the environmental pollution problems in Thailand. The country gives opportunities to foreign companies to come, operate and develop their business. In turn, companies need to show the way to manage the environment better for the environmentally sustainable, healthy development of the country.

6. Conclusion

1. Thailand is suffering serious environmental problems. Among the problems, the government and people are paying the greatest attention to the water quality, because it affects the agriculture, which is the major industry in Thailand.
2. There is one environmental regulation and another six regulations which indirectly control the environment in Thailand. The general environmental requirement is looser than that of the developed countries and the government is preparing to provide the regulations and the infrastructure to improve the environmental problems in Thailand. Unfortunately, the preparation of these environmental countermeasures is slow and the environmental problem is getting worse.
3. For global companies operating in Thailand, mere compliance to the environmental regulation is not enough, because the industrial standards for the environmental control are looser than comparable regulations in the developed countries. Global companies should provide the best practice for environmentally sustainable production and serve as leaders, to enable the country's sustainable development in environmentally friendly ways.

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Appendices,

Appendix-1

1) Industrial Effluent Standards

Items	Units	Standard values	Remarks
BOD (5 days, at 20 C)	mg/l	20 - 60	Fishery canning..... Max. 100 Starch industry - Centrifugal..... Max. 60 - Sedimentation..... Max. 100 Noodle industry..... Max. 100 Tanning industry..... Max. 100 Pulp industry..... Max. 100 Frozen Food industry..... Max. 100
Suspended solids (SS)	mg/l	Depend on dilution ratios of wastewater and receiving water	Ratio - 1/8 to 1/150..... Max. 30 - 1/151 to 1/300..... Max. 60 - 1/301 to 1/500..... Max. 150
Dissolved solids (DS)	mg/l	Max. 2,000 or under office's consideration but not more than 5,000	If salinity of receiving water is higher than 2,000 mg/l, DS in the effluent should not be higher than 5,000 mg/l of the DS in the receiving water
pH	-	5-9	
Permanganate value	mg/l	Max. 60	
Sulfide as H ₂ S	mg/l	Max. 1.0	
Cyanide as HCN	mg/l	Max. 0.2	
Tar	mg/l	none	
Oil & Grease	mg/l	Max. 5.0	Refinery & Lubricant oil industry Max. 15.0
Formaldehyde	mg/l	Max. 1.0	
Phenol & Cresols	mg/l	Max. 1.0	
Free Chlorine	mg/l	Max. 1.0	

Insecticides	mg/l	none	
Radioactivity	Becquerel/l	none	
Heavy metals		none	
Zinc (Zn)	mg/l	Max. 5.0	Zinc industry..... Max. 3.0
Chromium (Cr)	mg/l	Max. 0.5	Zinc industry..... Max. 3.0
Arsenic (As)	mg/l	Max. 0.25	
Copper (Cu)	mg/l	Max. 1.0	
Mercury (Hg)	mg/l	Max. 0.005	Zinc industry..... Max. 0.002
Cadmium (Cd)	mg/l	Max. 0.03	Zinc industry..... Max. 0.1
Barium (Ba)	mg/l	Max. 1.0	
Selenium (Se)	mg/l	Max. 0.02	
Lead (Pb)	mg/l	Max. 0.2	
Nickel (Ni)	mg/l	Max. 0.2	Zinc industry..... Max. 0.2
Manganese (Mn)	mg/l	Max. 5.0	
Silver (Ag)	mg/l	-	Zinc industry..... Max. 0.02

Remarks : A,B,C,D, size of community with more than 2500, between 501-2500, between 101-500 and less than 101 persons respectively

* Settled BOD (30 min)

** more than TDS of used water

*** Maximum allowance under epidemic condition only

Source: OSTC, Environmental Standards and Regulations

<http://www.ostc.thaiembdc.org/environment/water.html#3.2.1>

Appendix-2 Drafted Effluent Standards for Buildings

Building type	Size	Minimum Requirement	Remarks
1. Government offices. State enterprises. International agencies, Bank, Office buildings (except those specified otherwise in this Table)			working area only (excluding central service area)
	2,000 - 10,000 m ²	C	
	10,000 - 55,000 m ²	B	
	> 55,000 m ²	A	
2. Condominium			all sizes
	<= 100 units	C	
	101 - 500 units	B	
	> 500 units	A	
3. Hotels			
	60 - 200 rooms	B	
	> 200 rooms	A	
4. Hospitals			
	10-30 beds	B	
	> 30 beds	A	
5. Massage parlours (or equivalence)	>= 5,000 m ²	B	

6. Fresh-food markets			
	500 - 1,000 m ²	D	
	1,001 - 1,500 m ²	C	
	1,501 -2.500 m ²	B	
	> 2,500 m ²	A	
7. Housing estate			all sizes
	< 20 households	D	
	20-100 households	C	
	101-500 households	B	
	> 500 households	A	
8. Food service operations			dining area
	50-100 m ²	D	
	101-500 m ²	C	
	501-2,500 m ²	B	
	> 2,500 m ²	A	
9. Department stores			
	5,000 - 25,000 m ²	B	
	> 25,000 m ²	A	

10. Schools, Universities Colleges, Institute			
	5,000 - 25,000 m ²	B	
	> 25,000 m ²	A	
11. Dormitories			
	10-50 rooms	D	
	51 -250 rooms	C	
	> 250 rooms	B	
12. Fishing Piers	> 300 m ²	B	- loading, unloading and sorting area - excluding nitrogen parameter

Remarks: Concentrations of all parameters are the same as those stated in Domestic Effluent Guidelines (in 3.2.3)

Source: Proposed by the Sub-Committee on Domestic Effluent Apr. 10, BE. 2532 (1989)) and under the consideration of the Environmental Committee on Laws., cited in OSTC, Environmental Standards and Regulations, <http://www.ostc.thaiembdc.org/environment/water.html#3.2.1>

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Appendix -3**Water Characteristic Discharge into Deep Well**

Parameters	Units	Standard value (Max. allowance)
Color	Platinum Cobalt	50
Turbidity	JTU	50
pH	-	5.0 - 9.2
Total Solids	mg/l	2,000
BOD	mg/l	40
Oil and Grease	mg/l	5.0
Free Chlorine	mg/l	5.0
Copper (Cu)	mg/l	1.5
Zinc (Zn)	mg/l	15.0
Chromium (Cr)	mg/l	2.0
Arsenic (As)	mg/l	0.05
Cyanide (CN)	mg/l	0.2
Mercury (Hg)	mg/l	0.002
Lead (Pb)	mg/l	0.1
Cadmium (Cd)	mg/l	0.1
Barium (Ba)	mg/l	1.0

Penalty: A licensee who does not comply with this notification shall be punished by fine not exceeding twenty thousand baht

Source: Notification of the Ministry of Industry No. 5, B.E.2521(1978), issued under the Ground Water Act B.E.2520(1977), published in the Royal Government Gazette, Vol.95, Part 66, dated June 27, B.E. 2521 (1978)

Appendix-4-1**National Ambient Air Quality Standards**

<http://www.ostc.thaiembdc.org/environment/air.html#1.2.1>

Pollutants	1 -hr average value mg/m3	8-hr average value mg/m3	24-hr average value mg/m3	1-yr average value mg/m3	Methods of Measurement
Carbon Monoxide (CO)	50	20	-	-	Non-Dispersive Infrared Detection
Nitrogen Dioxide (NO ₂)	0.32	-	-	-	Gas Phase Chemiluminescence
Sulfur Dioxide (SO ₂)	-	-	0.30	0.10*	Pararosaniline
Suspended Particulate Matter (SPM)	-	-	0.33	0.10*	Gravimetric-High Volume
Photochemical Oxidant (O ₃)	0.20	-	-	-	Chemiluminescence
Lead (Pb)	-	-	-	0.01	Wet Ashing

Note: * = Geometric mean value.

Sources : (1) Standards : Notification of Office of the National Environment Board, No.2, dated November 6, B.E. 2524, published in the Royal Government Gazette, Vol. 98, Part 197, dated December 1, B.E. 2524 (1981) P. 4322-4323.

(2) Methods of Measurement: Notification of the Ministry of Science, Technology and Energy, issued under National Environmental Quality Act B.E. 2518, B.E. 2521, published in the Royal Government Gazette, Vol. 9S, Part 197, dated December 1, B.E. 2524 (1981) P. 4299-4306.

Appendix 4-2**Proposed Industrial Emission Standards by Industrial Environment
Division, Ministry of Industry**

No.	Substances	Sources	Proposed Standard Values
1	Particulate	-Boiler & furnace	
		Heavy oil as fuel	0.3 g/Nm ³
		Coal as fuel	0.5 g/Nm ³
		-Steel manufacturing	400 mg/Nm ³
		- Cement plant and calcium carbide plant	400 mg/Nm ³
		- Rock and gravel aggregate plants (production capacity more than 50,000 tons per year)	400 mg/Nm ³
		- Other source	500 mg/Nm ³
2	Smoke opacity	Boiler and Furnace	not exceed 40% Ringlemann scale
3	Aluminum	Furnace or smelter	(dust) 300 mg/Nm ³ (Al) 50 mg/Nm ³
4	Alcohol	any source	0.05 lb/min
5	Aldehyde	any source	0.05 lb/min
6	Ammonia	gas plant	25 ppm
7	Antimony	any source	25 mg/Nm ³
8	Aromatics	any source	0.05 lb/min

9	Asbestos	any source	27ug/Nm3
10	Arsenic	any source	20 mg/Nm3
11	Beryllium	any source	10 ug/Nm3
12	Carbonyls	Burning refuse	25 ppm
13	Chlorine	any source	20 mg/Nm3
14	Ethylene	from production or by usage	0.03 lb/min
15	Ester	any source	.0.05 lb/min
16	Fluorine	any source	0.3 lb/ton P2 05
17	Hydrogen Chloride	any source	200 mg/Nm3
18	Hydrogen Fluoride	any source	10 mg/Nm3
19	Hydrogen Sulphide	any source	100 ppm
20	Cadmium	any source	1.0 mg/Nm3
21	Copper	any source	dust 300 mg/Nm3 (Cu) 20 mg/Nmq
22	Lead	any source	dust 100 mg/Nm3 (Pb) 30 mg/Nm3
23	Mercury	any source	0.1 mg/Nm3
24	CO	any source	1,000 mg/Nm3
25	SO2	H2 S04 production	500 ppm
		Other activities:	
		- Bangkok and its vicinities	400 ppm
		- other area	700 ppm

26	N0x	Combustion source	1,000 mg/Nm ³
		HNO ₃ production	2,000 mg/Nm ³
		and others	
27	Nitric acid	any source	70 mg/Nm ³
28	Organic Material	any source	0.01 l/d/min
29	Phosphoric acid	any source	3 mg/Nm ³
30	Sulfur trioxide	any source also in	35 mg/Nm
		combination with H ₂ S ₀₄	as H ₂ S ₀₄
31	Sulfuric acid	any source	35 mg/Nm ³

Appendix-5

1.1.1 1.2.2 Motor Vehicle Emission Standards

		Emission Standards		
Organization	Parameters	Measuring Systems	Maximum Permissible Limit (%)	Measuring Methods (summary)
(1) ONEB (Office of the National Environment Board)	Black Smoke	Bosch or	50	1) At rapid acceleration under no-load condition to maximum rotating speed. Use maximum value of the two measurements.
		Hartridge Bosch	52 40	2) On test bench, running with full-load at 60% of the maximum rotating speed. Use average value the two measurements.
	CO	Non - Dispersive Infrared Detection	6	1) Idling 2) Average value of the two measurements
(2) The Police Department	Black Smoke	Smoke meter	40*	At proper rotating speed
(3) Department of Land Transport	Black Smoke	Bosch or	50	1) The same as ONEB in 1)
		Hartridge Bosch	52 40	2) The same as ONEB in 2)
	CO	Non -	6	The same as ONEB

		Dispersive Infrared Detection		
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* **Note:** The emission standards and measuring methods for black smoke issued by the Police Department will be changed to be the same as ONEB's

Sources:

(I) ONEB

Standards :

- Notification of Office of the National Environment Board, Dated January 28, B.E. 2531 (1988) published in the Royal Government Gazette. Vol. 1(5). Part 73, dated May 5, B.E. 2531 (1988) P. 3679-3680
- Notification of Office of the National Environment Board, Dated December 14, B.E. 2522 (1979) published in the Royal Government Gazette, Vol. 97, Part 35, dated March 4, B.E. 2523 (1980) P. 736 - 737.

Method of Measurement

- Notification of the Ministry of Science, Technology and Energy, issued under National Environmental Quality Act. B.E. 2518, B.E. 2521, dated February 22, B.E. 2531 (1988), published in the Royal Government Gazette. Vol. 105, Part 73, dated May 51 B.E. 2531 (1988) p. 3665 - 3666
- Notification of the Ministry of Science, Technology and Energy, issued under National Environmental Quality Act. B.E. 2518. B.E. 2521 dated February 7, B.E. 2523 (1980), published in the Royal Government Gazette, Vol. 97, Part 35, dated March 4, B.E. 2523 (1980) P. 715 - 718.

(2) The Police Department:

- Notification of the Police Department issued under the Announcement of the Revolutionary Party No. 16, dated February 3, B.E. 2527 (1984), published in the Royal Government gazette, Vol. 101, part 20, dated February 16, B.E. 2527 (1984) (special issue) p. 4 - 5.

(3) Department of Land Transport :

- Notification of the Department of land Transport issued under Land Transport Act B.E. 2522, dated September 9, B.E. 2531 (1988)

