
INDUSTRIAL ESTATE AUTHORITY OF THAILAND STRATEGY FOR ENVIRONMENTAL COMPLIANCE

HOMCHEAN, KASEMSRI

Director, Environmental and Safety Control Division, Industrial Estate Authority of Thailand, 618 Nikom Makkasan Rd., Rajdhevi, Bangkok 10400 Thailand

SUMMARY

Industrial Estate Authority of Thailand is a state enterprise established in 1972 under the Ministry of Industry. It is chartered to develop and operate industrial estates in order to promote systematic industrial growth.

All newly industrial estate projects of the Industrial Estate Authority of Thailand must be approved and allocated budget for investment by the Government. The environmental impact assessment must be approved by the Office of Environmental Policy and Planning of the Ministry of Science, Technology and Environment before commencing operation.

Currently, there are 28 estates of which 9 of them are owned and operated by the Industrial Estate Authority of Thailand. Others are joint venture between the Authority and private developers. All estates are provided with public utilities i.e. water supply, telephone, electricity and transportation systems as well as central wastewater treatment system and solid waste disposal facilities.

The Authority manages and regulates all activities in industrial estates i.e. grants the Land Use and Operation Permit; operates utility systems including wastewater treatment system, solid waste disposal; monitors environmental quality; regulates industrial operation; and controls pollution and safety.

In order to encourage industrial operation in compliance with environmental regulations, the Authority sets up measures as follows :

1 ENFORCEMENT

Industrial Estate Authority of Thailand is authorized to control industrial operations in industrial estates. The major legal tools are set forth in the Industrial Estate Authority of Thailand Act B.E. 2522, B.E. 2534 and B.E. 2539. (1979, 1991, 1996)

The Authority grants Land Use Permits for industrial operation inside industrial estates. An industrial operator must notify of its facility operation 30 days before the commencing date. The permit has to be renewed at 5 year intervals. In case of any violation, the Authority must give a warning notice or an order to terminate operation at a specified period of time or an order of permit cancellation depending on the degree of violation. Authorized officers inspect industrial operation regularly and in case of an emergency event or accidents.

The Authority issues rules and regulations to control pollution, e.g., wastewater treatment charges, fines and penalties; discharge criteria to central treatment; and solid waste disposal.

The environmental regulations issued by other ministries with which industrial operators must comply are as follows:

- Factory Act B.E. 2535 (1992) was issued by the Ministry of Industry to enforce all industries. Industrial Estate Authority of Thailand and Industrial Works Department use this act as a tool to regulate industrial operations inside industrial estates. Rules and regulations were issued in accordance with this act to control industrial pollution:
 - Notification of Ministry of Industry No.2 B.E. 2536 (1993) (Emission Standard)
 - Notification of Ministry of Industry No.2 B.E. 2539 (1996) (Effluent Standard)
 - Notification of Ministry of Industry No.6 B.E. 2540 (1997) (Hazardous Waste Management)
- Enhancement and Conservation of National Environmental Quality Act. B.E. 2535 was issued by Ministry of Science, Technology and Environment. Relating regulations issued in accordance with the Act. are as follows :
 - Notification of Ministry of Science, Technology and Environment No.3 B.E. 2539 (Effluent Standard for Industrial and Industrial Estate Sources.)
Industries and industrial estates have to comply with higher standard comparing the standards issued by Ministry of Industry and Ministry of Science, Technology and Environment.
 - Emission standards of different sources e.g. industry, incinerator, etc.
 - Environmental quality standard.
- Hazardous Substance Act. B.E. 2535
Industry concerning hazardous chemicals e.g. import, export transport, storage, package, manufacture etc. such chemicals has to comply with the Act.
- Public Health Act. B.E. 2535
This Act was issued by Ministry of Public Health concerning public health, sanitation and environmental e.g. municipal waste

Violation of any laws or regulations, the authorized officials of the mentioned agencies shall take legal action against industrial operators.

2 MONITORING

Industrial Estate Authority of Thailand is responsible for the quality of environment of industrial estates.

2.1 Wastewater monitoring

All industrial estates provide central wastewater treatment facilities. Discharge of industrial wastewater to central treatment systems must comply with Industrial Estate Authority of Thailand's criteria. If the wastewater exceeds the criteria, the factory must have a pretreatment system. The effluent of the central treatment systems must conform to the standard.

Monitoring of individual discharges to the central treatment systems and central effluent has been carried out by a contractor, the Authority also monitors effluent from central treatment plant to comply with effluent standard.

2.2 Air Pollution Monitoring

Any factories which have to submit an environmental impact assessment to the Office of Environmental Policy and Planning have to monitor stack emissions and ambient air according to the environmental impact assessment requirement and report the monitoring results to the Office.

2.3 Hazardous Waste Monitoring

Industrial Estate Authority of Thailand has to monitor hazardous waste transportation, storage and disposal according to the Notification of Ministry of Industry No.6 B.E. 2540. If the factories have contractors that handle hazardous waste management, the industrial operators must report to the Authority the contractors' name and qualifications, method of disposal, disposal and landfill site, and quality and type of wastes of each transfer.

2.4 Monitoring of the Industrial Estate Environment

At present there are 28 industrial estates under Industrial Estate Authority of Thailand, nine of which are operated by the Authority with remainder being joint venture projects. The Authority has contracted consultant firms for monitoring the environmental quality of the Authority's industrial estates, i.e. ambient air, incinerator stack emission, noise level, groundwater, surface water, sea water and silt.

Developers of joint venture industrial estates are responsible for the environmental monitoring program in regard to the environmental impact assessment. The analytical reports are sent to Industrial Estate Authority of Thailand before forwarding to the Office of Environmental Policy and Planning of the Ministry of Science, Technology and Environment.

2.4 Automated Environmental Monitoring System

Industrial Estate Authority of Thailand has planned to set up automated monitoring stations to check the quality of the ambient air and central effluent of industrial estates. The telemeter system will record real time information and transmit it to the Authority's headquarters by means of transmission line. Hence it will enhance immediate response to any environmental problems.

3 INCENTIVES

In order to enhance environmental compliance, the Authority offers incentives for industrial operators

- **Awards**

Industrial Estate Authority of Thailand grants annual awards for industrial operators for the best environmental performance. A committee of the Authority evaluates the facilities and environmental management by the end of the year.

- **ISO 14000 Promotion**

The Authority promotes ISO 14001 certification. In this regard, the Authority encourage consultant firm to organize seminars/training for industries for better understanding and knowledge of the standard. It is a steering wheel for environmental management system of industries which will enhance

environmental performance. In addition, it can reduce or eliminate trade barrier for export sector. The Authority itself has planned to achieve the certification for the headquarters' office and some estates by 2000.

- **Environmental Performance Rating**

The Authority is planning a project on rating environmental performance of industries in several classes. The result will be publicize annually. The project will be the cooperation between the Authority, local and international organizations as well as industries.

With these measures, environmental compliance should be improved and environmental quality will be better.

Acceptable Characteristics for Central Wastewater Treatment, Process

1.	Average BOD5	500	mg/l
2.	Average Suspended Solids	200	mg/l
3.	pH	5.0 - 9.0	
4.	Temperature	45	°C
5.	Sulphide as hydrogen sulphide	5	mg/l
6.	Cyanide as hydrogen cyanide	2	mg/l
7.	Oil and Grease	10	mg/l
8.	Tar	10	mg/l
9.	Formaldehyde	2	mg/l
10.	Phenol and Cresols	1	mg/l
11.	Free Chlorine	5	mg/l
12.	Insecticide	none	
13.	Radioactive compound	none	
14.	Fluoride (F)	5	mg/l
15.	Free Ammonia	5	mg/l
16.	Total ammonia Nitrogen as N	50	mg/l
17.	Mercury and Mercury Compound	0.005	mg/l
18.	Soluble Iron and Manganese	10	mg/l
19.	Chromium, Arsenic, Silver, Selenium, Lead, Nickle, Barium, Copper, Cadmium, Total or Each	1	mg/l
20.	Other materials that should not discharge into the waste water pipeline - High viscosity material - Settleable solids that Cause pipe clogging - Calcium Carbide Sludge		
21.	Synthetic Detergent	30	mg/l
22.	Chloride (Cl) as Chlorine	2,000	mg/l

Notification of Ministry of Industry
No. 2 B.E. 2536 (1993)
Issue in Accordance with the Factory Act B.E. 2535 (1992)
Emission Standard

1. Emissions from factory stacks must not be greater than the following standard:

<u>Item</u>	<u>Pollutants</u>	<u>Source</u>	<u>Quantity (mg/Nm³)</u>
1	Particulate	Boilers using fuel: - heavy oil - coal - others Steel, Aluminium Furnace Manufacturing process	300 400 400 300 400
2	Antimony	Manufacturing process	20
3	Arsenic	Manufacturing process	20
4	Copper	Smelting or refining	30
5	Lead	Manufacturing process	30
6	Chlorine	Manufacturing process	30
7	Hydrogen chloride	Manufacturing process	200
8	Mercury	Manufacturing process	3
9	Carbonmonoxide	Manufacturing process	1,000 or 870 ppm
10	Sulfuric acid	Manufacturing process	100 or 25 ppm
11	Hydrogen sulfide	Manufacturing process	140 or 100 ppm
12	Sulfur dioxide	Sulfuric acid Manufacturing process	1,300 or 500 ppm
13	Oxide of nitrogen	Boiler using fuels: - Coal - Others	940 or 500 ppm 470 or 250 ppm
14	Xylene	Manufacturing process	870 or 200 ppm

2. Sampling and measurement of pollutants must be conducted during industrial operation.

3. Measurement of pollutants must be conducted at normal pressure and the temperature of 25°C

Industrial Estate Authority of Thailand Owned and Operated Industrial Estates

<u>Location</u>	<u>Estate</u>
1. Existing	
Bangkok	1. Bangchan
	2. Ladkrabang
Samutprakarn	3. Bangpoo
	4. Bangplee
Chonburi	5. Laem Chabang
Rayong	6. Map Ta Phut
Lamphune	7. Northern Region
2. Under construction	
Songkhla	1. Southern
Pichit	2. Pichit
3. Proposed Projects	
Rayong	1. Map Ta Phut phase III
Surat Thani	2. NA
Ranong	3. NA
Supanburi	4. NA
Burirum	5. NA
Khonkaen	6. small industrial estate

Joint Venture Between Industrial Estate Authority of Thailand and Private Developers

<u>Location</u>	<u>Estate</u>
1. Existing	
Bangkok	1. Gemopolis
Samutprakarn	2. Bangpoo (expansion)
Chachoengsao	3. Wellgrow
	4. Gateway City
Chonburi	5. Chonburi (Bowin)
	6. Bangpakong II
	7. Pinthong
Rayong	8. Eastern
	9. Padaeng
Samut Sakorn	10. Samut Sakorn
Ratchaburi	11. Ratchaburi
Ayudhya	12. Hi-tech
	13. Bang pa-in
	14. Saharattana Nakorn
Saraburi	15. Kaengkhoi

2. Under construction

Udon Thani

Rayong

3. Proposed Projects

Rayong

Prachuab Kirikhan

Nakornsawan

Ayudhya

16. Nongkhae

1. Udon Thani

2. Eastern Seaboard

3. Amata City

1. Thai-Singapore 21

2. CP Land

3. Tuntex

4. SV Western Seaboard

5. Network

6. Tapchumpol

7. Chutikarn Factory House

Calculation Pattern of Central Treatment Charges

$$TC = C_g + C_f + C_v + C_p$$

$$= K_0 + K_1 V_i + K_2 \frac{V_i S_i}{1,000} + K_3 V_i \text{ or } 3[C_g + C_f + C_v] \text{ or } 5 [C_g + C_f + C_v]$$

$$TC = \text{Total Cost}$$

$$C_g = \text{General Cost (equally fixed charge for 100 baht/month)}$$

$$C_f = \text{Fixed Cost (depreciation cost of treatment plant)}$$

$$C_v = \text{Variable Cost (operating and maintenance cost upon BOD loading)}$$

$$C_p = \text{Penalty Cost (Discharge over IEAT's standard)}$$

$$= K_3 V_i \text{ if SS is higher than the criteria}$$

$$\text{or } = 3(C_g + C_f + C_v) \text{ if toxic pollutants are 1-1.5 times higher than the criteria}$$

$$\text{or } = 5(C_g + C_f + C_v) \text{ if toxic pollutants are more than 1.5 times higher than the criteria}$$

The constant values (K_0, K_1, K_2) vary from estate to estate. They are depended on construction cost and treatment process.

$$V_i = \text{Volume of wastewater from each factory}$$

$$S_i = \text{BOD}_5 \text{ (mg/l)}$$

**Notification of Ministry of Science, Technology and Environment
No. 3 (B.E. 2539)
Effluent Standard for Industrial and Industrial Estate Sourses**

1. pH	5.5 - 9.0	
2. TDS	3,000 - 5,000	mg/l *
3. SS	50 - 150	mg/l *
4. Temperature	40 °C	
5. Colour or Ordour is unobjectionable		
6. Sulfide (H ₂ S)	1.0	mg/l
7. Cyanide (HCN)	0.2	mg/l
8. Heavy metals		
8.1 Zn	5.0	mg/l
8.2 Cr ⁶⁺	0.25	mg/l
8.3 Cr ³⁺	0.75	mg/l
8.4 As	0.25	mg/l
8.5 Cu	2.0	mg/l
8.6 Hg	0.005	mg/l
8.7 Cd	0.03	mg/l
8.8 Ba	1.0	mg/l
8.9 Se	0.02	mg/l
8.10 Pb	0.2	mg/l
8.11 Ni	1.0	mg/l
8.12 Mn	5.0	mg/l
9. Fat, Oil & Grease	5 - 15	mg/l *
10. Formaldehyde	1.0	mg/l
11. Phenols	1.0	mg/l
12. Free Chlorine	1.0	mg/l
13. Pesticide	Nil	
14. BOD	520 - 60	mg/l *
15. TKN	100 - 200	mg/l *
16. COD	120 - 400	mg/l *

Remarks * The standard depends on the condition of receiving waters and type of industries, under consideration of the Pollution Control Committee.

**Notification of Ministry of Industry
NO. 2 (1996)
Industrial Effluent Standards**

<u>Parameter</u>	<u>Acceptable Concentration</u>
1. pH	5.5 -9.0
2. TDS	
2.1 Discharged into fresh waters	3,000 - 5,000 mg/l, depend on effluent volume, receiving waters or types of industries
2.2 Discharged into receiving waters with salinity > 2,000 mg/l	Less than TDS of receiving waters+ 5,000 mg/l
3. SS	50-150 mg/l, depend on effluent volume, receiving waters or types of industries
4. Heavy metals:	
4.1 Mercury	0.005 mg/l
4.2 Selenium	0.02 mg/l
4.3 Cadmium	0.03 mg/l
4.4 Lead	0.2 mg/l
4.5 Arsenic	0.25 mg/l
4.6 Chromium	
.Cr ⁺⁶	0.25 mg/l
.Cr ⁺³	0.75 mg/l
4.7 Barium	1.0 mg/l
4.8 Nickel	1.0 mg/l
4.9 Copper	2.0 mg/l
4.10 Zinc	5.0 mg/l
4.11 Manganese	5.0 mg/l
5. Sulphide as H ₂ S	1.0 mg/l
6. Cyanide as HCN	0.2 mg/l
7. Formaldehyde	1.0 mg/l
8. Phenols compound	1.0 mg/l
9. Free chlorine	1.0 mg/l
10. Pesticide	Nil
11. Temperature	40° C

12. Colour	Unobjectionable
13. Odour	Unobjectionable
14. Oil & Grease	5 -15 mg/l, depend on effluent volume, receiving waters, or types of industries
15. BOD ₅ - 20° C	20 -60 mg/l, depend on effluent volume, receiving waters, or types of industries
16. TKN	100 - 200 mg/l, depend on effluent volume, receiving waters, or types of industries
17. COD	120 - 400 mg/l, depend on effluent volume, receiving waters, or types of industries