BAT Guidance Note

on Best Available Techniques for the General Inorganic Chemicals Sector and the Production of Alumina

(1st Edition)

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Contents

PART A GENERAL INORGANIC CHEMICALS SECTOR

PART B PRODUCTION OF ALUMINA

APPENDICES

1. INTRODUCTION

1.1 GENERAL

This Guidance Note is one of a series issued by the Environmental Protection Agency (EPA), which provides guidance on the determination of Best Available Techniques (BAT) in relation to:

– applicants seeking Integrated Pollution Prevention and Control (IPPC) licences under Part IV of the Environmental Protection Agency Acts 1992 to 2007,

– existing Integrated Pollution Prevention and Control (IPPC) Licensees, whose licence is to be reviewed under the Environmental Protection Agency Acts 1992 to 2007,

– applicants seeking Waste Licenses under Part V of the Waste Management Acts 1996 to 2008,

– existing Waste Licensees, whose licence is to be reviewed under the Waste Management Acts 1996 to 2008.

This Guidance Note shall not be construed as negating the installation/facility statutory obligations or requirements under any other enactments or regulations.

1.2 BAT GUIDANCE NOTE STRUCTURE

This Guidance Note has been structured as follows:

Section	Details
1	Introduction
2	Interpretation of BAT
3	Sector(s) covered by this Guidance Note
Part A	**General Inorganic Chemicals Sector**
4	Process description, control techniques and risk to the environment
5	BAT for the General Inorganic Chemicals Sector
6	BAT Associated Emission Levels
7	Compliance Monitoring
Part B	**Production of Alumina**
4	Process description, control techniques and risk to the environment
5	BAT for the Production of Alumina
6	BAT Associated Emission Levels
7	Compliance Monitoring

Where relevant, references are made to other detailed guidance; such as the reference documents (BREF) published by the European Commission, Agency Guidance Notes for *Noise in Relation to Scheduled Activities*, and the determination of BAT should be made giving regard to these.

The information contained in this Guidance Note is intended for use as a tool to assist in determining BAT for the specified activities.

2. INTERPRETATION OF BAT

2.1 STATUS OF THIS GUIDANCE NOTE

This Guidance Note will be periodically reviewed and updated as required to reflect any changes in legislation and in order to incorporate technological advances as they arise.

Techniques identified in these Guidance Notes are considered to be best practice at the time of writing. The EPA encourages the development and introduction of new and innovative technologies and techniques, which meet BAT criteria and look for continuous improvement in the overall environmental performance of the sector's activities as part of sustainable development.

2.2 INTERPRETATION OF BAT

The concept of BAT was introduced as a key principle in the IPPC Directive 96/61/EC. This Directive has been incorporated into Irish law by the Protection of the Environment Act 2003. To meet the requirements of this Directive, relevant Sections of the Environmental Protection Agency Act 1992 and the Waste Management Act 1996 have been amended to replace BATNEEC (Best Available Technology Not Entailing Excessive Costs) with BAT.

Best available techniques (BAT) is defined in Section 5 of Environmental Protection Agency Acts, 1992 to 2007, and Section 5(2) of the Waste Management Acts 1996 to 2008, as the "most effective and advanced stage in the development of an activity and its methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for emission limit values designed to prevent or eliminate or, where that is not practicable, generally to reduce an emission and its impact on the environment as a whole", where:

B ***'best'*** in relation to techniques, means the most effective in achieving a high general level of protection of the environment as a whole

A ***'available techniques'*** means those techniques developed on a scale which allows implementation in the relevant class of activity under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced within the State, as long as they are reasonably accessible to the person carrying on the activity

T ***'techniques'*** includes both the technology used and the way in which the installation is designed, built, managed, maintained, operated and decommissioned.

The range of BAT associated emission level values specified in Section 6 indicate those that are achievable through the use of a combination of the process techniques and abatement technologies specified as BAT in Section 5. The licensee must demonstrate to the satisfaction of the Agency, during the licensing process, that the installation/facility will be operated in such a way that all the appropriate preventative measures are taken against pollution through the application of BAT and justify the application of other than the most stringent ELV in the range.

At the installation/facility level, the most appropriate techniques will depend on local factors. A local assessment of the costs and benefits of the available options may be needed to establish the best option. The choice may be justified on:

- the technical characteristics of the installation/facility;
- its geographical location;
- local environmental considerations;
- the economic and technical viability of upgrading existing installations/facility.

The overall objective of ensuring a high level of protection for the environment as a whole will often involve making a judgment between different types of environmental impact, and these judgments will often be influenced by local considerations. On the other hand, the obligation to ensure a high level of environmental protection including the minimisation of long-distance or transboundary pollution implies that the most appropriate techniques cannot be set on the basis of purely local considerations.

The guidance issued in this Note in respect of the use of any technology, technique or standard does not preclude the use of any other similar technology, technique or standard that may achieve the required emission standards and is demonstrated to the Agency to satisfy the requirement of BAT.

2.3 BAT HIERARCHY

In the identification of BAT, emphasis is placed on pollution prevention techniques rather than end-of-pipe treatment.

The IPPC Directive 96/61/EC and the Environmental Protection Agency Acts 1992 to 2007 (Section 5(3)), require the determination of BAT to consider in particular the following, giving regard to the likely costs and advantages of measures and to the principles of precaution and prevention:

(i) the use of low-waste technology,

(ii) the use of less hazardous substances,

(iii) the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate,

(iv) comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale,

(v) technological advances and changes in scientific knowledge and understanding,

(vi) the nature, effects and volume of the emissions concerned,

(vii) the commissioning dates for new or existing activities,

(viii) the length of time needed to introduce the best available techniques,

(ix) the consumption and nature of raw materials (including water) used in the process and their energy efficiency,

(x) the need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it,

(xi) the need to prevent accidents and to minimise the consequences for the environment, and

(xii) the information published by the Commission of the European Communities pursuant to any exchange of information between Member States and the industries concerned on best available techniques, associated monitoring, and developments in them, or by international organisations, and such other matters as may be prescribed.

3. SECTOR COVERED BY THIS GUIDANCE NOTE

This Guidance Note covers the following activities under the First Schedule to the Environmental Protection Agency Acts 1992 to 2007:

1.2 The extraction of aluminium oxide from an ore, not included in paragraph 5.13.

5.4 The manufacture of inorganic chemicals, not included in paragraph 5.12 to 5.17.

5.5 The manufacture of artificial fertilisers, not included in paragraph 5.12 to 5.17.

5.13 The production of basic inorganic chemicals, such as:

(a) gases, such as ammonia, chlorine or hydrogen chloride, fluorine or hydrogen fluoride, carbon oxides, sulphur compounds, nitrogen oxides, hydrogen, sulphur dioxide, carbonyl chloride,

(b) acids such as chromic acid, hydrofluoric acid, phosphoric acid, nitric acid, hydrochloric acid, sulphuric acid, oleum, sulphurous acids,

(c) bases, such as ammonium hydroxide, potassium hydroxide, sodium hydroxide.

(d) salts, such as ammonium chloride, potassium chlorate, potassium carbonate, sodium carbonate, perborate, silver nitrate,

(e) non-metals, metal oxides or other inorganic compounds such as calcium carbide, silicon, silicon carbide.

5.14 The production of phosphorous-based, nitrogen-based or potassium-based fertilisers (simple or compound fertilisers).

The Guidance Note is split into two parts to deal with each sector.

PART A GENERAL INORGANIC CHEMICALS SECTOR

‘General Inorganic Chemicals’ describes a sector that manufactures thousands of chemical compounds. Therefore, Part A of this Guidance Note provides a general overview for a number of common processes that are likely to be employed in any specific industry within the sector.

Reference should be made to the method used in the *Speciality Inorganic Chemicals BREF* (SIC BREF) (see BREF Section 6) when assessing BAT for any specific industry within the Inorganic Chemicals Sector in the Irish context. Examples of such industries include manufacture of:

- metal hydroxides
- metal sulphates
- hydrogen chloride
- chlor-alkali compounds.

PART B PRODUCTION OF ALUMINA

Part B deals specifically with the Production of Alumina.

The relevance of horizontal and cross-sectoral guidance notes, such as the BREF on *Emissions from Storage*, (Storage BREF), the BREF on *Industrial Cooling Systems* (Cooling Systems BREF), the BREF on *Large Combustion Plant*, (the Combustion BREF) or the BREF on *Economics and Cross-Media Effects* under IPPC (E & CME BREF) to the sector in general are dealt with in Part A. Therefore, Part A should also be consulted even if the reader's primary interest is in the production of alumina.

PART A - GENERAL INORGANIC CHEMICALS SECTOR

4. PROCESS DESCRIPTION, RISK TO THE ENVIRONMENT, AND CONTROL TECHNIQUES

(Note: any reference to BREF in this document means the reference document on *Best Available Techniques for the Production of Specialty Inorganic Chemicals*, published by the European Commission.)

4.1 DESCRIPTION OF PROCESS

At the general level, the production process at any inorganic chemicals installation can be divided into five principal stages:

- Raw and auxiliary materials supply, handling and preparation
- Synthesis
- Product separation and purification
- Product handling and storage
- Emissions abatement.

Each of these stages may be further subdivided into individual process steps or unit operations. A comprehensive list of these steps is given in Table 1 (see BREF Section 2.2).

These five stages are complemented by facilities for cooling, vacuum, energy and other utility systems, and by safety and management systems. Cooling systems are described in the Cooling Systems BREF while the Combustion BREF deals with combustion processes.

In addition, processes for the treatment of wastewater & waste gas in the chemical sector are described in the BREF on *Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector* (WW/WG BREF) and information on the treatment of solid wastes can be found in the BREF for the *Waste Treatment Industries* (WTI BREF).

Table 1: Possible Environmental impact of common processes in inorganic chemicals sector (see BREF Table 2.1).

Common Process Step	**Likely Environmental Impact**				
	Consumptions		Emissions		
	Energy	Water	Air	Water	Waste
Dissolution of Raw Materials		X			
Mixing	X		X		
Synthesis/Reaction	X	X	X	X	
Electrolysis	X	X	X	X	
Calcination	X		X		
Washing		X		X	X
Drying	X		X		
Dry Milling	X		X		
Wet Milling	X	X	X		
Grinding	X		X		
Sieving	X		X		
Condensation			X		
Distillation	X		X	X	X
Evaporation	X				
Filtration	X				X
Hydrolysis		X	X	X	
Extraction		X	X	X	X
Compaction	X		X		
Granulation	X		X		
Briquetting	X		X		
Storage and Handling	X	X	X	X	X
Waste Water Treatment	X	X	X	X	X
Waste Gas Treatment	X	X	X	X	X
Waste Treatment	X		X	X	X[1]
Combustion	X	X	X	X	
Cooling	X	X	X	X	X

[1] In addition to discharging to air and water, waste treatment discharges to land

4.2 RISK TO THE ENVIRONMENT

The risks to the environment from any industry, or specific installation within the sector, will depend on the raw materials used and the processes employed. Consumption of energy and water, emissions to air, water and land, and waste treatment are likely to be of concern in all circumstances.

Table 1 identifies the emissions and consumptions associated with each process step. A more detailed description of the consumptions and emissions associated with each process is provided in Sections 3.1, 3.2 3.3 of the SIC BREF.

The WTI BREF contains information on the emissions and consumptions associated with a number of common waste treatment techniques.

The BREF for The Chlor-Alkali Manufacturing Industry (see CH-AL BREF Section 2) describes the consumptions and emissions associated with electrolysis. The BREF on *Large Volume Inorganic Chemicals* (see LVIC BREF Section 1.3) gives a general overview of the emissions and consumptions associated with the inorganic chemicals sector generally.

4.2.1 Emissions to Air

There are five general stages and the three complementary activities which may be used to broadly describe any production process in the SIC sector (see BREF Section 4.1). These are a useful starting point for identifying the potential sources and types of emissions to air. Possible sources of emissions to air are listed in Section 3.1 of the SIC BREF.

With respect to the broader inorganic sector, a list of common air pollutants associated with the LVIC-S sector is given in Section 8.2.1 of the LVIC BREF. This list is relevant across the inorganic sector generally.

Emissions to air from storage and combustion are described in the Storage BREF and the Combustion BREF. Emissions to air from cooling are discussed in Section 3.5 of the Cooling Systems BREF.

4.2.2 Emissions to Water

As with emissions to air, there are five general stages and the three complementary activities which may be used to broadly describe any production process in the SIC sector (see BREF Section 4.1). These are a useful starting point for identifying the potential sources and types of emissions to water. Possible sources of emissions to water are listed in Section 3.2 of the SIC BREF.

A list of common water pollutants associated with the LVIC-S sector is given in Section 8.3.1 of the LVIC BREF. This list is relevant across the inorganic sector generally.

Emissions to water from storage and combustion are described in the Storage BREF and the Combustion BREF respectively. Emissions to water from cooling systems are described in Section 3.4.2 of the Cooling Systems BREF.

4.2.3 Waste

The nature of wastes from the sector is very dependent on the specific process involved. Waste streams may be hazardous due to the presence of toxic inorganic substances or heavy metals. See Section 3.3 of the SIC BREF for possible sources and descriptions of waste streams from the SIC sector.

Waste from the LVIC-S sector is described in Section 1.3.6, 8.5.3 & 8.5.4 of the LVIC BREF.

Information on residues and by-products from combustion is given in the Combustion BREF. Waste from cooling systems is described in Section 3.8 of the Cooling Systems BREF. Waste products from storage are described in the Storage BREF.

4.2.4 Odour, Vibration and Noise

Odour, vibration and noise nuisances are not a general issue of concern in the SIC sector although there may be local difficulties in certain situations.

The heavy machinery used in the LVIC-S sector can give rise to emissions of noise and/or vibration.

Odour can be a problem at some installations in the LVIC–S sector, especially where the process involves the handling, storage or processing of hydrogen sulphide, sulphur dioxide, ammonia or phosphates (see LVIC BREF Sections 7 & 8).

4.3 CONTROL TECHNIQUES

The existing or possible measures for eliminating, reducing and controlling emissions in the general inorganic chemicals sector are discussed in this section.

Reduction and control of emissions can be undertaken by two means: process-integrated measures or end-of-pipe abatement. Environmental protection is moving towards the former. They are intended to reduce the generation of waste gas, waste water, wastes, heat, vibration and noise (see SIC BREF Section 2.4 and WW/WG BREF Section 1.3.1).

Common end-of-pipe treatments of wastewater and waste gas are listed in Table 2 and Table 3 below.

4.3.1 Techniques for Prevention and Minimisation of Resource Consumption

4.3.1.1 Process Selection

The process selected will affect energy use and pollutant types. An indication of the emissions and consumptions associated with each process step can be found in Table 1.

4.3.1.2 Use of Energy

For guidance on the use of energy, see the EPA's Guidance Note on Energy Efficiency Auditing. Information on the efficiency of combustion can be found in the Combustion BREF.

4.3.1.3 Techniques for Prevention and Minimisation of Emissions

Techniques to reduce emissions in waste water and waste gas are listed in SIC BREF Section 4.3.1.4 & 4.3.1.5. The WW/WG BREF Section 3.3.4 provides further information on the treatment of waste water; Section 3.5 gives information on the treatment of waste gas.

4.3.1.4 Techniques for Treating Waste Water Emissions

Table 2 lists the treatment techniques for a number of waste water contaminants.

Table 2: Waste water contaminants and their treatment techniques

Technique	**TSS**	**BOD, COD, TOC**	**Refractory COD**	**AOX. EOX**	**N-total**	**NH_4-N (NH_3)**	**PO_4-P**	**Heavy Metals**	**Phenols**	**Oil**
Sedimentation	X	(X)^2						(X)^4		
Air Flotation	X	X^1						(X)^4		X
Filtration	X	(X)^2						(X)^4		
MF/UF	(X)^3	(X)^2								
Oil Separation		X								X
Precipitation							X	X		
Crystallisation							X	X		
Chemical Oxidation		X	X	X						
Wet air Oxidation		X	X	X					X	
SCWO		X	X	X					X	
Chemical reduction										
Chemical hydrolysis										
NF/RO		X	X	X				X		
Adsorption		X	X	X				X		

Ion Exchange		(X)[5]						X		
Extraction		X	X	X						
Distillation/Rectification		X	X	X						
Evaporation		(X)[6]						X		
Stripping		(X)[7]		X		X				
Anaerobic biological		X		(X)[8]	(X)[8]			X[9]		
Aerobic biological		X		(X)[8]			X		X	
Nitri/denitrification					X	X				

X[1] undissolved organic content
(X)[2] only solid
(X)[3] finely dispersed and low concentration
(X)[4] undissolved heavy metal compounds
(X)[5] ionic organic species
(X)[6] non-volatile organic content
(X)[7] volatile organic content
(X)[8] only biodegradable parts
X[9] in combination with sulphate precipitated as sulphides

4.3.1.5 Techniques for Treating Waste Gas Emissions

A list of a number of waste gas contaminants and their treatment techniques is given in Table 3.

Table 3: Techniques for Waste Gas Emission Reduction

Technique	**Dry Matter**	**Wet Matter**	**Inorganic Particulates**	**Organic Particulates**	**Inorganic gaseous or volatile components**	**Organic gaseous or volatile components**	**Odour**
	Dust Treatment						
Separator (pre)	X	X	X	X			
Cyclone (pre)	X	X	X	X			
Wet dust scrubber (FT)	X	X	X	X			
Electrostatic precipitator (FT)	X	X	X	X	(X)	(X)	
Fabric Filter (incl. ceramic filter) (FT)	X		X	X			
Catalytic filtration (FT)	X	X	X	X		X	
Two-stage dust filter (pol)	X		X	X			
Absolute (HEAP) filter (pol)	X		X	X			
HEAF (pol)		X					
Mist filter (pre, pol)		X			(X)		
	Gas Treatment						
Membrane separation (pre)						X	
Condenser (pre)					(X)	X	
Cryocondensation (pre)					(X)	X	(X)
Adsorption (FT)					X	X	X
Wet gas scrubber (water) (FT)	(X)	(X)	(X)	(X)	X	X	X
Wet gas scrubber (alkaline) (FT)	(X)	(X)	(X)	(X)	X	X	X
Wet gas scrubber (alkaline-oxidation) (FT)	(X)	(X)	(X)	(X)			X
Wet gas scrubber (acidic) (FT)	(X)	(X)	(X)	(X)	X	X	X
Biofiltration (FT)					X	X	X
Bioscrubbing (FT)					X	X	X
Biotrickling (FT)					X	X	X
Thermal oxidation (FT)				X		X	X
Catalytic oxidation (FT)						X	X
Flaring (FT)						X	X
	Combustion Gas Treatment						
Dry alkali injection (FT)					X		
Semi-dry alkali injection (FT)					X		
Wet lime injection (FT)					X		
SNCR (FT)					X		
SCR (FT)					X	(X)	

X	primary application
(X)	secondary application
(pre)	mainly as pre-treatment facility
(FT)	treatment technique used as final treatment technique
(pol)	mainly as polishing technique after standard technique

4.3.1.6 Treatment of Solid Wastes

Techniques for the recycling and/or disposal of solid wastes in the inorganic chemicals sector will depend on the materials involved. Information on solid waste associated with the inorganic chemicals sector can be found in Section 3.7.4 of the SIC BREF. The WTI BREF contains information on a number of waste treatment processes. Information on general environmental concerns associated with the treatment of waste are described in the WTI BREF.

4.3.1.7 Choice of Raw Materials

Substitution of raw materials for those of a higher purity reduces unwanted by-products and waste (see BREF Section 4.3.1).

4.3.2 Other Emissions

Information on soil protection measures, methods to reduce vibration, noise emission and heat emission can be found in Sections 8.5.3 & 8.5.5 of the LVIC BREF.

Emission reduction techniques for storage are described in the Storage BREF.

The Cooling Systems BREF Sections 3.4.3, 3.4.4 & 3.4.5 describes a number of methods to reduce emissions resulting from the treatment of cooling water while Section 3.5 contains information on the use of cooling air and air emissions; information on plume formation and plume abatement is contained in Section 3.5.3.

Techniques for the reduction of emissions from combustion are described in the Combustion BREF.

5. BEST AVAILABLE TECHNIQUES IN THE GENERAL INORGANIC CHEMICALS SECTOR

5.1 INTRODUCTION

As explained in Section 2, this Guidance Note identifies BAT but obviously does so in the absence of site-specific information. Accordingly, it represents the requirements expected of any new activity covered by the Note and ultimately the requirements expected of existing facilities, but exclude additional requirements, which may form part of the granting of a licence for a specific site.

For any specific industry within the Inorganic Chemicals Sector, reference should be made to the method used in the SIC BREF Section 6.

The method employs the four general steps:

- Assemble general information about the industry and its products
- Describe the applied processes and techniques
- Collect data on consumption and emission levels
- Examine the techniques to consider in the determination of BAT.

The technical feasibility of the measures listed below has been demonstrated by various sources. Used singly, or in combination, the measures represent BAT solutions when implemented in the appropriate circumstances. These circumstances depend on plant used, fuels used, nature of process, etc.

5.2 PROCESS SELECTION

Sections 4.1 to 4.7 of the SIC BREF list common techniques to consider in the determination of BAT but BAT, as such, is not identified for any specific process.

The E & CME BREF describes a method for comparing the cross-media effects from alternative processes and illustrates a method for comparing the costs and economic consequences of alternative processes.

5.3 GENERIC BAT

Section 5 of the SIC BREF lists BAT associated with the sector as a whole and is dealt with under the following headings:

- raw and auxiliary materials supply, storage, handling and preparation
- synthesis/reaction/calcination
- product handling and storage
- waste gas emission abatement
- waste water management and water emissions abatement
- infrastructure
- energy
- cross-boundary techniques.

5.4 BAT FOR WASTE WATER TREATMENT

Additional information on BAT for waste water is given in Section 4.3.1 of the WW/WG BREF, the techniques described consider BAT for:

- process-integrated measures

- waste water collection
- waste water treatment.

A methodology to assist in the determination of BAT for waste water treatment for a chemical installation is given in Figure 4.1 of the WW/WG BREF.

5.5 BAT FOR WASTE GAS TREATMENT

Additional information on BAT for the treatment of waste gas is described in Section 4.3.2 of the WW/WG BREF. Information on BAT for process-integrated measures, waste gas collection and waste gas treatment is also given in this section.

5.6 BAT FOR STORAGE

Information on what is considered BAT for a number of storage techniques is contained in the Storage BREF. Techniques described there refer to the storage of liquids and liquefied gases, transfer and handling of liquids and liquefied gases, storage of solids and transfer and handling of solids.

5.7 BAT FOR COOLING

General information on the application of BAT to industrial cooling systems is described in Section 4.2.2 of the Cooling Systems BREF. Information on the reduction of emissions to air and water from cooling can be found in Sections 4.6 & 4.7 of the Cooling Systems BREF. Sections 4.3, 4.4, 4.5, 4.8, 4.9 & 4.10 describe BAT to reduce energy consumption, water consumption, entrainment of organisms, noise, leakage and biological risk.

Further information on a number of waste gas and wastewater treatment techniques can be found in the BREF document on *Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector*, EIPPCB, February 2003.

6. BAT ASSOCIATED EMISSION LEVELS

BAT associated emission levels to air are given below

6.1 EMISSION LEVELS FOR DISCHARGES TO AIR

Achievable emission levels for discharges to air based on BAT are given in Table 6.1 below.

Table 6.1: BAT-Associated Emission Levels for Emissions to Air*

Constituent Group or Parameter Note 1	**Class**	**Emission Level (mg/m^3)**	**Mass Flow Threshold** Note 2 **(g/hr)**
Carcinogenic Substances (Note 3)	**Class I (limits set for class total)** - arsenic and its compounds (except for arsine), as As - benzo(a)pyrene - cadmium and its compounds, as Cd - water-soluble compounds of cobalt, as Co - chromium (VI) compounds (except for barium chromate and lead chromate), as Cr	0.05	0.15
	Class II (limits set for class total) - acrylamide - acrylonitrile - dinitrotoluenes - ethylene oxide - nickel and its compounds (except for nickel metal, nickel alloys, nickel carbonate, nickel hydroxide, nickel tetracarbonyl) as Ni - 4-vinyl-1,2-cyclohexane-diepoxy	0.5	1.5
	Class III (limits set for class total) - benzene - bromoethane - 1,3-butadiene - 1,2-dichloroethane - 1,2-propylene oxide (1,2-epoxy propane) - styrene oxide - o-toluidine - trichloroethane - vinyl chloride	1	2.5
Inorganic Dust Particles (Note 3)	**Class I (limits set on a per substance basis)** - mercury and its compounds, as Hg - thallium and its compounds, as Tl	0.05	0.25

	Class II (limits set for class total) - lead and its compounds, as Pb - cobalt and its compounds, as Co - nickel and its compounds, as Ni - selenium and its compounds, as Se - tellurium and its compounds, as Te	0.5	2.5
	Class III (limits set for class total) - antimony and its compounds, as Sb - chromium and its compounds, as Cr - easily soluble cyanides (e.g. NaCN), as CN - easily soluble fluorides (e.g. NaF), as F - copper and its compounds, as Cu - manganese and its compounds, as Mn - vanadium and its compounds, as V - tin and its compounds, as Sn - Other substances with risk phrases R40, R62 or R63	1	5
Vaporous or Gaseous Inorganic Substances	**Class I (limits set on a per substance basis)** - arsine - cyanogen chloride - phosgene - phosphine	0.5	2.5
	Class II (limits set on a per substance basis) - bromine and its gaseous compounds, as Hydrogen bromide - chlorine - hydrocyanic acid - fluorine and its gaseous compounds, as HF - hydrogen sulphide	3	15
	Class III (limits set on a per substance basis) - ammonia - gaseous inorganic compounds of chlorine, as HCl	30	150
	Class IV (limits set on a per substance basis) - sulphur oxides (sulphur dioxide and sulphur trioxide), as SO_2 - nitrogen oxides (nitrogen monoxide and nitrogen dioxide), as NO_2 - nitrogen monoxide and nitrogen dioxide, as NO_2 (thermal or catalytic post-combustion facilities) - Carbon monoxide	350 200 100	1800
General Dust		5-20 150	>200 <200
Organic Substances [Note 4]			
Other			Note 5

* For existing activities, BAT associated emission levels shall as a minimum, be considered TA Luft (Technical Instructions on Air Quality Control - TA Luft in

accordance with art. 48 of the Federal Immission Control Law (BImSchG) dated 15 March 1974 (BGBI. I p.721). Federal Ministry for Environment, Bonn 1986, including the amendment for Classification of Organic Substances according to section 3.1.7 TA.Luft, published in July 1997).

Notes to Table 6.1

Note 1: Where a substance falls into more than one category in Table 6.1, the lower emission limit value applies.

Note 2: The Mass Flow Threshold is calculated in g/hr or kg/hr and is determined to be the maximum emission which can occur over any one hour period of plant operation. Where the Mass Flow in the raw gas exceeds the mass flow threshold given in the Table, abatement will be required to reduce the emission to below the appropriate emission level or mass flow threshold.

Note 3: Where substances of several classes are present, in addition to the above limit, the sum of Classes I & II shall not exceed the Class II limit and the sum of Classes I & III, II &III or I, II & III shall not exceed the Class III limit.

Note 4: For organic substances reference should be made to the EPA BAT Guidance Document for the Organic Chemicals Sectors.

Note 5: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

6.2 EMISSION LEVELS FOR DISCHARGES TO WATER

The following table sets out emission levels that are achievable using BAT for wastewater treatment. However establishing emission limit values within a licence for direct discharges to surface water from wastewater treatment plant and stormwater discharges must ensure that the quality of the receiving water is not impaired or that the current Environmental Quality Standards (EQS) are not exceeded.

All discharges to sewer are subject to approval from the Water Services Authority.

Compliance with the Water Framework Directive (2000/60/EC) is required where relevant, in particular Article 16.

Table 6.2: BAT-Associated Emission Levels for Discharges to Water*

Constituent Group or Parameter	**Emission Level**	**Notes**
pH	6 - 9	
Toxicity Units (TU)	5 - 10	1
BOD_5	91% minimum removal[3]	
COD	75% minimum removal[3] or 30 - 250mg/l	
Suspended Solids	10 - 20mg/l	
Total Nitrogen (as N)	>80% removal[3], or 5 - 25mg/l	2, 4
Total Phosphorus (as P)	>80% removal[3], or 2mg/l	4
Total Ammonia (as N)	10mg/l	
Oils, Fats & Grease	10mg/l	
Mineral Oil (from interceptor)	20mg/l	
Mineral Oil (from biological treatment)	1.0mg/l	
Metals		5
Priority Substances (as per Water Framework Directive)		5
Cyanides		5
Other		5, 6

* All values refer to daily averages based on a 24-hour flow proportional composite sample, except where stated to the contrary and for pH, which refers to continuous values. Levels apply to effluent prior to dilution by uncontaminated streams, e.g. storm water, cooling water, etc.

* Temperature measured downstream of a point of thermal discharge must not exceed the unaffected temperature by more than 1.5°C in salmonid waters and 3°C in cyprinid waters (Freshwater Fish Directive 79/659/EEC).

Notes to Table 6.2

Note 1: The number of toxic units (TU) = 100/x hour EC/LC50 in percentage vol/vol so that higher TU values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

Note 2: Total Nitrogen means the sum of Kjeldahl Nitrogen, Nitrate N and Nitrite N.

Note 3: Reduction in relation to influent load.

Note 4: Limits will depend on the sensitivity of the receiving waterbody.

Note 5: BAT associated emissions levels are highly dependent on production process, wastewater matrix and treatment. These parameters shall be considered on a site-specific basis when setting emission limit values.

Note 6: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

7. COMPLIANCE MONITORING

The methods proposed for monitoring the emissions from the sector are set out below. Licence requirements may vary from those stated below due to site-specific considerations, sensitivity of receiving media, and scale of the operations.

7.1 MONITORING OF EMISSIONS TO AIR

- Monitoring of minor boiler stack emissions for SOx, NOx, CO and particulates, as required by the licence, taking account of the nature, magnitude and variability of the emission and the reliability of the controls.
- Monitoring of boiler combustion efficiency in accordance with the manufacturer's instructions at a frequency determined by the Agency.
- Annual monitoring of driers, filter exhausts and powder transfer or conditioning units for particulates – PM_{10}.
- Continuous monitoring on main emissions where technically feasible (e.g. TOC, HCl, Particulates, CO, SO_2, NOx).
- Periodic monitoring of stacks for other parameters as determined by the Agency.
- Monitor solvent / VOC usage by annual mass balance reports and use to determine fugitive emissions.
- Olfactory (sniff) assessment for odours should be carried out daily or as directed by the Agency at a minimum at four boundary locations and at the nearest odour sensitive locations to be agreed with the Agency.

7.2 MONITORING OF AQUEOUS EMISSIONS

- For uncontaminated cooling waters, continuous monitoring of temperature and flow.
- Continuous monitoring of flow, volume, pH, temperature and any other relevant parameters deemed necessary by the Agency, taking account of the nature, magnitude and variability of the emissions and the reliability of the control technique.
- Establish existing conditions prior to start-up of key emission constituents and salient flora and fauna.
- Monitoring of influent and effluent for the waste water treatment plant to establish % BOD and COD reduction and early warning of any difficulties in waste water treatment, or unusual loads.
- The potential for the treated effluent to have tainting and toxic effects should be assessed and if necessary measured by established laboratory techniques.
- Periodic biodegradability checks where appropriate on effluents to municipal waste treatment plants, both prior to start-up and thereafter.

7.3 MONITORING OF EMISSIONS TO GROUNDWATER

There should be no direct emissions to groundwater, including during extraction and treatment of groundwater.

7.4 MONITORING OF SOLID WASTE

- The recording in a register of the types, quantities, date and manner of disposal/recovery of all wastes.
- Leachate testing of sludges and other material as appropriate being sent for landfilling.
- Annual waste minimisation report showing efforts made to reduce specific consumption together with material balance and fate of all waste materials.

PART B - PRODUCTION OF ALUMINA

8. PROCESS DESCRIPTION, RISK TO THE ENVIRONMENT AND CONTROL TECHNIQUES

(Note: any reference to BREF in this document means the reference document on *Best Available Techniques in the Large Volume Inorganic Chemicals – Solids and Other Industry*, published by the European Commission.)

8.1 DESCRIPTION OF PROCESS

Alumina (aluminium oxide, Al_2O_3) is extracted from bauxite ore. The economic commercial process is the Bayer Process; see Section 4 of the BREF on *Non Ferrous Metals Industries*, (NFM BREF), Section 2.3 of the BREF on BAT for *Management of Tailings and Waste-Rock in Mining Activities* (MT & WRM BREF), and Section 12 of US Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, January 1995, (updated 2001-2004 (US EPA AP-42). There are four principal stages in the Bayer Process; these stages are described in the following sub-sections.

8.1.1 Digestion of Bauxite

Grinding: Bauxite is ground down to allow better solid-liquid contact during digestion. Recycled caustic soda solution is added to produce a pumpable slurry, and lime is introduced for phosphate control and mud conditioning.

Desilication: The silica component of the bauxite is chemically attacked by caustic soda. Prior to digestion, the slurry is heated and held at atmospheric pressure in pre-treatment tanks. Most desilication products pass out with the mud waste as sodium aluminium silicate compounds.

Digestion: Slurry is pumped through agitated, vertical digester vessels operating in series. Mixed with steam and caustic solution, alumina in the bauxite forms a concentrated sodium-aluminate solution leaving undissolved impurities, principally inert iron, titanium oxides and silica compounds. Reaction conditions are about 250°C and 3500 kPa. After digestion, approximately 30%, of the bauxite mass remains in suspension, as thin red mud slurry of silicates, oxides of iron and trace metals. Heat is recovered and recycled throughout the process, principally through recovery of flash steam from coolers.

8.1.2 Clarification of the Liquor Stream

Settling: Most red mud waste solids are settled from the liquor stream in single deck settling tanks. Flocculants improve the rate of mud settling and achieve good clarity in the overflow liquor.

Washing: The mud is washed with fresh water in counter-current washing trains to recover the soda and alumina content in the mud before being disposed of, usually in an on-site landfill known as the red-mud pond. Lime is added to remove carbonate (Na_2CO_3) and to regenerate caustic soda, allowing the insoluble calcium carbonate to be removed with the waste mud.

Filtration: Overflow liquor from the settling tanks, containing traces of fine mud, passes through pressure filters. Slaked lime slurry is used to produce a filter cake. Mud particles join the main red-mud stream at the washers.

Heat Recovery: The filtered liquor containing alumina, in clear supersaturated solution, is cooled by flash evaporation and the steam is recovered.

8.1.3 Precipitation of Alumina Hydrate

Crystallisation: The cooled pregnant liquor flows to rows of precipitation tanks, which are seeded with fine crystalline alumina to promote crystal growth. The entry temperature and the temperature gradient across the row, seed rate and caustic concentration are control variables used to achieve the required particle size distribution in the product.

Classification: The precipitated crystals are settled from the liquor stream and separated in classification tanks. The finer crystals are recycled to the precipitation tanks as seed. Spent caustic liquor from the classifiers is returned through an evaporation stage where it is re-concentrated, heated and recycled to the digesters. Fresh caustic soda is added to the stream to make up for process losses.

8.1.4 Calcination of Alumina

Washing: A slurry of coarse crystals ($Al_2O_3.3H_2O$) is pumped to hydrate storage tanks and is filtered and washed to remove process liquor.

Calcining: The resulting filter cake is calcined to remove both free moisture and chemically-combined water. Temperatures above 1,100°C are used.

Cooling: The calcined alumina is cooled – the heat is recovered to pre-heat secondary combustion air for the kilns – and the alumina is conveyed to silos for storage prior to shipment.

8.2 RISK TO THE ENVIRONMENT

The key environmental issues of concern for the production of alumina are:

- the disposal of red mud waste, the potential risk of caustic contamination of groundwater and surface water from the red-mud and leaks of process liquors
- emission to air in the form of dust
- the very intensive energy consumption of the process which could give rise to further emissions to air in the form of NO_X, SO_2 and CO_2.

8.2.1 Emissions to Air

Potential process emissions to the air include:
- particulate dust from calcining
- SO_2, CO_2 and NO_X from steam raising and calcining
- steam from liquor clarification.

Potential fugitive emissions to the air include:
- particulate matter from unloading, loading, storage and handling of solid materials (bauxite ore, alumina powder)
- landfill dust blow-off
- vents on storage tanks
- steam vents
- leakage from pumps, flanges, seals, etc.
- building losses (through doors, windows)
- odours from production process.

8.2.2 Emissions to Water

Emissions to water can originate directly from the processing plant or can occur when external water sources (e.g. rain water) pass through waste containment areas. These emissions include:
- contaminated storm water from engineered landfill
- boiler feed water treatment
- water treatment plant
- equipment and tank cleaning
- drainage from waste material storage
- boiler blow-down
- laboratory effluent.

In addition, emissions can occur from spills, leaks and other sources, including:
- leaks from process liquid storage tanks
- bund and storage pond overfill
- leaks from pipe work
- drains
- contaminated storm water in the process area.

8.2.3 Waste

The solid waste material from the Bayer Process includes:
- red mud
- sand
- salts (possibly containing vanadium and tellurium, cobalt and copper)
- sludges from waste water treatment plants
- trace quantities of metals, possibly including aluminium, iron, magnesium, potassium and chromium.

Additional solid waste may be generated during the handling of the raw bauxite ore or alumina powder, from packaging of process materials and waste from ancillary operations.

8.2.4 Noise

The heavy machinery used in the production of alumina can give rise to emissions of noise and/or vibration.

8.3 CONTROL TECHNIQUES

The existing or possible measures for eliminating, reducing and controlling emissions in the production of alumina are described in this section.

8.3.1 Techniques for Prevention and Minimisation of Resource Consumption

8.3.1.1 Process Selection

The economic, commercial process used in the production of alumina is the Bayer Process. The optimisation of this process will have an effect on releases of all pollutant types and will also have a significant effect on energy use (see NFM BREF Section 4.3.2).

8.3.1.2 Use of Energy

For guidance on measures in relation to the use of energy, have regard to the Agency's BAT Guidance Note on Energy. Energy efficient techniques are described in Section 4.2.1.1 of the NFM BREF.

The collection of waste heat through flash cooling and its re-use in the process can be implemented at several stages.

The parallel existence of a high electricity demand with a high heat load means that an alumina refinery is a prime candidate for CHP (combined heat and power).

8.3.1.3 Raw Materials

Processing bauxite with a high alumina content increases the yield of alumina.
Reuse of collected dusts and sodium hydroxide solution in the process increases the potential volume of alumina produced and reduces the volume of fresh sodium hydroxide required in the digestion stage.
Recovered lime from the red mud residue can also be re-used in the digestion stage.

8.3.2. Techniques for Prevention and Minimisation of Emissions

8.3.2.1 Choice of Raw Materials

Processing bauxite with a high alumina content reduces the quantity of red-mud produced, thereby reducing the requirement for landfill capacity, the risk of contamination of ground- or surface-water and the potential for dust blow-off from landfill surface.

The use of low sulphur fuels reduces SO_2 emissions.

8.3.2.2 Efficient Calciner Operation

Utilising an efficient calciner will reduce the energy required to calcine the aluminium hydroxide and will reduce dust emissions to the environment (see NFM BREF Sections 2.6.1 & 4.3.2).

8.3.2.3 Management of the Red-Mud Pond

Efficient washing of the red-mud and recovery of caustic soda reduces the risk of high pH leachate from the red mud pond.

Maintaining the surface of the red-mud damp reduces dust blow-off in the short term while covering it with organic overburden and, where possible, planting with grass or other plants eliminates blow-off in the longer term (see MT & WRM BREF Section 3.1.1).

8.3.3 Specific Techniques for NO_X Emissions

NO_X is primarily generated through the combustion of fuel, whether in the steam-raising plant or in the calciner furnace.

8.3.3.1 Minimisation of NO_X Formation

Techniques for minimising NO_X formation are:

- Use of low NO_X burners
- Dry low NO_X techniques in gas turbines, if these are used as part of a CHP plant configuration
- Heat recovery at various stages through the process reduces the overall consumption of fuel, thereby reducing the potential for emissions of NO_X.

8.3.4 Abatement of NO_X Formation

Techniques for abating NO_X emissions are described in the NFM BREF:

- Selective non-catalytic reduction (SNCR): Involves injecting ammonia based compounds into the exhaust gas to reduce NO_X to N_2O
- Selective catalytic reduction (SCR): operates similar to SNCR in that ammonia is used to reduce NO_X to N_2, assisted by a catalyst allowing a lower temperature range compared to SNCR.

8.3.4.1 Specific Techniques for SO_2 Emissions

SO_2 is primarily generated through the combustion of fuel, whether in the steam-raising plant or in the calciner furnace.

8.3.4.2 Minimisation of SO_2 Formation

Techniques for minimising SO_2 formation are:

- choice of raw fuels: minimise sulphur content
- heat recovery at various stages through the process reduces the overall consumption of fuel, thereby reducing the potential for emissions of SO_2.

8.3.4.3 Abatement of SO_2 Formation

Techniques for abating SO_2 emissions:

- Wet scrubbing with lime
- Sea-water scrubbing; however, cross media effects need to be considered (see NFM BREF Section 4.3.9).

8.3.5 Specific Techniques for Dust Emissions

8.3.5.1 Minimisation of Dust Emissions

Techniques for minimising dust and particulate emissions are describe in the NFM BREF are:

- Dust generated during the transfer of ore or alumina can be minimised through the use of:
  a) vacuum suction system for off-loading materials delivered by sea
  b) covered trucks or wagons and discharge to delivered by road transport
  c) storing bauxite ore in covered holding areas or silos
  d) storing processed alumina in silos or similar
  e) protecting areas where either bauxite or alumina is stored or transferred from wind and gusts, to prevent dust blow-off.
- Process dust emissions can be minimised using cyclones prior to dust abatement equipment (see NFM BREF Section 2.8.1.1.3)
- Fugitive dust emissions can be minimised through a simple and linear site layout, paved roads, closed storage with automatic handling, enclosed conveyors for dusty materials/fines, a minimum number of conveyor transfer points and good housekeeping. Other techniques such as the use of automatic devices and control systems, minimising process upsets and preventive maintenance will also help prevent fugitive dust emissions.

Dust emissions from the Bayer process itself can be in the form of bauxite or alumina. It is particularly important to control emissions in the thoracic and respirable ranges (less than 10 μm). The size of the alumina powder particles is determined during calcining. The typical size of a calcined alumina grain is 40 to 100 μm, composed of alumina crystallites of between 0.5 and 10 μm. Thus, alumina is likely to contain a dust fraction within the range of thoracic and respirable dust, whereas crushed and milled bauxite, having a minimum particle size in the region of 100 μm, is not.

Refer also to BREF Section 4.3.2.3 on minimising dust from the red mud pond.

8.3.5.2 Abatement of Dust Emissions

Techniques for abating dust emissions include:

- Electrostatic Precipitators (ESP) to abate dust emissions during calcining (see NFM BREF Section 2.8.1.1.1)
- Fabric and bag filters in the crushing process (see NFM BREF Section 2.8.1.1.4)
- Ceramic and metal mesh filters can be used in both the crushing and calcining processes and are capable of removing fine particles (PM_{10}) (see NFM BREF Section 2.8.1.1.5)
- Wet Scrubbers (see NFM BREF Section 2.8.1.1.6)
- Spray towers, floating bed scrubbers and quench tower and spray screens (see US EPA AP-42).

8.3.6 Specific Techniques for Emissions to Water

8.3.6.1 Minimisation of Emissions to Water

Techniques for minimising liquid emissions include:

- Appropriate design and construction of the red-mud pond
- Efficient use of water in the process cycle and operating a closed water system. Recycling of treated stormwater for secondary process uses, e.g. washing
- Recovery and re-use of sodium hydroxide solution
- Protection of stored material against rain ingress
- Installing condensers on all appropriate process equipment
- Draining, to sumps, all areas, where spillages are most likely
- Separation of liquid waste streams to allow for the efficient treatment of each stream by the required method
- Bunding of tanks and overfilling protection measures
- Use of over-ground pipelines
- Use of impervious, hard standing with appropriate drainage and collection in areas where process leaks are likely or where rainwater is likely to contact spillage.

Avoiding or minimising the contamination of waste water through appropriate site layout and design of surface water collection systems.

Keeping uncontaminated water separate from contaminated water and good housekeeping measures to minimise the likelihood of contamination by particulates.

Refer also to BREF Section 4.3.2.3 on the management of the red-mud pond.

8.3.6.2 Abatement of Emissions to Water

Any liquid that is not re-used or recycled requires treatment before being released, in order to remove solid particles and neutralise its acidity/alkalinity. Treatment of contaminated water may involve:

- coagulation/flocculation/precipitation
- sedimentation/filtration/flotation
- centrifugation
- pH correction
- mixture of liquid streams to utilise their properties (acid and alkali to neutralise each other).

8.3.7 Techniques for Recovery and Recycling of Wastes

Collected dust can be recovered and reused in the alumina production process. The economic value of dust generated during calcining leads to the use of extensive measures to reduce such emissions (see Section 12 of US EPA AP-42).

Dust generated during crushing and grinding can be recovered and used in the digestion process.

Emerging techniques are under investigation for the re-use of red-mud but these have not yet been developed sufficiently to demonstrate their viability.

8.3.7.1 Techniques for Appropriate Disposal of Wastes

For all waste streams, the emphasis is on the following:

- reducing the volume of waste produced
- re-using waste at an earlier stage of the process
- re-cycling waste for use in the process, or for use in another industry.

Only where the above techniques are incompatible with the process or waste produced should they be disposed of, by suitable means. The following techniques are used to treat sludge material, including red mud and other process waste, before disposal:

- gravity thickening
- dissolved air flotation
- filtration
- centrifugation.

The solid (or semi-solid) waste can then be disposed in landfill (on- or off-site), while the liquid drawn off can be re-used or disposed after further treatment, if necessary.

The principal waste from the production of alumina is red-mud and this is usually disposed of in an appropriate landfill on-site.

Refer also to Section 4.5 of the NFM BREF on Emerging Techniques and Section 6.5 of the MT & WRM BREF.

8.3.8 Noise

For guidance on measures in relation to noise have regard to the Agency's Guidance Note for Noise in Relation to Scheduled Activities and any other guidance issued by the Agency.

9. BEST AVAILABLE TECHNIQUES FOR THE PRODUCTION OF ALUMINA

9.1 INTRODUCTION

As explained in Section 2, this Guidance Note identifies BAT but obviously does so in the absence of site-specific information. Accordingly, it represents the requirements expected of any new activity covered by the Note and ultimately the requirements expected of existing facilities, but exclude additional requirements, which may form part of the granting of a licence for a specific site.

The technical feasibility of the measures listed below has been demonstrated by various sources. Used singly, or in combination, the measures represent BAT solutions when implemented in the appropriate circumstances. These circumstances depend on plant scale, fuels used, nature of process, etc.

9.2 PROCESS SELECTION

The Bayer Process is the standard technique to consider for the production of alumina from bauxite. However, consideration must be given to variations in this process (see NFM BREF Section 4.3.2).

9.3 GENERAL PRIMARY MEASURES

BAT for the production of alumina includes the following general primary measures:

- Maintaining a smooth and stable process by operating close to process parameter set points. This can be achieved by optimising process control including the use of computer based automatic control systems
- Maximising energy recovery and reuse:
    a) Design and operation of digesters to minimise energy use
    b) The use of fluidised bed calciners
    c) CHP
    d) Following the BAT Guidance Note on energy use
- Where practicable, selection of raw materials and fuels with low sulphur, nitrogen, chlorine, metals and volatile organic compound content
- Use of bauxite with a high content of alumina.

9.4 NITROGEN OXIDES

BAT for reducing NO_X emissions is the combination of the above described general primary measures and:

- Flame cooling
- Low NO_X burners
- Selective non-catalytic reduction (SNCR).

9.5 SULPHUR DIOXIDE

BAT for reducing SO_2 emissions are the combination of the above-described general primary measures and flue gas de-sulphurisation using wet or dry scrubbing.

9.6 DUST

BAT for reducing dust emissions are the combination of the above described general primary measures and:

- Minimisation of particulate matter from point sources by application of cyclones
- Efficient removal of particulate matter from point sources by application of:
  a) Electrostatic precipitators
  b) Fabric filters with multiple compartments and burst bag detectors
- Minimisation/prevention of dust emissions from fugitive sources as described in BREF Section 4.3.5.1 and, where this is not possible/practicable, abatement of dust emissions from fugitive sources as described in Section 4.3.5.2.

Fugitive releases should be considered in the design of the equipment, plant layout and operating procedures. It is equally important to minimise fugitive emissions, as it is process emissions.

Due to the low size range of alumina dust it may be appropriate to specify as BAT for control of alumina dust, measures which are capable of achieving lower ELVs than for crushed and milled bauxite. Table 2.10 in the NFM BREF lists the current emissions achievable using a range of abatement techniques and Section 2.8.3.2 explains the considerations to be made when choosing a particular technique.

9.7 WASTE WATER

Effluent should be minimised by recycling and re-use wherever practicable. Cooling water, storm water, bund water and effluents of different origin should be separated in order to permit appropriate treatment/recycling options. The use of lower quality water may be possible for some parts of the process rather than fresh water (e.g. dust suppression).

Appropriate methods to reduce emissions to water:

- The removal of metal compounds by neutralisation, ion exchange and precipitation
- The removal of organic compounds by gravity separation techniques, dissolved air flotation, flocculation, sedimentation and filtration
- Solids removal from waste waters by screening and grit settlement, followed by combinations of neutralisation, coagulation/flocculation, flotation, sedimentation and filtration
- Dewatering of sludges or waste solids. Methods available include combinations of gravity thickening, filtration, drying, centrifugation and sludge digestion
- The surface water from roofs and roadways should flow into surface water drains. Suitably designed interceptors and recovery systems should be provided to minimise the escape of oils and solids in the surface water discharged from the site.

9.8 WASTE

The recovery and reuse of collected particulate matter in the process is considered BAT. Where the collected dusts are not reusable utilisation of these dusts in other commercial products, where possible, is considered BAT.

Solid wastes from the processing of alumina (red mud, sand and salts) require treatment before they can be disposed of in landfill. Methods of disposal include:

- depositing red mud on or near the site in ponds lined with impervious clay or other suitable liners
- returning excess water from the ponds to the process, while spraying the pond with water to prevent dust blow-off
- use of deep thickeners to produce a red mud of 50% - 60% solids concentration
- minimising the lime solids in the red mud by recovering and introducing them at the digestion stage
- reclamation of the mud by neutralisation, covering with top soil and planting with vegetation.

Further information on a number of waste gas and wastewater treatment techniques can be found in the BREF document on Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector, EIPPCB, February 2003.

10. BAT ASSOCIATED EMISSION LEVELS

10.1 EMISSION LEVELS FOR DISCHARGES TO AIR

The BAT associated emission levels for emissions to air are as follows:

Table 10.1: BAT Associated Emission Levels for Emissions to Air

Parameter	Emission Levels [mg/m^3]
Particulates	20 - 50
Other	Note 1

Note to Table 10.1

Note 1: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

10.2 EMISSION LEVELS FOR DISCHARGES TO WATER

The following table sets out emission levels that are achievable using BAT for wastewater treatment. However establishing emission limit values within a licence for direct discharges to surface water from wastewater treatment plant and storm water discharges must ensure that the quality of the receiving water is not impaired or that the current Environmental Quality Standards (EQS) are not exceeded.

All discharges to sewer are subject to approval from the Sanitary Authority.

Compliance with the Water Framework Directive (2000/60/EC) is required where relevant, in particular Article 16.

Table 10.2: BAT Associated Emission Levels for Discharges to Water*

Constituent Group or Parameter	**Emission Levels**	**Notes**
pH	6 - 9	
Toxic units (TU)	5	1
BOD_5		5
Suspended solids	50mg/l	
Total Nitrogen (as N)	80% removal^3 or 5 - 15mg/l	2, 4
Total Phosphorus (as P)	>80% removal^3, or 2mg/l	4
Oils, fats and grease	10 - 15mg/l	
Mineral oil (from interceptor)	20mg/l	
Mineral oil (from biological treatment)	1.0mg/l	
Metals		5
Priority Substances (as per Water Framework Directive)		5
Other		5, 6

* All values refer to daily averages based on a 24-hour flow proportional composite sample, except where stated to the contrary and for pH, which refers to continuous values. Levels apply to effluent prior to dilution by uncontaminated streams, e.g. storm water, cooling water, etc.

* Temperature measured downstream of a point of thermal discharge must not exceed the unaffected temperature by more than 1.5°C in salmonid waters and 3°C in cyprinid waters (Freshwater Fish Directive 79/659/EEC).

Note to Table 10.2

Note 1: The number of toxic units (TU) = 100/x hour EC/LC50 in percentage vol/vol so that higher TU values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

Note 2: Total Nitrogen means the sum of Kjeldahl Nitrogen, Nitrate N and Nitrite N.

Note 3: Reduction in relation to influent load.

Note 4: Limits will depend on the sensitivity of the receiving waterbody.

Note 5: BAT associated emissions levels are highly dependent on production process, wastewater matrix and treatment. These parameters shall be considered on a site-specific basis when setting emission limit values.

Note 6: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

Reference should be made to Section 6.1 of Part A of this document.

11. COMPLIANCE MONITORING

The methods proposed for monitoring the emissions from the sector are set out below. Licence requirements may vary from those stated below due to site-specific considerations, sensitivity of receiving media, and scale of the operations.

11.1 MONITORING OF EMISSIONS TO AIR

- Continuous monitoring of the following from calciner exhausts (with periodic monitoring by specified methods as appropriate):
    a) gas volume (or alternative estimation method)
    b) temperature
    c) humidity
    d) O_2
    e) CO_2
    f) CO
    g) NO_X
    h) SO_2
    i) particulate matter (opacity may be acceptable as an alternative)
- Continuous monitoring of particulate matter in exhaust streams from the crushing/grinding process. Opacity may be acceptable as an alternative
- Periodic monitoring of particulates from sources other than calciners and crushers, typically once per quarter, taking account of the nature, magnitude and variability of the emission and the reliability of the controls
- Periodic monitoring of stacks for other parameters as determined by the Agency, including extractive sampling, visual inspection
- Pressure drop indicators to be fitted to all fabric filters and continuously monitored on major sources
- Where electrostatic precipitators are in use on major sources (e.g. calciners), corona power should be continuously recorded
- Monitoring of minor boiler stack emissions for SOx, NOx, CO and particulates, as required by the licence, taking account of the nature, magnitude and variability of the emission and the reliability of the controls
- Monitoring of boiler combustion efficiency in accordance with the manufacturer's instructions at a frequency determined by the Agency.

11.2 MONITORING OF AQUEOUS EMISSIONS

- For uncontaminated cooling waters, continuous monitoring of temperature and flow
- Continuous monitoring of flow, volume, pH, temperature and any other relevant parameters deemed necessary by the Agency, taking account of the nature, magnitude and variability of the emissions and the reliability of the control technique
- Testing of TOC/BOD/COD, turbidity and dissolved oxygen at a frequency set by the nature, magnitude and variability of the emission and the reliability of the control techniques
- Establish existing conditions prior to start-up of key emission constituents and salient flora and fauna
- Monitoring of influent and effluent for the waste water treatment plant to establish % BOD and COD reduction and early warning of any difficulties in waste water treatment, or unusual loads
- The potential for the treated effluent to have tainting and toxic effects should be assessed and if necessary measured by established laboratory techniques
- Periodic biodegradability checks where appropriate on effluents to municipal waste treatment plants, both prior to start-up and thereafter.

11.3 MONITORING OF EMISSIONS TO GROUNDWATER

There should be no direct emissions to groundwater, including during extraction and treatment of groundwater.

11.4 MONITORING OF SOLID WASTE

- The recording in a register of the types, quantities, date and manner of disposal/recovery of all wastes
- Leachate testing of sludges and other material as appropriate being sent for landfilling
- Annual waste minimisation report showing efforts made to reduce specific consumption together with material balance and fate of all waste materials.

Appendix 1

PRINCIPAL REFERENCES

[1] SIC BREF (Draft BREF on Production of Speciality Inorganic Chemicals, EIPPCB, September 2004).

[2] WW/WG BREF (BREF on Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector, EIPPCB, February 2003).

[3] WTI BREF (Draft BREF for the Waste Treatment Industries, EIPPCB, January 2004).

[4] Storage BREF (Draft BREF on Emissions from Storage, EIPPCB, July 2003).

[5] LVIC BREF (BREF on Large Volume Inorganic Chemicals – Solid, EIPPCB, August 2004).

[6] E & CME BREF (Draft BREF on Economics and Cross-Media Effects under IPPC, EIPPCB, September 2003).

[7] Monitoring BREF (BREF on the General Principles of Monitoring, EIPPCB, July 2003).

[8] Cooling Systems BREF (BREF on Industrial Cooling Systems, EIPPCB, December 2001).

[9] Combustion BREF (BREF on Large Combustion Plant, EIPPCB, March 2003).

[10] EPA Guidance Note on Energy Efficiency Auditing (Guidance Note on Energy Efficiency Auditing, Environmental Protection Agency, July 2003).

[11] NFM BREF (BREF on Non Ferrous Metals Industries, EIPPCB, May 2000).

[12] EPA BATNEEC Note on Alumina (Environmental Protection Agency, Integrated Pollution Control Licensing – BATNEEC Guidance Note for the Extraction of Alumina, LC 14(8/96), 1996, ISBN 1 899965 26 2).

[13] VDI Emission Control Aluminium Reduction (Verein Deutscher Ingenieure, Emission Control – Aluminium reduction plants, VDI 2286 Part 1, December 1998).

[14] US EPA AP-42 (US Environmental Protection Agency, Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, January 1995, (updated 2001-2004)).

[15] LCP Directive (Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants).

[16] CH-AL BREF (BREF on BAT in the Chlor-Alkali Manufacturing Industry, EIPPCB, December 2001).

[17] MT & WRM BREF (BREF on BAT for Management of Tailings and Waste-Rock in Mining Activities, EIPPCB, July 2004).

[18] Guidance Note For Noise in Relation to Scheduled Activities - 2ND Edition (EPA (2006)).

Appendix 2

GLOSSARY OF TERMS AND ABBREVIATIONS

AOX	Adsorbable Organic Halides
BOD	Biochemical Oxygen Demand
°C	Degree Celsius
CHP	Combined Heat and Power
CO	Carbon monoxide
COD	Chemical Oxygen Demand
CO_2	Carbon dioxide
EOX	Extractable Organic Halides
ESP	Electrostatic Precipitator
F	Fluorine
HCl	Hydrochloric acid
HEAF	High Efficiency Air Filter
HEPA	High Efficiency Particle Air
HF	Hydrofluoric acid
K	Degree Kelvin (0 °C = 273.15 K)
kPa	Kilopascal
m^3	Cubic metre
MF	Microfiltration
mg	Milligramme
N_2	Nitrogen
NF	Nanofiltration
NH_3	Ammonia
NH_4	Ammonium
NH_4-N	Ammonium (calculated as N)
Nm^3	Normal cubic metre (101.3 kPa, 273 K)
N_2O	Nitrous oxide
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
O_2	Oxygen
PM_{10}	Particles < 10µm in diameter
PO_4-P	Phosphate (calculated as P)
SCR	Selective Catalytic Reduction
SCWO	Super Critical Water Oxidation
SNCR	Selective Non-Catalytic Reduction

SO_2	Sulphur dioxide
SO_x	Sulphur oxides
t	Tonne (metric)
TSS	Total Suspended Solids
UF	Ultrafiltration
VOC	Volatile Organic Compounds