

# AIR QUALITY STANDARDS

## 1) Emission Standards

### (A) Industrial Emission Standards

No.	Pollutant	Source	Emission Standard	
			Production Process Without Fuel Combustion	Production Process With Fuel Combustion
1.	Particulate matter	Boiler or Heat generating source		
		- Heavy oil as fuel	-	240 mg/Nm <sup>3</sup>
		- Coal as fuel	-	320 mg/Nm <sup>3</sup>
		- Biomass as fuel	-	320 mg/Nm <sup>3</sup>
		- Other fuel	-	320 mg/Nm <sup>3</sup>
		Aluminium manufacture	300 mg/Nm <sup>3</sup>	240 mg/Nm <sup>3</sup>
2.	Sulfur dioxide	Production process	400 mg/Nm <sup>3</sup>	320 mg/Nm <sup>3</sup>
		Boiler or Heat generating source		
		- Heavy oil as fuel	-	950 ppm
		- Coal as fuel	-	700 ppm
		- Biomass as fuel	-	60 ppm
		- Other fuel	-	60 ppm
3.	Oxides of nitrogen (as nitrogen dioxide)	Production process	500 ppm	-
		Boiler or Heat generating source		
		- Heavy oil as fuel	-	200 ppm
		- Coal as fuel	-	400 ppm
		- Biomass as fuel	-	200 ppm
		- Other fuel	-	200 ppm
4.	Carbon monoxide	Production process	870 ppm	690 ppm
5.	Hydrogen sulfide	Production process	100 ppm	80 ppm
6.	Hydrogen chloride	Production process	200 mg/Nm <sup>3</sup>	160 mg/Nm <sup>3</sup>
7.	Sulfuric acid	Production process	25 ppm	-
8.	Xylene	Production process	200 ppm	-
9.	Cresol	Production process	5 ppm	-
10.	Antimony	Production process	20 mg/Nm <sup>3</sup>	16 mg/Nm <sup>3</sup>
11.	Arsenic	Production process	20 mg/Nm <sup>3</sup>	16 mg/Nm <sup>3</sup>
12.	Copper	Production process	30 mg/Nm <sup>3</sup>	24 mg/Nm <sup>3</sup>
13.	Lead	Production process	30 mg/Nm <sup>3</sup>	24 mg/Nm <sup>3</sup>
14.	Chlorine	Production process	30 mg/Nm <sup>3</sup>	24 mg/Nm <sup>3</sup>
15.	Mercury	Production process	3 mg/Nm <sup>3</sup>	2.4 mg/Nm <sup>3</sup>

- Remarks :**
- (1) Factory means a factory of type 2 and type 3 as specified in the Factory Act.
  - (2) Establishing a factory means manufacture, fabrication, packaging, repair, maintenance, test, improvement, transformation, transportation, storage or destruction of any thing according to the nature of the factory. The machine commissioning is not included in this definition.
  - (3) Production process means establishing a factory from which air emissions are discharged to the atmosphere.
  - (4) Production process with fuel combustion means the manufacturing process in which fuel combustion is involved and air emissions are discharged to the atmosphere.
  - (5) Biomass fuel means the fuel produced from organic substances or organisms including products from the agriculture, farming and forestry, for example, firewood, wood chip, husk, straw, trunk and leaves of sugar cane, fiber of palm, bunch of palm, fiber of coconut tree, feces, biogases, sludge or wastes from the agricultural product industries.
  - (6) If more than two types of fuel are used in a factory, the emission shall not exceed the emission standard of the fuel utilized at the highest proportion according to Industry Law.
  - (7) Close system means the combustion system which is designed to control air volume and operating condition for combustion, for example, cement kiln, boiler, etc.
  - (8) Open system means the combustion system is not designed for controlling air volume and operating condition for combustion, for example, white cement kiln, cupola, etc.
  - (9) The monitoring results of air emissions from a production process without fuel combustion are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and actual percent oxygen .
  - (10) The monitoring results of air emissions from a production process with fuel combustion in close system are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and excess air of 50% or at O<sub>2</sub> of 7%.
  - (11) The monitoring results of air emissions from a production process with fuel combustion in open system are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and actual percent oxygen.
  - (12) The notification is not applied to the emission sources which are regulated by the emission standards in accordance with the National Law of Promotion and Preservation of the Environmental Quality.

***Standard Analytical Methods***

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| 1. Particulate matter                    | Determination of Particulate Matter Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette.   |
| 2. Sulfur dioxide (SO <sub>2</sub> )     | Determination of Sulfur Dioxide Emissions from Stationary Sources or Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette. |
| 3. Oxides of nitrogen (NO <sub>x</sub> ) | Determination of Nitrogen Oxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette.   |

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| 4. Carbon monoxide                                | Determination of Carbon Monoxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette.   |
| 5. Hydrogen sulfide                               | Determination of Hydrogen Sulfide and Carbonyl Sulfide and Carbon Disulfide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette.  |
| 6. Chlorine and Hydrogen chloride                 | Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic or Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette. |
| 7. Sulfuric acid                                  | Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette.  |
| 8. Xylene and Cresol                              | Measurement of Gaseous Organic Compound Emission by Gas Chromatography (U.S. EPA) or other methods approved by DIW/PCD and published in the Royal Government Gazette.   |
| 9. Antimony, Arsenic, Copper,<br>Lead and Mercury | Determination of Metals Emission from Stationary Sources (U.S. EPA) or other methods approved by DIW/PC and published in the Royal Government Gazette.  |

- Sources :** Notification of the Ministry of Natural Resources and Environment B.E.2549 (2006), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated April 5, B.E.2549 (2006), which was published in the Royal Government Gazette, Vol.123, Part 50D dated May 18, B.E.2549 (2006).
- : Notification of the Ministry of Industry B.E.2549 (2006), issued under Factory Act B.E.2535 (1992) dated October 31, B.E.2549 (2006), which was published in the Royal Government Gazette, Vol.123, Special Part 125D dated December 4, B.E.2549 (2006).

**(B) Emission Standards for Existing Power Plants**

Existing Power Plants	Emission Standard					
	Sulfur dioxide (SO <sub>2</sub> ) (ppm)		Oxides of nitrogen (as NO <sub>2</sub> ) (ppm)		Particulate matter (PM) (mg/Nm <sup>3</sup> )	
1. Bangpakong (Thermal) Unit 1-4	800	320 <sup>(2)</sup>	250	200 <sup>(1)</sup>	320	120 <sup>(1)</sup>
2. Bangpakong (Combined Cycle) Unit 1 and 2	60		450		60	
Unit 3 and 4	60		230		60	
3. South Bangkok (Thermal)	800	320 <sup>(2)</sup>	180		240	120 <sup>(2)</sup>
4. South Bangkok (Combined Cycle) Unit 1	60		250		60	
Unit 2	60		175		60	
5. North Bangkok	500		180		150	
6. Sai Noi	60		230		60	
7. Surat Thani	1,000		200		320	
8. Lan Krabu	60		250		60	
9. Nong Chok (Gas Turbine)	60		230		60	
10. Wang Noi	60		175		60	
11. Num Phong (Combined Cycle)	60		250		60	
12. Mae Moh <sup>(3)</sup> Unit 1-3	1,300		500		180	
Unit 4-7 and Unit 8-13	320		500		180	
13. Other Power Plants - Coal	700		400		320	
- Oil	1,000		200		240	
- Natural Gas	60		200		60	

**Remarks :** (1) Effective on January 1, B.E.2543 (2000).

(2) Effective on April 1, B.E.2543 (2000).

(3) Total SO<sub>2</sub> loading of Mae Moh Unit 1-13 shall not be more than 11 ton/hr.

: Reference conditions are 25 degree celsius at 1 atm or 760 mmHg, dry basis, excess air of 50% or at O<sub>2</sub> of 7%.

**Source :** Notification of the Ministry of Science, Technology and Environment, No.2, B.E.2542 (1999) dated December 2, B.E.2542 (1999), which was published in the Royal Government Gazette, Vol.116, Special Part 108D dated December 27, B.E.2542 (1999). And Mae Moh, No.3 dated January 29 B.E.2544 (2001), which was published in the Royal Government Gazette, Vol.118, Special Part 24D dated March 16, B.E.2544 (2001).

**(C) Emission Standards for Power Plants**

1) Ministry of Industry and Ministry of Science Technology and Environment

Type and Size of Power Plant	Emission Standard		
	Sulfur dioxide (SO <sub>2</sub> ) (ppm)	Oxides of nitrogen (as NO <sub>2</sub> ) (ppm)	Particulate matter (PM) (mg/Nm <sup>3</sup> )
<b>1. Old Power Plant</b>			
1.1 Coal as fuel	700	400	320
1.2 Oil as fuel	950	200	240
1.3 Natural gas as fuel	60	200	60
1.4 Biomass as fuel	60	200	320
<b>2. New Power Plant</b>			
2.1 Coal			
(1) Power Plant Size < 300 MW	640	350	120
(2) Power Plant Size 300 - 500 MW	450	350	120
(3) Power Plant Size > 500 MW	320	350	120
2.2 Oil			
(1) Power Plant Size < 300 MW	640	180	120
(2) Power Plant Size 300 - 500 MW	450	180	120
(3) Power Plant Size > 500 MW	320	180	120
2.3 Natural gas (All Sizes)	20	120	60
2.4 Biomass (All Sizes)	60	200	120
<b>3. Existing Power Plant</b>			
3.1 Bangpakong			
(1) Unit 1-4 (Thermal)	320	200	120
(2) Unit 1 and 2 (Combined Cycle)	60	450	60
(3) Unit 3 and 4 (Combined Cycle)	60	230	60
3.2 South Bangkok			
(1) Thermal	320	180	120
(2) Unit 1 (Combined Cycle)	60	250	60
(3) Unit 2 (Combined Cycle)	60	175	60

**(C) Emission Standards for Power Plants (Cont'd)**

1) Ministry of Industry and Ministry of Science Technology and Environment

Type and Size of Power Plant	Emission Standard		
	Sulfur dioxide (SO <sub>2</sub> ) (ppm)	Oxides of nitrogen (as NO <sub>2</sub> ) (ppm)	Particulate matter (PM) (mg/Nm <sup>3</sup> )
<b>3. Existing Power Plant</b>			
3.3 North Bangkok	500	180	150
3.4 Surat Thani			
(1) Gas Turbine	60	230	60
(2) Combined Cycle	20	120	60
3.5 Lan Krabu	60	250	60
3.6 Nong Chok (Gas Turbine)	60	230	60
3.7 Wang Noi	60	175	60
3.8 Num Phong (Combined Cycle)	60	250	60
3.9 Mae Moh			
(1) Unit 1-3	1,300	500	180
(2) Unit 4-13	320	500	180

- Remarks:**
- (1) Old power plant means a plant generating, transmitting or distributing electricity which acquired a permit of factory operation or expansion No.88 before January 31, B.E.2539 (1996).
  - (2) New power plant means a plant generating, transmitting or distributing electricity which acquired a permit of factory operation or expansion No.88 since January 31, B.E.2539 (1996).
  - (3) Existing Power Plant means a plant generating, transmitting or distributing electricity, which has been original.
  - (4) Biomass fuel means the fuel produced from organic substances or organisms including products from the agriculture, farming and forestry, for example, firewood, chip of wood, husk, straw, trunk and leaves of sugar cane, fiber of palm, bunch of palm, fiber of coconut tree, feces, biological gases, sludge or solid wastes from a factory of agricultural products.
  - (5) Old power plant using biomass as fuel means the power plant, transmission or distribution using biomass as fuel which acquired a permit for factory operation or expansion No.88 before October 1, B.E.2547 (2004).
  - (6) New power plant using biomass as fuel means the power plant, transmission or distribution using the biomass as fuel which acquired a permit for factory operation or expansion at number 88 since October 1, B.E.2547 (2004).
  - (7) Reference conditions are 25 degree celsius at 1 atm or 760 mm.Hg dry basis, excess air of 50% or at O<sub>2</sub> of 7%.

**Source :** Notification of the Ministry of Industry B.E.2547 (2004), issued under Factory Act B.E.2535 (1992), dated September 28, B.E.2547 (2004), which was published in the Royal Government Gazette, Vol.121, Special Part 113D dated October 7, B.E.2547 (2004).

**(C) Emission Standards for Power Plants (Cont'd)**

2) Ministry of Natural Resources and Environment

Type and Size of Power Plant	Emission Standard		
	Sulfur dioxide (SO <sub>2</sub> ) (ppm)	Oxides of nitrogen (as NO <sub>2</sub> ) (ppm)	Particulate matter (PM) (mg/Nm <sup>3</sup> )
<b>New Power Plant</b>			
1.Coal			
(1.1) Power Plant Size < 50 MW	360	200	80
(1.2) Power Plant Size > 50 MW	180	200	80
2.Oil (All Sizes)	260	180	120
3.Natural gas (All Sizes)	20	120	60
4.Biomass (All Sizes)	60	200	120

- Remarks :**
- (1) New power plant means a plant generating, transmitting or distributing electricity which acquired a permit of factory operation or expansion since January 15, B.E.2553 (2010).
  - (2) Biomass fuel means the fuel produced from organic substances or organisms including products, agriculture, farming and forestry, for example, firewood, lumber, husk, thatch, trash, sugar cane stem and leaves, palm fiber, palm shell, bunch of palm, coconut shell, coconut fiber, waste plant, dung, biogas, sludge or wastes from a factory of agricultural products.
  - (3) Dry Basis means the condition at which moisture content of air samples is zero
  - (4) Reference conditions are 25 degree celsius at 1 atm or 760 mmHg dry basis, excess air of 50% or at O<sub>2</sub> of 7%.

**Source :** Notification of the Ministry of Natural Resources and Environment B.E.2553 (2010), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated december 20, B.E.2552 (2009), which was published in the Royal Government Gazette, Vol.127, Special Part 7D dated January 15, B.E.2553 (2010).

### **Standard Analytical Methods**

1. Sulfur dioxide (SO<sub>2</sub>) Determination of Sulfur Dioxide Emission from Stationary Sources or Determination of Sulfuric Acid and Sulfur Dioxide Emission from Stationary Sources (U.S.EPA) or other methods approved by the Pollution Control Department (PCD)/Department of Industrial Works (DIW)
2. Oxides of nitrogen (NO<sub>x</sub>) Determination of Nitrogen Oxide Emission from Stationary Sources (U.S.EPA) or other methods approved by the Pollution Control Department (PCD)/Department of Industrial Works (DIW)
3. Particulate matter (PM) Determination of Particulate Matter Emission from Stationary Sources (U.S.EPA) or other methods approved by the Pollution Control Department (PCD)/Department of Industrial Works (DIW)

### **Emission Standards for Power Plants with Mixed Fuel**

In case of power plants utilizing mixed fuel (mixture of various types of fuels) in each generating unit, emission standard values must be calculated based upon the proportion of each type of fuel as follows :

$$\text{Emission Standard} = AW + BX + CY + DZ$$

When A = Emission Standard when only coal is used as fuel.

B = Emission Standard when only oil is used as fuel.

C = Emission Standard when only natural gas is used as fuel.

D = Emission Standard when only biomass is used as fuel.

W = Proportion of Heat Input from coal being used as fuel.

X = Proportion of Heat Input from oil being used as fuel.

Y = Proportion of Heat Input from natural gas being used as fuel.

Z = Proportion of Heat Input from biomass being used as fuel.

### **Average Emission Concentration from Power Plants with more than 1 stack**

In case of power plants with more than 1 stack, the average emission concentration must be calculated as follows :

$$\text{Average Emission Concentration} = \frac{\sum_{i=1}^n Q_i C_i}{\sum_{i=1}^n Q_i}$$

When Q = Gas flow rate of stack<sub>i</sub> (m<sup>3</sup>/hr)

C = Concentration of gaseous emission (ppm) or particulate matter (mg/Nm<sup>3</sup>) at stack<sub>i</sub>

n = Number of stacks

i = 1, 2, 3, ....., n

- Sources :**
- Notification of the Ministry of Science, Technology and Environment, No.2, B.E.2542 (1999), issued under the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 (1992), dated December 2, B.E.2542 (1999), which was published in the Royal Government Gazette, Vol.116, Special Part 108D dated December 27, B.E.2542 (1999) and No.3 dated January 29, B.E.2544 (2001) published in the Royal Government Gazette, Vol.118, Special Part 24D dated March 16, B.E.2544 (2001).
  - : Notification of the Ministry of Industry B.E.2547 (2004), issued under Factory Act B.E.2535 (1992), dated September 28, B.E.2547 (2004). It was published in the Royal Government Gazette, Vol.121, Special Part 113D dated October 7, B.E.2547 (2004).
  - : Notification of the Ministry of Natural Resources and Environment B.E.2553 (2010), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated December 20, B.E.2552 (2009), which was published in the Royal Government Gazette, Vol.127, Special Part 7D dated January 15, B.E.2553 (2010).



**D) Emission Standards for Natural Gas Separation Plant**

No.	Pollutant	Emission Standard		Standard Analytical Methods
		Natural Gas Separation Plant Type 1	Natural Gas Separation Plant Type 2	
1.	PM (mg/Nm <sup>3</sup> )	≤ 60	≤ 60	Determination of Particulate Matter Emission from Stationary Sources, U.S.EPA
2.	SO <sub>2</sub> (ppm)	≤ 60	≤ 60	Determination of Sulfur Dioxide Emission from Stationary Sources or Determination of Sulfuric Acid and Sulfur Dioxide Emission from Stationary Sources, U.S.EPA
3.	CO (ppm)	≤ 690	≤ 690	Determination of Carbon Monoxide Emission from Stationary Sources, U.S.EPA
4.	H <sub>2</sub> S (ppm)	≤ 60	≤ 60	Determination of Hydrogen Sulfide Content of Fuel Gas Streams in Petroleum Refineries, U.S.EPA
5.	Hg (mg/Nm <sup>3</sup> )	≤ 0.08	≤ 0.08	Determination of Metals Emission from Stationary Sources, U.S.EPA
6.	NO <sub>x</sub> as NO <sub>2</sub> (ppm)	≤ 200	≤ 150	Determination of Nitrogen Oxide Emission from Stationary Sources, U.S.EPA

**Remarks :** (1) Natural Gas Separation Plant Type 1 means

- a. Natural Gas Separation Plant having operation permit before the effective date of this Notification announced in the Royal Government Gazette (July 16, B.E.2553 (2010)).
- b. Natural Gas Separation Plant applying for expansion permit before the effective date of this Notification announced in the Royal Government Gazette and getting permit within 2 years from the announced date (July 16, B.E.2553 (2010)).

(2) Natural Gas Separation Plant Type 2 means

- a. Natural Gas Separation Plant having operation permit after the effective date of this Notification announced in the Royal Government Gazette (July 16, B.E.2553 (2010)).
- b. Natural Gas Separation Plant applying for expansion permit after the effective date of this Notification announced in the Royal Government Gazette (July 16, B.E.2553 (2010)).

- c. Natural Gas Separation Plant having expansion permit after 2 years since the effective date of this Notification has been announced in the Royal Government Gazette (July 16, B.E.2553 (2010)).
- (3) Reference conditions are 25 degree celsius at 1 atm or 760 mmHg, dry basis, 50% excess air or 7% O<sub>2</sub>.

**Source :** Notification of the Ministry of Natural Resources and Environment B.E.2553 (2010), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated June 9, B.E.2553 (2010), and published in the Royal Government Gazette, Vol.127, Special Part 87D dated July 16, B.E.2553 (2010).

**(E) Emission Standard for Petroleum Refinery Plant**

Pollutant	Emission Standard						
	Gas Turbine	Furnace/ Boiler/ Cracking Unit (Non catalyst Regeneration or non catalyst type)			Cracking Unit (Coke combustion type)	Sulfur Recovery Unit	Standard Analytical Method
		Fuel Oil	Fuel Gas	Mixed Fuel			
<b>1. Old Petroleum Refinery</b>							
<b>1.1 PM (mg/Nm<sup>3</sup>)</b>	≤60	≤240	≤60	≤240	≤320	-	Determination of Particulate Matter Emissions from Stationary Sources, U.S.EPA
<b>1.2 SO<sub>2</sub> (ppm)</b>	≤60	≤950	≤60	≤950	≤700	≤500	Determination of Sulfur Dioxide Emissions from Stationary Sources or Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Stationary Sources, U.S.EPA
<b>1.3 NO<sub>x</sub> as NO<sub>2</sub> (ppm)</b>	≤200	≤200	≤200	≤200	≤400	≤200	Determination of Nitrogen Oxide Emissions from Stationary Sources, US.EPA
<b>1.4 CO (ppm)</b>	≤690	≤690	≤690	≤690	≤690	≤690	Determination of Carbon Monoxide Emissions from Stationary Sources, U.S.EPA
<b>1.5 H<sub>2</sub>S (ppm)</b>	-	-	-	-	-	≤60	Determination of Hydrogen Sulfide Content of Fuel Gas Streams in Petroleum Refineries, U.S.EPA
<b>1.6 Hg (mg/Nm<sup>3</sup>)</b>	-	≤2.4	-	≤2.4	≤2.4	-	Determination of Metal Emissions from Stationary Sources, U.S.EPA
<b>1.7 Pb (mg/Nm<sup>3</sup>)</b>	-	≤5	-	≤5	≤5	-	Determination of Metal Emissions from Stationary Sources, U.S.EPA

**(E) Emission Standards for Petroleum Refinery (Cont'd)**

Pollutant	Emission Standard						Standard Analytical Method
	Gas Turbine	Furnace/ Boiler/ Cracking Unit (Non catalyst Regeneration or non catalyst type)			Cracking Unit (Coke combustion type)	Sulfur Recovery Unit	
		Fuel Oil	Fuel Gas	Mixed Fuel			
<b>2. New Petroleum Refinery</b>							
<b>2.1 PM (mg/Nm<sup>3</sup>)</b>	≤60	≤240	≤60	≤240	≤320	≤120	Determination of Particulate Matter Emissions from Stationary Sources, U.S.EPA
<b>2.2 SO<sub>2</sub> (ppm)</b>	≤60	≤950	≤60	≤950	≤700	≤500	Determination of Sulfur Dioxide Emissions from Stationary Sources or Determination of Sulfuric Acid and Sulfur Dioxide Emissions from Stationary Sources, U.S.EPA
<b>2.3 NO<sub>x</sub> as NO<sub>2</sub> (ppm)</b>	≤120	≤200	≤120	≤200	≤200	≤200	Determination of Nitrogen Oxide Emissions from Stationary Sources, U.S.EPA
<b>2.4 CO (ppm)</b>	≤690	≤690	≤690	≤690	≤690	≤690	Determination of Carbon Monoxide Emissions from Stationary Sources, U.S.EPA
<b>2.5 H<sub>2</sub>S (ppm)</b>	-	-	-	-	-	≤60	Determination of Hydrogen Sulfide Content of Fuel Gas Streams in Petroleum Refineries, U.S.EPA
<b>2.6 Hg (mg/Nm<sup>3</sup>)</b>	-	≤2.4	-	≤2.4	≤2.4	-	Determination of Metal Emissions from Stationary Sources, U.S.EPA
<b>2.7 Pb (mg/Nm<sup>3</sup>)</b>	-	≤5	-	≤5	≤5	-	Determination of Metal Emissions from Stationary Sources, U.S.EPA

**Remarks :** (1) Old Petroleum refinery plant means

- a. Petroleum refinery plant having operation permit or expansion permit before the effective date of this Notification being announced in the Royal Government Gazette. (October 12, B.E.2554 (2011)).
- b. Petroleum refinery plant applying for operation permit expansion permit before the effective date of this Notification and getting permit after the effective date (October 12, B.E.2554 (2011)).

(2) New Petroleum refinery plant means

- a. Petroleum refinery plant applying for operation permit and having operation permit since the effective date of this Notification being announced in the Royal Government Gazette. (October 12, B.E.2554 (2011)).
- b. Process unit of Petroleum refinery plant having operation permit and modify before the effective date of this Notification, and having machinery modification with the application for expansion permit after the effective date of this Notification (October 12, B.E.2554 (2011)).

(3) “Refinery fuel oil” means the liquid fuels used in petroleum refining plants which are imported and / or produced from the production process for use as power sources in petroleum refining plants.

(4) “Refinery fuel gas” means the gas fuels used in petroleum refining plants which are imported and / or produced from the production process for use as power sources in petroleum refining plants.

“Refinery mixed fuel” means the fuel mixture of refinery fuel oil and refinery fuel gas.

(5) “Gas Turbine” means a turbine using hot gas generated from fuel combustion under pressure to rotate a generator.

(6) “Furnace” means system or any equipment used to generate heat by fuel combustion under condition of sufficient oxygen. The generated heat is utilized in the production

(7) “Boiler” means equipment using heat generated from fuel combustion to change water into steam for use in the production process.

(8) “Cracking Unit” means a unit that cracks large oil molecules in to smaller ones for value adding to the oil products. There are 2 type as follows:

- a. Cracking Unit type of non catalyst regeneration such as Hydro Cracking Unit, or non catalyst type such as Thermal Cracking Unit which uses heat for cracking.
- b. Cracking Unit type with coke combustion in catalyst regeneration such as Fluidized catalytic Cracking unit or Deep catalytic cracking unit.

(10) “Sulfur Recovery Unit” means a unit that removes sulfur from the gas by transforming sulfur in hydrogen sulfide gas and the other sulfur compounds into the liquid sulfur including combined gas treatment unit.

(11) Reference conditions are 25 degrees celsius at 1 atm or 760 mmHg, dry basis, and excess air of 50% or O<sub>2</sub> at 7%.

**Sources :** Notification of the Ministry of Industry B.E.2553 (2010), issued under Factory Act B.E.2535 (1992), dated October 26, B.E.2553 (2010), which was published in the Royal Government Gazette, Vol.127, Special Part 146D dated December 20, B.E.2553 (2010).

: Notification of the Ministry of Natural Resources and Environment B.E.2554 (2011), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated August 30, B.E.2554 (2011), which was published in the Royal Government Gazette, Vol.128, Special Part 121D dated October 12, B.E.2554 (2011).

**(F) Types and Sizes of Industries to be Installed with Continuous Emission Monitoring System (CEMS)**

No.	Size	Factory Category	Pollutants	Remark
1.	Electricity generating units of more than 29 MW capacity	Category No.88 as per the Ministerial Regulation B.E.2535 or similar sources	Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> ) SO <sub>2</sub> (ppm) NO <sub>x</sub> as NO <sub>2</sub> (ppm) O <sub>2</sub> (% by Volume)	- Omit SO <sub>2</sub> monitoring if no-sulfur fuel is used. - Omit SO <sub>2</sub> and Opacity or Particulate matter if NG is used.
2.	Boilers or heat sources generating more than 30 tons of steam per hour or 100 MMBTU per hour	All categories as per the Ministerial Regulation B.E.2535	Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> ) SO <sub>2</sub> (ppm) NO <sub>x</sub> as NO <sub>2</sub> (ppm) O <sub>2</sub> (% by Volume)	- Omit SO <sub>2</sub> monitoring if no-sulfur fuel is used. - Omit SO <sub>2</sub> and Opacity or Particulate matter if NG is used.
3.	Cement, lime, or plaster plants of all size: Kiln and Clinker Cooler	Category No.57 as per the Ministerial Regulation B.E.2535	Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> )	-
4.	Pulp & paper mills of all sizes: the Recovery furnace, Lime Kiln Digester, Brown stock washer, Evaporator and Condensate stripper system	Category No.38 as per the Ministerial Regulation B.E.2535	Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> ) Total Reduced Sulfur (TRS) (ppm)	-
5.	Petroleum refineries of all sizes: Fluid Catalytic Cracking Unit (FCCU), Fuel oil combustion Unit, Sulfur Recovery Unit (SRU)	Category No.49 as per the Ministerial Regulation B.E.2535	<b>FCCU :</b> Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> ) SO <sub>2</sub> (ppm) CO (ppm) <b>Fuel oil combustion unit :</b> SO <sub>2</sub> (ppm) O <sub>2</sub> (% by Volume) <b>SRU :</b> SO <sub>2</sub> (ppm) O <sub>2</sub> (% by Volume)	-
6.	Smelting, melting, casting, rolling, pulling or producing of primary iron and steel product of more than 100 ton per day capacity : Electric arc furnace, Blast furnace, or any Preheating unit using fuel oil or coal	Category No.59 as per the Ministerial Regulation B.E.2535	Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> )	-

**(F) Types and Sizes of Industries to be installed with Continuous Emission Monitoring System (CEMS) (Cont'd)**

No.	Size	Factory Category	Pollutants	Remark
7.	Smelting, mixing, refining, melting, casting, rolling, pulling or producing of primary metals other than iron or steel, all sizes; Roaster-smelter and Dryer of copper smelter and Sintering machine of zinc smelter	Category No.60 as per the Ministerial Regulation B.E.2535	<b>Roaster :</b> SO <sub>2</sub> (ppm) <b>Dryer of copper smelter :</b> Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> ) <b>Sintering machine of zinc smelter :</b> Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> )	-
8.	Lead smelters, all sizes; Sintering machine, converter	Category No.60 as per the Ministerial Regulation B.E.2535	Opacity (%) or Particulate matter (mg/Nm <sup>3</sup> ) SO <sub>2</sub> (ppm)	-
9.	Incinerator of all sizes for waste treatment center	Category No.101 as per the Ministerial Regulation B.E.2535	O <sub>2</sub> (% by Volume) CO (ppm) Temperature (°C)	-
10.	Sulfuric acid plants of all size	Category No.42 as per the Ministerial Regulation B.E.2535 or Similar Sources	SO <sub>2</sub> (ppm)	-

- Remark:** (1) Effective for factories locating in Map Ta Phut, Pha Daeng, Eastern Industrial Estate, and Asia Industrial Estate in Rayong Province or any other factories as specified by DIW.
- (2) Reference condition is 25 °C at 1 atm or 760 mmHg. Excess Air of 50% or at Oxygen of 7% and Dry Basis.
- (3) Requirements for the performance and installation of CEMS should comply with U.S. EPA method or other methods as approved by DIW.
- (4) New factories with permitted operation license after promulgated date of December 11, B.E.2544 (2001) shall install the CEMS prior to plant operation. Existing factories shall install the CEMS within 1 year.
- (5) Submitting information through Continuous Emission Monitoring System (CEMS) follow by the Notification of the Department of Industrial Works, B.E.2550 (2007).

**Sources :** Notification of the Ministry of Industry B.E.2544 (2001) for Factory in Map Ta Phut Industrial Estate, Pha Daeng Industrial Estate, Eastern Industrial Estate, Asia Industrial Estate in Rayong Province, dated December 11, B.E.2544 (2001). It was published in the Royal Government Gazette, Vol 119, Part 7D dated January 22, B.E.2545 (2002).

: Notification of the Department of Industrial Works, B.E.2550 (2007) and published in the Royal Government Gazette, Vol 124, Special Part 196D dated December 17, B.E.2550 (2007).

**(G) Emission Standards for Mining and Quarry Plants**

No.	Pollutants	Standard	Unit	Standard Analytical Methods
1.	Without capture/collection system - Particulate matter - Opacity (%)	- 20	- Percent	- Smoke Opacity Meter (at the distance of 1 meter around the source)
2.	With capture/collection system - Particulate matter - Opacity (%)	400 20	mg/Nm <sup>3</sup> Percent	U.S. EPA Method 5 Smoke Opacity Meter (at the emission stack)

**Source :** Notification of the Ministry of Science, Technology and Environment dated December 20, B.E.2539 (1996), which was published in the Royal Government Gazette, Vol.114, Part 6D dated January 21, B.E.2540 (1997).

**(H) Emission Standards for Steel Industry**

Steel Industry	Emission Standard		
	SO <sub>2</sub> (ppm)	NO <sub>x</sub> as NO <sub>2</sub> (ppm)	Particulate matter (mg/Nm <sup>3</sup> )
New Source	800	180	120
Existing Source	800	200	240

- Remarks :**
- (1) New source means steel industry with operation permit or expansion permit after the date when this Notification is announced in the Royal Government Gazette, dated May 8, B.E.2544 (2001).
  - (2) Existing source means steel industry with operation permit or expansion permit before the date when this Notification is announced in the Royal Government Gazette, dated May 8, B.E.2544 (2001).
  - (3) All furnaces or steel melting process such as electric furnace cupola, roasting, blast, cock oven, basic oxygen furnace, etc.
  - (4) Reference condition is 25°C at 1 atm or 760 mmHg excess air of 50% or at oxygen of 7% and dry basis. Except Electric Furnace. Emission concentration of furnace must be calculated based upon 25°C at 1 atm and dry basis.

**Source :** Notification of the Ministry of Science, Technology and Environment, issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), dated March 9, B.E.2544 (2001), which was published in the Royal Government Gazette, Vol.118, Part 37D dated May 8, B.E.2544 (2001).



***(I) Emission Standards for Municipal Waste Incinerators***

***Old Waste Incinerators and New Waste Incinerators (specific expansion after July 16, B.E.2553)***

No.	Pollutant	Emission Standard				Standard Analytical Method
		Old Waste Incinerators		New Waste Incinerators		
		1-50 tons/day capacity	More than 50 tons/day capacity	1-50 tons/day capacity	More than 50 tons/day capacity	
1.	PM (mg/Nm <sup>3</sup> )	≤ 400	≤ 120	≤ 320	≤ 70	Determination of Particulate Matter Emission from Stationary Sources, U.S.EPA
2.	SO <sub>2</sub> (ppm)	≤ 30	≤ 30	≤ 30	≤ 30	Determination of Sulfur Dioxide Emission from Stationary Sources or Determination of Sulfur Acid Mist and Sulfur Dioxide Emission from Stationary Sources, U.S.EPA
3.	NO <sub>x</sub> as NO <sub>2</sub> (ppm)	≤ 250	≤ 180	≤ 250	≤ 180	Determination of Nitrogen Oxide Emission from Stationary Sources, U.S.EPA
4.	HCl (ppm)	≤ 136	≤ 25	≤ 80	≤ 25	Determination of Hydrogen Chloride Emission from Stationary Sources, U.S.EPA
5.	Hg (mg/Nm <sup>3</sup> )	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05	Determination of Metals Emission from Stationary Sources, U.S.EPA
6.	Cd (mg/Nm <sup>3</sup> )	≤ 0.5	≤ 0.05	≤ 0.5	≤ 0.05	Determination of Metals Emission from Stationary Sources, U.S.EPA
7.	Pb (mg/Nm <sup>3</sup> )	≤ 1.5	≤ 0.5	≤ 1.5	≤ 0.5	Determination of Metals Emission from Stationary Sources, U.S.EPA
8.	Dioxin (ng/Nm <sup>3</sup> )	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.1	Determination of Polychlorinated Dibenzofurans from Stationary, U.S.EPA
9.	Opacity (%)	≤ 20	≤ 10	≤ 10	≤ 10	Sources Ringlemann's Method, U.S.EPA

- Remarks :**
- (1) "Old Waste Incinerators" means Municipal Waste Incinerators having operation permit or expansion permit before the effective date of this Notification announced in the Royal Government Gazette (July 16, B.E.2553 (2010)).
  - (2) "New Waste Incinerators" means Municipal Waste Incinerators having operation permit or expansion permit after the effective date of this Notification announced in the Royal Government Gazette, or the Waste Incinerators being operated after the effective date (July 16, B.E.2553 (2010)).
  - (3) The concentrations of air emission are based on the reference conditions at 25 degree Celsius, 1 atm or 760 mmHg, dry basis, with excess air of 50% or at O<sub>2</sub> of 7%.
  - (4) Dioxin means total chlorinated PCDD plus PCDF.

**Source :** Notification of the Ministry of Natural Resources and Environment B.E.2553 (2010), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated June 9, B.E.2553 (2010), which was published in the Royal Government Gazette, Vol.127, Special Part 87D dated July 16, B.E.2553 (2010).

**(J) Emission Standard for Industrial Hazardous Waste Incinerators**

No.	Pollutants	Emission Standard
1.	Particulate matter	35 mg/Nm <sup>3</sup>
2.	Hydrogen chloride	40 mg/Nm <sup>3</sup>
3.	Carbon monoxide	115 mg/Nm <sup>3</sup>
4.	Sulfur dioxide	80 mg/Nm <sup>3</sup>
5.	Oxides of nitrogen (as nitrogen dioxide)	150 mg/Nm <sup>3</sup>
6.	Dioxins/Furans-TEQ	0.5 ng/Nm <sup>3</sup>
7.	Mercury	0.1 mg/Nm <sup>3</sup>
8.	Semi Volatile Metals (Cadmium and Lead)	0.2 mg/Nm <sup>3</sup>
9.	Low Volatile Metals (Arsenic, Beryllium and Chromium)	1 mg/Nm <sup>3</sup>

- Remarks :**
- (1) “Industrial hazardous wastes or unused materials” means the wastes or unused materials generated from the manufacturing process of industries specified in Factory Act (B.E.2535), which are classified to be hazardous, according to the Notification of the Ministry of Industry Vol.6 (B.E.2540) under Factory Act (B.E.2535).
  - (2) “Incinerators for industrial hazardous wastes or unused materials” means a system or equipment which is used to dispose the industrial wastes or unused materials which are hazardous by means of combustion. This type of incinerators excludes those used for recycling wastes or unused materials to the process, and those for using wastes or unused material as fuel.
  - (3) Reference conditions are 25 degree celsius at 1 atm or 760 mmHg, dry basis, excess air of 50% or O<sub>2</sub> of 7%.

**Source :** Notification of the Ministry of Industry, B.E.2545 (2002), issued under Factory Act B.E.2535 (1992), dated October 2, B.E.2545 (2002), which was published in the Royal Government Gazette, Vol. 119, Special Part 106D dated October 30, B.E.2545 (2002).

**(K) Opacity Standard for Crematory**

Opacity (%)	Measurement Method
Not exceeding 10	Ringlemann’s Method

**Source :** Notification of the Ministry of Natural Resources and Environment, issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992), dated October 16, B.E.2546 (2003). It was published in the Royal Government Gazette, Vol. 120, Special Part 130D dated November 10, B.E.2546 (2003).

**(L) Emission Standard for Bulk Gasoline Terminals**

<b>Pollutant</b>	<b>Emission Standard (1-hr average)</b>	<b>Standard Analytical Method *</b>
Total VOCs in Gasoline Vapor Emission	17 milligrams of total VOCs/l in vapor emission (Effective on February 24, B.E.2553)	U.S. EPA Method 18 : Measurement of Gaseous Organic Compound Emission by Gas Chromatography U.S. EPA Method 25A : Determination of Total Gaseous Organic Concentration Using Flame Ionization Analyzer U.S. EPA Method 25B : Determination of Total Gaseous Organic Concentration Using Nondispersive Infrared Analyzer or other method approved by the PCD

- Remarks:**
- (1) “Fuel depot” means fuel depot, storage facilities of fuel and the location where fuel is loaded or unloaded by fuel oil pipeline transportation system, according to the law on control of fuel storage, loading or unloading of gasoline.
  - (2) “Gasoline vapor” means total volatile organic compounds (TVOCs) which are evaporated from gasoline at anytime due to temperature, atmosphere pressure, or both temperature and atmospheric pressure.
  - (3) The continuous stack sampling from the gasoline vapor emission control system is taken while the system is operating. The values obtained are then calculated for the 1-hr average concentration of gasoline vapor emission. For the intermittent sampling from the gasoline vapor emission control system while it is operating, the sampling shall be taken for not less than 4 times in 1-hr and the values obtained in each sampling period are then calculated for the average 1-hr concentration of gasoline vapor emission.
  - (4) The measurement of the average concentration of gasoline vapor emitted from fuel depot without gasoline vapor control system is to be taken at the ventilation point where gasoline vapor is most likely emitted.
  - (5) \* An explosion – proof system shall be provided and the instruments shall be calibrated before use.
  - (6) This notification is effective for Fuel depot in the following areas :
    - a. Bangkok, Nonthaburi, Prathum Thani and Samut Prakarn (effective on February 25, B.E.2553 (2010)),and
    - b. Areas specified by the Department of Energy to be equipped with fuel vapor control systems class 1 effective on the time period specified by the Ministry of Energy for the installation of fuel vapor control systems.

**Source :** Notification of the Ministry of Natural Resources and Environment B.E.2553 (2010), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated January 22, B.E.2553 (2010), which was published in the Royal Government Gazette, Vol.127, Special Part 26D dated February 24, B.E.2553 (2010).

**(M) Emission Standard for Existing Cement Plant**

Existing Cement Plant	Emission Standard		
	Particulate matter (PM) (mg/Nm <sup>3</sup> )	Sulfur dioxide (SO <sub>2</sub> ) (ppm)	Oxides of nitrogen (NO <sub>x</sub> as NO <sub>2</sub> ) (ppm)
1. Grey Cement Kiln	300	50	600
2. White Cement Kiln	300	600	600
3. Clinker Cooler Clinker Grinding Mill Coal Grinding Mill	200	-	-

**Source :** Notification of the Ministry of Natural Resources and Environment dated January 19, B.E.2547 (2004), which was published in the Royal Government Gazette, Vol.121 Special Part 12D dated January 30, B.E.2547 (2004).

**(N) Emission Standard for New Cement Plant**

New Cement Plant	Emission Standard		
	Particulate matter (PM) (mg/Nm <sup>3</sup> )	Sulfur dioxide (SO <sub>2</sub> ) (ppm)	Oxides of nitrogen (NO <sub>x</sub> as NO <sub>2</sub> ) (ppm)
1. Grey Cement Kiln	120	50	500
2. White Cement Kiln	120	500	500
3. Clinker Cooler Clinker Grinding Mill Coal Grinding Mill	120	-	-

**Remarks :** (1) Cement Plant means the factory operating for cement production, e.g. grey cement and white cement.  
(2) Existing Cement Plant means the cement plant acquiring a permit for factory operation or expansion before January 31, 2004.  
(3) New Cement Plant means the cement plant acquiring a permit for factory operation or expansion since January 31, 2004.  
(4) The monitoring results of grey cement kiln and white cement kiln are calculated as concentrations at the reference condition of 1 atm (or 760 mmHg), 25 °C, dry basis and excess air of 50% or at oxygen of 7%.  
(5) The monitoring results of clinker cooler and clinker grinding mill are calculated as concentrations at the reference condition of 1 atm (or 760 mmHg), 25 °C, dry basis and actual oxygen.

**Source :** Notification of the Ministry of Natural Resources and Environment dated January 19, B.E.2547 (2004), which was published in the Royal Government Gazette, Vol.121 Special Part 12D dated January 30, B.E.2547 (2004).

**(O) Emission Standard for Cement Plant**

New Cement Plant	Emission Standard		
	Particulate matter (PM) (mg/Nm <sup>3</sup> )	Sulfur dioxide (SO <sub>2</sub> ) (ppm)	Oxides of nitrogen (NO <sub>x</sub> as NO <sub>2</sub> ) (ppm)
1. Grey Cement Kiln	120	50	500
2. White Cement Kiln	120	500	500
3. Clinker Cooler	120	-	-
4. Clinker Grinding Mill	120	-	-
5. Coal Grinding Mill	120	-	-
6. Production Process			
Non-combustion	400	-	-
Combustion	320	700	400

- Remarks :** (1) Cement Plant means the factory operating for cement, lime and plaster production.
- (2) The pollutants measurement of air emission from cement plant shall be taken while the factory is operating and the clinker cooler is at normal status.
- (3) The monitoring results of grey cement kiln and white cement kiln are calculated as concentrations at the reference condition of 1 atm (or 760 mmHg), 25 °C, dry basis and excess air of 50% or at oxygen of 7%.
- (4) The monitoring results of clinker cooler and clinker grinding mill are calculated as concentrations at the reference condition of 1 atm (or 760 mmHg), 25 °C, dry basis and actual oxygen.

**Source :** Notification of the Ministry of Industry, B.E.2549 (2006) issued under Factory Act B.E.2535 (1992) dated October 31, B.E.2549 (2006) which was published in the Royal Government Gazette, Vol 123, Special Part 125D dated December 4, B.E.2549 (2006).

**(P) Emission Standards for Cement Plant Using Wastes as Fuel or Raw Materials**

No.	Pollutant	Unit	Type of Cement Plants	
			Existing Plants	New Plants
1.	PM	(mg/Nm <sup>3</sup> )	120	80
2.	SO <sub>2</sub>	(ppm)	50	30
3.	NO <sub>x</sub> as NO <sub>2</sub>	(ppm)	500	500
4.	Hydrogen Chloride	(ppm)	9	9
5.	Hydrogen Fluoride	(ppm)	3	3
6.	Total Organic Carbon	(ppm)	30	30
7.	Dioxin	(ng/Nm <sup>3</sup> )	0.5	0.5
8.	Mercury	(mg/Nm <sup>3</sup> )	0.1	0.1
9.	Total of Cadmium and Lead	(mg/Nm <sup>3</sup> )	0.2	0.2
10.	Total of Antimony, Arsenic, Beryllium, Chromium, Cobalt, Copper, Manganese, Nickel and Vanadium	(mg/Nm <sup>3</sup> )	1	1

- Remarks :**
- (1) Cement Plant using wastes as fuel or raw material means the factory for cement productions according to the notified Industry Law. The wastes to be used shall contain sewage or hazardous wastes according to Industry Law ; and/or chemical wastes regarding the hazardous material law of not more than 40% which is calculated from the following ;
    - a. The heat energy value obtained from the combustion of sewage, hazardous waste and/or chemical wastes used as fuel is equivalent to the heat energy value of all fuel combustion and
    - b. The weight of sewage or hazardous wastes and/or chemical wastes used as fuel is equivalent to the weight of all raw materials.
  - (2) Existing Cement Plant means the cement plant which utilized wastes as fuel or raw material acquiring a permit for factory operation or expansion before December 16, 2006.
  - (3) New Cement Plant means the cement plant which utilized wastes as fuel or raw material acquiring a permit for factory operation or expansion since December 16, 2006.
  - (4) Wastes means sewage or unused materials which are hazardous and/or nonhazardous as specified by Industry law except plants, animals and wood. It also includes chemical wastes according to Hazardous Material Law by Ministry of Industry.
  - (5) PM emission from clinker cooler, clinker grinding mill and coal grinding mill of cement plant which utilize waste as fuel and raw material shall not exceed 120 mg/Nm<sup>3</sup>.
  - (6) The monitoring results of cement plants using wastes as fuel and raw material are calculated as concentrations at the reference condition of 1 atm (or 760 mmHg), 25 °C, dry basis and oxygen at 7%. The emission monitoring results of clinker cooler, clinker grinding mill and coal grinding mill shall be determined based on the actual percentage of oxygen.

**Source :** Notification of the Ministry of Natural Resources and Environment dated November 8, B.E.2549 (2006), which was published in the Royal Government Gazette, Vol.123, Special Part 129D dated December 15, B.E.2549 (2006).

**(Q) Emission Standards for Infectious Waste Incinerators**

No.	Pollutants <sup>(1)</sup>	Emission Standard	Standard Analytical Methods
1.	PM (mg/Nm <sup>3</sup> )	120	Determination of Particulate Matter Emission from Stationary Sources, U.S.EPA
2.	SO <sub>2</sub> (ppm)	30	Determination of Sulfur Dioxide Emission from Stationary Sources or Determination of Sulfur Acid Mist and Sulfur Dioxide Emission from Stationary Sources, U.S.EPA
3.	NO <sub>x</sub> as NO <sub>2</sub> (ppm)	180	Determination of Nitrogen Oxide Emission from Stationary Sources, U.S.EPA
4.	Opacity (%)	10	Visual Determination of the Opacity Emission from Stationary Sources, U.S.EPA
5.	HCl (ppm)	25	Determination of Hydrogen Chloride Emission from Stationary Sources, U.S.EPA
6.	HF (ppm)	20	Determination of Hydrogen Chloride Emission from Stationary Sources or Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources -Isokinetic Method, U.S.EPA
7.	Dioxin <sup>(2)</sup> (ng/Nm <sup>3</sup> ) <sup>(3)</sup>	0.5	Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzofurans from Stationary Sources, U.S.EPA
8.	Hg (mg/Nm <sup>3</sup> )	0.05	Determination of Metals Emission from Stationary Sources, U.S.EPA
9.	Cd (mg/Nm <sup>3</sup> )	0.05	Determination of Metals Emission from Stationary Sources, U.S.EPA
10.	Pb (mg/Nm <sup>3</sup> )	0.5	Determination of Metals Emission from Stationary Sources, U.S.EPA

- Remarks :** <sup>(1)</sup> The concentrations of air emissions are based on the reference conditions of 25 °C, 760 mm.Hg or 1 atm, dry basis, and oxygen content of 7% or excess air of 50%.  
<sup>(2)</sup> Dioxin means total chlorinated PCDD plus PCDF .  
<sup>(3)</sup> 1 ng (nanogram) is equivalent to 10<sup>-6</sup> mg.

**Source :** Notification of the Ministry of Natural Resources and Environment dated December 15, B.E.2546 (2003), which was published in the Royal Government Gazette, Vol.120, Special Part 147D dated December 25, B.E.2546 (2003).

**(R) Emission Standard for Industrial Furnace Using Processed Used-Oil and Synthetic Fuel**

No.	Pollutants	Emission Standard	Standard Analytical Methods
1.	Particulate matter	240 mg/Nm <sup>3</sup>	Determination of Particulate Matter Emission from Stationary Sources, U.S.EPA
2.	Hydrogen chloride and Hydrogen fluoride	Total not exceed 85 ppm	Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic or Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic, U.S.EPA
3.	Carbon monoxide	110 ppm	Determination of Carbon Monoxide Emissions from Stationary Sources, U.S.EPA
4.	Sulfur dioxide	800 ppm	Determination of Sulfur Dioxide Emissions from Stationary Sources or Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources, U.S.EPA
5.	Oxides of nitrogen as NO <sub>2</sub>	200 ppm	Determination of Nitrogen Oxide Emission from Stationary Sources, U.S.EPA
6.	Dioxins/Furans as TEQ	0.5 ng/Nm <sup>3</sup>	Determination of Polychlorinated Dibenzo-p-Dioxins and Polychlorinated Dibenzo-furan Emission from Stationary Sources, U.S.EPA
7.	Mercury	0.15 mg/Nm <sup>3</sup>	Determination of Metals Emission from Stationary Sources, U.S.EPA
8.	Antimony, Arsenic, Cadmium, Selenium and Tellurium	Total not exceed 0.65 mg/Nm <sup>3</sup>	
9.	Vanadium, Chromium, Cobalt, Nickle, Copper, Lead, Manganese and Tin	Total not exceed 13 mg/Nm <sup>3</sup>	

- Remarks :**
- (1) Processed used-oil means used oil which is processed physically or chemically to be used as fuel. No other wastes, for example, solvent, pesticides are blended with the used oil in any step of physical or chemical process.
  - (2) Synthetic fuel means used-oil which is blended with the wastes so that it can be used as fuel.
  - (3) Industrial furnace means the furnace used in a manufacturing process of Factory No.59 (Iron and Steel Basic Industries), Factory No.60 (Non-ferrous Metal Basic Industries), Factory No.88 (Generation and distribution of electrical energy, and heating devices used in manufacturing process of Factory No.58 (1) (Concrete product, mixed concrete, gypsum or plaster products listed in Notification of the Ministry of Industry (B.E.2535)) issued under Factory Act B.E.2535. A boiler in manufacturing are included.



- (4) The air emission from Factory No.59 Iron and Steel Basic Industries of which total production rate is more than 100 ton per day, and Factory No.88 (Factory generating, transmitting or distributing electricity) using processed used-oil and synthetic fuel as fuel in industrial furnaces shall not exceed the limits specified in the Table. In addition, the emission concentrations of particulate matter, sulfur dioxide and oxides of nitrogen shall not exceed the standard specified in Notification of the Ministry of Science, Technology and Environment : Emission Standard for Steel Industry, dated March 9, B.E.2544 (2001) and Notification of the Ministry of Industry : Emission Standard for the Power Plant B.E.2547 (2004), dated September 28, B.E.2547 (2004).

**Source :** Notification of the Ministry of Industry B.E.2548 (2005) issued under Factory Act B.E.2535 (1992) dated May 20, B.E.2548 (2005), which was published in the Royal Government Gazette, Vol.122 Special Part 52D dated July 14, B.E.2548 (2005).

***(S) Emission Standard for Rice Mill***

Type	Parameter	Standard Value (%)	Measurement Methods
1. All size of Rice Mill Boilers	Opacity	Not exceeding 20, Effective before February 4, 2005	Ringlemann's method. The reading is determined as opacity according to the Notification of the Pollution Control Committee published in the Royal Government Gazette.
		Not exceeding 10, Effective since February 4, 2007	
2. The production rate of Rice Mill is more than 20 ton/day	PM-10	Not exceeding 0.100 mg/Nm <sup>3</sup> (100 µg/Nm <sup>3</sup> ) The difference of PM-10 concentration measured at upwind and downwind point.	Gravimetric System of High Volume and Dichotomous type, Beta Ray System, Tepered Element Oscillating Microbalance System or other system approved by the Pollution Control Department.

- Sources :**
- (1) Notification of the Ministry of Natural Resources and Environment : All types of Rice Mill is designated as pollution point source from which its emission must be controlled, dated September 28, B.E.2550 (2007), and published in the Royal Government Gazette, Vol.124, Special Part 161D dated October 24, B.E.2550 (2007).
  - (2) Notification of Pollution Control Committee : Methods for Opacity Monitoring of Emission from Rice Mill Boiler dated September 20, B.E.2548 (2005), published in the Royal Government Gazette, Vol.122 Part 102D dated November 17, B.E.2548 (2005).
  - (3) Notification of the Ministry of Natural Resources and Environment : All types of emission standard for Rice Mill dated September 28, B.E.2550 (2007), and published in the Royal Government Gazette, Vol.124, Special Part 161D dated October 24, B.E.2550 (2007).
  - (4) Notification of Pollution Control Committee on Principle, Method, Measuring instruments and monitoring location of fugitive dust from Rice Mill dated December 14, B.E.2550 (2007) and published in the Royal Government Gazette, Vol.125. Special Part 16D, dated January 23, B.E.2551 (2008).

**(T) Emission Standard for Rice Mill Boilers using Husk as Fuel**

Parameter	Standard Value (%)	Measurement Method
Opacity	Not exceeding 20, Effective before February 4, 2007	Ringlemann's method. The reading is determined as opacity according to the Notification of the Pollution Control Committee published in the Royal Government Gazette.
	Not exceeding 10, Effective since February 4, 2007	

**Source** : Notification of the Ministry of Industry, B.E.2549 (2006) issued under Factory Act B.E.2535 (1992) dated October 31, B.E.2549 (2006), and published in the Royal Government Gazette, Vol 123, Special Part 125D, dated December 4, B.E.2549 (2006).

**(U) Emission Standard for Boilers**

Parameter	Standard Value (%)	Measurement Method
Opacity	Not exceeding 10	Ringlemann's method. The reading is determined as opacity according to the notification of the pollution control committee published in the Royal Government Gazette.

**Remark** : Effective of factories having steam production rate of more than 1 ton/hr.

**Sources** : (1) Notification of the Ministry of Natural Resources and Environment dated October 13, B.E.2548 (2005), and published in the Royal Government Gazette, Vol. 122, Special Part 141D dated December 9, B.E.2548 (2005).  
(2) Notification of the Ministry of Industry, B.E.2549 (2006) issued under Factory Act B.E.2535 (1992) dated October 31, B.E.2549 (2006), and published in the Royal Government Gazette, Vol 123, Special Part 125D dated December 4, B.E.2549 (2006).

**(V) Emission Standard for Gold Smelting and Refining Process**

Pollutant	Emission Standard (ppm)	Standard Analytical Method
NO <sub>x</sub> as NO <sub>2</sub>	550	To be calculated at the reference conditions of 1 atm or 760 mmHg, 25°C, dry basis U.S. EPA Method 7 : Determination of Nitrogen Oxide Emission from Stationary Source or the other methods approved by the Pollution Control Committee.

**Sources** : (1) Notification of the Ministry of Natural Resources and Environment : Emission Standard for Gold Smelting and Refining Process dated July 13, B.E.2547 (2004), which was published in the Royal Government Gazette, Vol.121 Special Part 88D dated August 6, B.E.2547 (2004).  
(2) Notification of the Ministry of Natural Resources and Environment : Gold Smelting and Refining Process is designated as Emission Point Source which must be controlled dated July 13, B.E.2547 (2004), published in the Royal Government Gazette, Vol.121 Special Part 88D dated August 6, B.E.2547 (2004).

## (W) Emission Standard for Chemical Plant

### (1) Emission Concentration

No.	Pollutant	Emission Standard	Measurement Methods
1.	1,2-Dichloroethane	5 mg/Nm <sup>3</sup>	Sampling Bag/Gas Chromatography or other method approved by PCD and published in the Royal Government Gazette.
2.	Vinyl Chloride	5 mg/Nm <sup>3</sup>	

### (2) Total Emission ( in 1 year period)

No.	Type of Process	1,2-Dichloroethane	Vinyl Chloride
1.	Production process and storage of 1,2 - Dichloroethane and Vinyl Chloride.	Not more than 20 g / 1 ton of 1,2-Dichloroethane used	Not more than 100 g / 1 ton of vinyl chloride produced
2.	S-PVC process or PVC production process by suspension process	-	Not more than 100 g / 1 ton S-PVC produced
3.	Paste PVC process or PVC production by emulsion process	-	Not more than 2,000 g / 1 ton Paste-PVC produced

**Remarks :** (1) “The Chemical Plant” means the factory type No. 42 or No.44 under the Factory Act that produces, uses and has storage of 1,2-dichloroethane or vinyl chloride.

(2) “Old Chemical Plant” means the chemical plant having operation permit or expansion permit before the effective date of this Notification announced in the Royal Government Gazette (August 10, B.E.2553 (2010)).

(3) “New Chemical Plant” means the chemical plant having operation permit or expansion permit since the effective date of this Notification announced in the Royal Government Gazette (August 10, B.E.2553 (2010)).

(4) The monitoring results of air emissions from a production process without fuel combustion are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and actual percent oxygen.

(5) The monitoring results of air emissions from a production process with fuel combustion are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and at O<sub>2</sub> of 7%.

**Source :** Notification of the Ministry of Natural Resources and Environment, issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated July 8, B.E.2553 (2010), and published in the Royal Government Gazette, Vol.127, Special Part 96D dated August 10, B.E.2553 (2010).

: Notification of Pollution Control Committee B.E.2556 (2013), dated October 10, B.E.2556 (2013), which was published in the Royal government Gazette, Vol.130, Special Part 162D dated November 22, B.E.2556 (2013).

**(X) Emission Standards for Glass Plant**

No.	Pollutant	Emission Source	Emission Standard
1.	Particulate matter	Furnace using the following : - Heavy oil as fuel - Other fuel	240 mg/Nm <sup>3</sup> 320 mg/Nm <sup>3</sup>
2.	Sulfur dioxide	Furnace using sulfate compounds as raw material and using the following : - Heavy oil as fuel - Other fuel  Furnace not using sulfate compounds as raw material and using the following : - Heavy oil as fuel - Other fuel	950 ppm 300 ppm  950 ppm 60 ppm
3.	Oxides of nitrogen (as nitrogen dioxide)	All Furnaces	1,750 ppm
4.	Carbon monoxide	All Furnaces	690 ppm
5.	Hydrogen chloride	All Furnaces	40 ppm
6.	Hydrogen fluoride	All Furnaces	70 ppm
7.	Lead	All Furnaces	5 mg/Nm <sup>3</sup>
8.	Arsenic	All Furnaces	1 mg/Nm <sup>3</sup>

- Remarks :** (1) Glass Plant means factories for manufacturing glass, fiberglass or glass products.  
(2) Closed system means the fuel and/or raw material combustion system which is designed to control air volume and operating condition for combustion.  
(3) Open system means the fuel and/or raw material combustion system is not designed for controlling air volume and operating condition for combustion.  
(4) The monitoring results of air emissions from a production process with fuel combustion in closed system are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and excess air of 50% or at O<sub>2</sub> of 7%.  
(5) The monitoring results of air emissions from a production process with fuel combustion in open system are reported as concentrations at the reference conditions of 1 atm (or 760 mm Hg), 25°C, dry basis and actual percent oxygen.

**Standard Analytical Method**

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| 1. Particulate matter                    | Determination of Particulate Matter Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW.   |
| 2. Sulfur dioxide (SO <sub>2</sub> )     | Determination of Sulfur Dioxide Emissions from Stationary Sources or Determination of Sulfuric Acid Mist and Sulfur Dioxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW. |
| 3. Oxides of nitrogen (NO <sub>x</sub> ) | Determination of Nitrogen Oxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW.   |
| 4. Carbon monoxide                       | Determination of Carbon Monoxide Emissions from Stationary Sources (U.S. EPA) or other methods approved by DIW.  |

5. Hydrogen chloride and Hydrogen fluoride Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Non-Isokinetic or Determination of Hydrogen Halide and Halogen Emissions from Stationary Sources Isokinetic (U.S. EPA) or other methods approved by DIW.
6. Lead and Arsenic Determination of Metals Emission from Stationary Sources (U.S. EPA) or other methods approved by DIW.

**Source :** Notification of the Ministry of Industry B.E.2555 (2012), issued under Factory Act B.E.2535 (1992) dated May 8, B.E.2555 (2012), and published in the Royal Government Gazette, Vol.129, Special Part 102D dated June 28, B.E.2555 (2012).

**(Y) Smoke Opacity Standard of Fugitive Dust from Harbor**

Pollutant	Smoke Opacity Value (%)	Measurement Method
Fugitive Dust	Not exceeding 15 (Effective since December 4, 2007)	Smoke Opacity Meter as specified by the Pollution Control Committee in the Royal Government Gazette.
	Not exceeding 5 (Effective since December 4, 2008)	

- Remarks :**
- (1) Harbor means site for vessel service of anchoring, landing, loading or transfer of goods. This includes any part of building or harbor extending over and under river, canal, basin, lake or sea in territorial water of Thailand where people can utilize together. The coastal area and area where are used for transfer, loading and storage of such goods are also included.
  - (2) Smoke Opacity Value of fugitive dust means photometric value which is decreased while beam shine through dust to Light Detector, comparing with photometric value with no dust. The measurement unit is percentage.
  - (3) Fugitive Dust means dust or particles being dispersed to the atmosphere due to the operation of a harbor of owner that is pollution source.
  - (4) Smoke Opacity Meter means a meter measuring smoke opacity based on transmissometry from a light source of specific light wavelength passing dust to Light Detector, and measure the decreased photometric value comparing with total photometric value from light source.
  - (5) The following types of harbor are emission sources to be controlled :
    - a. Harbor for loading or transfer of gypsum, coal or sand.
    - b. Harbor for loading or transfer of cement products, such as lime, cement and/or other similar products.
    - c. Harbor for loading or transfer of agricultural products such as cassava, cassava line, corn, wheat or other similar agricultural products.

- Sources :**
- (1) Notification of Ministry of Natural Resource and Environment, Smoke Opacity Standard of Fugitive Dust from Harbor dated November 2, B.E.2550 (2007) and published in the Royal Government Gazette, Vol.124 Special Part 188D, dated December 3, B.E. 2550 (2007).
  - (2) Notification of Ministry of Natural Resources and Environment, Some Type of Harbor that is pollution source will be controlled air emission to atmosphere dated November 2, B.E.2550 (2007) and published in the Royal Government Gazette, Vol.124 Special Part 188D, dated December 3, B.E. 2550 (2007).