

WATER QUALITY STANDARDS

1) Industrial Effluent Standards for Industrial Plants and Industrial Estates

Item	Unit	Standard Value
1. pH Value	-	5.5-9.0
2. Total Dissolved Solids (TDS)	mg/l	2.1) Not more than 3,000 mg/l depending on receiving water or type of industry under consideration of Pollution Control Committee (PCC) but no exceeding 5,000 mg/l. 2.2) Not exceeding TDS of receiving water having salinity of more than 2,000 mg/l or TDS of sea water if discharging to sea by not more than 5,000 mg/l.
3. Suspended Solids (SS)	mg/l	Not more than 50 mg/l depending on receiving water or type of industry or type of waste water treatment system under consideration of PCC but not exceeding 150 mg/l.
4. Temperature	°C	Not more than 40
5. Color and Odor	-	Not objectionable
6. Sulfide (as H ₂ S)	mg/l	Not more than 1.0
7. Cyanide (as HCN)	mg/l	Not more than 0.2
8. Heavy Metals		
8.1 Zinc (Zn)	mg/l	Maximum permitted value is 5.0
8.2 Chromium (Hexavalent)	mg/l	Maximum permitted value is 0.25
8.3 Chromium (Trivalent)	mg/l	Maximum permitted value is 0.75
8.4 Arsenic (As)	mg/l	Maximum permitted value is 0.25
8.5 Copper (Cu)	mg/l	Maximum permitted value is 2.0
8.6 Mercury (Hg)	mg/l	Maximum permitted value is 0.005
8.7 Cadmium (Cd)	mg/l	Maximum permitted value is 0.03
8.8 Barium (Ba)	mg/l	Maximum permitted value is 1.0
8.9 Selenium (Se)	mg/l	Maximum permitted value is 0.02
8.10 Lead (Pb)	mg/l	Maximum permitted value is 0.2
8.11 Nickel (Ni)	mg/l	Maximum permitted value is 1.0
8.12 Manganese (Mn)	mg/l	Maximum permitted value is 5.0
9. Fat, Oil and Grease (FOG)	mg/l	Not more than 5 mg/l depending on receiving water or type of industry under consideration of PCC but not exceeding 15 mg/l.
10. Formaldehyde	mg/l	Not more than 1
11. Phenols	mg/l	Not more than 1

1) Industrial Effluent Standards for Industrial Plants and Industrial Estates (Cont'd)

Item	Unit	Standard Value
12. Free Chlorine	mg/l	Not more than 1
13. Pesticide	mg/l	None
14. Biochemical Oxygen Demand (BOD ₅)*	mg/l	Not more than 20 mg/l unless the specific type of industry, or different capacity level of receiving water can be permitted to be more than 20 mg/l by PCC but the maximum allowable value shall not be more than 60 mg/l.
15. Total Kjeldahl Nitrogen (TKN)**	mg/l	Not more than 100 mg/l unless the specific type of industry, or different capacity level of receiving water can be permitted to be more than 100 mg/l by PCC consideration but the maximum allowable value shall not more than 200 mg/l.
16. Chemical Oxygen Demand (COD)***	mg/l	Not more than 120 mg/l depending on receiving water or type of industry under consideration of PCC but not exceeding 400 mg/l.

Remarks : * 10 types of industries which has been accepted by PCC to discharge the effluent of which BOD₅ is up to 60 mg/l as follows :

- | | |
|---------------------------------|------------------------------------|
| (1) animal furnishing factories | (6) tanning and grinding factories |
| (2) starch factories | (7) pulp and paper factories |
| (3) food from starch factories | (8) chemical factories |
| (4) animal feed factories | (9) pharmaceutical factories |
| (5) textile factories | (10) frozen room factories |

** Effective after 1 year of announcement by Ministry of Science, Technology and Environment for factories type 2 and 3, but after 2 years for factories type 13(2) and 15(1). There are discharge the effluent of which TKN is up to 100 mg/l.

*** 5 types of industries which are permitted by PCC to discharge the effluent of COD up to 400 mg/l as follows :

- (1) food from starch factories
- (2) animal feed factories
- (3) textile factories
- (4) tanning and grinding factories
- (5) pulp and paper factories

(1) mg/l means milligram per liter.

(2) Factory means factories according to the Factory Law.

(3) Industrial Estate means industrial estates according to the Industrial Estate Law or any industrial projects from which the wastewater is discharged into public water resources or into the environment.

Sources : Notification of Ministry of Science, Technology and Environment No.3, B.E.2539 (1996) dated January 3, B.E.2539 (1996), which was published in the Royal Government Gazette, Vol.113, Part 13D, dated February 13, B.E.2539 (1996).

: Notification of Ministry of Science, Technology and Environment No.4, B.E.2539 (1996) dated January 3, B.E.2539 (1996), which was published in the Royal Government Gazette, Vol.113, Part 13D, dated February 13, B.E.2539 (1996).

: Notification of the Pollution Control Committee dated August 20, B.E.2539 (1996) has issued types of factories that are allowed to discharge effluent having different standard specified in Ministerial Notification No.3 (B.E.2539) which was published in the Royal Government Gazette, Vol.113, Part 75D, dated September 17, B.E.2539 (1996).

: Notification of Ministry of Industry, No.2 B.E.2539 (1996), issued under Factory Act B.E.2535 (1992) dated June 14, B.E.2539 (1996), which was published in the Royal Government Gazette, Vol.113, Part 52D, dated June 27, B.E.2539 (1996).

Note : The draft of the legislation is currently under preparation for new edition.

Analytical Methods of Effluent from Industrial Plants and Industrial Estates according to Notification of MOSTE No.3 (January 3, 1996)

Parameter	Analytical Method
1. pH Value	1. pH Meter
2. Total Dissolved Solids (TDS)	2. Evaporation (Temperature 103-105 °C, 1 hour)
3. Suspended Solids (SS)	3. Glass Fiber Filter Disc
4. Temperature	4. Thermometer
5. Sulfide as H ₂ S	5. Titration
6. Cyanide as HCN	6. Distillation following Pyridine-Barbituric Acid
7. Heavy metals	
7.1 Zinc (Zn)	7.1-7.8 Atomic Absorption Spectrophotometry-Direct Aspiration
7.2 Chromium (Cr)	or Plasma Emission Spectroscopy-Inductively Coupled
7.3 Copper (Cu)	Plasma : ICP
7.4 Cadmium (Cd)	
7.5 Barium (Ba)	
7.6 Lead (Pb)	
7.7 Nickel (Ni)	
7.8 Manganese (Mn)	
7.9 Arsenic (As)	7.9-7.10 Atomic Absorption Spectrophotometry-Hydrate Generation
7.10 Selenium (Se)	or Plasma Emission Spectroscopy-Inductively Coupled
	Plasma : ICP
7.11 Mercury (Hg)	7.11 Atomic Absorption Cold Vapour Technique
8. Fat, Oil and Grease (FOG)	8. Extraction by organic solvent
9. Formaldehyde	9. Spectrophotometry
10. Phenols	10. Distillation, 4-Aminoantipyrine
11. Free chlorine	11. Iodometric Method
12. Pesticides	12. Gas Chromatography
13. Biochemical Oxygen Demand (BOD ₅)	13. Azide Modification at 20 °C, 5 days or other methods approved by PCC
14. Total Kjeldahl Nitrogen (TKN)	14. Kjeldahl Method
15. Chemical Oxygen Demand (COD)	15. Potassium Dichromate Digestion

- Remarks :**
- (1) Analytical methods of effluent from industrial plants and industrial estates should follow Manual of Water and Wastewater Analysis by Thai Environmental Engineer Association, or Standard Methods for the Examination of Water and Wastewater by American Public Health Association (APHA), American Water Work Association and Water Environment Federation.
 - (2) The sampling methods, frequency and sampling duration of effluent will be specified by Pollution Control Department in the Royal Gazette.
 - (3) MOSTE : Ministry of Science, Technology and Environment.
 - (4) Wastewater means waste in liquid state including pollutants or contaminants in such liquid.
 - (5) Discharge means wastewater generated from an industrial process or industrial estate which is discharged into public water resources or the environment, including wastewater generated from workers and other activities in the factory or industrial estate. All discharges have to meet the standard.

Note : The draft of the legislation is currently under preparation for new edition.

2) Industrial Effluent Standards for Industrial Estate

Parameter	Unit	Standard (Range or Maximum Permitted Values)
1. Biochemical Oxygen Demand (BOD ₅)	mg/l	Not more than 500
2. Chemical Oxygen Demand (COD)	mg/l	Not more than 750
3. pH Value	-	5.5-9.0
4. Total Dissolved Solids (TDS)	mg/l	Not more than 3,000
5. Suspended Solids (SS)	mg/l	Not more than 200
6. Total Kjeldahl Nitrogen (TKN)	mg/l	Not more than 100
7. Heavy Metals		
- Mercury (Hg)	mg/l	Not more than 0.005
- Selenium (Se)	mg/l	Not more than 0.02
- Cadmium (Cd)	mg/l	Not more than 0.03
- Lead (Pb)	mg/l	Not more than 0.20
- Arsenic (As)	mg/l	Not more than 0.25
- Chromium (Cr)		
- Hexavalent Chromium (Cr ⁶⁺)	mg/l	Not more than 0.25
- Trivalent Chromium (Cr ³⁺)	mg/l	Not more than 0.75
- Barium (Ba)	mg/l	Not more than 1.0
- Nickel (Ni)	mg/l	Not more than 1.0
- Copper (Cu)	mg/l	Not more than 2.0
- Zinc (Zn)	mg/l	Not more than 5.0
- Manganese (Mn)	mg/l	Not more than 5.0
- Silver (Ag)	mg/l	Not more than 1.0
- Total Iron	mg/l	Not more than 10.0
8. Sulfide as H ₂ S	mg/l	Not more than 1
9. Cyanide as HCN	mg/l	Not more than 0.2
10. Formaldehyde	mg/l	Not more than 1
11. Phenols Compound	mg/l	Not more than 1
12. Free Chlorine	mg/l	Not more than 1
13. Chloride as Cl ₂	mg/l	Not more than 2,000
14. Fluoride	mg/l	Not more than 5
15. Pesticide	-	None
16. Temperature	°C	Not more than 45
17. Color	-	Not objectionable
18. Odor	-	Not objectionable
19. Oil & Grease	mg/l	Not more than 10
20. Surfactants	mg/l	Not more than 30

Source : Notification of the Industrial Estate Authority of Thailand No.78/2554 (2011) dated November 23, B.E.2554 (2011).

3) Building Effluent Standards

Parameter	Unit	Range or Maximum Permitted Value for Category				
		A	B	C	D	E
1. pH Value	-	5-9	5-9	5-9	5-9	5-9
2. BOD ₅	mg/l	20	30	40	50	200
3. Solids						
3.1 Suspended Solids	mg/l	30	40	50	50	60
3.2 Settleable Solids	mg/l	0.5	0.5	0.5	0.5	-
3.3 TDS*	mg/l	500	500	500	500	-
4. Sulfide	mg/l	1.0	1.0	3.0	4.0	-
5. Total Kjeldahl Nitrogen (TKN)	mg/l	35	35	40	40	-
6. Organic-Nitrogen ⁽¹⁾	mg/l	10	10	15	15	-
7. Ammonia-Nitrogen ⁽¹⁾	mg/l	-	-	25	25	-
8. Fat, Oil and Grease (FOG)	mg/l	20	20	20	20	100

Remark : * These values are in addition to the TDS of the water used.

Sources : Notification of the Ministry of Natural Resources and Environment, dated November 7, B.E.2548 (2005), which was published in the Royal Government Gazette, Vol.122, Part 125D dated December 29, B.E.2548 (2005).

⁽¹⁾ Ministerial Regulation No.44, B.E.2538 (1995) and No.51, B.E.2541 (1998) issued under Building Control Act B.E.2522 (1979).

Type and Size of Buildings Subject to Effluent Control

Building Type	Size	Level of Standard*	Remarks
1. Condominium	Less than 100 units	C	
	100 but not more than 500 units	B	
	500 units or more	A**	
2. Hotels	Less than 60 rooms	C	
	60 but not greater than 200 rooms	B	
	200 rooms or more	A**	
3. Dormitories	From 10 to not more than 50 rooms	D ⁽¹⁾	
	From 50 to 250 rooms	C	
	250 rooms or more	B	
4. Massage parlors (or equivalent)	Less than 1,000 m ²	D ⁽¹⁾	
	From 5,000 m ² to not greater than 6,000 m ²	C	
	5,000 m ² or more	B	
5. Hospitals	Less than 10 beds	D ⁽¹⁾	
	From 10 to not greater than 30 beds	B	
	30 beds or more	A**	
6. Schools, Colleges, Universities or Institutes	Less than 5,000 m ²	D ⁽¹⁾	
	From 5,000 m ² to not greater than 25,000 m ²	B	
	25,000 m ² or more	A**	
7. Government offices, State enterprises, International agencies, Banks, and Office Buildings	Less than 5,000 m ²	D ⁽¹⁾	Working area only (excluding central service area)
	From 5,000 m ² to not greater than 10,000 m ²	C	
	10,000 m ² to not greater than 55,000 m ²	B	
	55,000 m ² or more	A**	
8. Department stores	Less than 1,000 m ²	D ⁽¹⁾	
	From 1,000 m ² to not greater than 5,000 m ²	C ⁽¹⁾	
	From 5,000 m ² to not greater than 25,000 m ²	B	
	25,000 m ² or more	A**	

Type and Size of Buildings Subject to Effluent Control (Cont'd)

Building Type	Size	Level of Standard*	Remarks
9. Fresh food markets	From 500 m ² to not greater than 1,000 m ²	D	
	From 1,000 m ² to not greater than 1,500 m ²	C	
	From 1,500 m ² to not greater than 2,500 m ²	B	
	2,500 m ² or more	A**	
10. Restaurants and food shops or food centers	Less than 100 m ²	E	Dining area
	From 100 m ² to not greater than 250 m ²	D	
	From 250 m ² to not greater than 500 m ²	C	
	From 500 m ² to not greater than 2,500 m ²	B	
	2,500 m ² or more	A**	
11. Residential Building ⁽¹⁾	Less than 2,000 m ²	D	
	From 2,000 m ² to not greater than 10,000 m ²	C	
	10,000 m ² or more	B	
12. Housing Estate ⁽¹⁾	From 10 to not greater than 100 units	C	

Remarks : * Level of Standard refers to the 8 parameters listed in standard value-Building Effluent Standards.

** This type and size of building will be controlled by the Pollution Control Officer as specified in Section 69 of the Act.

Sources : Notification of the Ministry of Natural Resources and Environment dated November 7, B.E.2548 (2005), which was published in the Royal Government Gazette, Vol.122, Part 125D dated December 29, B.E.2548 (2005).

(1) Ministerial Regulation No.44, B.E.2538 (1995) and No.51, B.E.2541 (1998) issued under Building Control Act B.E.2522 (1979).

4) Housing Estate Standards

Parameter	Unit	Range or Maximum Permitted Values for Category	
		A 100 units but not more than 500 Units	B more than 500 units
1. pH Value	-	5.5-9.0	5.5-9.0
2. BOD ₅	(mg/l)	≤ 30	≤ 20
3. Suspended Solids	(mg/l)	≤ 40	≤ 30
4. Settleable Solids	(mg/l)	≤ 0.5	≤ 0.5
5. Total Dissolved Solids	(mg/l)	increasing from the existing condition by not more than 500	increasing from the existing condition by not more than 500
6. Sulfide	(mg/l)	≤1	≤1
7. Total Kjeldahl Nitrogen (TKN)	(mg/l)	≤35	≤35
8. Fat, Oil and Grease	(mg/l)	≤20	≤20

Analytical Methods of Effluent from Housing Estate

Parameter	Analytical Method
1. pH Value	1. pH Meter
2. Biochemical Oxygen Demand (BOD ₅)	2. Azide Modification at 20°C for 5 days or other methods approved by PCD
3. Suspended Solids (SS)	3. Glass Fiber Filter Disc
4. Settleable Solids	4. Imhoff cone
5. Total Dissolved Solids (TDS)	5. Evaporation (Temperature 103-105°C, 1 hour)
6. Sulfide	6. Titration
7. Total Kjeldahl Nitrogen (TKN)	7. Kjeldahl Method
8. Fat Oil and Grease	8. Extraction by organic solvent

Source : Notification of Ministry of Natural Resources and Environment, dated November 7, B.E. 2548 (2005), which was published in the Royal Government Gazette, Vol.122, Part 125D, dated December 29, B.E.2548 (2005).

5) Effluent Standard for Sanitary Wastewater Treatment Systems

Parameter	Unit	Standard
1. pH Value	-	5.5-9.0
2. BOD ₅ *	(mg/l)	Not more than 20
3. Suspended Solids **	(mg/l)	Not more than 30
4. Fat, Oil and Grease	(mg/l)	Not more than 5
5. Total Phosphorus	(mg-P/l)	Not more than 2
6. Total Nitrogen	(mg-N/l)	Not more than 20

Remarks : * If the final treatment unit is Stabilization Pond or Oxidation Pond, the BOD used is the filtrate BOD. To determine BOD, the effluent sample is filtered through glass fiber filter disc which is used for suspended solids determination before BOD analysis as specified in the latest edition of Standard Methods for the Examination of Water and Wastewater.

** The value shall not exceed 50 mg/l if the final treatment unit is Stabilization Pond or Oxidation Pond.

*** Analytical method of effluent from community wastewater treatment systems shall follow the standard method for the Examination of Water and Wastewater (APHA, AWWA and WEF) or PCD approval method.

Source : Notification of the Ministry of Natural Resources and Environment dated April 7, B.E.2553 (2010) was issued under the Enhancement and Conservation of National Environmental Quality Act, B.E.2535 (1992) and published in the Royal Gazette, Vol. 127, Special Part 69D dated June 2, B.E.2553 (2010).

6) Effluent Standard from Pig Farm

Parameter	Unit	Maximum Standard Values	
		Large Farm	Small and Medium Farm
1. pH Value	-	5.5-9.0	5.5-9.0
2. Biochemical Oxygen Demand (BOD)	mg/l	60	100
3. Chemical Oxygen Demand (COD)	mg/l	300	400
4. Suspended Solids (SS)	mg/l	150	200
5. Total Kjeldahl Nitrogen (TKN)	mg/l	120	200

Remarks : (1) For large and medium farm it was effective on February 24, B.E.2545 (2002).
 (2) Large Farm is more than 600 Livestock Units (LU).
 (3) Medium Farm is 60-600 LU, Small Farm is 6-60 LU.
 (4) 1 LU = 500 kg

Analytical Methods of Effluent from Pig Farm

Parameter	Analytical Method
1. pH Value	1. pH Meter
2. Biochemical Oxygen Demand (BOD ₅)	2. Azide Modification at 20°C for 5 days or other methods approved by PCD
3. Chemical Oxygen Demand (COD)	3. Potassium Dichromate Digestion
4. Suspended Solids (SS)	4. Glass Fiber Filter Disc
5. Total Kjeldahl Nitrogen (TKN)	5. Kjeldahl Method

Sources : Notification of the Ministry of Natural Resources and Environment under the Enhancement and Conservation of the National Environmental Quality Act, B.E.2535 (1992). It was published in the Royal Government Gazette Vol.122, Part 125D dated December 29, B.E.2548 (2005).

: Notification of the Ministry of Natural Resources and Environment No.2, B.E.2552 (2009) under the Enhancement and Conservation of the National Environmental Quality Act, B.E.2535 (1992). It was published in the Royal Government Gazette Vol.127, Part 7D dated January 15, B.E.2553 (2010).

7) Effluent Quality Standard for Coastal Aquaculture

Parameter	Unit	Range or Maximum Permitted Values	Analytical Method
1. pH Value	-	6.5-9.0	pH Meter by Electrometric
2. Biochemical Oxygen Demand (BOD ₅)	mg/l	20	Azide Modification by Synthetic Seawater
3. Suspended Solids (SS)	mg/l	70	Glass Fiber Filter Disc of 1.2 μm pore size
4. NH ₃ -N	mg-N/l	1.1	Modified Idophenol Blue
5. Total Phosphorus	mg-P/l	0.4	Ascorbic Acid
6. H ₂ S	mg/l	0.01	Methylene Blue
7. Total Nitrogen (Mixed of Total Dissolve Nitrogen and Total Particulate Nitrogen)	mg-N/l	4	1) Persulfate Digestion 2) Nitrogen Analyzer

Remarks : (1) The sampling method of effluent must be grab sampling taken at the discharge point of the coastal aquaculture area.

(2) The analysis of effluent is based on Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WEF), Practical Handbook of Seawater Analysis (Stickland and Parsons), Method of Seawater Analysis (Koroleff), Determination of Ammonia in Estuary (Sasaki and Sawada), Methods of Seawater Analysis (Grasshoff K.) and/or Manual for Water and Wastewater Examination of Environmental Engineering Association of Thailand.

Source : Notification of the Ministry of Natural Resources and Environment dated March 19, B.E.2547 (2004) was issued under the Enhancement and Conservation of National Environmental Quality Act, B.E.2535 (1992) and published in the Royal Gazette, Vol. 121, Special Part 49D dated May 1, B.E.2547 (2004).

8) Effluent Quality Standard for Fishery Activities

Parameter	Unit	Range or Maximum Permitted Values	Analytical Method
1. pH Value	-	5.0-9.0	pH Meter by Electrometric
2. Biochemical Oxygen Demand (BOD ₅)	mg/l	200	Azide Modification by Synthetic Seawater
3. Suspended Solids (SS)	mg/l	200	Glass Fiber Filter Disc of 1.2 µm pore size
4. Oil and Grease	mg/l	20	Extraction by organic solvent
5. Total Kjeldahl Nitrogen	mg/l	250	Kjeldahl Method

- Remarks :**
- (1) The sampling method of effluent must be grab sampling taken at the discharge point of the fishery activities area.
 - (2) The analysis of effluent is based on Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WEF), Practical Handbook of Seawater Analysis (Stickland and Parsons), Method of Seawater Analysis (Koroleff), Determination of Ammonia in Estuary (Sasaki and Sawada), Methods of Seawater Analysis (Grasshoff K.) and/or Manual for Water and Wastewater Examination of Environmental Engineering Association of Thailand.

Source : Notification of the Ministry of Natural Resources and Environment dated April 10, B.E.2549 (2006) was issued under the Enhancement and Conservation of National Environmental Quality Act, B.E.2535 (1992). It was published in the Royal Gazette, Vol. 123, Part 50D dated May 18, B.E.2549 (2006).

9) Effluent Quality Standard for Petrol Service Stations

Parameter	Unit	Standard
1. pH Value	-	5.5-9.0
2. Chemical Oxygen Demand (COD)	mg/l	≤ 200
3. Suspended Solids (SS)	mg/l	≤ 60
4. Fat, Oil and Grease	mg/l	≤15

Analytical Methods of Effluent Quality from Petrol Service Stations

Parameter	Analytical Method
1. pH Value	1. pH Meter
2. Chemical Oxygen Demand (COD)	2. Potassium Dichromate Digestion
3. Suspended Solids (SS)	3. Glass Fiber Filter Disc
4. Fat, Oil and Grease	4. Extraction by Organic Solvent

- Remarks :** (1) The sampling method of effluent shall be grab sampling taken at the discharge point of the Petrol Service Station. In case of the multiple effluent points, the samples shall be taken at all discharge points.
- (2) The sampling and analysis for effluent of the Petrol Service Station is based on Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WEF).

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

10) Effluent Quality Standard of Aquaculture Pond of Brackish Aquatic Animals

Parameter	Unit	Standard		Analytical Method
		Type 1	Type 2	
1. pH Value	-	6.5-8.5	6.5-8.5	pH Meter
2. Salinity	%	$\leq 50^{1/}$	$\leq 50^{1/}$	Electrometric Conductivity or Density
3. BOD ₅	mg/l	-	20	Azide Modification at 20°C 5 days or Azide Modification by Synthetic Seawater
4. Suspended Solids	mg/l	-	70	Glass Fiber Filter Disc
5. NH ₃ -H	mg-N/l	-	1.1	Modified Indophenol Blue
6. Total Phosphorus	mg-P/l	-	0.4	Ascorbic Acid
7. H ₂ S	mg/l	-	0.01	Methylene Blue
8. Total Nitrogen	mg-N/l	-	4	Persulfate Digestion and analysis by Nitrogen Analyzer or Kjeldahl Method or High-temperature catalytic oxidation

Remarks : (1) The aquaculture pond for the brackish aquatic animals are classified into 2 types as follow:

-Type 1-Size of the aquaculture pond is smaller than 10 rai.

-Type 2-Size of the aquaculture pond is larger than 10 rai.

(2) The sampling of effluent shall be grab sampling taken at the discharge point of the aquaculture pond for the brackish aquatic animals.

(3) The analysis of effluent is based on Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WEF), Practical Handbook of Seawater Analysis (Stickland and Parsons), Method of Seawater Analysis (Koroleff), Determination of Ammonia in Estuary (Sasaki and Sawada), Methods of Seawater Analysis (Grasshoff K.) and/or Manual for Water and Wastewater Examination of Environmental Engineering Association of Thailand.

(4) ^{1/} means the salinity value is higher 50% more than the existing salinity of the effluent discharge area by no more than 50%.

Source : Notification of the Ministry of the Natural Resources and Environment dated May 4, B.E.2550 (2007), which was published in the Royal Government Gazette Vol.124, Special Part 84D dated July 13, B.E.2550 (2007).

11) Effluent Standard from Inland Aquaculture

Parameter	Unit	Maximum Permitted Value			
		Standard A	Standard B	Standard C	
				> 10	< 10
1. Biochemical Oxygen Demand (BOD)	mg/l	20	20	20	-
2. Suspended solids (SS)	mg/l	80	80	80	-
3. NH ₃ -N (Ammonia Nitrogen)	mg-N/l	-	1.1	1.1	-
4. Total Nitrogen - Total Dissolved Nitrogen and Total Particulate Nitrogen	mg-N/l	-	4.0	4.0	-
5. Total Phosphorus	mg-P/l	-	0.5	0.5	-
6. pH Value	-	-	6.5-8.5	6.5-8.5	6.5-8.5
7. Conductivity at 25°C	dS/m	-	-	0.75	0.75

- Remarks :**
- (1) Inland Aquaculture means land being adjusted to store water by various means for aquaculture except aquaculture ponds for coastal or brackish aquatic animals assigned to be pollution sources by Minister.
 - (2) Aquatic Animal means fresh water animal culture breeding a pond, such as fish, shrimp, mussel, turtle and crocodile.
 - (3) Pond Area means pond area used for breeding, including canals and drainage.
 - (4) Effluent means treated wastewater of which quality complies with the effluent standard.
 - (5) Inland Aquaculture type A means an aquaculture pond of herbivore using water from natural resources without adding salts substances, such as seawater, salty groundwater, salt or other substances in inland aquaculture.
 - (6) Inland Aquaculture type B means an aquaculture pond of carnivore using water from natural resources without adding salty substances, such as seawater, salty groundwater, salt or other substances in inland aquaculture.
 - (7) Inland Aquaculture type C means an aquaculture pond of all species of aquatic animals, using salty substance such as seawater, salty groundwater, salt or other additives for adjusting the saltiness of water to be suitable for the species.
 - (8) The sampling of effluent for checking the compliance is taken by grab sampling at discharge point outside inland aquaculture.
 - (9) Analytical methods for effluent quality from an aquaculture pond are in accordance with those in Standard Methods for the Examination of Water and Wastewater, edited by American Public Health Association, American Water Works Association, Water Environment Federation.

Sources : Notification of the Ministry of Natural Resources and Environment: Effluent Standard for Inland Aquaculture, dated November 23, B.E.2550 (2007), and published in the Royal Government Gazette, Vol.125. Special Part 21 D, dated January 30, B.E.2551 (2008).

- : Notification of the Ministry of Natural Resources and Environment: Designated Inland Aquaculture as Pollution Point Sources, dated November 23, B.E.2550 (2007), and published in the Royal Government Gazette, Vol.125. Special Part 21 D, dated January 30, B.E.2551 (2008).

12) Coastal Water Quality Standard

Parameter	Unit	Standard						Standard Analytical Method
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	
		Conservation of Natural Resources	Coral Conservation	Aqua-culture	Recreation	Industries and Harbour	Communities	
1. Floatable Solids	-	NOB	NOB	NOB	NOB	NOB	NOB	Visual Testing
2. Floatable Oil & Grease	-	NV	NV	NV	NV	NV	NV	Visual Testing
3. Colour	Forel-Ule	1.0-22.0	1.0-22.0	1.0-22.0	1.0-22.0	1.0-22.0	1.0-22.0	Forel-Ule color scale
4. Odour	-	NOB	NOB	NOB	NOB	NOB	NOB	Odour Testing
5. Temperature	°C	$\Delta \leq 1.0$	N	$\Delta \leq 1.0$	$\Delta \leq 2.0$	$\Delta \leq 2.0$	$\Delta \leq 2.0$	Thermometer or Electrical Sensor Method
6. pH Value	-	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	7.0-8.5	pH Meter
7. Transparency	m	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	Secchi Disc For Coastal Water
8. Suspended Solids (SS)	mg/l	**	**	**	**	**	**	Gravimetric Method
9. Salinity	ppt	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	$\Delta \leq 10 \%$	Argentometric or Electrical Conductivity Method or Density or Refractometer
10. Petroleum Hydrocarbons	µg/l	≤ 0.5	≤ 0.5	≤ 0.5	≤ 1.0	≤ 5.0	≤ 5.0	Pre-concentration and Fluorescence Spectrophotometry
11. DO	mg/l	≥ 4.0	≥ 6.0	≥ 4.0	≥ 4.0	≥ 4.0	≥ 4.0	Azide Modification Method or Membrane Electrode Method or Winkler Method
12. Total Coliform Bacteria	MPN/100 ml	$\leq 1,000.0$	$\leq 1,000.0$	$\leq 1,000.0$	$\leq 1,000.0$	$\leq 1,000.0$	$\leq 1,000.0$	Multiple Tube Fermentation Technique
13. Fecal Coliform Bacteria	CFU/100 ml	≤ 70.0	≤ 70.0	≤ 70.0	≤ 100.0	≤ 100.0	≤ 100.0	Membrane Filter Technique
14. Enterococci Bacteria	CFU/100 ml	-	≤ 35.0	-	≤ 35.0	-	-	Membrane Filter Technique
15. NO ₃ -N	µg-N/l	≤ 20.0	≤ 20.0	≤ 60.0	≤ 60.0	≤ 60.0	≤ 60.0	Cadmium reduction Method and Colorimetric Method
16. PO ₄ -P	µg-P/l	≤ 15.0	≤ 15.0	≤ 45.0	≤ 15.0	≤ 45.0	≤ 45.0	Colorimetric Method
17. Unionized NH ₃ -N	µg-N/l	≤ 70.0	≤ 70.0	≤ 100.0	≤ 70.0	≤ 70.0	≤ 70.0	Phenol-Hypochlorite Method
18. Total Hg	µg/l	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	Pre-concentration and Cold-Vapor/Hydride Generation-Atomic Absorption Spectrometric Method or Cold-Vapor/Hydride Generation-Atomic Fluorescence Spectrometric Method or Inductively Coupled Plasma Method
19. Cd	µg/l	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	Pre-concentration and Electrothermal Atomic Absorption Spectrometric Method or Inductively Coupled Plasma Method
20. Total Cr	µg/l	≤ 100.0	≤ 100.0	≤ 100.0	≤ 100.0	≤ 100.0	≤ 100.0	See Cadmium Standard Analytical Method
21. Cr hexavalent	µg/l	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0	See Cadmium Standard Analytical Method
22. Pb	µg/l	≤ 8.5	≤ 8.5	≤ 8.5	≤ 8.5	≤ 8.5	≤ 8.5	See Cadmium Standard Analytical Method
23. Cu	µg/l	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	≤ 8.0	See Cadmium Standard Analytical Method
24. Mn	µg/l	≤ 100.0	≤ 100.0	≤ 100.0	≤ 100.0	≤ 100.0	≤ 100.0	Pre-concentration and Flame Atomic Absorption Spectrometric Method or Electrothermal Atomic Absorption Spectrometric Method or Inductively Coupled Plasma Method

12) Coastal Water Quality Standard (Cont'd)

Parameter	Unit	Standard						Standard Analytical Method
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	
		Conser- vation of Natural Resources	Coral Conser- vation	Aqua- culture	Recrea- tion	Industries and Harbour	Commu- nities	
25. Zn	µg/l	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0	See Manganese Standard Analytical Method
26. Fe	µg/l	≤ 300.0	≤ 300.0	≤ 300.0	≤ 300.0	≤ 300.0	≤ 300.0	See Manganese Standard Analytical Method
27. F	mg/l	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	SPADNS Colorimetric Method
28. Phenol	mg/l	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	≤ 0.03	Distillation and Aminoantipyrine Colorimetric Method
29. Sulfide	µg/l	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	Methylene Blue Colorimetric Method
30. Cyanide	µg/l	≤ 7.0	≤ 7.0	≤ 7.0	≤ 7.0	≤ 7.0	≤ 7.0	Pyridine Barbituric Acid Colorimetric Method
31. PCBs	µg/l	ND	ND	ND	ND	ND	ND	Pre-concentration and Gas Chromatography with Electron Capture Detector
32. As	µg/l	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	Pre-concentration and Hydride Generation-Atomic Absorption Spectrometric Method or Electrothermal Atomic Absorption Spectrometric Method or Inductively Coupled Plasma Method
33. Residual Chlorine	mg/l	-	-	-	-	< 0.01	< 0.01	N,N-diethyl-p-phenylenediamine Method
34. Radioactivity								
α-Gross	Becquerel/l	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	≤ 0.1	Co-precipitation Method
β- Gross*	Becquerel/l	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	≤ 1.0	Evaporation Method
35. Tributyltin	ng/l	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0	Pre-concentration and Gas Chromatography with Flame Photometric Detector or Gas Chromatography with Mass Spectrophotometry or High Performance Liquid Chromatography-ICP-MS
36. Organochlorine Pesticide								Spectrophotometry or High Performance Liquid Chromatography-ICP-MS
Aldrin	µg/l	≤ 1.3	≤ 1.3	≤ 1.3	≤ 1.3	≤ 1.3	≤ 1.3	***
Chordane	µg/l	≤ 0.004	≤ 0.004	≤ 0.004	≤ 0.004	≤ 0.004	≤ 0.004	***
DDT	µg/l	≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001	≤ 0.001	***
Dieldrin	µg/l	≤ 0.0019	≤ 0.0019	≤ 0.0019	≤ 0.0019	≤ 0.0019	≤ 0.0019	***
Endrin	µg/l	≤ 0.0023	≤ 0.0023	≤ 0.0023	≤ 0.0023	≤ 0.0023	≤ 0.0023	***
Endosulfan	µg/l	≤ 0.0087	≤ 0.0087	≤ 0.0087	≤ 0.0087	≤ 0.0087	≤ 0.0087	***
Heptachlor	µg/l	≤ 0.0036	≤ 0.0036	≤ 0.0036	≤ 0.0036	≤ 0.0036	≤ 0.0036	***
Lindane	µg/l	≤ 0.16	≤ 0.16	≤ 0.16	≤ 0.16	≤ 0.16	≤ 0.16	***
37. Other Pesticide								
Alachlor	µg/l	ND	ND	ND	ND	ND	ND	***
Ametryn	µg/l	ND	ND	ND	ND	ND	ND	***
Atrazine	µg/l	ND	ND	ND	ND	ND	ND	***
Carbaryl	µg/l	ND	ND	ND	ND	ND	ND	***
Carbendazim	µg/l	ND	ND	ND	ND	ND	ND	***

12) Coastal Water Quality Standard (Cont'd)

Parameter	Unit	Standard						Standard Analytical Method
		Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	
		Conser- vation of Natural Resources	Coral Conser- vation	Aqua- culture	Recrea- tion	Industries and Harbour	Commu- nities	
37. Other Pesticide (Con't)								
Chlorpyifos	µg/l	ND	ND	ND	ND	ND	ND	***
Cypermethrin	µg/l	ND	ND	ND	ND	ND	ND	***
2, 4-D	µg/l	ND	ND	ND	ND	ND	ND	***
Diuron	µg/l	ND	ND	ND	ND	ND	ND	***
Glyphosphate	µg/l	ND	ND	ND	ND	ND	ND	***
Malathion	µg/l	ND	ND	ND	ND	ND	ND	***
Mancozeb	µg/l	ND	ND	ND	ND	ND	ND	***
Methyl parathion	µg/l	ND	ND	ND	ND	ND	ND	***
Parathion	µg/l	ND	ND	ND	ND	ND	ND	***
Propanil	µg/l	ND	ND	ND	ND	ND	ND	***

Remarks : NOB = not objectionable

Δ = change from natural condition

NV = invisible

≤ = not more than

ND = non-detectable

≥ = not less than

N = not changed from natural condition

- = not available

* = excluding natural Potassium 40

** = The results should not be changed by more than the sum of daily or monthly or yearly average and the standard deviation. Daily average was calculated from hourly measurement or at least 5 samples taken at equal time interval within one day. Monthly average was calculated from daily measurement or at least 4 samples taken at equal time interval within one month. Yearly average was calculated from monthly measurement at equal time interval and the same place within one year.

*** = Standard analytical method of all pesticides is Pre-concentration and Gas Chromatography with Mass Spectrophotometry or High Performance Liquid Chromatography (HPLC)

(1) The sampling points are as follows :

- If the depth at the monitoring point is less than 5 meters, the samples are to be taken at 1 meter depth and 1 meter above the bottom level.
- If the depth at the monitoring point is between 5-20 meters, the samples are to be taken at 1 meter depth, at the middle level and at 1 meter above the bottom level.
- If the depth at the monitoring point is between 20-40 meters, the samples are to be taken at 1, 10, 20, 30 meters depth, and at 1 meter above the bottom level.
- If the depth at the monitoring point is between 40-100 meters, the samples are to be taken at 1, 20, 40, 80 meters depth and at 1 meter above the bottom level.
- If the depth at the monitoring point is more than 100 meters, the samples are to be taken at 1 meter depth of every 50 meters, and at 1 meter above the bottom level.
- If the depth at the monitoring point is less than or equal to 1 meter, the samples are to be taken at the middle level of coastal water depth except the Total Coliform Bacteria, Fecal Coliform Bacteria and Enterococci Bacteria are to be sampled at 30 centimeters under the water surface. The floatable solids, colour, transparency, floatable oil and grease are not sampled but measured at the monitoring point.

(2) The sampling of coastal water is to be taken during ebb tide to the lowest tide only in the area being influenced by high tide and low tide.

- (3) The sampling and analysis of coastal water is based on Standard Methods for the Examination of Water and Wastewater (APHA, AWWA and WEF), Method of Seawater Analysis (Grasshoff, 1999) Practical Handbook of Seawater Analysis (Strickland and Parson, 1972), A Manual of Chemical and Biological Methods for Seawater Analysis (Parsons et.al., 1984), Recommended Guidelines for Measuring Organic Compounds in Puget Sound Water, Sediment and Tissue Samples (Puget Sound Estuary Program, 1997), Prescribed Procedures for Measurement of Radioactivity in Drinking Water (Krieger and Whittaker, 1980), Proceedings of the Organotin Symposium, Comprehensive Method for Determination of Aquatic Butyltin and Butylmethyltin Species at Ultra Trace Levels Using Simultaneous Hybridization/Extraction with GC/FPD Detection (Matthias et.al., 1986 a,b), or other methods notified by Pollution Control Board. Chloride interference is to be reduced, otherwise pre-concentration is to be conducted before analysis.

Source : Notification of the National Environment Board No.27, B.E.2549 (2006) dated December 26, B.E.2549 (2006), and published in the Royal Government Gazette, Vol.124, Part 11D dated February 1, B.E.2550 (2007).

Classification of Coastal Water Quality

Classification	Uses / Characteristics
Class 1	Coastal water quality for conservation of natural resources. These areas are natural coastal resources for reproduction or nursing some fetus, aquatic animals, nutrition source and resident of zooplankton, phytoplankton and sea-grass.
Class 2	Coastal water quality for coral conservation areas. These coral community areas cover the horizontal radiance areas with surface water which confine from a perpendicular line with an outset connecting coral line to 1,000 meters.
Class 3	Coastal water for aquaculture activities. These areas was notified to be used for aquaculture activities by Fishery Laws.
Class 4	Coastal water quality for recreation. These areas was notified by Local Government law for swimming or water recreation.
Class 5	Coastal water quality for industries and harbour. These areas are close to the following : (1) Industrial estate zones according to the regulation of Industrial Estate Authority of Thailand (IEAT). (2) Industrial zones according to Industrial Law. (3) Port zones according to Navigation law at territorial waters of Thailand. These are confined by the lowest of coastal line to 1,000 meters as horizontal plane of water surface.
Class 6	Coastal water quality for community zone. These areas are close to the municipality notified by Municipal, Pattaya city and Bangkok laws, only for the areas close to the beach, which are confined by the lowest of coastal line to 1,000 meters as horizontal plane of water surface.

Source : Notification of the National Environment Board No.27, B.E.2549 (2006) dated December 26, B.E.2549 (2006), which was published in the Royal Government Gazette, Vol.124, Part 11D dated February 1, B.E.2550 (2007).

13) Surface Water Quality

No.	Parameter	Statistical Value	Unit	Standard Value of Surface Water for Class				
				1	2	3	4	5
1.	Color, Odor and Taste	-	-	n	n	n	n	-
2.	Temperature	-	°C	n	n'	n'	n'	-
3.	pH Value	-	-	n	5 - 9	5 - 9	5 - 9	-
4.	Dissolved Oxygen	P 20	mg/l	n	≥ 6.0	≥ 4.0	≥ 2.0	-
5.	BOD ₅ (20 °C, 5 days)	P 80	mg/l	n	≤ 1.5	≤ 2.0	≤ 4.0	-
6.	Total Coliform Bacteria	P 80	MPN/100 ml	n	≤ 5,000	≤ 20,000	-	-
7.	Fecal Coliform Bacteria	P 80	MPN/100 ml	n	≤ 1,000	≤ 4,000	-	-
8.	NO ₃ -N	Max. allowable	mg/l	n	not more than 5.0		-	-
9.	NH ₃ -N	Max. allowable	mg/l	n	not more than 0.5		-	-
10.	Phenols	Max. allowable	mg/l	n	not more than 0.005		-	-
11.	Copper (Cu)	Max. allowable	mg/l	n	not more than 0.1		-	-
12.	Nickel (Ni)	Max. allowable	mg/l	n	not more than 0.1		-	-
13.	Manganese (Mn)	Max. allowable	mg/l	n	not more than 1.0		-	-
14.	Zinc (Zn)	Max. allowable	mg/l	n	not more than 1.0		-	-
15.	Cadmium (Cd)	Max. allowable	mg/l	n	not more than 0.005*		-	-
16.	Cr (hexavalent)	Max. allowable	mg/l	n	not more than 0.05**		-	-
17.	Lead (Pb)	Max. allowable	mg/l	n	not more than 0.05		-	-
18.	Hg (total)	Max. allowable	mg/l	n	not more than 0.002		-	-
19.	Arsenic (As)	Max. allowable	mg/l	n	not more than 0.01		-	-
20.	Cyanide (CN)	Max. allowable	mg/l	n	not more than 0.005		-	-
21.	Radioactivity							
	- α Gross	Max. allowable	Becquerel/l	n	not more than 0.1		-	-
	- β Gross	Max. allowable	Becquerel/l	n	not more than 1.0		-	-
22.	Total Organochlorine Pesticides	Max. allowable	mg/l	n	not more than 0.05		-	-
23.	DDT	Max. allowable	µg/l	n	not more than 1.0		-	-
24.	α-BHC	Max. allowable	µg/l	n	not more than 0.02		-	-
25.	Dieldrin	Max. allowable	µg/l	n	not more than 0.1		-	-
26.	Aldrin	Max. allowable	µg/l	n	not more than 0.1		-	-
27.	Heptachlor & Heptachlor epoxide	Max. allowable	µg/l	n	not more than 0.2		-	-
28.	Endrin	Max. allowable	µg/l	n	none		-	-

Remarks : P = Percentile value
n = naturally
n' = naturally but changing by no more than 3 °C
* = when water hardness not more than 100 mg/l as CaCO₃
** = when water hardness is more than 100 mg/l as CaCO₃
≤ = not more than
≥ = not less than
MPN = Most Probable Number

Source : Notification of the National Environment Board No.8, B.E.2537 (1994), issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated January 20, B.E.2537 (1994), which was published in the Royal Government Gazette, Vol.111, Part 16 D, dated February 24, B.E..2537 (1994).

Note : The draft of the legislation is currently under preparation for new edition.

Classification and Surface Water Usage

Classification	Condition & Beneficial Usages
Class 1	Extra clean fresh surface water resources used for : (1) Conservation. It is unnecessary to be treated by water treatment process, but a process for pathogenic destruction is required. (2) Conservation of ecosystem where basic organisms can breed naturally. (3) Conservation of water resource ecosystem.
Class 2	Very clean fresh surface water resources used for : (1) Consumption which requires conservational water treatment processes before use. (2) Aquatic organism conservation. (3) Fisheries (4) Recreation
Class 3	Moderately clean fresh surface water resources used for : (1) Consumption, but the water should be conservationally treated before use. (2) Agriculture
Class 4	Fairly clean fresh surface water resources used for : (1) Consumption, but requires special water treatment process before use. (2) Industry
Class 5	The sources which are not classified as class 1-4 and used for navigation.

Source : Notification of the National Environment Board No.8, B.E.2537 (1994), which was issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1994) dated January 20, B.E.2537 (1994), and published in the Royal Government Gazette, Vol.111, Part 16 D, dated February 24, B.E.2537 (1994).

Note : The draft of the legislation is currently under preparation for new edition.

Analytical Methods for Surface Water

Parameter	Analytical Method
1. Water Temperature	Thermometer
2. pH Value	Electrometric pH meter
3. DO	Azide Modification
4. BOD	Azide Modification; 20 °C; 5 days
5. Coliform Bacteria	Multiple Tube Fermentation Technique
6. NO ₃ -N	Cadmium Reduction
7. NH ₃ -N	Distillation Nesslerization
8. Phenol	Distillation, 4-Amino antipyrine
9. As	Atomic Absorption-Gaseous Hydride
10. CN	Pyridinebarbituric acid
11. Cu	Atomic Absorption-Direct Aspiration
12. Ni	Atomic Absorption-Direct Aspiration
13. Mn	Atomic Absorption-Direct Aspiration
14. Zn	Atomic Absorption-Direct Aspiration
15. Total Hg	Atomic Absorption-Cold Vapour Technique
16. Cd	Atomic Absorption-Direct Aspiration
17. Cr hexavalent	Atomic Absorption-Direct Aspiration
18. Pb	Atomic Absorption-Direct Aspiration
19. Radioactivity	Low Background Proportional Counter
20. Total Organochlorine Pesticides	Gas Chromatography

Remark: The sampling and analysis of surface water is based on Standard Methods for Examination of Waste Water (APHA, AWWA and WPCF)

Source : Notification of the National Environment Board No.8, B.E.2537 (1994), which was issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1994) dated January 20, B.E.2537 (1994), and published in the Royal Government Gazette, Vol.111, Part 16 D, dated February 24, B.E.2537 (1994).

Note : The draft of the legislation is currently under preparation for new edition.

14) Groundwater Quality Standards

Items	Standard Value
1. Volatile Organic Compounds 1.1 Benzene 1.2 Carbon Tetrachloride 1.3 1,2-Dichloroethane 1.4 1,1-Dichloroethylene 1.5 cis-1,2-Dichloroethylene 1.6 trans-1,2-Dichloroethylene 1.7 Dichloromethane 1.8 Ethylbenzene 1.9 Styrene 1.10 Tetrachloroethylene 1.11 Toluene 1.12 Trichloroethylene 1.13 1,1,1-Trichloroethane 1.14 1,1,2-Trichloroethane 1.15 Total Xylenes	Not more than 5 µg/l Not more than 5 µg/l Not more than 5 µg/l Not more than 7 µg/l Not more than 70 µg/l Not more than 100 µg/l Not more than 5 µg/l Not more than 700 µg/l Not more than 100 µg/l Not more than 5 µg/l Not more than 1,000 µg/l Not more than 5 µg/l Not more than 200 µg/l Not more than 5 µg/l Not more than 10,000 µg/l
2. Heavy Metals 2.1 Cadmium 2.2 Hexavalent Chromium 2.3 Copper 2.4 Lead 2.5 Manganese 2.6 Nickel 2.7 Zinc 2.8 Arsenic 2.9 Selenium 2.10 Mercury	Not more than 0.003 mg/l Not more than 0.05 mg/l Not more than 1.0 mg/l Not more than 0.01 mg/l Not more than 0.5 mg/l Not more than 0.02 mg/l Not more than 5.0 mg/l Not more than 0.01 mg/l Not more than 0.01 mg/l Not more than 0.001 mg/l
3. Pesticides 3.1 Chlordane 3.2 Dieldrin 3.3 Heptachlor 3.4 Heptachlor Epoxide 3.5 DDT 3.6 2,4-D	Not more than 0.2 µg/l Not more than 0.03 µg/l Not more than 0.4 µg/l Not more than 0.2 µg/l Not more than 2.0 µg/l Not more than 30 µg/l

14) Groundwater Quality Standards (Cont'd)

Items	Standard
3. Pesticides (Cont'd)	
3.7 Atrazine	Not more than 3 µg/l
3.8 Lindane	Not more than 0.2 µg/l
3.9 Pentachlorophenol	Not more than 1 µg/l
4. Others	
4.1 Benzo(a)pyrene	Not more than 0.2 µg/l
4.2 Cyanide	Not more than 200 µg/l
4.3 PCBs	Not more than 0.5 µg/l
4.4 Vinyl Chloride	Not more than 2 µg/l

Remarks : Analytical Methods

- 1.1-1.15, 4.4 : Purge and Trap GC or Purge and Trap GC/MS.
- 2.1-2.7 : Direct Aspiration/AAS or Inductively Coupled Plasma/Plasma Emission Spectroscopy.
- 2.8-2.9 : Hydride Generation/AAS or Inductively Coupled Plasma/Plasma Emission Spectroscopy.
- 2.10 : Cold-Vapor AAS/Plasma Emission Spectroscopy.
- 3.1-3.5 : Liquid-Liquid Extraction GC/MS or Liquid-Liquid Extraction GC (Method I).
- 3.6-3.7 : Liquid-Liquid Extraction GC.
- 3.8 : Liquid-Liquid Extraction GC (Method I).
- 3.9-4.1 : Liquid-Liquid Extraction GC/MS or Liquid-Liquid Extraction GC.
- 4.2 : Pyridine Barbituric Acid or Colorimetry or Ion Chromatography.
- 4.3 : Liquid-Liquid Extraction GC (Method II).
- Or other methods approved by the PCD.

Source : Notification of the National Environmental Board No.20, B.E.2543 (2000), which was issued under the Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) dated August 31, B.E.2543 (2000), and published in the Royal Government Gazette, Vol.117, Special Part 95D, dated September 15, B.E.2543 (2000).

15) Groundwater Quality Standards for Drinking Purpose

Property	Parameter	Unit	Standard	
			Optimal Value	Max. Allowable
Physical	Color	Pt-Co	5	15
	Turbidity	JTU	5	20
	pH Value	-	7.0 - 8.5	6.5 - 9.2
Chemical	Fe	mg/l	≤ 0.5	1.0
	Mn	mg/l	≤ 0.3	0.5
	Cu	mg/l	≤ 1.0	1.5
	Zn	mg/l	≤ 5.0	15.0
	Sulphate	mg/l	≤ 200	250
	Chloride	mg/l	≤ 250	600
	Fluoride	mg/l	≤ 0.7	1.0
	Nitrate	mg/l	≤ 45	45
	Total hardness as CaCO ₃	mg/l	≤ 300	500
	Non Carbonate hardness as CaCO ₃	mg/l	≤ 200	250
	Total dissolved solids	mg/l	≤ 600	1,200
Toxic	As	mg/l	none	0.05
	Cyanide (CN)	mg/l	none	0.1
	Pb	mg/l	none	0.05
	Hg	mg/l	none	0.001
	Cd	mg/l	none	0.01
	Se	mg/l	none	0.01
Bacterial	Standard Plate Count	Colonies/cm ³	≤ 500	-
	Coliform Bacteria	MPN/100 cm ³	< 2.2	-
	<i>E.Coli</i>		none	-

Remarks : - Pt-Co = Platinum Cobalt Scale

-JTU = Jackson Turbidity Unit

-MPN = Most Probable Number

Source : Notification of the Ministry of Natural Resources and Environment, B.E.2551 (2008) issued under the Groundwater Act, B.E.2520 (1977) which was published in the Royal Government Gazette, Vol. 125, Special Part 85D dated May 21, B.E.2551 (2008).

16) Effluent Quality Discharged into Irrigation System

Parameter	Unit	Standard (Range or Maximum Permitted Values)
1. pH Value	-	6.5-8.5
2. Conductivity	μMole/cm	2,000
3. Total Dissolved Solids (TDS)	mg/l	1,300
4. Biochemical Oxygen Demand (BOD ₅)	mg/l	20
5. Suspended solids (SS)	mg/l	30
6. Sulfide (as H ₂ S)	mg/l	1
7. Cyanide (as HCN)	mg/l	0.2
8. Fat, Oil and Grease	mg/l	5
9. Formaldehyde	mg/l	1
10. Phenol & Cresols	mg/l	1
11. Free chlorine	mg/l	1
12. Pesticides	mg/l	None
13. Radioactivity	Bacquerel/l	None
14. Color and Odor	-	Not objectionable
15. Tar	-	None
16. Temperature	°C	40
17. Total Kjeldahl Nitrogen (TKN)	mg/l	35
18. Dissolved Oxygen (DO)	mg/l	100
19. Chemical Oxygen Demand (COD)	mg/l	100
20. Heavy metals		
- Zinc (Zn)	mg/l	5.0
- Chromium (Cr)	mg/l	0.3
- Arsenic (As)	mg/l	0.25
- Copper (Cu)	mg/l	1.0
- Mercury (Hg)	mg/l	0.005
- Cadmium (Cd)	mg/l	0.03
- Barium (Ba)	mg/l	1.0
- Selenium (Se)	mg/l	0.02
- Lead (Pb)	mg/l	0.1
- Nickel (Ni)	mg/l	0.2
- Manganese (Mn)	mg/l	5.0

Source : Royal Irrigation Department Order No.73/2554 (2011) dated April 1, B.E.2554 (2011).