

NATIONAL ENVIRONMENTAL QUALITY (EMISSION) GUIDELINES

The Ministry of Environmental Conservation and Forestry (MOECAAF), in exercise of the power conferred by sub-section (b) of section 42 of the 2012 Environmental Conservation Law (ECL), hereby issues the following Guidelines.

CHAPTER I **General Provisions**

Objective

1. These national Environmental Quality (Emission) Guidelines (hereafter referred to as Guidelines) provide the basis for regulation and control of noise and vibration, air emissions, and effluent discharges—as provided for in sub-sections (e–g) of section 10 of the Environmental Conservation Law—from various sources in order to prevent pollution for purposes of protection of human and ecosystem health.

Definitions

2. The expressions contained in these Guidelines shall have the same meanings as are assigned to them under the ECL and Environmental Impact Assessment (EIA) Procedure. In addition thereto, the following expressions shall have the meanings given hereunder:
 - (a) **Adverse impact** means any adverse environmental, social, socioeconomic, health, occupational safety or human health effect suffered or borne by any entity, natural person, or natural resource, including, but not limited to, the environment, flora and fauna, where such effect is attributable in any degree or extent to, or arises in any manner from, any action or omission on the part of the project proponent, or from the design, preparation, development (i.e. all phases), construction, implementation, maintenance, operation, or decommissioning of a project or any activities related thereto.
 - (b) **Concentration** means the quantity of a physical, chemical, biological or pathogenic substance in air or water with the dimension of mass per volume (or sometimes mass per mass) calculated according to a common measurement unit (e.g. milligram per liter).
 - (c) **EIA report** means a report comprising a systematic assessment of a proposed activity or project that is prepared to aid in determining whether such activity or project has the potential to significantly affect the environment, humans or other living things, and in deciding whether such activity or project should be allowed or not. The form, content and structure of the report shall be in accordance with the Ministry's requirements and guidelines, and include an Environmental Management Plan (EMP).
 - (d) **Emission** means the direct or indirect release of any substance, radiation, vibration, heat or noise from individual or diffuse sources into the air, water, land or any

subterranean area. Emissions include emissions of solid waste, effluent, gas, noise, odor, light, radiation, vibration or heat.

- (e) **Environmental compliance certificate (ECC)** is a legal document through which the Ministry approves an Initial Environmental Examination (IEE) report or an EIA report, or an EMP.
- (f) **EMP** means a document contemplated with form, content and structure in accordance with the Ministry's requirements and guidelines, which describes the measures to be taken for avoiding, preventing, mitigating, monitoring and compensating for all adverse impacts resulting from the design, preparation, development (i.e. all phases), construction, implementation, operation, maintenance, decommissioning, closure and post-closure or other aspects of the proposed project or activity.
- (g) **Good practice** means that practice which is recognized by a consensus of relevant stakeholders (including without limitation government, industry, labor, financiers, and academia) as having been adopted by leading, reputable companies of international standard, which is capable of being adhered to within the Republic of the Union of Myanmar, and which, when carried out by or in respect of an activity or project, can be expected to further reduce adverse impacts arising from an activity or project related thereto.
- (h) **Guideline values** are maximum contaminant concentrations or specified ranges that should not be exceeded in air and water emissions.
- (i) **IEE report** means a report comprising a systematic assessment of a proposed project or activity that is prepared to aid in determining whether or not potential impacts of a project or activity is significant, whether or not it is necessary to carry out EIA, and in deciding whether such project or activity should be allowed or not. The form, content and structure of the report shall be in accordance with the Ministry's requirements and guidelines, and include an EMP.
- (j) **Ministry** means the ministry assigned by the Union Government to perform on matters relating to the environment.
- (k) **Parameter** means indicators used to measure the level or concentration (population density in case of biological pollutants) against guidelines or standards. The result of measurement could be shown in either numeric or textual form.
- (l) **Point of compliance** means the location on land or in water at which a given substance concentration must meet the applicable Guideline value.
- (m) **Pollution** means any direct or indirect alteration, effect of the physical, thermal, chemical or biological properties of any part of the environment including land, water and atmosphere by discharging, emitting, dispersing, or depositing hazardous substances or wastes so as to effect beneficial use of the environment, or to affect public health, safety or welfare, or animals or plants or to contravene any condition, limitation or prohibition contained in the prior permission issued under the ECL.
- (n) **Pollution prevention** refers to the use of processes, practices, materials, products, substances or energy that avoids or minimizes the creation of pollutants and waste, and reduces the overall risk to the environment or human health.

- (o) **Project** means any commercial, economic, agricultural, social, academic, scientific, or other project, activity, program, business, service or undertaking, whether regarded individually or in the aggregate, the performance of which (requires any approval or is licensed, restricted, or otherwise regulated to any extent by any part of the Union government and which) may have an adverse impact.

Scope of Application

3. These Guidelines have been primarily excerpted from the International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines, which provide technical guidance on good international industry pollution prevention practice for application in developing countries. The Guidelines are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of these Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving them.
4. Unless otherwise indicated, these Guidelines refer to emission sources, and are intended to prevent or minimize adverse impacts to ambient environmental quality by ensuring that pollutant concentrations do not reach or exceed ambient guidelines and standards. The Guidelines apply to projects or activities that generate noise or air emissions during any stage of the project life cycle, and / or that have either direct or indirect discharge of process waste wastewater, wastewater from utility operations or storm water to the environment
5. General and industry-specific Guidelines as specified in Annex 1 – Emissions Guidelines shall apply to any project subject to EIA Procedure, as adopted by the Ministry, in order to protect the environment and to control pollution in the Republic of the Union of Myanmar. These Guidelines specifically apply to all project types listed in the EIA Procedure under ‘Categorization of Economic Activities for Assessment Purposes’ which sets out projects that are subject to EIA, IEE, or EMP.
6. Provisions of the general and applicable industry-specific Guidelines shall be reflected in project EMP and ECC and together constitute a project’s commitment to take necessary measures to avoid, minimize and control adverse impacts to human health, safety, and the environment through reducing the total amount of emissions generation; adopting process modifications, including waste minimization to lower the load of pollutants requiring treatment; and as necessary, application of treatment techniques to further reduce the load of contaminants prior to release or discharge.
7. Further reference should be made by projects to applicable industry-specific IFC EHS guidelines for advice on means of achieving limit values specified in Annex 1.
8. These Guidelines supersede any existing national guideline or standard provision relating to regulation and control of noise, air, and water emissions from activities and projects subject to the EIA Procedure.

CHAPTER II

Implementation Procedures

9. As specified in Article 56 of the EIA Procedure, all projects are obliged to use, comply with and refer to applicable national guidelines or standards or international standards adopted by the Ministry. These Guidelines will henceforth be applied by the Ministry in satisfying this requirement until otherwise modified or succeeded by other guidelines or standards.
10. As specified in Article 77 of the EIA Procedure, following project approval, a project shall commence implementation strictly in accordance with the project EMP and any additional requirements set out in the project ECC, which according to Article 82 of the EIA Procedure, will encompass conditions relating to emissions. In this regard, the Ministry will require that projects shall adhere to general and applicable industry-specific guidelines as specified in Annex 1.
11. While these Guidelines are generally applicable to all projects subject to the EIA Procedure, it is the prerogative of the Ministry to decide how Guidelines should be applied to existing projects, as distinguished from new projects. If the Ministry considers that less stringent levels or measures than those provided for in these Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed on an interim basis.
12. As specified in Article 95 of the EIA Procedure, projects shall engage in continuous, proactive and comprehensive self monitoring of the project and comply with applicable guidelines and standards. For purposes of these Guidelines, projects shall be responsible for the monitoring of their compliance with general and applicable industry-specific Guidelines. Projects shall be responsible for ensuring compliance at the point of compliance specified in the applicable Guidelines.
13. To demonstrate compliance with these monitoring requirements as specified in articles 97 and 98 of the EIA Procedure, projects shall submit monitoring reports to the Ministry at least every six months or more frequently as provided in the EMP and ECC. Monitoring reports shall *inter alia* document compliance, difficulties encountered in complying with EMP and ECC conditions, number and type of non-compliance with EMP and ECC, and monitoring data of prescribed environmental parameters as detailed in the EMP and ECC.
14. In instances of self-reported noncompliance or, as provided for in articles 100 and 101 of the EIA Procedure, identification of noncompliance with the EMP and ECC conditions during monitoring and inspection by the Ministry, the project is required to undertake remedial measures to bring the project into compliance within a specified time period.
15. In instances of continued noncompliance or insufficient response by the project to control emissions as specified in these Guidelines, the Ministry, as provided for in Article 112 of the EIA Procedure, shall have the right to impose penalties on a project for such breach of environmental obligations.

Annex 1

Emission Guidelines

1.0 General Environmental, Health, and Safety

1.1 Air Emissions

Projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimize impacts by ensuring that: emissions do not result in contaminant concentrations that reach or exceed national ambient quality guidelines and standards, or in their absence the current World Health Organization (WHO) Air Quality Guidelines¹ summarized below; and emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards (i.e. not exceeding 25 percent of the applicable air quality standards) to allow additional, future sustainable development in the same air shed. Sector-specific guidelines summarized hereinafter shall be applied by all projects to ensure that air emissions conform to good industry practice.

WHO Ambient Air Quality Guidelines

Parameter	Averaging Period	Guideline Value in $\mu\text{g}/\text{m}^3$
Dichloromethane	24-hour	3,000
Nitrogen dioxide	1-year	40
	1-hour	200
Ozone	8-hour daily maximum	100
Particulate matter PM ₁₀ ^a	1-year	20
	24-hour	50
Particulate matter PM _{2.5} ^b	1-year	10
	24-hour	25
Sulfur dioxide	24-hour	20
	10-minute	500

^a PM₁₀ = Particulate matter 10 micrometers or less in diameter

^b PM_{2.5} = Particulate matter 2.5 micrometers or less in diameter

1.2 Wastewater

Sector-specific guidelines apply to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or storm water to the environment. They are also applicable to industrial discharges to sanitary sewers that discharge to the environment without any treatment. Wastewater generated from project operations includes process wastewater, wastewater from utility operations, runoff from process and storage areas, and miscellaneous activities including wastewater from laboratories, equipment maintenance shops, etc. Projects with the potential to generate process wastewater, sanitary (domestic) sewage, or storm water should incorporate the necessary precautions to avoid, minimize, and control

¹ Air quality guidelines global update. 2005. World Health Organization

adverse impacts to human health, safety or the environment. Sector-specific guidelines summarized hereinafter shall be applied by all projects to ensure that effluent emissions conform to good industry practice.

1.3 Noise Levels

Noise prevention and mitigation measures should be applied by all projects where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception. Noise impacts should not exceed the levels presented below, or result in a maximum increase in background levels of 3 dBA at the nearest receptor location off-site.

Receptor	One Hour LAeq (dBA) ^a	
	Daytime 07:00 – 22:00 (10:00 – 22:00 for Public holidays)	Nighttime 22:00 – 07:00 (22:00 – 10:00 for Public holidays)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

^a Equivalent continuous sound level in decibels

1.4 Odor

Point and diffuse source odors from industries should be minimized using available prevention and control techniques as described in sector-specific guidelines. Point source activities are those that involve stack emissions of odor and which generally can be controlled using waste reduction, waste minimization and cleaner production principles or conventional emission control equipment. Diffuse source activities are generally dominated by area or volume source emissions of odor (e.g. intensive agricultural activities) and which can be more difficult to control. Projects should control odors to ensure that odors that are offensive or unacceptable to neighbors do not occur. Generally, ambient odor levels should not exceed seven odor units (i.e. one odor units is the threshold at which an odor concentration is detectable by people) in the vicinity of a project or activity.

2.0 Sector-specific Environmental, Health and Safety

2.1 Forestry

2.1.1 Board and Particle-based Products²

Effluent Levels

² Environmental, health, and safety guidelines for board and particle-based products. 2007. International Finance Corporation, World Bank Group

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Chemical oxygen demand	mg/L	150
Formaldehyde	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Condensable volatile organic compounds	mg/Nm ³ (as carbon) ^a	130
Formaldehyde	mg/Nm ³	20 (Wood dryers) 5 (Other sources)
Particulate matter PM ₁₀ ^b	mg/Nm ³	20 (Medium density fiberboard) 20 (Wood dryers) 50 (Other sources)

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

2.1.2 Sawmilling and Manufactured Wood Products³

Effluent Levels (for wood treatment and preservation effluent^a)

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Arsenic	mg/L	0.1
Chemical oxygen demand	mg/L	150
Chromium (total)	mg/L	0.5
Chromium (hexavalent)	mg/L	0.1
Copper	mg/L	0.5
Fluorides	mg/L	5
Oil and grease	mg/L	10
Pesticides (each)	mg/L	0.05
pH	S.U. ^b	6-9

³ Environmental, health, and safety guidelines for sawmilling and manufactured wood products. 2007. International Finance Corporation, World Bank Group

Phenols (mono- and dihydric)	mg/L	0.5
Polychlorinated dibenzo-p-dioxins / dibenzo furans	mg/L	0.1
Polycyclic aromatic hydrocarbons (each)	mg/L	0.05
Temperature increase	°C	<3 ^c
Total suspended solids	mg/L	50

^a Process wastewater containing chemical preservatives should be contained as part of closed loop application system

^b S.U. = Standard unit

^c At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels (for sawmill facilities)

Parameter	Unit	Guideline Value
Volatile organic compounds	mg/Nm ^{3a}	20
Wood dust	mg/Nm ³	50

^a Milligrams per normal cubic meter at specified temperature and pressure

2.1.3 Forest Harvesting Operations⁴

The forestry sector does not typically give rise to significant effluent discharges or point source air emissions. Where potentially contaminated water runoff or dust exists, the following source effluent levels and general air emissions guidelines shall apply.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

⁴ Environmental, health, and safety guidelines for forest harvesting operations. 2007. International Finance Corporation, World Bank Group

2.1.4 Pulp and Paper Mills⁵

Effluent Levels

Parameter	Unit	Guideline Value
<i>Bleached kraft pulp, integrated</i>		
5-day Biochemical oxygen demand	kg/ADt ^a	1
Adsorbable organic halogen	kg/ADt	0.25
Chemical oxygen demand	kg/ADt	20
Flow	m ³ /ADt	50
pH	S.U. ^b	6-9
Total nitrogen	kg/ADt	0.2
Total phosphorus	kg/ADt	0.03
Total suspended solids	kg/ADt	1.5
<i>Unbleached kraft pulp, integrated</i>		
5-day Biochemical oxygen demand	kg/ADt	0.7
Chemical oxygen demand	kg/ADt	10
Flow	m ³ /ADt	25
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.2
Total phosphorus	kg/ADt	0.02
Total suspended solids	kg/ADt	1.0
<i>Sulfite pulp, integrated and non-integrated</i>		
5-day Biochemical oxygen demand	kg/ADt	2.0
Adsorbable organic halogen	kg/ADt	0.005
Chemical oxygen demand	kg/ADt	30
Flow	m ³ /ADt	55
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.5
Total phosphorus	kg/ADt	0.05
Total suspended solids	kg/ADt	2.0
<i>Chemi-thermo-mechanical</i>		
5-day Biochemical oxygen demand	kg/ADt	1.0
Chemical oxygen demand	kg/ADt	5
Flow	m ³ /ADt	20
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.2
Total phosphorus	kg/ADt	0.01
Total suspended solids	kg/ADt	1.0
<i>Mechanical pulping, integrated</i>		

⁵ Environmental, health, and safety guidelines for pulp and paper mills. 2007. International Finance Corporation, World Bank Group

5-day Biochemical oxygen demand	kg/ADt	0.5
Adsorbable organic halogen	kg/ADt	0.01
Chemical oxygen demand	kg/ADt	5.0
Flow	m ³ /ADt	20
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.1
Total phosphorus	kg/ADt	0.01
Total suspended solids	kg/ADt	0.5
<i>Recycled fiber, without de-inking, integrated</i>		
5-day Biochemical oxygen demand	kg/ADt	0.15
Adsorbable organic halogen	kg/ADt	0.005
Chemical oxygen demand	kg/ADt	1.5
Flow	m ³ /ADt	10
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.05
Total phosphorus	kg/ADt	0.005
Total suspended solids	kg/ADt	0.15
<i>Recycled fiber, with de-inking, integrated</i>		
5-day Biochemical oxygen demand	kg/ADt	0.2
Adsorbable organic halogen	kg/ADt	0.005
Chemical oxygen demand	kg/ADt	4.0
Flow	m ³ /ADt	15
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.1
Total phosphorus	kg/ADt	0.01
Total suspended solids	kg/ADt	0.3
<i>Recycled fibre tissue mills</i>		
5-day Biochemical oxygen demand	kg/ADt	0.5
Adsorbable organic halogen	kg/ADt	0.005
Chemical oxygen demand	kg/ADt	4.0
Flow	m ³ /ADt	25
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.25
Total phosphorus	kg/ADt	0.015
Total suspended solids	kg/ADt	0.4
<i>Uncoated fine paper mills</i>		
5-day Biochemical oxygen demand	kg/ADt	0.25
Adsorbable organic halogen	kg/ADt	0.005
Chemical oxygen demand	kg/ADt	2.0
Flow	m ³ /ADt	15
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.2

Total phosphorus	kg/ADt	0.01
Total suspended solids	kg/ADt	0.4
<i>Coated fine paper mills</i>		
5-day Biochemical oxygen demand	kg/ADt	0.25
Adsorbable organic halogen	kg/ADt	0.005
Chemical oxygen demand	kg/ADt	1.5
Flow	m ³ /ADt	15
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.2
Total phosphorus	kg/ADt	0.01
Total suspended solids	kg/ADt	0.4
<i>Tissue mills</i>		
5-day Biochemical oxygen demand	kg/ADt	0.4
Adsorbable organic halogen	kg/ADt	0.01
Chemical oxygen demand	kg/ADt	1.5
Flow	m ³ /ADt	25
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.25
Total phosphorus	kg/ADt	0.015
Total suspended solids	kg/ADt	0.4
<i>Fiber preparation, non-wood</i>		
5-day Biochemical oxygen demand	kg/ADt	2.0
Chemical oxygen demand	kg/ADt	30
Flow	m ³ /ADt	50
pH	S.U.	6-9
Total nitrogen	kg/ADt	0.5
Total phosphorus	kg/ADt	0.05
Total suspended solids	kg/ADt	2.0

^a ADt = Air dried metric ton

^b S.U. = Standard unit

Air Emission Levels

Parameter	Type of Mill	Unit	Guideline Value
Nitrogen oxide (as Nitrogen dioxide)	Kraft, bleached	kg/ADt ^a	1.5 for hardwood pulp
			2.0 for softwood pulp
	Kraft, unbleached integrated	kg/ADt	1.5 for hardwood pulp
			2.0 for softwood pulp

	Sulfite, integrated and non-integrated	kg/ADt	2.0
Sulfur dioxide (as Sulfur)	Kraft, bleached	kg/ADt	0.4
	Kraft, unbleached integrated		0.4
	Sulfite, integrated and non-integrated		1.0
Total reduced sulfur compounds (as Sulfur)	Kraft, bleached	kg/ADt	0.2
	Kraft, unbleached integrated		0.2
Total suspended particulates	Kraft, bleached	kg/ADt	0.5
	Kraft, unbleached integrated		0.5
	Sulfite, integrated and non-integrated		0.15

^a ADt = Air dried metric ton

2.2 Agribusiness / Food Production

2.2.1 Mammalian Livestock Production⁶

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

⁶ Environmental, health, and safety guidelines for mammalian livestock production. 2007. International Finance Corporation, World Bank Group

2.2.2 Poultry Production⁷

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.3 Plantation and Annual Crop Production^{8,9,10}

Effluent Levels

Parameter	Unit	Maximum Concentration
Arsenic	mg/L	0.1
Biological oxygen demand	mg/L	30
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	125
Heavy metals (total)	mg/L	10
Lead	mg/L	0.1
Mercury	mg/L	0.01
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400

⁷ Environmental, health, and safety guidelines for poultry production. 2007. International Finance Corporation, World Bank Group

⁸ Environmental, health, and safety guidelines for plantation crop production. 2007. International Finance Corporation, World Bank Group

⁹ Environmental, health, and safety guidelines for annual crop production. 2007. International Finance Corporation, World Bank Group

¹⁰ Agriculture nonpoint source fact sheet: polluted runoff. 2005. United States Environmental Protection Agency

Total nitrogen	mg/L	10
Total organochlorine pesticides	mg/L	0.1
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

2.2.4 Aquaculture¹¹

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.5 Sugar Manufacturing¹²

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Biocides	mg/L	0.05
Chemical oxygen demand	mg/L	250

¹¹ Environmental, health, and safety guidelines for aquaculture. 2007. International Finance Corporation, World Bank Group

¹² Environmental, health, and safety guidelines for sugar manufacturing. 2007. International Finance Corporation, World Bank Group

Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.6 Vegetable Oil Production and Processing¹³

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

Air Emission Levels

Parameter	Unit	Guideline Value
Dust	mg/Nm ^{3a}	10 (dry dust) 40 (wet dust)
Hexane / Volatile organic compounds	mg/Nm ³	100

¹³ Environmental, health, and safety guidelines for vegetable oil production and processing. 2015. International Finance Corporation, World Bank Group

Volatile organic compounds ^b	Kg solvent loss/t feedstock	Animal fat: 1.5
		Castor: 3
		Rape seed: 1
		Sunflower seed: 1
		Soya beans (normal crush): 0.8
		Soya beans (white flakes): 1.2
		Other seeds and other vegetable matter: 1.5 (fractionation excluding degumming) 4 (degumming)

^a Milligrams per normal cubic meter at specified temperature and pressure

^b Refers to total solvent loss

2.2.7 Dairy Processing¹⁴

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.8 Fish Processing¹⁵

Effluent Levels

¹⁴ Environmental, health, and safety guidelines for dairy processing. 2007. International Finance Corporation, World Bank Group

¹⁵ Environmental, health, and safety guidelines for fish processing. 2007. International Finance Corporation, World Bank Group

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Chlorine, total residual	mg/L	0.2
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

Air Emission Levels

Parameter	Unit	Guideline Value
Ammonia	mg/m ³	1
Amines and amides	mg/m ³	5
Hydrogen sulfide, Sulfides, and Mercaptans	mg/m ³	2

2.2.9 Meat Processing¹⁶

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400

¹⁶ Environmental, health, and safety guidelines for meat processing. 2007. International Finance Corporation, World Bank Group

Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.10 Poultry Processing¹⁷

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.11 Breweries and Distilleries¹⁸

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250

¹⁷ Environmental, health, and safety guidelines for poultry processing. 2007. International Finance Corporation, World Bank Group

¹⁸ Environmental, health, and safety guidelines for breweries. 2007. International Finance Corporation, World Bank Group

Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

2.2.12 Food and Beverage Processing¹⁹

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Active ingredients / Antibiotics	To be determined on a case specific basis	
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

Air Emission Levels

Emissions from food processing activities are principally associated with matter and odor. Particulate matter PM₁₀ emissions should typically not exceed 50 mg/Nm³.

2.3 Chemicals

¹⁹ Environmental, health, and safety guidelines for food and beverage processing. 2007. International Finance Corporation, World Bank Group

2.3.1 Pharmaceuticals and Biotechnology Manufacturing²⁰

Actual parameters for effluent levels and air emission levels applicable to individual are to be determined on a case specific basis reflecting project-specific risks and potential impacts.

Effluent Levels

Parameter	Unit	Guideline Value
1,2-Dichloroethane	mg/L	0.1
5-day Biochemical oxygen demand	mg/L	30
Acetates (each) ^a	mg/L	0.5
Acetonitrile	mg/L	10.2
Active ingredient (each)	mg/L	0.05
Adsorbable organic halogen	mg/L	1
Amines (each) ^b	mg/L	102
Ammonia	mg/L	30
Arsenic	mg/L	0.1
Benzene	mg/L	0.02
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	150
Chlorobenzene	mg/L	0.06
Chloroform	mg/L	0.013
Chromium (hexavalent)	mg/L	0.1
Dimethyl sulfoxide	mg/L	37.5
Isobutyraldehyde	mg/L	0.5
Isopropanol	mg/L	1.6
Isopropyl ether	mg/L	2.6
Ketones (each) ^c	mg/L	0.2
Mercury	mg/L	0.01
Methanol / Ethanol (each)	mg/L	4.1
Methyl cellosolve	mg/L	40.6
Methylene chloride	mg/L	0.3
n-Heptane	mg/L	0.02
n-Hexane	mg/L	0.02
o-Dichlorobenzene	mg/L	0.06
Oil and grease	mg/L	10
pH	S.U. ^d	6-9
Phenol	mg/L	0.5
Tetrahydrofuran	mg/L	2.6
Toluene	mg/L	0.02

²⁰ Environmental, health, and safety guidelines for pharmaceuticals and biotechnology manufacturing. 2007. International Finance Corporation, World Bank Group

Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	10
Xylenes	mg/L	0.01

^a n-Amyl acetate, n-Butyl acetate, Ethyl acetate, Isopropyl acetate, Methyl formate

^b Including Diethylamine and Triethylamine

^c Including Acetone, Methyl isobutyl ketone

^d S.U. = Standard unit

Air Emission Levels

Parameter	Unit	Guideline Value
Active ingredient (each)	mg/Nm ^{3a}	0.15
Ammonia	mg/Sm ^{3b}	30
Arsenic	mg/Sm ³	0.05
Benzene, Vinyl chloride, Dichloroethane (each)	mg/Nm ³	1
Bromides (as Hydrogen bromide)	mg/Sm ³	3
Chlorides (as Hydrogen chloride)	mg/Sm ³	30
Ethylene oxide	mg/Sm ³	0.5
Hazardous air pollutants	kg/year	900-1,800 ^c
Mutagenic substance	mg/Sm ³	0.05
Particulate matter PM ₁₀ ^d	mg/Nm ³	20
Total Class A ^e	mg/Nm ³	20 ^f
Total Class B ^g	mg/Nm ³	80 ^h
Total organic carbon	mg/Nm ³	50
Volatile organic compounds	mg/Nm ³	20-150 ⁱ 50 ^j

^a Milligrams per normal cubic meter at specified temperature and pressure

^b Milligrams per standard cubic meter at specified temperature and pressure

^c Process-based annual mass limit

^d PM₁₀ = Particulate matter 10 micrometers or less in diameter

^e Class A compounds are those that may cause significant harm to human health and the environment

^f Applicable when total Class A compounds exceed 100 g/year

^g Class B compounds are organic compounds of less environmental impact than Class A compounds

^h Applicable when total Class B compounds, expressed as Toluene, exceed the lower of 5 tones/year or 2 kg/hour

ⁱ Facilities with solvent consumption >50 tones/year

^j Waste gases from oxidation plants

2.3.2 Coal Processing²¹

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	30
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	150 (40 cooling water)
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Cobalt	mg/L	0.5
Copper	mg/L	0.5
Cyanides	mg/L	0.5
Heavy metals (total)	mg/L	3
Iron	mg/L	3
Lead	mg/L	0.5
Manganese	mg/L	2
Mercury	mg/L	0.02
Nickel	mg/L	1
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenol	mg/L	0.5
Sulphide	mg/L	1
Ammoniacal nitrogen (as Nitrogen)	mg/L	5
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	35
Vanadium	mg/L	1
Zinc	mg/L	1

^a S.U. = Standard unit

Air Emission Levels

Parameter	Unit	Guideline Value
<i>Coal Preparation Plant</i>		
Conveying, storage and preparation gas opacity	%	10
Pneumatic coal cleaning equipment opacity	%	10

²¹ Environmental, health, and safety guidelines for coal processing. 2007. International Finance Corporation, World Bank Group

Pneumatic coal cleaning equipment particulate	mg/Nm ^{3a}	40
Thermal dryer gas opacity	%	20
Thermal dryer particulate	mg/Nm ³	70
<i>Overall</i>		
Ammonia	mg/Nm ³	30
Carbonyl sulfide + Carbon disulfide	mg/Nm ³	3
Heavy metals (total)	mg/Nm ³	1.5
Hydrogen sulfide	mg/Nm ³	10
Mercury	mg/Nm ³	1.0
Nitrogen oxide	mg/Nm ³	200-400 ^b
Particulate matter PM ₁₀ ^c	mg/Nm ³	30-50 ^b
Sulfur dioxide	mg/Nm ³	150-200
Volatile organic compounds	mg/Nm ³	150

^a Milligrams per normal cubic meter at specified temperature and pressure

^b Lower value for plants of >100 MW equivalent, higher value for plants of <100 MWth equivalent

^c PM₁₀ = Particulate matter 10 micrometers or less in diameter

2.3.3 Natural Gas Processing²²

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	150
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanide (free)	mg/L	0.1
Cyanide (total)	mg/L	1
Heavy metals (total)	mg/L	5
Iron	mg/L	3
Lead	mg/L	0.1
Nickel	mg/L	1.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenol	mg/L	0.5
Total Nitrogen	mg/L	40
Total phosphorus	mg/L	3

²² Environmental, health, and safety guidelines for natural gas processing. 2007. International Finance Corporation, World Bank Group

Total residual chlorine	mg/L	0.2
Total suspended solids	mg/L	50
Zinc	mg/L	1

^a S.U. = Standard unit

Air Emission Levels

Parameter	Unit	Guideline Value
Carbon monoxide	mg/Nm ^{3a}	100
Nitrogen oxide	mg/Nm ³	150 ^b 50 ^c
Particulate matter PM ₁₀ ^d	mg/Nm ³	10
Sulfur dioxide	mg/Nm ³	75
Volatile organic compounds	mg/Nm ³	150

^a Milligrams per normal cubic meter at specified temperature and pressure

^b Applicable to facilities with a total heat input capacity of up to 300 MW

^c Applicable to facilities with a total heat input capacity greater than 300 MW

^d PM₁₀ = Particulate matter 10 micrometers or less in diameter

2.3.4 Oleochemicals Manufacturing²³

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	40
Chemical oxygen demand	mg/L	150
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total nitrogen	mg/L	30
Total phosphorus	mg/L	5
Total suspended solids	mg/L	50

^a S.U. = Standard unit

Air Emission Levels

Parameter	Unit	Guideline Value
Volatile organic compounds	mg/Nm ^{3a}	100

^a Milligrams per normal cubic meter at specified temperature and pressure

²³ Environmental, health, and safety guidelines for oleochemicals manufacturing. 2007. International Finance Corporation, World Bank Group

2.3.5 Nitrogenous Fertilizer Production²⁴

Effluent Levels

Parameter	Unit	Guideline Value
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
<i>Ammonia and Nitric Acid Plants</i>		
Ammonia	mg/L	5
Total nitrogen	mg/L	15
Total suspended solids	mg/L	30
<i>Urea Plants</i>		
Ammonia (prill / granulation)	mg/L	5
Urea (prill / granulation)	mg urea/L	1
<i>Ammonium Nitrate / Calcium Ammonium Nitrate Plants</i>		
Ammonium nitrate	mg/L	100
Ammonia	mg/L	5
Total nitrogen	mg/L	15
Total suspended solids	mg/L	30

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
<i>Ammonia Plants</i>		
Ammonia	mg/Nm ^{3a}	50
Total nitrogen	mg/Nm ³	300
Total suspended solids	mg/Nm ³	50
<i>Nitric Acid Plants</i>		
Ammonia	mg/Nm ³	10
Nitrogen oxide	mg/Nm ³	200
Nitrous oxide	mg/Nm ³	800
Particulate matter PM ₁₀ ^b	mg/Nm ³	50
<i>Urea / Urea Ammonium Nitrate Plants</i>		
Ammonia (prill / granulation)	mg/Nm ³	50
Particulate matter PM ₁₀	mg/Nm ³	50

²⁴ Environmental, health, and safety guidelines for nitrogenous fertilizer manufacturing. 2007. International Finance Corporation, World Bank Group

Urea (prill / granulation)	mg/Nm ³	50
<i>Ammonium Nitrate / Calcium Ammonium Nitrate Plants</i>		
Ammonia	mg/Nm ³	50
Particulate matter PM ₁₀	mg/Nm ³	50

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

2.3.6 Phosphate Fertilizer Manufacturing²⁵

Effluent Levels

Parameter	Unit	Guideline Value
Ammonia	mg/L	10
Cadmium	mg/L	0.1
Fluorides	mg/L	20
	kg/ton NPK ^a	0.03
	kg/ton Phosphorus oxide	2
Heavy metals (total)	mg/L	10
pH	S.U. ^b	6-9
Total nitrogen	mg/L	15
Total phosphorus	mg/L	5
Total suspended solids	mg/L	50

^a NPK = Nitrogen, phosphorus, potassium

^b S.U. = Standard unit

Air Emission Levels

Parameter	Unit	Guideline Value
<i>Phosphoric Acid Plants</i>		
Fluorides (gaseous as Hydrogen fluoride)	mg/Nm ^{3a}	5
Particulate matter PM ₁₀ ^b	mg/Nm ³	50
<i>Phosphate Fertilizer Plants</i>		
Ammonia	mg/Nm ³	50
Fluorides (gaseous as Hydrogen fluoride)	mg/Nm ³	5
Hydrogen chloride	mg/Nm ³	30
Nitrogen oxide	mg/Nm ³	500 (nitro-phosphate unit) 70 (mix acid unit)
Particulate matter PM ₁₀	mg/Nm ³	50

²⁵ Environmental, health, and safety guidelines for phosphate fertilizer manufacturing. 2007. International Finance Corporation, World Bank Group

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

2.3.7 Pesticides Formulation, Manufacturing and Packaging²⁶

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	30
Active ingredients (each)	mg/L	0.05
Adsorbable organic halogens	mg/L	1
Ammonia	mg/L	10
Arsenic	mg/L	0.1
Chemical oxygen demand	mg/L	150
Chlorinated organics	mg/L	0.05
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Mercury	mg/L	0.01
Nitrorganics	mg/L	0.05
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenol	mg/L	0.5
Total phosphorus	mg/L	2
Total suspended solids	mg/L	10-20 ^b
Zinc	mg/L	2

^a S.U. = Standard unit

^b Lower value for pesticide manufacturing, higher value for pesticide formulation

Air Emission Levels

Parameter	Unit	Guideline Value
Ammonia, gaseous inorganic chlorine compounds	mg/Nm ^{3a}	30
Bromines, Cyanides, Fluorines, Hydrogen sulfide	mg/Nm ³	3
Chloride	mg/Nm ³	5
Chlorine	mg/Nm ³	3
Particulate matter PM ₁₀ ^b	mg/Nm ³	20, 5 ^c

²⁶ Environmental, health, and safety guidelines for pesticides formulation, manufacturing and packaging. 2007. International Finance Corporation, World Bank Group

Total organic carbon	mg/Nm ³	50
Volatile organic compounds	mg/Nm ³	20

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

^c Applicable where very toxic compounds are present

2.3.8 Petroleum-based Polymers Manufacturing²⁷

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	25
Adsorbable organic halogens	mg/L	0.3
Benzene	mg/L	0.05
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	150
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Lead	mg/L	0.5
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenol	mg/L	0.5
Sulphide	mg/L	1
Temperature increase	°C	<3 ^b
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	30
Vinyl chloride	mg/L	0.05
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
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²⁷ Environmental, health, and safety guidelines for petroleum-based polymers manufacturing. 2007. International Finance Corporation, World Bank Group.

Acrylonitrile	mg/Nm ^{3a}	5 (15 from dryers)
Ammonia	mg/Nm ³	15
Dioxin / Furans	ng TEQ ^b /Nm ³	0.1
Formaldehyde	mg/m ³	0.15
Heavy metals (total)	mg/Nm ³	1.5
Hydrogen chloride	mg/Nm ³	10
Mercury	mg/Nm ³	0.2
Nitrogen oxides	mg/Nm ³	300
Particulate matter PM ₁₀ ^c	mg/Nm ³	20
Sulfur oxides	mg/Nm ³	500
Vinyl chloride	g/t s-PVC ^d	80
	g/t e-PVC ^e	500
Volatile organic compounds	mg/Nm ³	20

^a Milligrams per normal cubic meter at specified temperature and pressure

^b TEQ = Toxicity equivalence factor

^c PM₁₀ = Particulate matter 10 micrometers or less in diameter

^d Grams per ton suspension polyvinylchloride

^e Grams per tone emulsion polyvinylchloride

2.3.9 Petroleum Refining (integrated facilities)²⁸

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	30
Benzene	mg/L	0.05
Benzo(a)pyrene	mg/L	0.05
Chemical oxygen demand	mg/L	150
Chromium (hexavalent)	mg/L	0.05
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanide (free)	mg/L	0.1
Cyanide (total)	mg/L	1
Iron	mg/L	3
Lead	mg/L	0.1
Mercury	mg/L	0.02
Nickel	mg/L	0.5
Oil and grease	mg/L	10

²⁸ Environmental, health, and safety guidelines for petroleum refining. 2007. International Finance Corporation, World Bank Group

pH	S.U. ^a	6-9
Phenol	mg/L	0.2
Sulphides	mg/L	1
Temperature increase	°C	<3 ^b
Total nitrogen	mg/L	10 ^c
Total phosphorus	mg/L	2
Total suspended solids	mg/L	30
Vanadium	mg/L	1

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c The effluent concentration of total nitrogen may be up to 40 mg/L in processes that include hydrogenation

Air Emission Levels

Parameter	Unit	Guideline Value
Hydrogen sulfide	mg/Nm ^{3a}	10
Nickel	mg/Nm ³	1
Nitrogen oxide	mg/Nm ³	450
Particulate matter PM ₁₀ ^b	mg/Nm ³	50
Sulfur oxide	mg/Nm ³	150 (for sulfur recovery units) 500 (for other units)
Vanadium	mg/Nm ³	5

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = particulate matter 10 micrometers or less in diameter

2.3.10 Large Volume Petroleum-based Organic Chemicals Manufacturing²⁹

Effluent Levels

Parameter	Unit	Guideline Value
1,2-Dichloroethane	mg/L	1
5-day Biochemical oxygen demand	mg/L	25
Adsorbable organic halogens	mg/L	1
Benzene	mg/L	0.05
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	150

²⁹ Environmental, health, and safety guidelines for large volume petroleum-based organic chemicals manufacturing. 2007. International Finance Corporation, World Bank Group

Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Lead	mg/L	0.5
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenol	mg/L	0.5
Sulphide	mg/L	1
Temperature increase	°C	<3 ^b
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	30
Vinyl chloride	mg/L	0.05
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
1,2-Dichloroethane	mg/Nm ^{3a}	5
Acrylonitrile	mg/Nm ³	0.5 (incineration) 2 (scrubbing)
Ammonia	mg/Nm ³	15
Benzene	mg/Nm ³	5
Caprolactam	mg/m ³	0.1
Dioxin / Furans	ng TEQ ^b /Nm ³	0.1
Ethylene	mg/Nm ³	150
Ethylene oxide	mg/m ³	2
Formaldehyde	mg/m ³	0.15
Heavy metals (total)	mg/Nm ³	1.5
Hydrogen chloride	mg/Nm ³	10
Hydrogen cyanide	mg/m ³	2
Hydrogen sulfide	mg/m ³	5
Mercury and compounds	mg/Nm ³	0.2
Nitrobenzene	mg/m ³	5
Nitrogen oxides	mg/Nm ³	300
Organic sulfide and Mercaptans	mg/m ³	2
Particulate matter PM ₁₀ ^c	mg/Nm ³	20

Phenols, Cresols and Xylols (as Phenol)	mg/Nm ³	10
Sulfur oxides	mg/m ³	100
Vinyl chloride	mg/Nm ³	5
Volatile organic compounds	mg/Nm ³	20

^a Milligrams per normal cubic meter at specified temperature and pressure

^b TEQ = Toxicity equivalence factor

^c PM₁₀ = Particulate matter 10 micrometers or less in diameter

2.3.11 Large Volume Inorganic Compounds Manufacturing and Coal Tar Distillation³⁰

Effluent Levels

Parameter	Unit	Guideline Value
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
<i>Ammonia Plants</i>		
Ammonia	mg/L	10 ^c
Total suspended solids	mg/L	30
<i>Nitric Acid Plants</i>		
Ammonia	mg/L	10
Nitrates	mg/L	25
Total suspended solids	mg/L	30
<i>Sulfuric Acid Plants</i>		
Fluoride	mg/L	20
Total phosphorus	mg/L	5
Total suspended solids	mg/L	30
<i>Phosphoric Acid Plants</i>		
Fluoride	mg/L	20
Total phosphorus	mg/L	5
Total suspended solids	mg/L	30
<i>Hydrofluoric Acid Plants</i>		
Fluorides	kg/ton HF ^d	1
Suspended solids	kg/ton HF	1
	mg/L	30
<i>Chlor-alkali / Hydrochloric Acid Plants</i>		
Adsorbable organic halogens	mg/L	0.5
Chemical oxygen demand	mg/L	150
Chlorine	mg/L	0.2

³⁰ Environmental, health, and safety guidelines for large volume inorganic compounds manufacturing and coal tar distillation. 2007. International Finance Corporation, World Bank Group

Mercury	mg/L	0.05
	g/ton chlorine	0.1
Sulphides	mg/L	1
Total suspended solids	mg/L	20
<i>Soda Ash Plants</i>		
Ammonia (as Nitrogen)	mg/L	10
Phosphorus	kg/ton	0.2
Suspended solids	kg/ton	270
Total suspended solids	mg/L	30
<i>Carbon Black Plants</i>		
Chemical oxygen demand	mg/L	100
Total suspended solids	mg/L	20
<i>Coal Tar Distillation Plants</i>		
5-day Biochemical oxygen demand	mg/L	35 (monthly average) 90 (daily maximum)
Anthracene, Naphthalene and Phenanthrene (each)	µg/L	20 (monthly average) 60 (daily maximum)
Total suspended solids	mg/L	50 (monthly average) 160 (daily maximum)

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c Load based guideline: 0.1 kg/ton of product

^d HF = Hydrofluoric acid

Air Emission Levels

Parameter	Unit	Guideline Value
<i>Ammonia Plants</i>		
Ammonia	mg/Nm ^{3a}	50
Nitrogen oxide	mg/Nm ³	300
Particulate matter PM ₁₀ ^b	mg/Nm ³	50
<i>Nitric Acid Plants</i>		
Ammonia	mg/Nm ³	10
Nitrogen oxide	mg/Nm ³	300
Nitrous oxide	mg/Nm ³	800
<i>Sulfuric Acid Plants</i>		
Hydrogen sulfide	mg/Nm ³	5
Nitrogen oxide	mg/Nm ³	200
Sulfur dioxide	mg/Nm ³	450 (2 kg/ton acid)
Sulfur trioxide	mg/Nm ³	60 (0.075 kg/ton acid)

<i>Phosphoric / Hydrofluoric Acids Plants</i>		
Fluorides (gaseous as Hydrogen fluoride)	mg/Nm ³	5
Particulate matter PM ₁₀ / Calcium fluoride	mg/Nm ³	50 (0.10 kg/ton phosphate rock)
<i>Chlor-alkali / Hydrochloric Acid Plants</i>		
Chlorine gas	mg/Nm ³	1 (partial liquefaction) 3 (complete liquefaction)
Hydrogen chloride	ppmv ^c	20
Mercury	mg/Nm ³	0.2 (annual average emission of 1 g/ton chlorine)
<i>Soda Ash Plants</i>		
Ammonia	mg/Nm ³	50
Hydrogen sulfide	mg/Nm ³	5
Nitrogen oxide	mg/Nm ³	200
Particulate matter PM ₁₀	mg/Nm ³	50
<i>Carbon Black Plants</i>		
Carbon monoxide	mg/Nm ³	500
Nitrogen oxide	mg/Nm ³	600
Particulate matter PM ₁₀	mg/Nm ³	30
Sulfur dioxide	mg/Nm ³	850
Volatile organic compounds	mg/Nm ³	50
<i>Coal Tar Distillation Plants</i>		
Particulate matter PM ₁₀	mg/Nm ³	50
Tar fume	mg/Nm ³	10
Volatile organic compounds	mg/Nm ³	50

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

^c ppmv = Parts per million by volume

2.4 Oil and Gas

2.4.1 Offshore Oil and Gas Development³¹

This guideline applies to seismic exploration, exploratory and production drilling, development and production activities, offshore pipeline operations, offshore transportation, tanker loading and unloading, ancillary and support operations, and decommissioning.

Effluent Levels

³¹ Environmental, health, and safety guidelines for offshore oil and gas development. 2007. International Finance Corporation, World Bank Group

This guideline is primarily applicable to discharges in offshore locations (i.e. greater than 12 nautical miles from shore). Discharge water quality to near-shore waters should be established on a case specific basis taking into account the environmental sensitivities and assimilative capacity of receiving waters.

Parameter	Guideline
Drilling fluids and cuttings (Non-aqueous drilling fluid)	<p>Non-aqueous drilling fluid – re-inject or ship-to-shore, no discharge to sea</p> <p>Drilled cuttings – re-inject or ship-to-shore, no discharge except:</p> <ul style="list-style-type: none"> - Oil concentration lower than 1% by weight on dry cuttings - Mercury – maximum 1 mg/kg dry weight in stock barite - Cadmium – maximum 3 mg/kg dry weight in stock barite - Discharge via a caisson at least 15 meters below sea surface
Drilling fluids and cuttings (Water-based drilling fluid)	<ul style="list-style-type: none"> - Water-based drilling fluid – re-inject or ship-to-shore, no discharge to sea <p>Water-based drilling fluids and cuttings – re-inject or ship-to-shore, no discharge to sea except:</p> <ul style="list-style-type: none"> - Mercury – 1 mg/kg dry weight in stock barite - Cadmium – 3 mg/kg dry weight in stock barite - Maximum chloride concentration must be less than four times ambient concentration of fresh or brackish receiving water - Discharge via a caisson at least 15 meters below sea surface
Produced water	<p>Re-inject – Discharge to sea maximum one day oil and grease discharge should not exceed 42 mg/L; 30 day average should not exceed 29 mg/L</p>
Completion and well work-over fluids	<p>Ship-to-shore or re-inject – No discharge to sea except:</p> <ul style="list-style-type: none"> - Maximum one day oil and grease discharge should not exceed 42 mg/L; 30 day average should not exceed 29 mg/L - Neutralize to attain a pH of 5^a or more
Produced sand	<p>Ship-to-shore or re-inject – No discharge to sea except when oil concentration lower than 1% by weight on dry sand</p>
Hydrotest water	<ul style="list-style-type: none"> - Send to shore for treatment and disposal - Discharge offshore following environmental risk analysis, careful selection of chemicals - Reduce use of chemicals
Cooling water	<p>The effluent should result in a temperature increase</p>

	of no more than 3°C at edge of the zone where initial mixing and dilution take place; where the zone is not defined, use 100 meters from point of discharge
Desalination brine	Mix with other discharge waste streams if feasible ^b
Sewage	Compliance with MARPOL 73/78 ^b
Food waste	Compliance with MARPOL 73/78 ^b
Storage displacement water	Compliance with MARPOL 73/78 ^b
Bilgewater	Compliance with MARPOL 73/78 ^b
Deck drainage (non-hazardous and hazardous drains)	Compliance with MARPOL 73/78 ^b

^a S.U. = Standard unit

^b In nearshore waters, carefully select discharge location based on environmental sensitivities and assimilative capacity of receiving waters

2.4.2 Onshore Oil and Gas Development³²

This guideline applies to seismic exploration, exploratory and production drilling, development and production activities, transport activities including pipelines, other facilities (i.e. pump stations, metering stations, pigging stations, compressor stations, storage facilities), ancillary and support operations, and decommissioning.

Emissions, Effluent and Waste Levels

Parameter	Guideline
Drilling fluids and cuttings	Treatment and disposal in accordance with applicable standards provided in the IFC Onshore Oil and Gas Development EHS guideline
Produced sand	Treatment and disposal in accordance with applicable standards provided in the IFC Onshore Oil and Gas Development EHS guideline
Produced water	Treatment and disposal in accordance with applicable standards provided in the IFC Onshore Oil and Gas Development EHS guideline For discharge to surface waters or to land: <ul style="list-style-type: none"> - 5-day Biochemical oxygen demand 25 mg/L - Chemical oxygen demand 125 mg/L - Chlorides 600 mg/L (average), 1,200 mg/L maximum - Heavy metals (total)^a 5 mg/L - pH 6-9^b - Phenols 0.5 mg/L

³² Environmental, health, and safety guidelines for onshore oil and gas development. 2007. International Finance Corporation, World Bank Group

	<ul style="list-style-type: none"> - Sulfides 1 mg/L - Total hydrocarbon content 10 mg/L - Total suspended solids 35 mg/L
Hydrotest water	<p>Treatment and disposal in accordance with applicable standards provided in the IFC Onshore Oil and Gas Development EHS guideline</p> <p>For discharge to surface waters or to land:</p> <ul style="list-style-type: none"> - 5-day Biochemical oxygen demand 25 mg/L - Chemical oxygen demand 125 mg/L - Chlorides 600 mg/L (average), 1,200 mg/L maximum - Heavy metals (total) 5 mg/L - pH 6-9 - Phenols 0.5 mg/L - Sulfides 1 mg/L - Total hydrocarbon content 10 mg/L - Total suspended solids 35 mg/L
Completion and well work-over fluids	<p>Treatment and disposal in accordance with applicable standards provided in the IFC Onshore Oil and Gas Development EHS guideline</p> <p>For discharge to surface waters or to land:</p> <ul style="list-style-type: none"> - pH 6-9 - Total hydrocarbon content 10 mg/L
Storm water drainage	<p>Storm water runoff should be treated through an oil / water separation system able to achieve oil and grease concentration of 10 mg/L</p>
Cooling water	<p>The effluent should result in a temperature increase of no more than 3°C at edge of the zone where initial mixing and dilution take place; where the zone is not defined, use 100 meters from point of discharge</p>
Sewage	<p>Holding and discharge to municipal or centralized wastewater treatment systems or onboard treatment to achieve:</p> <ul style="list-style-type: none"> - 5-day Biochemical oxygen demand 30 mg/L - Chemical oxygen demand 125 mg/L - Oil and grease 10 mg/L - pH 6-9 - Total coliform bacteria 400 MPN^c/100 ml - Total nitrogen 10 mg/L - Total phosphorus 2 mg/L - Total suspended solids 50 mg/L
Air emissions	<p>Achieve WHO ambient air quality guidelines summarized in 1.1, and apply the following limit value to emissions:</p> <ul style="list-style-type: none"> - Hydrogen sulfide 5 mg/Nm³

^a Heavy metals include: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, Vanadium and Zinc

^b S.U. = Standard unit

^c MPN = Most probable number

2.4.3 Liquefied Natural Gas Facilities³³

This guideline applies to liquefied natural gas (LNG) base load liquefaction plants, transport by sea, and regasification and peak shaving terminals. For coastal LNG facilities including harbors, jetties, and terminals additional guidance is given in the guideline for Ports, Harbors and Terminals.

Effluent Levels

Parameter	Guideline
Hydrotest water	For discharge to surface waters or to land: <ul style="list-style-type: none"> - Total hydrocarbon content 10 mg/L - pH 6-9^a - 5-day Biochemical oxygen demand 25 mg/L - Chemical oxygen demand 125 mg/L - Total suspended solids 35 mg/L - Phenols 0.5 mg/L - Sulfides 1 mg/L - Heavy metals (total) 5 mg/L - Chlorides 600 mg/L (average), 1,200 mg/L maximum
Hazardous storm water drainage	Storm water runoff should be treated through an oil / water separation system able to achieve oil and grease concentration of 10 mg/L
Cooling water	The effluent should result in a temperature increase of no more than 3°C at edge of the zone where initial mixing and dilution take place; where the zone is not defined, use 100 meters from point of discharge. Free chlorine (total residual oxidant in estuarine / marine water) concentration in cooling / cold water discharges (to be sampled at point of discharge) should be maintained at 0.2 parts per million
Sewage	Holding and discharge to municipal or centralized wastewater treatment systems or onboard treatment to achieve: <ul style="list-style-type: none"> - 5-day Biochemical oxygen demand 30 mg/L - Chemical oxygen demand 125 mg/L

³³ Environmental, health, and safety guidelines for liquefied natural gas facilities. 2007. International Finance Corporation, World Bank Group

	<ul style="list-style-type: none"> - Oil and grease 10 mg/L - pH 6-9 - Total coliform bacteria 400 MPN^b/100 ml - Total nitrogen 10 mg/L - Total phosphorus 2 mg/L - Total suspended solids 50 mg/L
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^a S.U. = Standard unit

^b MPN = Most probable number

2.5 Infrastructure

2.5.1 Tourism and Hospitality Development³⁴

This guideline applies to tourism and hospitality facilities, including hotels, resorts and other accommodation and catering facilities. Wastewater discharges should be managed through conventional treatment to achieve the indicated limit values for discharge of sanitary water.

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Chemical oxygen demand	mg/L	250
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^c MPN = Most probable number

2.5.2 Railways³⁵

Process effluents from railway maintenance facilities involving metals machining, cleaning, and plating and finishing processes, including painting, should comply with the following levels applicable to treated effluent.

Effluent Levels

³⁴ Environmental, health, and safety guidelines for tourism and hospitality development. 2007. International Finance Corporation, World Bank Group

³⁵ Environmental, health, and safety guidelines for railways. 2007. International Finance Corporation, World Bank Group

Parameter	Unit	Guideline Value
Aluminum	mg/L	3
Ammonia	mg/L	10
		20 (electroplating)
Arsenic	mg/L	0.1
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	250
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanides (free)	mg/L	0.2
Cyanides (total)	mg/L	1
Fluorides	mg/L	20
Iron	mg/L	3
Lead	mg/L	0.2
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenols	mg/L	0.5
Silver	mg/L	0.2
Sulfide	mg/L	1
Temperature increase	°C	<3 ^b
Tin	mg/L	2
Total nitrogen	mg/L	15
Total phosphorus	mg/L	5
Total suspended solids	mg/L	50
		25 (electroplating)
Volatile organic halogens	mg/L	0.1
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

2.5.3 Ports, Harbors and Terminals³⁶

This guideline applies to commercial ports, harbors and terminals for cargo and passenger transfer. Given the nature of port operations where there are few stationary effluents (e.g. wastewater and storm water). Discrete point source sanitary wastewater and storm water

³⁶ Environmental, health, and safety guidelines for ports, harbors and terminals. 2007. International Finance Corporation, World Bank Group

should achieve the following source effluent levels and general air emissions guidelines shall apply.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

2.5.4 Airports³⁷

This guideline applies to the operation of commercial airports. Activities associated with aircraft operators including aircraft maintenance are covered by the Airlines guideline. Airport operations should establish site-specific discharge levels based on the requirements of publicly-operated sewage collection and treatment systems or, if discharged directly to surface waters, discrete point source sanitary wastewater and storm water should achieve the following source effluent levels and general air emissions guidelines shall apply.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

³⁷ Environmental, health, and safety guidelines for airports. 2007. International Finance Corporation, World Bank Group

2.5.5 Airlines³⁸

This guideline applies to aircraft maintenance, including engine services, accessory parts overhaul, aircraft washing, aircraft repainting, and testing.

Effluent Levels

Emission and effluents from heavy maintenance facilities should be treated to a level consistent with the following limit values.

Parameter	Unit	Guideline Value
Aluminum	mg/L	3
Ammonia	mg/L	10
		20 (electroplating)
Arsenic	mg/L	0.1
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	250
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanides (free)	mg/L	0.2
Cyanides (total)	mg/L	1
Fluorides	mg/L	20
Iron	mg/L	3
Lead	mg/L	0.2
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenols	mg/L	0.5
Silver	mg/L	0.2
Sulfide	mg/L	1
Temperature increase	°C	<3 ^b
Tin	mg/L	2
Total nitrogen	mg/L	15
Total phosphorus	mg/L	5
Total suspended solids	mg/L	50
		25 (electroplating)
Volatile organic halogens	mg/L	0.1
Zinc	mg/L	2

³⁸ Environmental, health, and safety guidelines for airlines. 2007. International Finance Corporation, World Bank Group

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Ammonia	mg/Nm ^{3a}	50
Hydrogen chloride	mg/Nm ³	10
Nitrogen oxides	mg/Nm ³	350
Particulate matter PM ₁₀ ^b (metal surface treatments)	mg/Nm ³	5
Particulate matter PM ₁₀ (plastic processing)	mg/Nm ³	3
Total organic carbon (rubber vulcanization)	mg/Nm ³	80
Volatile halogenated hydrocarbons (metal surface treatments)	mg/Nm ³	20
Volatile organic compounds (metal and plastic coating)	mg/Nm ³	100 (up to 15 ton/year solvent consumption)
		75 (more than 15 ton/year solvent consumption)
		50 (drying processes)
Volatile organic compounds (rubber conversion)	mg/Nm ³	20 ^c
Volatile organic compounds (surface cleaning)	mg/Nm ³	20-75 ^d

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

^c Facilities with solvent consumption greater than 15 ton/year

^d 20 mg/Nm³ for waste gases from surface cleaning using VOC classified as carcinogenic, mutagenic or toxic to reproduction; 75 mg/Nm³ for waste gases from other surface cleaning

2.5.8 Toll Roads³⁹

This guideline applies to construction, operation and maintenance of large, sealed road projects including associated bridges and overpasses. While roads do not typically give rise to significant point source effluents or air emissions, discrete point source sanitary wastewater and storm water should achieve the following source effluent levels and general air emissions guidelines shall apply.

³⁹ Environmental, health, and safety guidelines for toll roads. 2007. International Finance Corporation, World Bank Group

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

2.5.9 Telecommunications⁴⁰

This guideline applies to telecommunications infrastructure such as fixed line and wireless voice and data transmission infrastructure, including long distance terrestrial and submarine cables, as well as radio and television broadcasting, and associated telecommunications and broadcasting installations and equipment. While telecommunications activities do not typically give rise to significant point source effluents or air emissions, the following source effluent levels and general air emissions shall apply to site operations, especially with regard to effluents or emissions during construction operations or from administrative and maintenance facilities.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

Additionally site operations should comply with guidance on exposure limits for general public exposure to electric and magnetic fields as set out by the International Commission on Non-ionizing Radiation Protection as summarized below.

⁴⁰ Environmental, health, and safety guidelines for telecommunications. 2007. International Finance Corporation, World Bank Group

Frequency	Electric Field (V/m ^a)	Magnetic Field (μT ^b)
3 – 150 kHz ^c	87	6.25
10 – 400 MHz ^d	28	0.092
2 – 300 GHz ^e	61	0.20

^a Volts per meter, ^b Micro tesla, ^c Kilohertz, ^d Megahertz, ^e Gigahertz

2.5.10 Crude Oil and Petroleum Product Terminals⁴¹

This guideline is applicable to land and shore-based petroleum storage terminals receiving and dispatching bulk shipments of crude oil, gasoline, middle distillates, aviation gas, lube oil, residual fuel oil, compressed natural gas, liquid petroleum gas, and specialty products from pipelines, tankers, railcars, and trucks for subsequent commercial distribution. Process effluent discharge quality limit values from should be established on a site-specific basis, taking into account effluent characteristics and receiving water use. Storm water runoff from terminals should be treated as required to achieve the following effluent levels. General air emissions guidelines shall apply and volatile organic compound emissions from all sources should be controlled such that ambient air quality levels do not exceed health-based standards.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

2.5.11 Retail Petroleum Networks⁴²

This guideline is applicable to retail petroleum networks primarily dedicated to the sale of petroleum-based automotive fuels, including liquid petroleum gas and compressed natural gas, and which may provide limited vehicle repair and washing services. Wastewater, including storm water, automobile washing and other effluents, from retail petroleum facilities should be

⁴¹ Environmental, health, and safety guidelines for crude oil and petroleum product terminals. 2007. International Finance Corporation, World Bank Group

⁴² Environmental, health, and safety guidelines for retail petroleum networks. 2007. International Finance Corporation, World Bank Group

treated as required to achieve the following effluent levels. General air emissions guidelines shall apply and volatile organic compound emissions from all sources should be controlled such that ambient air quality levels do not exceed health-based standards.

2.5.12 Health Care Facilities⁴³

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Cadmium	mg/L	0.05
Chemical oxygen demand	mg/L	250
Chlorine (total residual)	mg/L	0.2
Chromium (total)	mg/L	0.5
Lead	mg/L	0.1
Mercury	mg/L	0.01
Oil and grease	mg/L	15
pH	S.U. ^a	6-9
Phenols	mg/L	0.5
Polychlorinated dibenzodioxin and dibenzofuran	Ng/L	0.1
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total suspended solids	mg/L	50

^a S.U. = Standard Unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most Probable Number

Air Emission Levels (for hospital waste incineration facilities)

Parameter	Unit	Guideline Value
Antimony, Arsenic, Lead, Chromium, Cobalt, Copper, Manganese, Nickel, Vanadium	mg/Nm ^{3a}	0.5
Cadmium + Thallium	mg/Nm ³	0.05
Carbon monoxide	mg/Nm ³	50
Hydrogen chloride	mg/Nm ³	10
Hydrogen fluoride	mg/Nm ³	1
Mercury	mg/Nm ³	0.05

⁴³ Environmental, health, and safety guidelines for health care facilities. 2007. International Finance Corporation, World Bank Group

Nitrogen oxide	mg/Nm ³	200-400 ^b
Polychlorinated dibenzodioxin and dibenzofuran	ng/Nm ³ TEQ ^c	0.1
Sulfur dioxide	mg/Nm ³	50
Total organic carbon	mg/Nm ³	10
Total particulate matter	mg/Nm ³	10

^a Milligrams per normal cubic meter at specified temperature and pressure

^b 200 mg/m³ for new plants or for existing plants with a nominal capacity exceeding 6 tons per hour, 400 mg/m³ for existing incinerators with a nominal capacity of 6 tons per hour or less

^c TEQ = Toxicity equivalence factor

2.5.13 Solid Waste Management Facilities⁴⁴

The following limit values are applicable to facilities or projects dedicated to the management of municipal solid waste and industrial waste including waste receipt, unloading, processing, and storage; landfill disposal; physico-chemical and biological treatment; and incineration projects. Industry-specific waste management activities (e.g. medical waste) are covered in the relevant industry-specific guidelines.

Effluent Levels (for landfills)

Parameter	Unit	Guideline Value			
		Hazardous Waste Landfills		Municipal Solid Waste Landfills	
		Daily Max.	Monthly Average	Daily Max	Monthly Average
5-day Biochemical oxygen demand	mg/L	220	56	140	37
Ammonia (as Nitrogen)	mg/L	10	4.9	10	4.9
Analine	mg/L	0.024	0.015	-	-
Arsenic	mg/L	1.1	0.54	-	-
a-Terpineol	mg/L	0.042	0.019	0.033	0.016
Benzoic acid	mg/L	0.119	0.073	0.12	0.071
Chromium (total)	mg/L	1.1	0.46	-	-
Naphthalene	mg/L	0.059	0.022	-	-
p-Cresol	mg/L	0.024	0.015	0.025	0,014
pH	S.U. ^a	6-9	6-9	6-9	6-9
Phenol	mg/L	0.048	0.029	0.026	0,015
Pyridine	mg/L	0.072	0.025	-	-
Total suspended solids	mg/L	88	27	88	27

⁴⁴ Environmental, health, and safety guidelines for waste management facilities. 2007. International Finance Corporation, World Bank Group.

Zinc	mg/L	0.535	0.296	0.2	0.11
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^a S.U. = Standard unit

Air Emission Levels (from incinerators)

Parameter	Unit	Guideline Value ^a
Cadmium	mg/m ³	0.05-0.1 (0.5–8 hour average)
Carbon monoxide	mg/m ³	50-150
Hydrochloric acid	mg/m ³	10
Hydrogen fluoride	mg/m ³	1
Mercury	mg/m ³	0.05-0.1 (0.5–8 hour average)
Nitrogen oxide	mg/m ³	200-400 (24 hour average)
Polychlorinated dibenzodioxin and dibenzofuran	ng TEQ ^b /m ³	0.1
Sulfur dioxide	mg/m ³	50 (24 hour average)
Total metals	mg/m ³	0.5-1 (0.5–8 hour average)
Total suspended particulates	mg/m ³	10 (24 hour average)

^a Applicable to both municipal solid waste and hazardous waste incinerators

^b TEQ = Toxicity equivalence factor

Incinerator bottom ash and other solid residue from industrial or medical hazardous wastes should be treated and disposed as hazardous waste unless it can be demonstrated to be not hazardous.

2.5.14 Centralized Wastewater Treatment Facilities⁴⁵

The following limit values are applicable to treated domestic sewage and contaminated storm water before being discharged to surface waters

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Ammonia	mg/L	10
Arsenic	mg/L	0.1
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	250
Chlorine (total residual)	mg/L	0.2

⁴⁵ Pollution prevention and abatement handbook. 1998. Toward cleaner production. World Bank Group in collaboration with United Nations Environment Programme and the United Nations Industrial Development Organization

Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanide (free)	mg/L	0.1
Cyanide (total)	mg/L	1
Fluoride	mg/L	20
Heavy metals (total)	mg/L	10
Iron	mg/L	3.5
Lead	mg/L	0.1
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenols	mg/L	0.5
Selenium	mg/L	0.1
Silver	mg/L	0.5
Sulphide	mg/L	1
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^b /100 ml	400 ^c
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

Biosolids and Sludge Disposal⁴⁶

Sludge from wastewater treatment facilities can be dewatered and disposed of to a landfill or through incineration. Where sludge has been demonstrated to have sufficiently low levels of toxic and microbial constituents, solids can be applied to land as a soil amendment material or used in agriculture as a fertilizer. The following limit values should apply.

Parameter	Unit ^a	Guideline Value
Arsenic	mg/kg	75
Cadmium	mg/kg	85
Chromium (total)	mg/kg	3000
Copper	mg/kg	4300
Lead	mg/kg	840

⁴⁶ USEPA Standards for the use and disposal of sewage sludge. 2006. United States Environmental Protection Agency Title 40 Code of Federal Regulations Part 503

Mercury	mg/kg	57
Molybdenum	mg/kg	75
Nickel	mg/kg	420
Selenium	mg/kg	100
Total coliform bacteria	MPN ^b /g ^c	1000
Zinc	mg/L	7500

^a Dry weight

^b MPN = Most probable number

^c Per gram of total solids (dry weight)

2.6 General Manufacturing

2.6.1 Cement and Lime Manufacturing⁴⁷

Effluent Levels

Parameter	Unit	Guideline Value
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels (for cement manufacturing)

Parameter	Unit	Guideline Value
Cadmium + Thallium	mg/Nm ^{3a}	0.05
Dioxins / Furans	mg TEQ ^b /Nm ³	0.1
Dust (other point sources including clinker cooling, cement grinding)	mg/Nm ³	50
Hydrogen chloride	mg/Nm ³	10
Hydrogen fluoride	mg/Nm ³	1
Mercury	mg/Nm ³	0.05
Nitrogen oxide	mg/Nm ³	600
Particulate matter PM ₁₀ ^c (existing kilns)	mg/Nm ³	100
Particulate matter PM ₁₀ (new kiln system)	mg/Nm ³	30
Sulfur dioxide	mg/Nm ³	400
Total metals ^d	mg/Nm ³	0.5
Total organic carbon	mg/Nm ³	10

⁴⁷ Environmental, health, and safety guidelines for cement and lime manufacturing. 2007. International Finance Corporation, World Bank Group

^a Milligrams per normal cubic meter at specified temperature and pressure

^b TEQ = Toxicity equivalence factor

^c PM₁₀ = Particulate matter 10 micrometers or less in diameter

^d Total metals are Arsenic, Lead, Cobalt, Chromium, Copper, Manganese, Nickel, Vanadium and Antimony

Air Emission Levels (for lime manufacturing)

Parameter	Unit	Guideline Value
Dust	mg/Nm ^{3a}	50
Sulfur dioxide	mg/Nm ³	400
Nitrogen oxide	mg/Nm ³	500
Hydrogen chloride	mg/Nm ³	10

^a Milligrams per normal cubic meter at specified temperature and pressure

2.6.2 Ceramic Tile and Sanitary Ware Manufacturing⁴⁸

Effluent Levels (for ceramic tile)

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Cadmium	mg/L	0.1
Chromium (total)	mg/L	0.1
Cobalt	mg/L	0.1
Copper	mg/L	0.1
Lead	mg/L	0.2
Nickel	mg/L	0.1
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total suspended solids	mg/L	50
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels (for ceramic tile)

Parameter	Unit	Guideline Value
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⁴⁸ Environmental, health, and safety guidelines for ceramic tile and sanitary ware manufacturing. 2007. International Finance Corporation, World Bank Group

Cadmium	mg/Nm ³	0.2
Hydrogen chloride	mg/Nm ³	30
Hydrogen fluoride	mg/Nm ³	5
Lead	mg/Nm ³	0.5
Nitrogen oxide	mg/Nm ³	600 ^a
Particulate matter PM ₁₀ ^b	mg/Nm ³	50 ^c
Sulfur dioxide	mg/Nm ³	400 ^a
Total organic carbon	mg/Nm ³	20

^a Kiln operations

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

^c Dryer and kiln stacks

2.6.3 Glass Manufacturing⁴⁹

Effluent Levels

Parameter	Unit	Guideline Value
Antimony	mg/L	0.3
Arsenic	mg/L	0.1
Boric acid	mg/L	2
Chemical oxygen demand	mg/L	130
Fluorides	mg/L	5
Lead	mg/L	0.1
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total suspended solids	mg/L	30

^aS.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Arsenic	mg/Nm ^{3a}	1
Cadmium	mg/Nm ³	0.2
Fluorides	mg/Nm ³	5
Hydrogen chloride	mg/Nm ³	30
Lead	mg/Nm ³	5

⁴⁹ Environmental, health, and safety guidelines for glass manufacturing. 2007. International Finance Corporation, World Bank Group

Nitrogen oxide		mg/Nm ³	1,000
Other heavy metals (total)		mg/Nm ³	5 ^b
Particulates	Natural gas	mg/Nm ³	100 ^c
	Other fuels		50 ^c
Sulfur dioxide		mg/Nm ³	700–1,500 ^d

^a Milligrams per normal cubic meter at specified temperature and pressure

^b 1 mg/Nm³ for Selenium

^c Where toxic metals are present, not to exceed 20 mg/Nm³; to achieve dust emissions of 50 mg/Nm³ installation of secondary treatments (bag fillers or electrostatic precipitators) is necessary

^d 700 mg/Nm³ for natural gas firing, 1,500 mg/Nm³ for oil firing

2.6.4 Construction Materials Extraction⁵⁰

Thus guideline applies to construction materials extraction activities such as aggregates, limestone, slates, sand, gravel, clay, gypsum, feldspar, silica sands, and quartzite, as well as extraction of dimension stone. Construction materials extraction operations do not typically generate point sources or effluents or emissions with the exception of dewatering effluents which may contain suspended solids. Effluent and storm water flows should be managed so as to achieve the following effluent levels. The principle sources of air emission are fugitive dust from earth works and materials handling and transport facilities. Prevention and control of air emissions should be sufficient to achieve the general air emission guideline for ambient air quality.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

2.6.5 Textiles Manufacturing⁵¹

⁵⁰ Environmental, health, and safety guidelines for construction materials extraction. 2007. International Finance Corporation, World Bank Group.

⁵¹ Environmental, health, and safety guidelines for textiles manufacturing. 2007. International Finance Corporation, World Bank Group

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	30
Adsorbable organic halogens	mg/L	1
Ammonia	mg/L	10
Cadmium	mg/L	0.02
Chemical oxygen demand	mg/L	160
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Cobalt	mg/L	0.5
Color	m ⁻¹	7 (436 nm ^a , yellow) 5 (525 nm, red) 3 (620 nm, blue)
Copper	mg/L	0.5
Nickel	mg/L	0.5
Oil and grease	mg/L	10
Pesticides	mg/L	0.05–0.10 ^b
pH	S.U. ^c	6–9
Phenol	mg/L	0.5
Sulfide	mg/L	1
Temperature increase	°C	<3 ^d
Total coliform bacteria	MPN ^e /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50
Zinc	mg/L	2

^a Nanometers

^b 0.05 mg/L for total pesticides (organophosphorus pesticides excluded); 0.10 mg/L for organophosphorus pesticides

^c S.U. = Standard unit

^d At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^e MPN = Most probable number

Air Emission Levels

Parameter	Unit	Guideline Value
Ammonia	mg/Nm ^{3a}	30
Carbon disulfide	mg/Nm ³	150
Chlorine	mg/Nm ³	5
Formaldehyde	mg/Nm ³	20

Hydrogen sulfide	mg/Nm ³	5
Particulates	mg/Nm ³	50 ^b
Volatile organic compounds	mg/Nm ³	2/20/50/75/100/150 ^{c,d}

^a Milligrams per normal cubic meter at specified temperature and pressure

^b As the 30-minute mean for stack emissions

^c Calculated as total carbon

^d As the 30-minute mean for stack emissions: 2 mg/Nm³ for volatile organic compounds classified as carcinogenic or mutagenic with mass flow greater than or equal to 10 g/hour; 20 mg/Nm³ for discharges of halogenated volatile organic compounds with a mass flow equal or greater than 100 g/hour; 50 mg/Nm³ for waste gases from drying of large installations (solvent consumption > 15 tons/year); 75 mg/Nm³ for coating application processes for large installations (solvent consumption > 15 tons/year); 100 mg/Nm³ for small installations (solvent consumption < 15 tons/year); if solvent is recovered from emissions and reused, the limit value is 150 mg/Nm³

2.6.6 Tanning and Leather Finishing⁵²

Effluent Levels (for tanning and leather finishing)

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Ammonia	mg/L	10
Chemical oxygen demand	mg/L	250
Chloride	mg/L	1,000
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenols	mg/L	0.5
Sulfate	mg/L	300
Sulfide	mg/L	1.0
Temperature increase	°C	<3 ^b
Total coliform bacteria	MPN ^c /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

^c MPN = Most probable number

⁵² Environmental, health, and safety guidelines for tanning and leather finishing. 2007. International Finance Corporation, World Bank Group

Air Emission Levels (for leather finishing)

Pollutant	Unit	Guideline Value
Upholstery leather	kg of hazardous air pollutant loss per 100 m ² of leather processed	3.3
Water resistant / specialty leather		2.7
Non-water resistant leather		1.8

2.6.7 Semiconductors and Other Electronics Manufacturing⁵³

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	50
Adsorbable organic halogens	mg/L	0.5
Ammonia	mg/L	10
Arsenic	mg/L	0.1
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	160
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanide (free)	mg/L	0.1
Cyanide (total)	mg/L	1
Fluoride	mg/L	5
Lead	mg/L	0.1
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Selenium	mg/L	1
Silver	mg/L	0.1
Temperature increase	°C	<3 ^b
Tin	mg/L	2
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50
Zinc	mg/L	2

^a S.U. = Standard unit

⁵³ Environmental, health, and safety guidelines for semiconductors and electronics manufacturing. 2007. International Finance Corporation, World Bank Group

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Acetone	mg/Nm ^{3a}	150
Ammonia	mg/Nm ³	30
Arsine and arsenic compounds	mg/Nm ³	0.5
Hydrogen chloride	mg/Nm ³	10
Hydrogen fluoride	mg/Nm ³	5
Inorganic hazardous air pollutants ^b	ppmv ^c	0.42
Organic hazardous air pollutants ^b	ppmv	20
Phosphine	mg/Nm ³	0.5
Volatile organic compounds ^d	mg/Nm ³	20

^a Milligrams per normal cubic meter at specified temperature and pressure

^b Industry-specific hazardous air pollutants include: Antimony compounds, Arsenic compounds, Arsine, Carbon tetrachloride, Catechol, Chlorine, Chromium compounds, Ethyl acrylate, Ethylbenzene, Ethylene glycol, Hydrochloric acid, Hydrofluoric acid, Lead compounds, Methanol, Methyl isobutyl ketone, Methylene chloride, Nickel compounds, Perchloroethylene, Phosphine, Phosphorus, Toluene, 1,1,1-trichloroethane, Trichloroethylene (phased-out), and Xylenes

^c ppmv = Parts per million by volume

^d Applicable to surface cleaning processes

2.6.8 Printing⁵⁴

Effluent Levels

Parameter	Unit	Guideline Value
5-day Biochemical oxygen demand	mg/L	30
Adsorbable organic halogens	mg/L	1
Aluminum	mg/L	3
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	150
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanide	mg/L	0.2
Iron	mg/L	3
Lead	mg/L	1

⁵⁴ Environmental, health, and safety guidelines for printing. 2007. International Finance Corporation, World Bank Group

Oil and grease	mg/L	10
pH	S.U. ^a	6–9
Silver	mg/L	0.5
Temperature increase	°C	<3 ^b
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50
Zinc	mg/L	0.5

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Isocyanates	mg/Nm ^{3a}	0.1 ^b
Nitrogen oxide	mg/Nm ³	100 – 500 ^c
Particulates	mg/Nm ³	50 ^d
Volatile organic halogens	mg/Nm ³	100 ^{e,f}
		20 ^{e,g}
		75 ^{e,h}
		100 ^{e,i}

^a Milligrams per normal cubic meter at specified temperature and pressure

^b As 30 minute mean for contained sources, excluding particulates; from all processes / activities using Isocyanates

^c As 30 minute mean for contained sources; from turbines, reciprocating engines or boilers used as volatile organic compounds abatement equipment

^d As 30 minute mean for contained sources; from all processes / activities

^e Calculated as Total carbon

^f Heatset web offset printing with 15–25 tons/year solvent consumption

^g Heatset web offset printing with >25 tons/year solvent consumption

^h Publication rotogravure with >25 tons/year solvent consumption

ⁱ Other rotogravure, flexography, rotary screen printing, laminating, or varnishing units (>15 tons/year solvent consumption); rotary screen on textile / card board (>30 tons/year solvent consumption)

2.6.9 Foundries⁵⁵

Effluent Levels

Parameter	Unit	Guideline Value
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⁵⁵ Environmental, health, and safety guidelines for foundries. 2007. International Finance Corporation, World Bank Group

Aluminum	kg/ton	0.02 ^a
Ammonia	mg/L (as Nitrogen)	5
Cadmium	mg/L	0.01
Chemical oxygen demand	mg/L	125
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Fluoride	mg/L (as Fluorine)	5
Iron	mg/L	5
Lead	mg/L	0.2
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^b	6-9
Phenol	mg/L	1
Temperature increase	°C	<3 ^c
Tin	mg/L	2
Total suspended solids	mg/L	35
Zinc	mg/L	0.5

^a Aluminum smelting and casting

^b S.U. = Standard unit

^c At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Amines	mg/Nm ^{3a}	5 ^b
Carbon monoxide	mg/Nm ³	200 ^c
		150 ^d
Chloride	mg/Nm ³	5 ^e
Chlorine	mg/Nm ³	5 ^f
Copper and compounds	mg/Nm ³	5-20 ^g
Fluoride	mg/Nm ³	5 ^h
Hydrogen sulfide	ppm v/v ⁱ	5
Lead, cadmium and their compounds	mg/Nm ³	1-2 ^j
Nickel, Cobalt, Chromium, Tin and their compounds	mg/Nm ³	5
Nitrogen oxide	mg/Nm ³	400 ^k
		120 ^c
		150 ^l
Oil Aerosol / mist	mg/Nm ³	5
Particulate matter PM ₁₀ ^m	mg/Nm ³	20 ⁿ
		50 ^o

Polychlorinated dibenzodioxin and dibenzofuran	ng TEQ ^p /m ³	0.1
Sulfur dioxide	mg/Nm ³	400 ^c
		50 ^g
		120 ^f
Volatile organic compounds	mg/Nm ³	20 ^c
		30
		15 ^s

^a Milligrams per normal cubic meter at specified temperature and pressure

^b Non-ferrous metal melting (aluminum)

^c Non-ferrous metal melting (shaft furnaces)

^d Cold box molding and core making shop

^e Furnace emissions where chloride flux is used

^f Thermal sand reclamation systems and solvent based investment foundry coating, shelling, and setting operation

^g Higher value applicable to copper and its alloy producing processes

^h Furnace emissions where fluoride flux is used

ⁱ Parts per million volume/volume

^j Higher value applicable to non-ferrous metal foundries from scrap

^k Ferrous metal melting (maximum emissions level considered on best available technology base and based on cokeless cupola furnaces)

^l From thermal sand reclamation systems / regeneration units

^m PM₁₀ = Particulate matter 10 micrometers or less in diameter

ⁿ Particulate matter emissions when toxic metals are present

^o Particulate matter emissions when toxic metals are not present

^p Ferrous metal melting (cupola furnaces)

^q TEQ = Toxicity equivalence factor

^r Maximum emissions level considered on best available technology base and based on cold blast cupola furnaces

^s Ferrous metal melting (electric arc furnaces); cupola furnaces may have higher emissions levels (up to 1,000 mg/Nm³)

2.6.10 Integrated Steel Mills⁵⁶

Effluent Levels

Parameter	Unit	Guideline Value
Ammonia	mg/L (as Nitrogen)	5
Cadmium	mg/L	0.01
Chemical oxygen demand	mg/L	250
Chromium (hexavalent)	mg/L	0.1

⁵⁶ Environmental, health, and safety guidelines for integrated steel mills. 2007. International Finance Corporation, World Bank Group

Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanides (free)	mg/L	0.1
Cyanides (total)	mg/L	0.5
Fluoride	mg/L (as Fluorine)	5
Iron	mg/L	5
Lead	mg/L	0.2
Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenol	mg/L	0.5
Polycyclic aromatic hydrocarbons	mg/L	0.05
Sulfides	mg/L	0.1
Temperature increase	°C	<3 ^b
Tin	mg/L	2
Total nitrogen	mg/L	30
Total phosphorus	mg/L	2
Total suspended solids	mg/L	35
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Ammonia	mg/Nm ^{3a}	30
Benzo(a)pirene	mg/Nm ³	0.1
Cadmium	mg/Nm ³	0.2
Carbon monoxide	mg/Nm ³	100 (electric arc furnace)
		300 (coke oven)
Chromium	mg/Nm ³	4
Fluoride	mg/Nm ³	5
Hydrogen chloride	mg/Nm ³	10
Hydrogen fluoride	mg/Nm ³	10
Hydrogen sulfide	mg/Nm ³	5
Lead	mg/Nm ³	2
Nickel	mg/Nm ³	2
Nitrogen oxide	mg/Nm ³	500
		750 (coke oven)
Oil mist	mg/Nm ³	15

Particulate matter PM ₁₀ ^b	mg/Nm ³	20-50 ^c
Polychlorinated dibenzodioxin and dibenzofuran	ng TEQ ^d /m ³	0.1
Sulfur dioxide	mg/Nm ³	500
Tar fume	mg/Nm ³	5
Volatile organic compounds	mg/Nm ³	20

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

^c Lower value where toxic metals are present

^d TEQ = Toxicity equivalence factor

2.6.11 Base Metal Smelting and Refining⁵⁷

Effluent Levels (for nickel, copper, lead, zinc and aluminum smelting and refining)

Parameter	Unit	Guideline Value
Aluminum	mg/L	0.2
Arsenic	mg/L	0.05
Cadmium	mg/L	0.05
Chemical oxygen demand	mg/L	50
Copper	mg/L	0.1
Fluoride	mg/L	5
Hydrocarbons	mg/L	5
Lead	mg/L	0.1
Mercury	mg/L	0.01
Nickel	mg/L	0.1
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total suspended solids	mg/L	20
Zinc	mg/L	0.2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative

Air Emission Levels (for nickel, copper, lead, zinc and aluminum smelting and refining – varying by metal type / smelting process)

Parameter	Unit	Guideline Value
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⁵⁷ Environmental, health, and safety guidelines for base metal smelting and refining. 2007. International Finance Corporation, World Bank Group

Acid mists / gases	mg/Nm ^{3a}	50
Ammonia	mg/Nm ³	5
Arsine	mg/Nm ³	0.5
Carbon monoxide and carbonyls	mg/Nm ³	5
Chlorine	mg/Nm ³	0.5
Dioxins	ng TEQ ^b /m ³	0.1-0.5
Dust	mg/Nm ³	1-5
Hydrogen chloride	mg/Nm ³	5
Hydrogen fluoride	mg/Nm ³	0.5
Mercury	mg/Nm ³	0.02
Nitrogen oxides	mg/Nm ³	100-300
Polyfluorinated hydrocarbons	anode effects/ cell /day	0.1
Sulfur dioxide	mg/Nm ³	< 50-200
Total fluoride	mg/Nm ³	0.8
Total organic carbon	mg/Nm ³	5-50
Volatile organic compounds / solvents	mg/Nm ³	5-15

^a Milligrams per normal cubic meter at specified temperature and pressure

^b TEQ = Toxicity equivalence factor

2.6.12 Metal, Plastic, Rubber Products Manufacturing⁵⁸

Effluent Levels

Parameter	Unit	Guideline Value
Aluminum	mg/L	3
Ammonia	mg/L	10
		20 (electroplating)
Arsenic	mg/L	0.1
Cadmium	mg/L	0.1
Chemical oxygen demand	mg/L	250
Chromium (hexavalent)	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Cyanides (free)	mg/L	0.2
Cyanides (total)	mg/L	1
Fluorides	mg/L	20
Iron	mg/L	3
Lead	mg/L	0.2

⁵⁸ Environmental, health, and safety guidelines for metal, plastic, rubber products manufacturing. 2007. International Finance Corporation, World Bank Group

Mercury	mg/L	0.01
Nickel	mg/L	0.5
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Phenols	mg/L	0.5
Silver	mg/L	0.2
Sulfide	mg/L	1
Temperature increase	°C	<3 ^b
Tin	mg/L	2
Total nitrogen	mg/L	15
Total phosphorus	mg/L	5
Total suspended solids	mg/L	50
		25 (electroplating)
Volatile organic halogens	mg/L	0.1
Zinc	mg/L	2

^a S.U. = Standard unit

^b At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Air Emission Levels

Parameter	Unit	Guideline Value
Ammonia	mg/Nm ^{3a}	50
Hydrogen chloride	mg/Nm ³	10
Nitrogen oxides	mg/Nm ³	350
Particulate matter PM ₁₀ ^b (metal surface treatments)	mg/Nm ³	5
Particulate matter PM ₁₀ (plastic processing)	mg/Nm ³	3
Total organic carbon (rubber vulcanization)	mg/Nm ³	80
Volatile halogenated hydrocarbons (metal surface treatments)	mg/Nm ³	20
Volatile organic compounds (metal and plastic coating)	mg/Nm ³	100 (up to 15 ton/year solvent consumption)
		75 (more than 15 ton/year solvent consumption)
		50 (drying processes)
Volatile organic compounds (rubber conversion)	mg/Nm ³	20 ^c
Volatile organic compounds (surface cleaning)	mg/Nm ³	20-75 ^d

^a Milligrams per normal cubic meter at specified temperature and pressure

^b PM₁₀ = Particulate matter 10 micrometers or less in diameter

^c Facilities with solvent consumption greater than 15 ton/year

^d 20 mg/Nm³ for waste gases from surface cleaning using VOC classified as carcinogenic, mutagenic or toxic to reproduction; 75 mg/Nm³ for waste gases from other surface cleaning

2.7 Mining⁵⁹

Effluent Levels

Parameter	Unit	Guideline Value
Arsenic	mg/L	0.1
Cadmium	mg/L	0.05
Chemical oxygen demand	mg/L	150
Chromium (hexavalent)	mg/L	0.1
Copper	mg/L	0.3
Cyanide	mg/L	1
Cyanide (free)	mg/L	0.1
Cyanide (weak acid dissociable)	mg/L	0.5
Iron (total)	mg/L	2
Lead	mg/L	0.2
Mercury	mg/L	0.002
Nickel	mg/L	0.5
pH	S.U. ^a	6-9
Temperature	°C	<3 degree differential
Total suspended solids	mg/L	50
Zinc	mg/L	0.5

^a S.U. = Standard unit

2.8 Power

2.8.1 Wind Energy⁶⁰

Wind energy facilities do not typically generate process effluents and emissions during operations. Any wastewater discharges should be treated as required to achieve the following effluent levels. General air emission and noise guidelines shall apply.

Effluent Levels

⁵⁹ Environmental, health, and safety guidelines for mining. 2007. International Finance Corporation, World Bank Group

⁶⁰ Environmental, health, and safety guidelines for wind energy. 2007. International Finance Corporation, World Bank Group

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

^b MPN = Most probable number

2.8.2 Geothermal Power Generation^{61,62}

Potential contaminants in geothermal effluents will vary according to the mineralogy of the host geological formation, temperature of the geothermal water, and site-specific facility processes. Spent geothermal fluids are typically re-injected to the host rock formation, resulting in minor effluent volumes. If spent geothermal fluids are not re-injected, and effluents are considered likely to have elevated heavy metal concentrations the following effluent levels should apply. Minor air emissions of hydrogen sulfide, mercury vapor, and sulfur dioxide may arise as fugitive emissions from the cooling tower if the condensation process involves direct contact of steam with cooling water. Although geothermal energy projects do not normally generate significant point source emissions during construction and operations, hydrogen sulfide and other types of emissions should not result in ambient concentrations exceeding the following ambient air quality levels.

Effluent Levels

Parameter	Unit	Guideline Value
Arsenic	mg/L	0.1
Cadmium	mg/L	0.05
Chemical oxygen demand	mg/L	150
Chromium (hexavalent)	mg/L	0.1
Copper	mg/L	0.3
Cyanide	mg/L	1
Cyanide (free)	mg/L	0.1
Cyanide (weak acid dissociable)	mg/L	0.5
Iron (total)	mg/L	2

⁶¹ Environmental, health, and safety guidelines for geothermal power generation. 2007. International Finance Corporation, World Bank Group

⁶² Air Quality Guidelines for Europe. 2000. Second edition. WHO Regional Publication, European Series No. 91. World Health Organization

Lead	mg/L	0.2
Mercury	mg/L	0.002
Nickel	mg/L	0.5
pH	S.U. ^a	6-9
Temperature	°C	<3 degree differential
Total suspended solids	mg/L	50
Zinc	mg/L	0.5

^a S.U. = Standard unit

Ambient Air Quality

Parameter	Unit	Guideline Value
Hydrogen sulfide	µg/m ³	7 ^a
Inorganic mercury vapor	µg/m ³	1 ^b
Sulfur dioxide	µg/m ³	500 ^c

^a Average over 30 minute period

^b Annual average

^c Average over 10 minute period

2.8.3 Electric Power Transmission and Distribution⁶³

This guideline applies to power transmission between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. The power transmission and distribution sector does not typically give rise to significant effluents or air emissions. Where potentially contaminated water run-off or dust exists, site operations should comply with the following effluent guideline and general air quality guideline.

Effluent Levels

Parameter	Unit	Maximum Concentration
Biological oxygen demand	mg/L	30
Chemical oxygen demand	mg/L	125
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Total coliform bacteria	MPN ^b /100 ml	400
Total nitrogen	mg/L	10
Total phosphorus	mg/L	2
Total suspended solids	mg/L	50

^a S.U. = Standard unit

⁶³ Environmental, health, and safety guidelines for electric power transmission and distribution. 2007. International Finance Corporation, World Bank Group

^b MPN = Most probable number

Additionally, exposure limits for general public exposure to electric and magnetic fields should comply with International Commission on Non-ionized Radiation Protection guidelines for limiting general public exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz).

Frequency	Electric Field (V/m ^a)	Magnetic Field (μT ^b)
50 Hz ^c	5000	100
60 Hz	4150	83

^a Volts per meter, ^b Micro tesla, ^c Hertz

2.8.4 Thermal Power⁶⁴

Effluent Levels

Parameter	Unit	Guideline Value
Arsenic	mg/L	0.5
Cadmium	mg/L	0.1
Chromium (total)	mg/L	0.5
Copper	mg/L	0.5
Iron	mg/L	1
Lead	mg/L	0.5
Mercury	mg/L	0.005
Oil and grease	mg/L	10
pH	S.U. ^a	6-9
Temperature increase	°C	<3 ^b
Total residual chlorine	mg/L	0.2
Total suspended solids	mg/L	50
Zinc		1

^a S.U. = Standard unit

^b Temperature increase due to discharge of once-through cooling water

Air Emission Levels (applicable to non-degraded airsheds)

Combustion Technology / Fuel	Parameter / Guideline Values		
	Particulate matter PM ₁₀ ^a	Sulfur dioxide	Nitrogen oxides
Combustion turbine			

⁶⁴ Environmental, health, and safety guidelines for thermal power. 2007. International Finance Corporation, World Bank Group

Fuels other than natural gas (unit > 50 MW ^b)	50 mg/Nm ^{3c}	Use of ≤ 1% Sulfur fuel	152 ppm
Natural gas (all turbine types; unit > 50 MW)	-	-	51 ppm
<i>Boiler</i>			
Liquid fuels (plant > 600 MW)	50 mg/Nm ³	200 mg/Nm ³	400 mg/Nm ³
Liquid fuels (plant 50-600 MW)	50 mg/Nm ³	900 mg/Nm ³	400 mg/Nm ³
Natural gas	-	-	240 mg/Nm ³
Other gaseous fuels	50 mg/Nm ³	400 mg/Nm ³	240 mg/Nm ³
Solid fuels (plant > 600 MW)	50 mg/Nm ³	200 mg/Nm ³	510 mg/Nm ³
Solid fuels (plant 50-600 MW)	50 mg/Nm ³	900 mg/Nm ³	510 mg/Nm ³
<i>Reciprocating engine</i>			
Biofuels / gaseous fuels other than natural gas	50 mg/Nm ³	-	30% higher than for other fuels
Liquid fuels (plant > 300 MW)	50 mg/Nm ³	585 mg/Nm ³	740 mg/Nm ³
Liquid fuels (plant 50-300 MW)	50 mg/Nm ³	1170 mg/Nm ³	1460 mg/Nm ³
Natural gas	-	-	200 mg/Nm ³

^a PM₁₀ = Particulate matter 10 micrometers or less in diameter

^b Megawatt

^c Milligrams per normal cubic meter at specified temperature and pressure