
# Draft BAT Guidance Note on Best Available Techniques for the Initial Melting and Production of Iron & Steel Sector

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# Contents

# 1. INTRODUCTION

## 1.1 GENERAL

This Guidance Note is one of a series issued by the Environmental Protection Agency (EPA) providing 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 Control (IPC) licensees whose licence is to be reviewed under the Environmental Protection Agency Acts, 1992 to 2007;
- Applicants seeking Waste licences 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 | Sectors Covered by the Guidance Note |
| 4 | Process Description, Risk to Environment and Control Techniques |
| 5 | Best Available Techniques |
| 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 Note for Storage and Transfer of Materials for Scheduled Activities*, *Agency Guidance Note 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 industrial activities of Iron and Steel Production Classes 3.1.1 & 3.1.2.

# 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 current 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. Operators should therefore continue to keep up to date with the best available techniques relevant to the activity and discuss appropriate innovations with the EPA.

## 2.2 INTERPRETATION OF BAT

The concept of BAT was introduced as a key principle in the *IPPC Directive 96/61/EC* [1]. This Directive has been incorporated into Irish law by the *Protection of the Environment Act 2003*. This implementing legislation extended the concept of BAT to all *EPA Act* authorised facilities, regardless of whether or not they were included in *Annex I* of the *IPPC Directive*. 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. Thus, for activities regulated by these Acts, BAT must be applied.

BAT reference documents (BREF) are produced by the European Commission as an expert opinion of what is considered to be BAT for a specific sector and is intended to be a driver towards improved environmental performance across the European Union. The Best Available Techniques Reference Document on the Production of Iron and Steel has been prepared (December 2001) and is referenced throughout this document. It should be noted that a review of this BREF document began in September 2006.

Best available techniques (BAT) is defined in the *Protection of the Environment Act 2003* 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 values designed to prevent or eliminate or where that is not practicable, generally to reduce an emission and its impacts 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.

[1] Directive 2008/1/EC codified version.

T ***"techniques"*** includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned.

The essence of BAT is that the selection of techniques to protect the environment should achieve an appropriate balance between realising environmental benefits and the costs incurred by the person carrying on the activity. In the identification of BAT, emphasis is placed on pollution prevention techniques, including cleaner technologies and waste minimisation, rather than end-of-pipe treatment.

In terms of emission levels, the limits identified in this Guidance Note (Section 6) are regarded as representing BAT for a new activity. At installation level, the most appropriate techniques will depend on local factors. A local assessment of cost and benefits of the available options may be needed to establish the best option. The choice may be justified on:

- Technical characteristics of the installation;
- Its geographic location;
- Local environmental considerations;
- The economic and technical viability of upgrading existing installations.

The overall objective of ensuring a high level of protection for the environment as a whole will often involve making trade-off judgments 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.

The entire range of techniques, technologies, standards identified would not necessarily be appropriate in specific cases. The specific choice depends on a wide range of circumstances but the crucial factor is that the selected regime achieves BAT. In general terms what is BAT for one installation is likely to be BAT for a comparable installation. However, determination of what is BAT is ultimately a matter for case-by-case decision taking into account that individual circumstances may affect BAT judgments and what are the appropriate permit conditions.

## 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 2008/1/EC and the Environmental Protection Agency Acts 1992 and 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;

(vi) 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;

(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.

## 2.4 OTHER ACTIVITIES

As well as the processing on Iron and Steel Production Classes 3.1.1 and 3.1.2, other ancillary activities may take place on a installation, all relevant BAT Notes applicable to the activities should be considered by the applicant in preparing an application.

# 3. SECTOR COVERED BY THIS GUIDANCE NOTE

This Guidance Note covers sector 3.1.1 and 3.1.2 of the activities specified in the *First Schedule* of the *Environmental Protection Agency Acts 1992 to 2007*. These are:

**3.1.1** The production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2.5 tonnes per hour.

**3.1.2** The initial melting or production of iron or steel not included in paragraph 3.1.1.

The document covers the environmental aspects of iron and steel making in integrated steel works and electric arc furnace steel making.

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

(Note: Any reference to Iron & Steel BREF in this document means the Reference Document on Best Available Techniques on the Production of Iron and Steel, published by the European Commission, December 2001).

The general production sequences involved in the Iron and Steel Industry Classes 3.1.1 and 3.1.2 and Class 3.8 covering pressing, drawing and stamping of large castings where the production area exceeds 500 square meters are described herein, the risks to the environment are presented in Section 4.2.

## 4.1 DESCRIPTION OF PROCESSES

### 4.1.1 General Production Processes

The production of Iron and Steel in the aforementioned Class 3.1.1 and 3.1.2 involving:

- Integrated Steelworks:
  - Sinter Plants;
  - Pelletisation Plans (typically not part of an integrated steelworks);
  - Coke Oven Plants;
  - Blast Furnaces;
  - Basic Oxygen Steel Making & Casting.
- Electric Arc Furnace Steel Making.

#### *4.1.1.1 Integrated Steelworks (Iron & Steel BREF 3.2)*

This involves production in the classic blast furnace/basic oxygen furnace in large industrial complexes known as integrated steelworks. These are characterised by networks of interdependent material and energy flows between the various production units including sinter plants, pelletisation plants, coke oven plants, blast furnaces and basic oxygen steel making plants with subsequent casting.

The process routes of an integrated steelworks are outlined in the Iron and Steel BREF 3.2.1. The blast furnace is the main operational unit producing iron (pig iron). The two types of iron ore preparation plants are sinter and pellet plants. Coke and powdered coal are the main reducing agents in the blast furnace. The slag from the furnace is granulated, pelletised or tapped into slag pits. The liquid iron is transported to a basic oxygen furnace where carbon content is lowered. Upstream ladle desulphurisation of the pig iron and downstream ladle metallurgy of the steel may also be applied. On leaving the basic oxygen furnace the liquid steel is cast either into ingots or by means of continuous casting.

The interdependency of the different production processes/units in terms of energy, by-products/residue, air and water is presented in the Iron and Steel BREF 3.2.2.

#### *4.1.1.1.1 Sinter Plants (Iron and Steel BREF 4)*

Sintering involves agglomerating the furnace charge, which consists of a mixture of fine ores, additives, iron-bearing, recycled material from downstream operations such as course dust and sludge from blast-furnace gas cleaning, mill scale, casting scale etc., to which coke breeze is added for ignition purposes. Sinter plant operations include:

- Blending and mixing of raw materials (Iron and Steel BREF 4.1.2);
- Sinter strand operations (Iron and Steel BREF 4.1.3);
- Hot sinter screening and cooling (Iron and Steel BREF 4.1.4).

#### *4.1.1.1.2 Pelletisation Plants (Iron and Steel BREF 5)*

Pelletisation involves the preparation of iron oxide materials for primary and secondary steel making. Pellets are formed from raw materials – fine ore and additives of <0.05mm formed into spheres (9-11mm) using very high temperatures.

The applied processes and techniques involved are:

- Grinding and drying/dewatering (Iron and Steel BREF 5.1.1);
- Green ball preparation (Iron and Steel BREF 5.1.2);
- Induration (Iron and Steel BREF 5.1.3);
- Screening and handling (Iron and Steel BREF 5.1.4).

#### *4.1.1.1.3 Coke Oven Plants (Iron and Steel BREF 6)*

Coal pyrolysis involves the heating (1,000 – 1,100°) of coal in an oxidation free atmosphere to produce gases, liquids and a solid residue (char or coke). This produces blast furnace and foundry cokes. Coke is the primary reducing agent in blast furnaces active both as a support material and a matrix through which gas circulates in the stock column. The coke making process can be subdivided into:

- Coal handling (Iron and Steel BREF 6.1.1);
- Battery operation (coal changing, heating/firing, coking, coke pushing, coke quenching) and coke handing and preparation. (Iron and Steel BREF 6.1.2);
- Collection and treatment of coke oven gas (Iron and Steel BREF 6.1.3);
- Coke oven water flows (Iron and Steel BREF 6.1.4).

#### *4.1.1.1.4 Blast Furnaces (Iron and Steel BREF 7)*

A blast furnace is a closed system into which iron bearing materials (iron ore, lump, sinter and/or pellets), additives (slag formers such as limestone) and reducing agents (coke) are continuously fed from the top of the furnace shaft through a charging system that prevents escape of blast furnace gas. A hot air blast enriched with oxygen and auxiliary reducing agents (coal, powder, oil, natural gas and in a few cases plastics) are injected on the tuyere level providing a counter-current of reducing gases. The air blast reacts with the reducing agents to produce mainly carbon monoxide, which in turn reduces iron oxides to metal iron. The liquid iron is collected in the hearth along with the slag and both are cast on a regular basis. The liquid iron is transported in torpedo vessels to the steel plant and the slag is processed to produce aggregate, granulate or pellet for road construction and cement manufacture. The blast furnace gas is collected at the top of the furnace. It is treated and distributed around the world to be used as a fuel for heating or electricity production.

The main operations are:

- Charging of raw materials (Iron and Steel BREF 7.1.1);
- Generation of hot blast (Iron and Steel BREF 7.1.2);
- Blast furnace operation (Iron and Steel BREF 7.1.3);
- Direct injection of reducing agents (Iron and Steel BREF 7.1.4);
- Casting (Iron and Steel BREF 7.1.5);
- Slag processing (Iron and Steel BREF 7.1.6).

#### *4.1.1.1.5 Basic Oxygen Steel Making and Casting (Iron and Steel BREF 8)*

The Basic Oxygen Furnace (BOF) and the Electric Arc Furnace (EAF) are then used to produce steel.

The objective in oxygen steel making is to burn (oxidise) the undesirable impurities in the metallic feedstock. The main elements oxidised are carbon, silicon, manganese, phosphorous and sulphur.

The production of steel by the BOF process is a discontinuous process involving the following steps:

- Transfer and storage of hot metal (Iron and Steel BREF 8.1.1);
- Pre-treatment of hot metal (desulphurisation) (Iron and Steel BREF 8.1.2);
- Oxidation in the BOF (decarburisation and oxidation of impurities) (Iron and Steel BREF 8.1.3);
- Secondary metallurgical treatment (Iron and Steel BREF 8.1.4);
- Casting (continuous and/or ingot) (Iron and Steel BREF 8.1.5).

#### *4.1.1.2 Electric Steel Making and Casting (Iron and Steel BREF 9)*

The direct smelting of iron containing materials such as scrap is usually performed in the Electric Arc Furnace (EAF). The major feed stock for the EAF is ferrous scrap which may contain scrap iron from inside the steelworks, cut off from steel product manufacturers, capital or post consumer scrap and direct –reduced iron. As in the BOF a slag is formed from lime to collect undesirable components in the steel. The main operations are

- Raw material handling and storage (Iron and Steel BREF 9.1.1);
- Furnace charging with/without scrap preheating (Iron and Steel BREF 9.1.2 and 9.1.3);
- EAF scrap melting (Iron and Steel BREF 9.1.4);
- Steel and slag tapping (Iron and Steel BREF 9.1.5);
- Ladle and furnace treatments (Iron and Steel BREF 9.1.6);
- Slag handling (Iron and Steel BREF 9.1.7);
- Continuous casting (Iron and Steel BREF 9.1.8).

## 4.2 RISK TO THE ENVIRONMENT

### 4.2.1 Introduction

In this Section, the major sources of emission to air and water are identified, as are the principal sources of waste from the sector. The identified list of sources is not all

encompassing and neither will every plant falling within an individual sector have every one of the emissions, which are associated with the sector as a whole.

The key environmental impacts of this sector include:

- Noise from materials handling, rolling mills, billet casting and air extraction equipment;
- Emissions to air from scrap preparation, furnace fumes, dust and finishing processes;
- Discharges of contaminated water from material decontamination, cooling and wet scrubbing processes;
- Wastes from refractories, slags, fluxes, bag houses and electrostatic precipitators;
- Land contamination from oily residues and, potentially, the historical use of the site; and energy consumption by furnaces, air-handling equipment, motors and drives.

### 4.2.2 Emissions to Air

The principal atmospheric emissions for different processes in the industry are given in Table 2 below.

**Table 2: Summary of sources and emissions to air.**

| Process stage | Component in off-gas |
|---|---|
| Sintering (Iron and Steel BREF 4.2.2.1.) | Sulphur Oxides, Nitrogen Oxides<br>Carbon Monoxide, Fluorides<br>Dust, Heavy Metals (Pb, Hg, Zn), Alkali-chlorides, Hydrocarbons,<br>Polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs), Polychlorinated Bipheyls (PCBs), Organohalogen compounds,<br>Polycyclic Aromatic Hydrocarbons (PAHs), Cooling Particulates. |
| Pelletisation (Iron and Steel BREF 5.2.2) | Particulates, Nitrogen Oxides($NO_x$) Sulphur Dioxides, HCl and HF |
| Coke Oven Plants (Iron and Steel BREF 6.2.2) | Fugitive emissions (leakages from lids, ovendoors, leveler doors, accession pipes and emissions from coal charging, coke pushing, coke quenching), and coke oven gas treatment, waste gas from underfiring systems, Particulates, Methane, Hydrocarbons, Benzene, Poly Aromatic Hydrocarbons (PAHs), Carbon Monoxide, Sulphur Dioxide, Hydrogen Sulphide, Ammonia, Nitrogen oxides, BaP (Benzo(a)pyrene). |
| Blast Furnace (Iron and Steel BREF 7.2.2) | Waste Gas (Iron and Steel BREF 7.2.2.1) Particulates, Hydrocarbons, CN components, Ammonia, PAH, CO, Carbon Dioxide, Hydrogen, Hydrogen Sulphide, Heavy metals (Mn, Zn, Pb), nitrogen oxides, sulphur dioxide. |
| Basic Oxygen Steel making and Casting (Iron and Steel BREF 8.2.2) | Emission during oxygen blowing and converter gas (Iron and Steel BREF 8.2.2.1.1.2),<br>Particulates, Al, As, Cd, Cr, Cu, Fe, Hg, Mg, Mn, Pb, Zn, Sulphur Oxides, Nitrogen Oxides, Carbon |

| | |
|---|---|
| | Monoxide, Hydrogen Fluoride, PAH, PCDD/F.<br>Emission from ladles, ladle furnaces, BOF and other equipment used in secondary metallurgy (Iron and Steel BREF 8.2.2.1.1.3) , Particulates,<br>Secondary off gases (Iron and Steel BREF 8.2.21.2), Particulates. |
| Electric Steel Making and Casting (Iron and Steel BREF 9.2.2.1) | Off gas emissions (Iron and Steel BREF 9.2.2.1),<br>Primary off gases (Iron and Steel BREF 9.2.2.1.1),<br>Off gases directly collected from the EAF (Iron and Steel BREF 9.2.2.1.1.1), Particulates, Hg, Zn, Sulphur Oxides, Nitrogen Oxides, VOCs, PCBs, Chlorobenzene, PCDD/Fs, PAHs (Iron and Steel BREF 9.2.2.1.1.2),<br>Particulates, Secondary off gases from scrap handling and charging, steel tapping, secondary metallurgy with tapping operations and from continuous casting (Iron and Steel BREF 9.2.2.1.1.2),<br>Particulates, alkaline fumes from slag processing (Iron and Steel BREF 9.2.2.1.3). |

### 4.2.3 Emissions to Water

The principal emissions to water for different processes in the industry are given in Table 3 below.

**Table 3: Summary of sources and emissions to water**.

| Process stage | Wastewater component |
|---|---|
| Sintering (Iron and Steel BREF 4.2.2.2) | Rinsing water,<br>Cooling water,<br>Waste gas treatment water. |
| Pelletisation (Iron and Steel BREF 5.2.2.6) | Scrubber water (high HF concentrations likely)<br>Wet rinsing. |
| Coke Oven Plant (Iron and Steel BREF 6.2.3) | Gas treatment water,<br>Coke oven waste water,<br>Phenols, ammonia, cyanide,<br>Wet oxidation process wastewater (Ammonia, sulphur compounds, arsenic compounds),<br>Cooling water. |
| Blast Furnace (Iron and Steel BREF 7.2.2.3) | Wastewater from slag granules,<br>(Pb, Cr, Cu, Zn, Ni, TOC, COD),<br>Blow down from cooling water circuit. |
| Basic Oxygen Steel making and Casting (Iron and Steel BREF 8.2.2.3) | Scrubbing water from BOF Treatments (suspended solids), Water from direct cooling continuous casting (metal oxides, hydrocarbons). |
| Electric Steel making and Casting (Iron and Steel BREF 9.2.2.3) | Drainage water from scrap yard (Iron and Steel BREF 9.2.2.3.1),<br>Off gas scrubbing (Iron and Steel BREF 9.2.2.3.2),<br>Continuous Casting (Iron and Steel BREF 9.2.2.3.3). |

### 4.2.4 Wastes

Waste produced during production of pig iron and steel is presented in Table 4 below.

**Table 4: Summary of waste produced**

| Source | Waste |
|---|---|
| Sintering (Iron and Steel BREF 4.2.2.3) | Dust (dedusting and sieving),<br>Waste gas treatment sludge,<br>Filter dust. |
| Pelletisation (Iron and Steel BREF 5.2.2.7) | Sorting and beneficiation of raw materials.<br>Dust abatement system waste. |
| Blast Furnace (Iron and Steel BREF 7.2.2.2) | Dust and sludge from BF gas treatments,<br>Slag from blast furnaces. |
| Basic Oxygen Steel making and Casting (Iron and Steel BREF 8.2.2.2) | Desulphurisation slag,<br>BOF slag, Spittings,<br>Coarse dusts and sludges from BOF gas treatment,<br>Fine dusts and sludges from BOF gas treatment,<br>Dust from secondary de-dusting,<br>Slag from secondary metallurgy,<br>Slag from continuous casting,<br>Mill scale from continuous casting<br>Rubble. |
| Electric Steel making and Casting (Iron and Steel BREF 9.2.2.2) | Slags from carbon steel/low alloyed steel production:<br>• Slag from EAF;<br>• Slag from ladle.<br>Slags from high alloyed steel production:<br>• Slag from EAF;<br>• Slag from ladle;<br>• AOD slag.<br>Dusts from carbon steel/low alloyed/high alloyed steel production,<br>Refractory bricks. |

### 4.2.5 Noise

Noise and vibration can arise from the movement and storage of raw materials and products, large fans and air filtration systems, grinding and milling operations, casting installations, venting of steam and use of pumps. This can potentially create a nuisance to site neighbours and the environment. Noise can either be continuous or intermittent depending on the operation of equipment. Specific noise sources in the iron and steel industry include:

- Sintering (Iron and Steel BREF 4.2.2.5).

The noise sources include:

- Sinter waste gas fans;
- Sinter cooling fans.
- Electric Steel making and Casting (Iron and Steel BREF 9.2.2.5)

The noise sources include:

- Melting shop including EAF;
- Scrap yard;

- Primary de-dusting;
- Roof hood de-dusting;
- Water management equipment.

### 4.2.6 Soil Pollution

The principal sources of soil pollution in the iron and steel industry include:

- Coke Oven plants (Iron and Steel BREF 6.2.5)

In the coke oven gas treatment plant, tar and other organic compounds (e.g. BTX) are recovered from the coke oven gas. Spillage or leakage of these compounds may cause a soil pollution hazard, depending on local soil conditions. Furthermore, spillage or leakage of coal water may also cause a soil pollution hazard.

- Electric Steel making and Casting (Iron and Steel BREF 9.2.2.4)

In many cases the scrapyard is unpaved and uncovered. Contamination of soil may arise from storage of scrap contaminated with mineral oil/emulsions or other compounds. There is no information available about extent and impact of such soil contamination.

If the yard for slag processing is unpaved and the raw slag contains free calcium oxide alkaline water may enter the soil.

### 4.2.7 Energy

The principal areas in the iron and steel industry requiring significant energy inputs are:

- Sintering (Iron and Steel BREF 4.2.2.4)
- Pelletisation (Iron and Steel BREF 5.2.2.8)
- Coke Oven Plants (Iron and Steel BREF 6.2.4)
- Blast Furnaces (Iron and Steel BREF 7.2.2.4)
- Basic Oxygen Steel making and Casting (Iron and Steel BREF 8.2.2.4).

### 4.2.8 Site Remediation

The condition of the site when activity ceases and the need for remediation is a potential environmental issue.

### 4.2.9 Decommissioning and Aftercare

The purpose of decommissioning is to return the installation on completion of operations to a condition suitable for the selected afteruse. To do this the operator will need to demonstrate that following decommissioning the condition of the installation will not cause or be likely to cause environmental pollution. Aftercare involves any measures that are necessary to be taken in relation to the installation for the purposes of preventing environmental pollution following the cessation of activities at the installation and restoration of the site. The length of this aftercare period will vary from site to site and the licence holder remains responsible for the aftercare until the Agency accepts the surrender of the licence.

The extent of the decommissioning/restoration will be dependent on the design of the installation, any waste materials deposited on the site and the selected afteruse.

For an Iron and Steel to be decommissioned it must be:

- **Free of Contamination from Waste:** the installation should be clear of deposited residues, waste and any contamination resulting from the manufacturing activities. The land should be decontaminated to restore it to a state established prior to licensing in agreement with the EPA. For existing installations the standards for decontamination must be agreed with the EPA; and
- **Free from Continuing Emissions**: there should be no releases from the site that require management by the operator, for example surface water run off, dust, odour, etc.

The necessary measures shall be taken upon definitive cessation of activities to avoid any pollution risk and return the site of operation to a satisfactory state. Soil and water protection are of major importance and re-suspension of soil and dust to air needs to be prevented.

Further information is available in the EPA Guidance on Environmental Liability Risk Assessment, Residual Management Plans and Financial Provision (EPA 2006).

## 4.3 CONTROL TECHNIQUES

The applied control measures for eliminating, reducing and controlling emissions in the iron and steel industry are described in this Section. References to more details and descriptions in the BREF document are given.

### 4.3.1 General Preventative Methods

An Environmental Management System (EMS) is a tool that operators can use to address design, construction, maintenance, operation and decommissioning issues in a systematic, demonstrable way. An EMS includes the organisational structure, responsibilities, practices, procedures, processes and resources for developing, implementing, maintaining, reviewing and monitoring the environmental policy. Environmental Management Systems are most effective and efficient where they form an inherent part of the overall management and operation of an installation.

An environmental management system (EMS) for an IPPC installation contains the following components:

- Defining of an environmental policy;
- Planning and establishing objectives and targets;
- Implementing and operating procedures;
- Checking and corrective action;
- Management review;
- Preparing a regular environmental statement;
- Validating by certification body or external EMS verifier;
- Considering design for end-of-life plant decommissioning;
- Development of cleaner technologies;
- Benchmarking.

### 4.3.2 Techniques for Prevention and Minimisation of Resource Consumption

#### *4.3.2.1 Minimisation of Energy Use*

The control of energy use in iron and steel installations include:

- Use of basic, low cost physical energy efficiency techniques, such as insulation, containment methods (such as seals and self-closing doors), and avoidance of unnecessary discharge of heated water or air (for example, by fitting simple control systems such as timers and sensors), gravity feed systems;
- Energy recovery techniques such as:
    - Recovery of sensible heat from pelletisation, sinter cooler waste gas and application of waste gas recirculation;
    - Recovery of GOG and BF gases;
    - Heat Recovery from sintering and sinter loading (Iron and Steel BREF 4.3.1 PI.3);
    - Recovery of sensible heat from induration strand (Iron and Steel BREF 5.3 PI.1);
    - Direct injection of reducing agents to blast furnace (Iron and Steel BREF 7.3 PI.1);
    - Energy recovery from blast furnace gas (Iron and Steel BREF 7.3 PI.2);
    - Energy recovery from blast furnace top gas pressure (Iron and Steel BREF 7.3 PI.3);
    - Energy savings at hot furnace gas stoves (Iron and Steel BREF 7.3 PI.4);
    - Blast furnace slag heat recovery (Iron and Steel BREF 7.5);
    - High oxycoal blast furnace techniques (Iron and Steel BREF 7.5);
    - Energy recovery from BOF gas (Iron and Steel BREF 8.3 PI.1);
    - New net-shape casting and horizontal casting in basic oxygen steel making and casting;
    - Electric arc furnace process optimisation (Iron and Steel BREF 9.3 PI.1);
    - Electric arc furnace scrap preheating (Iron and Steel BREF 9.3 (PI.2);
    - Electric arc furnace efficient post combustion in combination with advanced off-gas treatment (Iron and Steel BREF 9.3 EP.2);
    - Electric arc furnace injection of liquite coke powder for off gas treatment (Iron and Steel BREF 9.3 EP.3);
    - Electric arc furnace new concepts (Iron and Steel BREF 9.5).

#### *4.3.2.2 Minimisation of Water Use*

The most frequent uses of water in the Iron and Steel industry is as a coolant and in gas scrubbing systems. Recycling and reuse techniques are process-integrated measures. Recycling involves recirculation of the liquid to the process where it has been generated. Reuse of an effluent means the re-circulation of one source of water for another purpose, e.g. surface run-off may be reused as cooling water.

#### *4.3.2.3 Raw Materials*

Installations control raw material use by maintaining inventory and control procedures including operational procedures to determine the most suitable material for use, thus preventing use of materials that may have an unacceptable environmental impact in their manufacture, end-use and ultimate disposal.

### 4.3.3 Control Techniques for Specific Unit Operations

#### *4.3.3.1 Sintering*

Process integrated and end of pipe control techniques applied for environmental protection and energy saving at sinter plants are provided in the Iron and Steel BREF 4.3.

#### *4.3.3.2 Pelletisation*

Applied process integrated and end of pipe techniques are provided in the Iron and Steel BREF 5.3.

#### *4.3.3.3 Coke Oven Plants*

Process integrated and end of pipe techniques for environmental protection and energy saving at coke oven plants are provided in the Iron and Steel BREF 6.3.

#### *4.3.3.4 Blast Furnace*

Process integrated and end of pipe techniques for environmental protection and energy saving at Blast Furnace plants are provided in the Iron and Steel BREF 7.3.

#### *4.3.3.5 Basic Oxygen Steel Making and Casting*

Process integrated and end of pipe techniques for Basic Oxygen and Steel making Casting are provided in the Iron and Steel BREF 8.3.

#### *4.3.3.6 Electric Steel Making and Casting*

Process integrated and end of pipe techniques for Electric Steel making and Casting are provided in the Iron and Steel BREF 9.3.

### 4.3.4 Emission Control

#### *4.3.4.1 Minimisation of Emissions to Air*

For all iron and steel operations fugitive air emissions are minimised by covering and sealing unit operations such as furnaces, buildings, process and storage areas, good housekeeping and regular preventative maintenance programmes. Specific process examples include:

- Use of cold bonded pellets and briquettes (Iron and Steel BREF 5.5.2);
- Gas tight operations of coke oven gas treatment plants (Iron and Steel BREF 6.3 EP.10);
- Single character coke oven system (Iron and Steel BREF 6.5.5);
- Use of tar free runner liners in blast furnaces (Iron and Steel BREF 7.3 PI.5);
- Maintenance of Coke oven chambers, oven doors and frame seals, ascension pipes, charging holes and other equipment;
- Techniques for prevention and minimisation of Air emissions from sinter plants (Iron and Steel BREF 4.2.2.1);
- Lowering the sulphur content of the sulphur feed (Iron and Steel BREF 4.3.1 PI.4);
- Top layer sintering to reduce PCDD/F (Iron and Steel BREF 4.3.1. PI.6);
- Emission optimised sintering (Iron and Steel BREF 4.3.1 PI.7);
- Smooth and undisturbed operation of the coke oven plant (Iron and Steel BREF 6.3 PI.1);

- Maintenance of coke ovens (Iron and Steel BREF 6.3 PI.2);
- Improvement of coke oven doors and frame seals (Iron and Steel BREF 6.3 PI.4);
- Maintaining free gas flow in the coke oven (Iron and Steel BREF 6.3 PI.5);
- Emission reduction at coke oven firing (Iron and Steel BREF 6.3 PI.4);
- Coke dry quenching (Iron and Steel BREF 6.3 PI.7);
- Larger coke oven chambers (Iron and Steel BREF 6.4 PI.8);
- Non recovery coking (Iron and Steel BREF 6.3 PI.9);
- Minimising oven charging (Iron and Steel BREF 6.3 EP.1);
- Sealing of ascension pipes and charging holes (Iron and Steel BREF 6.3 EP.2);
- Minimising leakage between coke oven chamber and heating chamber (Iron and Steel BREF 6.3 EP.3);
- Use of raw materials with low sulphur content (Iron and Steel BREF 4.2.2.1.2.5);
- Fume suppression during casting (Iron and Steel BREF 7.3 EP.3);
- Lowering the zinc content of scrap (Iron and Steel BREF 8.3 PI.2);
- Offline sampling and steel analysis for basic oxygen steel making and casting (Iron and Steel BREF 8.3 PI.3);
- New reagent in the basic oxygen steel making and casting desulphurisation process (Iron and Steel BREF 8.5);
- Replacing air above the hot metal in basic oxygen steel making and casting by inert gases (Iron and Steel BREF 8.5);
- Electric arc furnace advance emission collection systems (Iron and Steel BREF 9.3 EP.1);
- Waste gas re-circulation if sinter quality and productions are not significantly affected by applying re-circulation of part of the waste gas from the entire surface of the sinter strand on Sectional waste gas re-circulation.

#### *4.3.4.2 Minimisation of Emissions to Water*

For all Iron and Steel operations control techniques for emissions to water include:

- Minimisation of discharges of cooling water and materially polluted waster water and avoidance of plumes from re-cooling towers (Iron and Steel BREF 3.2.2.3);
- Measures implemented to minimise the contamination risk of process or surface water, surface water should not drain directly into a surface watercourse without interception, passing through a silt trap and oil interceptor before final discharge (IS EN 858 – 2:2003 Installations for the separation of light liquids);
- Regular interceptor cleaning and maintenance procedures implemented;
- Roads and hardstanding areas impermeable (i.e. a recognised sealed surface, e.g. asphalt or concrete, that is not readily permeable to liquids) and designed to direct rainfall/surface run-off to the surface water drainage system with an interceptor before the drainage point. Where there are permeable areas such as grass or landscaping adjacent to impermeable surfaces, there should be kerbing to prevent run-off from the impermeable surfaces onto this ground;
- The installation designed and operated so as to prevent spillage or escape of substances that could pollute the surface or groundwater system with suitable emergency procedures as per the *EPA Guidance Note on Storage and Transfer of Materials for Scheduled Activities.*

#### *4.3.4.3 Minimisation of Noise Emissions*

Noise emissions are minimised with good maintenance preventing equipment such as fans and pumps from becoming unbalanced. The interconnections between equipment can be designed to prevent or minimise the transmission of noise. In addition buildings should be constructed with acoustic cladding insulation. Patterns of raw material delivery should be monitored to ensure that vehicle movements are avoided during specific periods and noisy activities are carried on indoors where possible.

#### *4.3.4.4 Solid Waste Minimisation*

Control techniques for solid waste minimisation in the Iron and Steel industry are outline in the Iron and Steel BREF 3.2.2.2.

### 4.3.5 Control techniques for abatement and disposal

#### *4.3.5.1 Air Emissions*

Control techniques for air emissions in the iron and steel industry include:

- **Dust/Fine Particulates (including heavy metals)**
    - Electrostatic precipitators (Iron and Steel BREF 4.3.2 & 5.3);
    - Cyclones (Iron and Steel BREF 4.3.2);
    - Fabric or bag filters (Iron and Steel BREF 4.3.2);
    - Wet scrubbers (Iron and Steel BREF 4.3.2);
    - De dusting of coke pushing (Iron and Steel BREF 6.3);
    - Wet quenching (Iron and Steel BREF 6.3);
    - Removal of particulate matter in pelletisation plant drying and induration zones (Iron and Steel BREF);
    - Blast furnace gas treatment (Iron and Steel BREF 7.3);
    - De-dusting of blast furnace tapholes and runner (Iron and Steel BREF 7.3.2);
    - Primary de-dusting in basic oxygen steel making and casting (Iron and Steel BREF 8.3);
    - Particulate matter abatement from pig iron treatment in basic oxygen steel making and casting (Iron and Steel BREF 8.3);
    - De-dusting of secondary off gases in basic oxygen steel making and casting (Iron and Steel BREF 8.3);
    - Dust hot-briquetting and recycling with recovery of high zinc concentrated pellets for external reuse (Iron and Steel BREF 8.3);
    - Electric arc furnace steel making advance emission collection system (Iron and Steel BREF 8.3).

- **Total Carbon and VOCs, hydrocarbons and polyaromatic hydrocarbons**
    - Lowering the content of volatile hydrocarbons in the sinter feed (Iron and Steel BREF 4.3.1);
    - After burners and scrubbers (Iron and Steel BREF 2.8.1.5, 2.8.3.2.5 & 2.8.1.1.7);
    - Bio-filters and reactors (Iron and Steel BREF 2.8.1.5);
    - Hydrocarbons in sinter plants (Iron and Steel BREF 4.2.2.1.2.8);

- Activated carbon traps and chiller / condenser systems (Iron and Steel BREF 2.8.1.5);
- Fine wet scrubber (Iron and Steel BREF 4.3.2 4).

- **Polychlorinates dibenzo-p-dioxins and - furans (PCDD/F) and Polychlorinated bi-phenyls (PCBs)**

Control Techniques for minimisation of dioxin formation are considered in Sections 5.4.2 and 5.4.3 as regards feed control and furnace operation. PCB's in sinter plans are referenced in the Iron and Steel BREF 4.2.2.1.2.10.

Dioxins may be also absorbed onto other particulate matter and can be removed using high efficiency dust filtration. The collected dusts may have high dioxin concentrations and may need to be disposed of or treated carefully. Catalytic oxidation systems are also available for the destruction of dioxins (Iron and Steel BREF 4.3.2 EP.2). In High Efficiency Dust Removal, dioxins can be absorbed on the particulate matter with large surface area, collected dust is then treated in high temperature furnaces to destroy PCDD/PCDF and recover metals. Fine wet scrubber (Iron and Steel BREF 4.3.2 (EP.4) and absorption techniques (Iron and Steel BREF 4.5.1) are also used. Control techniques for dioxin removal in electric arc furnaces slag recycling (Iron and Steel BREF 9.3 EP.4) and electric arc furnaces injection of lignite coke for off gas treatment (Iron and Steel BREF 9.3 EP.3) and Dioxins control in sinter plants (Iron and Steel BREF 4.2.2.1.2.9) are also available.

Inorganic Process Gases

Gases such as $NH_3$, $SO_2$, HF, HCl, alkali chlorides and $NO_x$ are produced in several processes. Control techniques include:

- Wet scrubbers (Iron and Steel BREF 4.3.2 EP.4);
- Sulphur capture (Iron and Steel BREF 4.3.2 EP.2);
- Ammonia stripper (Iron and Steel BREF 4.3.2 EP.9);
- Fabric filter (Iron and Steel BREF 4.3.2 EP.2);
- Selective catalytic reduction NOx (Iron and Steel BREF 4.3.2 EP.7);
- Gas suspension absorber (Iron and Steel BREF 5.3 EP.3);
- De-NOx of waste gas from coke oven firing (Iron and Steel BREF 6.3 EP.6)
- Inorganic gases in sinter plants (Iron and Steel BREF 4.2.2.1.2.4, 4.2.2.1.2.5, 4.2.2.1.2.6 and 4.2.2.1.2.7);
- Inorganic gases in pelletisation (Iron and Steel BREF 5.2.2.2, 5.2.2.4 & 5.2.2.5);
- Process optimisation for minimisatio(Iron and Steel BREF 4.3.1 PI.1);
- Process integrated NOx abatement (Iron and Steel BREF 5.3 PI.2).

#### *4.3.5.2 Wastewater*

The control technique for wastewater in the Iron and Steel industry sectors are as follows:

- Sinter plants (Iron and Steel BREF 4.2.2.2);
- Pelletisation (Iron and Steel BREF 5.2.2.6);
- Treatment and re-use of blast furnace scrubber water (Iron and Steel BREF 7.3 EP.5);
- Treatment of waster water from wet de-dusting in basic oxygen steel making and casting (Iron and Steel BREF 8.3 EP.5);

- Treatment of waste water from continuous casting in basic oxygen steel making and casting (Iron and Steel BREF 8.3 EP.6);
- Coke oven waste water treatment (Iron and Steel BREF 6.3 EP.11);
    - Removing tar (PAH) from coal water (Iron and Steel BREF 6.3 EP.8).

#### *4.3.5.3 Noise & Vibration*

Control techniques used by the Iron and Steel industry include:

- The use of embankments to screen the source of noise;
- The enclosure of noisy plant or components in sound absorbing structures;
- The use of anti-vibration supports and interconnections for equipment;
- The orientation of noise emitting machinery;
- The change of the frequency of the sound;
- Use of acoustic screens around fixed/mobile plant and equipment;
- Fitting silencing equipment to plant e.g. baffles/muffles.

#### *4.3.5.4 Waste*

After all options for the reduction, recovery, reuse and recycling of wastes have been exhausted, appropriate treatment and disposal of such wastes is carried out.

Such techniques for waste treatment in the Iron & Steel industry include:

- Hydrocyclone of blast furnace sludge (Iron and Steel BREF 7.3 EP.4);
- Processing of zinc rich sludge dust in basic oxygen steel making and casting (Iron and Steel BREF 8.5);
- Electric arc furnace slag recycling (Iron and Steel BREF 9.3 EP.4);
- Electric arc furnace dust recycling (Iron and Steel BREF 9.3 EP.5).

# 5. BEST AVAILABLE TECHNIQUES FOR THE IRON AND STEEL 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 requirement expected of existing IPPC installations by October 2007, but does not include additional requirements, which may form part of the granting of a licence for a specific site.

The approach to be used in selecting BAT is based on the following hierarchy:

- Process design/redesign changes to eliminate emissions and wastes.
- Waste reduction by means of process control, inventory control, etc.
- Substitution of fuels, etc., by environmentally less harmful materials.
- Reuse of materials within the process and in products.
- Recycling of wastes in other applications.
- End-of-pipe techniques to control abate or treat emissions.
- Safe disposal.

Note: that where hazardous materials are present such as flammable/explosive vapours or dusts are handled, safety procedures (acceptable to HSA) should be adopted and nothing in this note should be construed as advice to the contrary.

## 5.2 BAT - GENERAL PREVENTATIVE METHODS

General BAT for Iron and Steel Sector activities are as follows:-

- Training and education of staff and operators.
- Process control optimisation.
- Sufficient maintenance of the technical units and the associated abatement techniques.
- Operation of an environmental management system that optimises management, increases awareness and includes goals and measures, process and job instructions, etc.

### 5.2.1 Management Systems

Effective management is important in achieving good environmental performance. It is an important component of BAT and forms part of the definition of techniques given in Article 2 of the Directive.

The components of an environmental management system are outlined in Section 4.3.1 of this document.

## 5.3 BAT FOR PREVENTION AND MINIMISATION OF RESOURCE CONSUMPTION

### 5.3.1 Minimisation of Energy Use

The main uses of energy in iron and steel plants and during casting include; furnace operation, scrap pre-treatment, metal melting, extrusion, rolling, mould making, heat treatment, post casting activities, heating, lighting and power in installation buildings, pumps, air treatment and wastewater treatment processes.

The applicant should demonstrate that in the design of the installation and in any treatment processes energy efficiency and recovery has been considered. For iron and Steel operations BAT is:

- The use of basic, low cost physical energy efficiency techniques, such as insulation, containment methods (such as seals and self-closing doors), and avoidance of unnecessary discharge of heated water or air (for example, by fitting simple control systems such as timers and sensors), gravity feed systems;
- The consideration of energy saving opportunities in process buildings, control rooms, offices and for all equipment purchased for the activity;
- Heat Recovery from sintering and sinter loading (Iron and Steel BREF 4.3.1 PI.3);
- Heat recovery from sintering and sinter cooling (Iron and Steel BREF 4.3.1 PI.5);
- Waste gas re-circulation e.g. Emission Optimised Sintering (Iron and Steel BREF 4.3.1 PI.7);
- Sectional waste gas re-circulation (Iron and Steel BREF 4.3.1 PI.8).
- Recovery of sensible heat from induration strand (Iron and Steel BREF 5.3 PI.1);
- Smooth and undisturbed operation of the coke oven plant (Iron and Steel BREF 6.3 PI.1);
- Maintenance of coke ovens (Iron and Steel BREF 6.3 PI.2);
- Improvement of oven door and frame seals (Iron and Steel BREF 6.3 PI.3);
- Cleaning of oven door and frame seals (Iron and Steel BREF 6.3 PI.4);
- Direct injection of reducing agents to blast furnace (Iron and Steel BREF 7.3 PI.1);
- Energy recovery from blast furnace gas (Iron and Steel BREF 7.3 PI.2);
- Energy recovery from blast furnace top gas pressure (Iron and Steel BREF 7.3 PI.3);
- Energy savings at hot furnace gas stoves (Iron and Steel BREF 7.3 PI.4);
- Energy recovery from BOF gas (Iron and Steel BREF 8.3 PI.1);
- Electric arc furnace process optimisation (Iron and Steel BREF 9.3 PI.1);
- Electric arc furnace scrap preheating (Iron and Steel BREF 9.3 (PI.2);
- Electric arc furnace efficient post combustion in combination with advanced off-gas treatment (Iron and Steel BREF 9.3 EP.2);
- Electric arc furnace injection of lignite coke powder for off gas treatment (Iron and Steel BREF 9.3 EP.3);

The applicant should review energy consumption on an annual basis and examine options for:

- Optimisation of energy supply;
- Optimising/reducing energy consumption;
- Optimising heat and energy recovery.

Many of the aspects of energy efficiency are likely to be delivered through management techniques, operating and maintenance procedures, which overlap and form part of the EMS for the activity.

For additional guidance on the use of energy, see the EPA's Guidance Note on Energy Efficiency Auditing.

### 5.3.2 Minimisation of Water Use

The most frequent uses of water in the iron and steel plants and during casting is as a coolant and in gas scrubbing systems. The use of water should be minimised within the BAT criteria for the prevention or reduction of emissions and be commensurate with the prudent use of water as a natural resource.

Reducing water use may be a valid environmental (or economic) aim in itself and there are distinct benefits to be gained from reducing the water used, in particular:

- Reducing the size of (a new) treatment plant thereby supporting the cost–benefit BAT justification of better treatment; cost savings where water is purchased or disposed off to another party;
- Associated benefits within the process such as reduction of energy requirements for heating and pumping, and reduced dissolution of pollutants into the water, leading to reduced sludge generation in the effluent treatment plant.

Techniques and methods for the reuse of water are already successfully used in the iron and steel industry to minimise the amount of liquid effluent that has to be discharged as wastewater. Recycling and reuse techniques are process-integrated measures. Recycling involves recirculation of the liquid to the process where it has been generated. Reuse of an effluent means the re-circulation of one source of water for another purpose, e.g. surface run-off may be reused as cooling water. BAT for minimisation of water use is:

- Develop diagram of the water circuits with indicative flows and prepare a mass balance for water use that will reveal where reductions can be made;
- Review water consumption on an annual basis by completing a water efficiency audit;
- Closed loop water cooling system (Iron and Steel BREF 9.3 PI.3);
- Water should be recycled within the process from which it issues, by treating it first if necessary. Where this is not practicable, it should be recycled to another part of the process, which has a lower water quality requirement;
- Where water is used in cleaning and washing down, use should be minimised by:
    - Vacuuming, scraping or mopping in preference to hosing down;
    - Evaluating the scope for re-using wash water;
    - Trigger controls on all hoses, hand lances and washing equipment;
- Drainage systems should be designed to avoid contamination of roof and surface water. Where possible this should be retained for use. That which cannot be used should be discharged separately;

### 5.3.3 Raw Materials

Installations should be operated in such a way that materials are used efficiently, including minimising their use and their impact by selection

The Operator should:

- Maintain a detailed inventory of raw materials used on-site;
- Have procedures for the regular review of new developments in raw materials and the implementation of any suitable ones which are less hazardous;
- Quality assurance procedures for the control of the content of raw materials;
- Demonstrate the steps which have been, or may be, taken to:
    - Substitute less harmful materials or those which can be more readily abated and when abated lead to substances which in themselves are more readily dealt with;
    - Understand the fate of by-products and contaminants and their environmental impact;
- As part of the installation design, specify materials with minimal environmental impact should be selected and used;
- Have operational procedures to determine the most suitable material for use, thus preventing use of materials that may have an unacceptable environmental impact in their manufacture, end-use and ultimate disposal;
- The installation designed and operated so as to prevent spillage or escape of substances that could pollute the surface or groundwater system with suitable emergency procedures as per the *EPA Guidance Note on Storage and Transfer of Materials for Scheduled Activities.*

## 5.4 BAT – Preventive Measures for Specific Unit Operations

### 5.4.1 Sintering

For sinter plants BAT is process integrated and end-of-pipe techniques.

Process integrated measures are:

- Process optimisation for minimisation of PCDD/F emissions (Iron and Steel BREF 4.3.1 PI.1);
- Recycling of iron-containing waste into the sinter plant (Iron and Steel BREF 4.3.1 PI.2);
- Lowering the content of volatile hydrocarbons in the sinter feed (Iron and Steel BREF 4.3.1 PI.3);
- Lowering the sulphur content of the sinter feed (Iron and Steel BREF 4.3.1 PI.4);
- Heat recovery from sintering and sinter cooling (Iron and Steel BREF 4.3.1 PI.5);
- Top-layer-sintering (Iron and Steel BREF 4.3.1 PI.6);
- Waste gas re-circulation e.g. Emission Optimised Sintering (Iron and Steel BREF 4.3.1 PI.7);
- Sectional waste gas re-circulation (Iron and Steel BREF 4.3.1 PI.8).

End-of-pipe techniques are:

- Electrostatic precipitator (ESP) (Iron and Steel BREF 4.3.2 EP.1);
- Fabric filter system (Iron and Steel BREF 4.3.2 EP.2);
- Cyclone (Iron and Steel BREF 4.3.2 EP.3);
- Fine wet scrubber (Iron and Steel BREF 4.3.2 EP.4);
- Desulphurisation (Iron and Steel BREF 4.3.2 EP.5);
- Regenerative activated carbon (Iron and Steel BREF 4.3.2 EP.6);
- Selective catalytic reduction (Iron and Steel BREF 4.3.2 EP.7).

### 5.4.2 Pelletisation (Iron and Steel BREF 5.3)

BAT for pellet plants is process integrated and end of pipe techniques.

Process-integrated measures are:

- Recovery of sensible heat from induration strand (Iron and Steel BREF 5.3 PI.1);
- Process integrated $NO_X$ abatement (Iron and Steel BREF 5.3 PI.2).

End-of-pipe techniques are:

- Electrostatic precipitation at the grinding mills (Iron and Steel BREF 5.3 EP.1);
- Removal of particulate matter from the drying and induration zone (Iron and Steel BREF 5.3 EP.2);
- Gas suspension absorber (Iron and Steel BREF 5.3 EP.3).

### 5.4.3 Coke Oven Plants (Iron and Steel BREF 6.3)

BAT is process integrated and end of pipe techniques for environmental protection and energy saving at coke oven plants.

Process-integrated measures are:

- Smooth and undisturbed operation of the coke oven plant (Iron and Steel BREF 6.3 PI.1);
- Maintenance of coke ovens (Iron and Steel BREF 6.3 PI.2);
- Improvement of oven door and frame seals (Iron and Steel BREF 6.3 PI.3);
- Cleaning of oven door and frame seals (Iron and Steel BREF 6.3 PI.4);
- Maintaining free gas flow in the coke oven (Iron and Steel BREF 6.3 PI.5);
- Emission reduction during coke oven firing (Iron and Steel BREF 6.3 PI.6);
- Coke dry quenching (Iron and Steel BREF 6.3 PI.7);
- Larger coke oven chambers (Iron and Steel BREF 6.3 PI.8);
- Non-recovery coking (Iron and Steel BREF 6.3 PI.9).

End-of-pipe techniques are:

- Minimising oven charging emissions (Iron and Steel BREF 6.3 EP.1);
- Sealing of ascension pipes and charging holes (Iron and Steel BREF 6.3 EP.2);
- Minimising leakage between coke oven chamber and heating chamber (Iron and Steel BREF 6.3 EP.3);
- De-dusting of coke oven pushing (Iron and Steel BREF 6.3 EP.4);

- Emissions minimised wet quenching (Iron and Steel BREF 6.3 EP.5);
- De-$NO_x$ of waste gas from coke oven firing (Iron and Steel BREF 6.3 EP.6);
- Coke oven gas desulphurisation (Iron and Steel BREF 6.3 EP.7);
- Removing tar (and PAH) from the coal water (Iron and Steel BREF 6.3 EP.8);
- Ammonia stripper (Iron and Steel BREF 6.3 EP.9);
- Wastewater treatment plant (Iron and Steel BREF 6.3 EP.10).

### 5.4.4 Blast Furnace (Iron and Steel BREF 7.3)

BAT is process integrated and end of pipe techniques for environmental protection and energy saving at Blast Furnace plants.

Process-integrated measures are:

- Direct injection of reducing agents (Iron and Steel BREF 7.3 PI.1);
- Energy recovery from blast furnace gas (Iron and Steel BREF 7.3 PI.2);
- Energy recovery from top gas pressure (Iron and Steel BREF 7.3 PI.3);
- Energy savings at the hot stove (Iron and Steel BREF 7.3 PI.4);
- Use of tar-free runner linings (Iron and Steel BREF 7.3 PI.5).

End-of-pipe techniques are:

- Blast furnace gas treatment (Iron and Steel BREF 7.3 EP.1);
- De-dusting of tap holes and runners (Iron and Steel BREF 7.3 EP.2);
- Fume suppression during casting (Iron and Steel BREF 7.3 EP.3);
- Hydro-cyclonage of blast furnace sludge (Iron and Steel BREF 7.3 EP.4);
- Treatment and reuse of scrubbing water (Iron and Steel BREF 7.3 EP.4);
- Condensation of fume from slag granulation (Iron and Steel BREF 7.3 EP.6).

### 5.4.5 Basic Oxygen Steel making and Casting (Iron and Steel BREF 8.3)

BAT is process integrated and end of pipe techniques for basic oxygen and steel making and casting.

Process-integrated measures are:

- Energy recovery from the BOF gas (Iron and Steel BREF 8.3 PI.1);
- Lowering the zinc-content of scrap (Iron and Steel BREF 8.3 PI.2);
- On-line sampling and analysis of steel (Iron and Steel BREF 8.3 PI.3).

End-of-pipe techniques are:

- Primary de-dusting (Iron and Steel BREF 8.3 EP.1);
- Particulate matter abatement from pig iron pre-treatment (Iron and Steel BREF 8.3 EP.2);
- Secondary de-dusting (Iron and Steel BREF 8.3 EP.3);
- Dust hot briquetting and recycling (Iron and Steel BREF 8.3 EP.4);
- Treatment of wastewater from wet de-dusting (Iron and Steel BREF 8.3 EP.5);
- Treatment of wastewater from continuous casting (Iron and Steel BREF 8.3 EP.6).

### 5.4.6 Electric Steel Making and Casting (Iron and Steel BREF 9.3)

BAT is process integrated and end of pipe techniques for Electric Steel making and Casting.

Process-integrated measures are:

- EAF process optimisation (Iron and Steel BREF 9.3 PI.1);
- Scrap preheating (Iron and Steel BREF 9.3 PI.2);
- Closed loop water cooling system (Iron and Steel BREF 9.3 PI.3).

End-of-pipe techniques are:

- Advanced emission collection systems (Iron and Steel BREF 9.3 EP.1);
- Efficient post-combustion in combination with advanced off gas treatment (Iron and Steel BREF EP.2);
- Injection of lignite coke powder for off gas treatment (Iron and Steel BREF 9.3 EP.3);
- Recycling of EAF slags (Iron and Steel BREF 9.3 EP.4);
- Recycling of EAF dusts (Iron and Steel BREF 9.3 EP.5).

## 5.5 Techniques for the Prevention and Minimisation of Emissions

### 5.5.1 Minimisation of Emissions to Air (Iron and Steel BREF 3.2.2.1)

For all iron and steel plants and casting operations BAT for minimisation of fugitive air emissions is as follows:

- Covering of skips and vessels;
- Avoidance of outdoor or uncovered stockpiles (where possible), where unavoidable, use of sprays, binders, stockpile management techniques, windbreaks, etc.;
- Wheel and road cleaning;
- Closed conveyors, pneumatic conveying (noting the higher energy needs), minimising drops;
- Regular housekeeping, external surfaces of the process building, ancillary plant and open yards and storage areas should be inspected at least annually and cleaned if necessary to prevent the accumulation of dusty material in circumstances where the dust may become wind entrained;
- Cleaning operations should be carried out by methods which minimise emissions of particulate matter to air;
- Piping directly from bulk tanks avoiding losses that occur when transferring between containers;
- Enclosed buildings can be designed to have a negative air pressure to prevent odour emissions from doorways;
- Process optimisation for minimisation of PCDD/F emissions (Iron and Steel BREF 4.3.1 PI.1);
- Gas tight operations of coke oven gas treatment plants (Iron and Steel BREF 6.3 EP.10);
- Use of tar free runner liners in blast furnaces (Iron and Steel BREF 7.3 PI.5);

- Process integrated NO, abatement (Iron and Steel BREF 5.3 PI.2).
- Lowering the sulphur content of the sulphur feed (Iron and Steel BREF 4.3.1 PI.4);
- Lowering the content of volatile hydrocarbons in the sinter feed (Iron and Steel BREF 4.3.1 PI.3);
- Top layer sintering to reduce PCDD/F (Iron and Steel BREF 4.3.1. PI.6);
- Emission optimised sintering (Iron and Steel BREF 4.3.1 PI.7);
- Smooth and undisturbed operation of the coke oven plan (Iron and Steel BREF 6.3 PI.1);
- Maintenance of coke ovens (Iron and Steel BREF 6.3 PI.2);
- Improvement of coke oven doors and frame seals (Iron and Steel BREF 6.3 PI.4);
- Maintaining free gas flow in the coke oven (Iron and Steel BREF 6.3 PI.5);
- Emission reduction at coke oven firing (Iron and Steel BREF 6.3 PI.4);
- Coke dry quenching (Iron and Steel BREF 6.3 PI.7);
- Larger coke oven chambers (Iron and Steel BREF 6.4 PI.8);
- Non recovery coking (Iron and Steel BREF 6.3 PI.9);
- Minimising oven charging (Iron and Steel BREF 6.3 EP.1);
- Sealing of ascension pipes and charging holes (Iron and Steel BREF 6.3 EP.2);
- Minimising leakage between coke oven chamber and heating chamber (Iron and Steel BREF 6.3 EP.3);
- Fume suppression during casting (Iron and Steel BREF 7.3 EP.3);
- Lowering the zinc content of scrap (Iron and Steel BREF 8.3 PI.2);
- Offline sampling and steel analysis for basic oxygen steel making and casting (Iron and Steel BREF 8.3 PI.3);
- New reagent in the basic oxygen steel making and casting desulphurisation process (Iron and Steel BREF 8.5);
- Electric arc furnace advance emission collection systems (Iron and Steel BREF 9.3 EP.1).

### 5.5.2 Minimisation of Emissions to Water

For all iron and steel plants, BAT for minimisation of water emissions includes all control techniques presented in Section 4.3.4.2 and 5.3.2 above.

### 5.5.3 Minimisation of Noise Emissions

For Best Available Techniques for noise minimisation from the various processes used by the Iron and Steel and casting industries refer to the EPA Guidance Notes for Noise in Relation to Scheduled Activities 2006.

### 5.5.4 Solid Waste Minimisation

BAT for solid waste minimisation in all iron and steel plants and casting operations is:

- Effective utilisation (recycling or reuse) of solid wastes/by-products;
- Controlled disposal of unavoidable wastes/by-products;
- Recycling of iron-containing waste into the sinter plant (Iron and Steel BREF 4.3.1 PI.2);

- Recycling of by-products containing iron and carbon from the integrated works taking account the oil content of the single by-product;
- Selective recycling back to sinter process;
- Ongoing identification and implementation of waste prevention opportunities. Particular attention should be paid to impurities in raw materials, which will be concentrated within particular waste streams;
- Active participation and commitment of staff at all levels including, for example, staff suggestion schemes;
- Monitoring of materials usage and reporting against key performance measures;
- Minimisation of process residues from the Iron and Steel industry;
- Minimisation of residues arising from the abatement systems.

## 5.6 BAT - Measures for Treatment Abatement and Disposal

### 5.6.1 Air Emissions

For all iron and steel plants and casting operations, BAT is to minimise the formation of air emissions as outlined above in Section 5.5.1, then the following general techniques should be considered in the determination of BAT for any remaining emissions:

- All operations which generate emissions to air are contained and adequately extracted to suitable abatement plant, where this is necessary to meet specified emission limits;
- Hot emissions take place from the minimum practicable number of stacks, in order to obtain maximum advantage from thermal buoyancy, if practicable a multi-flue stack should be used;
- Stack heights are sufficient to ensure adequate dispersion under normal conditions, minimum stack height is 3 metres above roof ridge height of any building within a distance of 5 times the stack height and in no circumstances should it be less than 8 metres above ground level;
- Demonstrate that all reasonably practicable steps are taken during start-up and shut down, and changes of fuel or combustion load in order to minimise emissions;
- Wet scrubbers (Iron and Steel BREF 4.3.2 EP.4) ;
- Ammonia stripper (Iron and Steel BREF 4.3.2 EP.9);
- Fabric filter (Iron and Steel BREF 4.3.2 EP.2);
- Selective catalytic reduction NOx (Iron and Steel BREF 4.3.2 EP.7);
- Electrostatic precipitation at the grinding mills (Iron and Steel BREF 5.3 EP.1);
- Removal of particulate matter from the drying and induration zone (Iron and Steel BREF 5.3 EP.2);
- Gas suspension absorber (Iron and Steel BREF 5.3 EP.3);
- Electrostatic precipitator (ESP) (Iron and Steel BREF 4.3.2 EP.1);
- Fabric filter system (Iron and Steel BREF 4.3.2 EP.2);
- Cyclone (Iron and Steel BREF 4.3.2 EP.3);
- Fine wet scrubber (Iron and Steel BREF 4.3.2 EP.4);
- Desulphurisation (Iron and Steel BREF 4.3.2 EP.5);
- Regenerative activated carbon (Iron and Steel BREF 4.3.2 EP.6);

- De-NOx of waste gas from coke oven firing (Iron and Steel BREF 6.3 EP.6)
- Coke oven gas desulphurisation (Iron and Steel BREF 6.3 EP.7);
- Removing tar (and PAH) from the coal water (Iron and Steel BREF 6.3 EP.8);
- Ammonia stripper (Iron and Steel BREF 6.3 EP.9);
- Particulate matter abatement from pig iron pre-treatment (Iron and Steel BREF 8.3 EP.2);
- Process optimisation for minimisation of PCDD/F emission in sintering process (Iron and Steel BREF 4.3.1 PI.1);
- Lowering the content of volatile hydrocarbons in the sinter feed (Iron and Steel BREF 4.3.1 PI.3);
- Temperature monitoring on exhausts from furnaces and after-burners;
- Catalytic oxidation systems for the destruction of dioxins (Iron and Steel BREF 4.3.2 EP.2);
- Fine wet scrubber (Iron and Steel BREF 4.3.2 (EP.4);
- Control techniques for dioxin removal in electric arc furnaces slag recycling (Iron and Steel BREF 9.3 EP.4) and electric arc furnaces injection of lignite coke for off gas treatment (Iron and Steel BREF 9.3 EP.3);
- Process control techniques on collection and abatement equipment including:
    - Reagent metering systems;
    - Microprocessor control of reagent feed and plant performance is used;
    - On-line monitoring of temperature, pressure drop, particulates or other pollutants emitted, EP current and voltage and scrubber liquor flow and pH;
    - Alarms provided to indicate operational problems such as pump failure;
        - Operators and maintenance personnel trained and assessed in the use of operating instructions and the use of the modern control techniques described;

### 5.6.2 Wastewater

The best available treatment technique for wastewater treatment or a combination of the different treatment methods can only be chosen on a site by site basis by taking into account the site specific factors. BAT is:

- Treatment and re-use of blast furnace scrubber water (Iron and Steel BREF 7.3 EP.5);
- Wastewater treatment plant (Iron and Steel BREF 6.3 EP.10);
- Treatment and reuse of scrubbing water (Iron and Steel BREF 7.3 EP.4);
- Treatment of waster water from wet de-dusting in basic oxygen steel making and casting (Iron and Steel BREF 8.3 EP.5);
- Treatment of waste water from continuous casting in basic oxygen steel making and casting (Iron and Steel BREF 8.3 EP.6);
- Coke oven waste water treatment (Iron and Steel BREF 6.3 EP.11);
- Removing tar (PAH) from coal water (Iron and Steel BREF 6.3 EP.8).

Effluent streams should be kept separate as treatment will be more efficient, the properties of dissimilar waste streams should be used where possible to avoid adding further chemicals, e.g. neutralising waste acid and alkaline streams;

Wastewater treatment process control techniques including:

- Reagent metering systems;
- Microprocessor control of reagent feed and plant performance;
- On-line monitoring of temperature, turbidity, pH, conductivity, REDOX, TOC, individual metals and flow is used;
- Operators, maintenance personnel trained and assessed in the use of operating instructions and the use of the process control techniques.

Where effluent is treated off-site at a Local Authority sewage treatment works, the operator may be required to demonstrate that:

- All appropriate measures have been taken to reduce effluent volume and pollutant concentration;
- The treatment provided at the sewage treatment works is as good as would be achieved if the emission was treated on-site, based on reduction of load (not concentration) of each substance to the receiving water;
- A suitable monitoring programme is in place for emissions to sewer, taking into consideration the potential inhibition of any downstream biological processes.

### 5.6.3 Noise & Vibration

Noise and vibration can arise from the movement and storage of raw materials and products, large fans and air filtration systems, grinding and milling operations, casting installations, venting of steam and use of pumps. This can potentially create a nuisance to site neighbours and the environment. Noise can either be continuous or intermittent depending on the operation of equipment.

Having taken into account the measures outlined in Section 5.5.3 above on noise minimisation, the following Best Available Techniques correctly designed, constructed and sized for the application can be used for the noise abatement from the various processes used by the Iron and Steel industry:

- The use of embankments to screen the source of noise;
- The enclosure of noisy plant or components in sound absorbing structures;
- The use of anti-vibration supports and interconnections for equipment;
- The orientation of noise emitting machinery;
- The change of the frequency of the sound;
- Use of acoustic screens around fixed/mobile plant and equipment.

For additional guidance on measures in relation to noise, have regard to the EPA Guidance Note for Noise in relation to scheduled activities (2006).

### 5.6.4 Waste

After all options for the reduction, recovery, reuse and recycling of wastes have been exhausted, appropriate treatment and disposal of such wastes should be carried out. BAT is:

- Hydrocyclone of blast furnace sludge (Iron and Steel BREF 7.3 EP.4);
- Processing of zinc rich sludge dust in basic oxygen steel making and casting (Iron and Steel BREF 8.5);
- Electric arc furnace slag recycling (Iron and Steel BREF 9.3 EP.4);
- Electric arc furnace dust recycling (Iron and Steel BREF 9.3 EP.5).

# 6. BAT ASSOCIATED EMISSION LEVELS

This Section contains emission limits and other requirements that are representative of BAT within the iron and steel sector and casting operations.

## 6.1 EMISSION LEVELS FOR DISCHARGES TO AIR

The BAT associated emission levels for emissions to air given below in Table 6.1.

All parameters will not be relevant to every installation and will depend on the type of substances and processed in use at the installation, and other site-specific factors. The requirement for compliance with S.I. No. 543 of 2002 – Emissions of Volatile Organic Compounds from Organic Solvents Regulations, 2002, need to be established by the licensee.

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

| Constituent Group or Parameter Note1 | Class | Emission Level ($mg/m^3$) Note 2 | Mass Flow Threshold Note 2 (g/hr) |
|---|---|---|---|
| Carcinogenic Substances (Note 3) | Class I (limits set for class total)<br>- arsenic and its compounds (except for arsine), as As<br>- benzo(a)pyrene<br>- cadmium and its compounds, as Cd<br>- water-soluble compounds of cobalt, as Co<br>- chromium (VI) compounds (except for barium chromate and lead chromate), as Cr | 0.05 | 0.15 |
| | Class II (limits set for class total)<br>- acrylamide<br>- acrylonitrile<br>- dinitrotoluenes<br>- ethylene oxide<br>- nickel and its compounds (except for nickel metal, nickel alloys, nickel carbonate, nickel hydroxide, nickel tetracarbonyl) as Ni<br>- 4-vinyl-1,2-cyclohexane-diepoxy | 0.5 | 1.5 |
| | Class III (limits set for class total)<br>- benzene<br>- bromoethane<br>- 1,3-butadiene<br>- 1,2-dichloroethane<br>- 1,2-propylene oxide (1,2-epoxy propane)<br>- styrene oxide<br>- o-toluidine<br>- trichloroethane<br>- vinyl chloride | 1 | 2.5 |

| | | | |
|---|---|---|---|
| Vaporous or Gaseous Inorganic Substances | Class I (limits set on a per substance basis)<br>- arsine<br>- cyanogen chloride<br>- phosgene<br>- phosphine | 0.5 | 2.5 |
| | Class II (limits set on a per substance basis)<br>- bromine and its gaseous compounds, as Hydrogen bromide<br>- chlorine<br>- hydrocyanic acid<br>- fluorine and its gaseous compounds, as HF<br>- hydrogen sulphide | 3 - 5 | 15 |
| | Class III (limits set on a per substance basis)<br>- ammonia<br>- gaseous inorganic compounds of chlorine, as HCl | 30 | 150 |
| | Class IV (limits set on a per substance basis)<br>- sulphur oxides (sulphur dioxide and sulphur trioxide), as $SO_2$<br>- nitrogen oxides (nitrogen monoxide and nitrogen dioxide), as $NO_2$ | 350 | 1800 |
| | - nitrogen monoxide and nitrogen dioxide, as $NO_2$ (thermal or catalytic post combustion facilities) | 200 | |
| | - carbon monoxide (thermal or catalytic post combustion facilities) | 100 | |
| Inorganic Dust Particles (Note 4) | Class I (limits set on a per substance basis)<br>- mercury and its compounds, as Hg<br>- thallium and its compounds, as Tl | 0.05 | 0.25 |
| | Class II (limits set for class total)<br>- lead and its compounds, as Pb<br>- cobalt and its compounds, as Co<br>- nickel and its compounds, as Ni<br>- selenium and its compounds, as Se<br>- tellurium and its compounds, as Te | 0.5 | 2.5 |
| | Class III (limits set for class total)<br>- antimony and its compounds, as Sb<br>- chromium and its compounds, as Cr<br>- easily soluble cyanides (e.g. NaCN), as CN<br>- easily soluble fluorides (e.g. NaF), as F<br>- copper and its compounds, as Cu<br>- manganese and its compounds, as Mn<br>- vanadium and its compounds, as V<br>- tin and its compounds, as Sn<br>- Other substances with risk phrases R40, R62 or R63 | 1 | 5 |

| | | | |
|---|---|---|---|
| Lead | | 0.5 - 2 | 2.5 |
| Zinc | | 5 - 10 | |
| Total particulates | | 5 -10 | |
| Dioxins | | 0.1-0.5 (ITEQ)(ng/$m^3$) | |
| Volatile organic compounds (VOCs) used in activities covered by the Solvents Regulations | | Refer to the BAT Guidance Note on Best Available Techniques for solvent use in coating, cleaning and degreasing and Solvent Regulations (S.I. 543 of 2002) | |
| Other | | | Note 5 |

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 Chemical Sector.

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.

These values apply prior to any dilution with for example uncontaminated storm waters or cooling waters. All values refer to daily averages, except where otherwise stated to the contrary, and except for pH which refers to continuous values.

**Table 6.2: BAT Associated Emission Limits for Discharges to Water***

| Constituent Group or Parameter | Emission Level (mg/l unless otherwise stated) | Percentage Reduction [3] | Notes |
|---|---|---|---|
| pH | 6 - 9 pH Units | - | |
| Toxicity | 1 TU | | 1 |
| $BOD_5$ | 25 | >90% | |
| COD | 100 - 500 | >75% | |
| Suspended Solids | 35 | | |
| Total Ammonia (as N) | 10 | | |
| Total Nitrogen (as N) | 10 - 25 | >80% | 2, 4 |
| Total Phosphorus (as P) | 2 | >80% | 4 |
| Mineral Oil (from interceptor) | 20 | | |
| Mineral Oil (from biological treatment) | 1.0 | | |
| Phenols | | | 5 |
| Fish Tainting | No Tainting | | ** |
| Cadmium | 0.01 | | |
| Mercury | 0.005 | | |
| Lead | 0.5 | | |
| Zinc | 0.5 | | |
| Chromium (VI) | 0.1 | | |
| Chromium (Total) | 0.5 | | |
| Nickel | 0.5 | | |
| Metals | | | 5, 6 |
| Organohalogens | | | 5 |
| Priority Substances (as per Water Framework Directive) | | | 5 |
| Other | | | 5, 7 |

* 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$^{o}$C in salmonid waters and 3$^{o}$C in cyprinid waters (Freshwater Fish Directive 79/659/EEC).

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: PARCOM recommendation 92/4 applies to a wastewater emission from the electroplating industry discharging to water or public sewer. Where the sum of metals specified in combined is < 200g/day prior to treatment, their emission level values may be increased fourfold. Applies to activities other than printed circuit board manufacture. Applies to wastewater streams specially treated (PARCOM).

Note 7: Any relevant polluting substances as specified in Schedule to S.I. No. 394 of 2004: EPA (Licensing)(Amendment) Regulations, 2004.

Note **: No substance shall be discharged in a manner which, or at a concentration which, following initial dilution causes tainting of fish or shellfish, interferes with normal patterns of fish migration or which accumulates in sediments or biological issues to the detriment of fish, wildlife or their predators.

## 6.3 EMISSION LIMIT VALUES FOR DISCHARGES TO GROUNDWATER

It is unlikely that an Iron and Steel installation would wish to discharge drainage to groundwater, however, the Groundwater Directive (80/68/EEC) which has been enacted in Ireland through the Protection of Groundwater Regulations 1999 (SI 41/1999), and the Local Government (Water Pollution) (Amendment) Regulations 1999 (SI No. 42 1999) prohibits direct emissions and requires strict controls to prevent indirect emissions of substances scheduled in List I of the Directive. The designer should consider the proposed operations of the site and consider the most appropriate method of disposal. The EPA sets strict controls and ELVs on a case-by-case basis for substances contained in List II of the Directive and requirements are made to limit indirect discharges of List II substances. An inventory of authorisations given for direct discharge of List II substances to groundwater must be kept.

# 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

The most common components measured in the Iron and Steel and casting sector are particulates, metals, sulphur dioxide, VOCs, dioxins and nitrogen oxides. Acids including HCl and HF are determined for some processes as are chlorides and fluorides.

Gas flow should be measured or otherwise determined to relate concentrations to mass releases. Temperature and pressure must be measured and recorded to relate measurements to reference conditions and water vapour content must be measured where it is likely to exceed 3% unless the measuring techniques used provide results on a dry basis. Periodic visual and olfactory assessment of releases should be undertaken where appropriate, to ensure that all final releases to air are essentially colourless, free from persistent mist or fume and from droplets.

For guidance on monitoring of emissions to air, have regard to the Air Emissions Monitoring Guidance Note AG2 issued by the Agency.

Table 9 indicates the likely monitoring frequencies for release to air from principle emission sources/abatement equipment in this sector:

**Table 9: Compliance Monitoring Emissions to Air.**

| Emission | Type of monitoring |
|---|---|
| Total Particulate | Continuous monitoring in exhaust streams<br>Extractive sampling form other sources |
| Oxides of nitrogen as $NO_2$ | Continuous monitoring/ Extractive sampling |
| Sulfur Dioxide as $SO_2$ | Continuous monitoring/ Extractive sampling |
| Ammonia | Extractive sampling |
| Chlorides as HCl | Continuous monitoring/ Extractive sampling |
| Fluorides as HF | Extractive sampling |
| Bromides as HBr | Extractive sampling |
| Chlorine as $Cl_2$ | Extractive sampling |
| VOCs as C | Extractive sampling |
| Dioxins ($ng/m^3$ TEQ) | Extractive sampling |
| Copper, lead, zinc or their compounds | Extractive sampling |
| Cadmium, arsenic, nickel, mercury, zinc, chromium or their compounds | Extractive sampling |
| Platinum Group Metals | Extractive sampling |
| Phosphorous as P | Extractive sampling |

The determination of a requirement for continuous monitoring and recording for any of the parameters listed above in Table 9 is based on:

- The potential environmental impact is significant or the concentration of the substance varies widely;
- A substance is abated and continuous monitoring is required to show the abatement plant performance; or

- Where other control measures are required to achieve satisfactory levels of emission.

Where continuous monitoring is required by the permit, instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of arrestment plant failure or malfunction, the activation of alarms should be automatically recorded and readings should be on display to appropriately trained operating staff.

All continuous monitors should be operated, maintained and calibrated (or referenced) in accordance with the appropriate standards and manufacturers' instructions, which should be made available for inspection by the regulator. Instruments should be operated to ensure less than 5% downtime over any 3-month period and all relevant maintenance and calibration (or referencing) should be recorded.

Continuous particulate monitoring is required for bag filter emissions (e.g. opacity/pressure drop). For other sources of particulate emissions, periodic monitoring may be adequate once the nature, magnitude and variability of emissions have been taken into account. Weekly maintenance of all air handling plant (e.g. pressure drop across filters) should also be carried out.

The introduction of dilution air to achieve emission concentration limits is not permitted. Dilution air may be added where justified for waste gas cooling or improved dispersion. In such cases, monitoring should be carried out upstream of the dilution air input or procedures designed to correct for the ratio of input air to the satisfaction of the regulatory agency.

Where abatement equipment is required to comply with the particulate matter provisions of this note then the particulate matter emissions should be continuously monitored to indicate the performance of the abatement plant. Where airflow is less than 150 $m^3$ per minute, surrogate parameters as an alternative to continuous monitoring may be considered where the operator can demonstrate equivalent control to the satisfaction of the regulator.

Where wet scrubbers are being used, monitoring surrogate parameters may be acceptable as an alternative to continuous monitoring where the operator can demonstrate equivalent control. Scrubber liquor flow should be continuously monitored, triggering an alarm and stand-by pump in the event of pump failure.

Compliance monitoring for fugitive air emissions are presented in Table 10 below.

| Parameter | Concentration/Trigger Levels |
|---|---|
| Dust deposition | Monthly composite samples |
| Particulates ($PM_{10}$) | Monthly composite samples |

**Table 10: Ambient Limits for Fugitive Emissions to Air**

### 7.1.1 Reference Conditions for Air Emissions

The reference conditions for concentrations of substances in emissions to air from contained sources are:

In the case of non-combustion gases:

(i) Temperature 273 K, Pressure 101.3 kPa (no correction for water vapour content).

In the case of combustion gases:

(i) Temperature 273 K; Pressure 101.3 kPa, dry gas; 3% oxygen for liquid and gas fuels; 6% oxygen for solid fuels.

These units and reference conditions may not be suitable for continuous monitoring methods, which may, by agreement with the Agency, be converted into values more suited to the available instrumentation for day-to-day control purposes. All period averages should cover operating hours only, but excluding start-up and shutdown.

### 7.1.2 Interpretation of Compliance for Air Emissions

Emissions to air under normal operation including start-up and shutdown should be free from visible smoke and not give rise to nuisance odours detectable beyond the site boundary.

For continuously monitored emissions, the following will be required for compliance with measurements based on 30-minute mean values (unless otherwise stated):

(i) 97% of all 30 minute mean measurements shall be below 1.2 times the emission limit.
(ii) No 30-minute mean measurement shall exceed 2.0 times the emission limit.
(iii) All daily mean values shall be less than the emission concentration limit.

Where periodic monitoring is used to check compliance:

(i) For any parameter, where due to sampling/analytical limitations, a 30-minute sample is inappropriate, a suitable sampling period should be employed and the value obtained therein shall not exceed the emission limit value.
(ii) For flow, no hourly or daily mean value, calculated on the basis of appropriate spot readings, shall exceed the relevant limit value.
(iii) For all other parameters, no 30-minute mean value shall exceed the emission limit value.

## 7.2 Monitoring of Aqueous Emissions

Monitoring of process effluents prior to discharge should include at least the parameters outlined in Table 11:

**Table 11: Monitoring Frequency for Emissions to Water**

| Constituent Group or Parameter | Monitoring Frequency |
|---|---|
| Flowrate | Continuous and integrated daily flowrate |
| pH | Continuous |
| Temperature | |
| Conductivity mS/cm@20$^{o}$C | |
| Turbidity NTU | |
| Number of Toxicity Units | Annual |
| Fish Tainting | |

| | |
|---|---|
| Biological Oxygen Demand | Flow weighted sample or composite samples, weekly analysis, reported as flow weighted monthly averages |
| COD | |
| Suspended Solids | |
| Total Ammonium | |
| Non-ionised Ammonia | |
| Nitrates | |
| Phosphorus | |
| Sulphates | |
| Fluorides | |
| Chlorides | |
| Total Hydrocarbons | |
| Cadmium (mg/l) | |
| Nickel (mg/l) | |
| Silver (mg/l) | |
| Lead (mg/l) | |
| Arsenic (mg/l) | |
| Chromium (VI) (mg/l) | |
| Chromium | |
| Zinc (mg/l) | |
| Copper (mg/l) | |
| Aluminium (mg/l) | |
| Manganese (mg/l) | |

Generally, monitoring should be carried out during commissioning, start-up, normal operation and shutdown. Where monitoring shows that substances are not emitted in significant quantities, consideration can be given to a reduced monitoring frequency.

Monitoring of process effluents released to sewer should include at least the parameters outlined in Table 12:

**Table 12: Sewer Discharge Monitoring**

| Parameter | Monitoring frequency |
|---|---|
| Flowrate | Continuous (using a flow proportional sampler to create a 24 h composite sample which is analysed daily against emission limits) and integrated daily flowrate |
| pH | Continuous |
| Temperature | Dependent on process but may be continuous |
| COD/BOD | Flow weighted sample or composite samples, weekly analysis, reported as flow weighted monthly averages |

Other parameters may include influent and effluent from the wastewater treatment plant to establish an early warning of any difficulties in the operation of the plant or unusual loads.

In addition, the Operator should have a detailed analysis carried out covering a broad spectrum of substances to establish that all relevant substances have been taken into account when setting the release limits. Any substances found to be of concern, or any other individual substances to which the local environment may be susceptible and upon which the operations may impact, should also be monitored more regularly.

This would particularly apply to the heavy metals. Composite sampling is the technique most likely to be appropriate where the concentration does not vary excessively.

A number of ground water monitoring locations will be established based on the hydrogelical characteristics of the installation location. Sampling and analysis will generally be carried out at least annually for relevant parameters.

### 7.2.1 Interpretation of Compliance for Wastewater Emissions

Emission limits for wastewater emissions are interpreted as follows:

For continuously monitored emissions:

(i) No flow value shall exceed the specific limit.
(ii) No pH value shall deviate from the specified range.

For non-continuous monitoring:

(i) No pH value shall deviate from the specified range.
(ii) No temperature value shall exceed the limit value.
(iii) For parameters other than pH, temperature and flow, eight out of ten consecutive results, calculated as daily mean concentration or mass emission value on the basis of flow proportional composite sampling, shall not exceed the emission limit value. No individual result similarly calculated shall exceed 1.2 times the emission limit value.
(iv) For parameters other than pH, temperature and flow, no grab sample value shall exceed 1.2 times the emission limit value.

## 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 Wastes

A full record, available for inspection at all times must be kept on matters relating to the waste management operations and practices carried out onsite and contains minimum details of

- Type and quantities of waste
- The names of the agent and transporter of the waste.
- The name of the persons responsible for the ultimate disposal/recovery of the waste.
- The ultimate destination of the waste.
- Written confirmation of the acceptance and disposal/recovery of any hazardous waste consignments sent off-site.
- The tonnages and EWC Code for waste materials listed in the licence, sent off-site for disposal/recovery.
- Details of any rejected consignments.
- The tonnages and EWC Code for the waste materials listed in the licence for recovery on-site.
- 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.

Where sludges and other waste materials are being disposed of to landfill, leachate testing should be carried out.

## 7.5 NOISE MONITORING

An annual noise survey should be conducted as outlined in guidance issued by the Agency, e.g., *Environmental Noise Survey Guidance Document, Environmental Protection Agency, 2003*.

## 7.6 MONITORING OF PROCESS VARIABLES

Some process variables will have potential environmental impact and these should be identified and monitored as appropriate. Examples might be:

- Raw materials monitoring for contaminants where contaminants are likely and there is inadequate supplier information;
- Oxygen, carbon monoxide, pressure or temperature in the furnace atmosphere or off-gases;
- Plant efficiency where it has an environmental relevance;
- Energy consumption across the plant and at individual points of use in accordance with the energy plan. Frequency – normally continuous and recorded;
- Fresh water use across the activities and at individual points of use should be monitored as part of the water efficiency plan. Frequency – continuous and recorded;
- The quantity of each class of waste generated.

# Appendix 1

## Principal References

### EU

BREF 2001, European Commission. Reference Document on Best Available Techniques on the production of Iron and Steel.

BREF 2004, European Commission IPPC Reference Document on BAT in the Smitheries and Foundries Industry.

BREF 2001, European Commission. Reference Document on Best Available Techniques in the Ferrous Metals Processing Industry.

BREF 2001, European Commission. Reference Document on Best Available Techniques in the Non Ferrous Metals Industry.

### Legislation

- Environment Protection Agency Act, 1992
- Protection of the Environment Act 2003
- Local Government (Water Pollution) Act 1977
- Council Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances. (OJ L20, 26/01/80). [amended by 85/208/EC (OJ L89, 29/03/85); 87/144/EC (OJ L57, 27/02/87); 2000/60/EC (OJ L 327, 22/12/00)].
- Protection of Groundwater Regulations 1999 (SI 41/1999)
- Local Government (Water Pollution) (Amendment) Regulations 1999 (SI 42/1999)
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (SI 293/1988)
- European Communities (Quality of Surface Water Intended for the Abstraction of drinking Water) Regulations, 1989 (SI 294/1989)
- Local Government (Water Pollution) Act 1990
- Environment Protection Agency Act, 1992 (Urban Waste Water Treatment) Regulations, 1994. SI 419/1994
- Council Directive 78/659/EEC on the quality of fresh waters needing protection or improvement in order to support fish life. (OJ L327, 22/12/00)
- Water Quality (Dangerous Substances) Regulations, 2001. SI 12/2001
- Air Pollution Act 1987
- Air Pollution (Air Quality Standards) Regulations, 2002 (SI 271/2002 – replaces SI 244/1987) European Community (1996) Council Directive 96/62/EC on ambient air quality assessment and management (OJ: L296/55/96) & Daughter Directives 1999/30/EC and 2000/69/EC
- European Community (1991). Council Directive 91/689/EEC on hazardous waste (OJ L377, 31/12/91)
- Waste Management Acts 1996 - 2003
- European Community (1999). Council Directive 1999/31/EC on the landfill of waste (OJ L182, 16/7/99)
- European Communities (Amendment of Waste Management (Licensing) Regulations 2002), SI 337/2002.
- European Community (1996). Council Directive 2008/1/EC concerning integrated pollution prevention and control. (OJ L257, 10/10/96)

- Wildlife Act 1976 and Wildlife (Amendment) Act 2000, and Regulations made there under European Communities (Natural Habitats) Regulations,1997(SI 94/1997) & Amendments
- European Communities (Conservation of Wildbirds) Amendment Regulations, 1997 (SI 210/1997)
- DIRECTIVE 2004/107/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 15 December 2004 relating to arsenic,cadmium,mercury,nickel and polycyclic aromatic hydrocarbons in ambient air

## EPA Publications

- EPA (Environmental Protection Agency) 2004 Guidance Note on Storage and Transfer of Materials for Scheduled Activities.
- EPA (Environmental Protection Agency) 2006 Guidance on Environmental Liability, Risk Assessment, Residual Management Plans and Financial Provision.
- EPA Guidance Note on Energy Efficiency Auditing July 2003
- EPA (Environmental Protection Agency) 2006 Guidance Notes for Noise in Relation to Scheduled Activities.
- EPA (Environmental Protection Agency) 1996 Integrated Pollution Control BATNEEC.
- Guidance Note for the Chemical Sector
- EPA (Environmental Protection Agency) 2001 Parameters for Water Quality,
- Interpretation and Standards.
- EPA (Environmental Protection Agency) Parameters for Water Quality Objectives and Standards 2001.
- EPA (Environmental Protection Agency) 1997 Environmental Quality Objectives and Environmental Quality Standards - the aquatic environment, a discussion document.
- BATNEEC Guidance Note, Class 3.1, Production of Iron and Steel
- Integrated Pollution Prevention and Control (IPPC). Best Available Technique Reference BAT Document on the production of Iron and Steel.

## Other references

- Integrated Pollution Prevention and Control (IPPC). UK Secretary of State's Guidance for A2 Activities in the Iron and Steel Sector IPPC SG4.
- IPPC S202 Technical Guidance for Iron and Steel and the production of Carbon and Graphite.

# Appendix 2

## Glossary of Terms and Abbreviations

### TERMS

| | |
|---|---|
| Baseline Monitoring: | Monitoring in and around the location of a proposed installation so as to establish background environmental conditions prior to any development of the proposed installation. |
| Borehole | A shaft installed for the monitoring of and/or the extraction of groundwater. Established by placing a casing and well screen into the boring. |
| Direct Discharge | Introduction into groundwater of substances in Lists I or II without percolation through the ground or subsoil. |
| Decommissioning: | Works carried out on a installation or to allow planned afteruse. |
| Effluent | A liquid, which flows from a process or system. |
| Emission | As defined in the EPA Act, 1992. |
| Groundwater | Water, which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. |
| Indirect Discharge | Introduction into groundwater of substances in Lists I or II after percolation through the ground or subsoil. |
| List I/II Substances | Substances referred to in the EU Directives on Dangerous Substances (76/464/EEC) and Groundwater (80/68/EC). |
| Receiving Water | A body of water, flowing or otherwise, such as a stream, river, lake, estuary or sea, into which water or wastewater is discharged. |
| Trigger Level: | Is a value which when encountered requires certain actions to be taken. |

## Abbreviations

| | |
|---|---|
| Bop | Benzo(a)pyrene |
| BAT | Best Available Techniques |
| BATNEEC | Best Available Techniques Not Entailing Excessive Cost |
| BOD | Biological Oxygen Demand |
| BREF | BAT reference - sector notes produced by the European Commission |
| °C | Degree Celsius |
| CO | Carbon Monoxide |
| $CO_2$ | Carbon Dioxide |
| COD | Chemical Oxygen Demand |
| DMEA | Dimethylethylamine |
| EIA | Environmental Impact Assessment |
| EIS | Environmental Impact Statement |
| ELV | Emission Limit Value |
| EMP | Environmental Management Programme |
| EMS | Environmental Management System |
| EPA | Environmental Protection Agency |
| EQO | Environmental Quality Objective |
| EQS | Environmental Quality Standard |
| IPC | Integrated Pollution Control; as established by the EPA Act of 1992 |
| IPPC | Integrated Pollution Prevention and Control |
| mg | Milligram |
| Iron and Steel BREF | Reference Document on Best Available Techniques on the production of Iron and Steel, published by the European Commission 2001 |
| $Nm^3$ | Normal cubic metre (101.3 kPa, 273 K) |
| NOx | Nitrogen Oxides |
| POE | Protection of the Environment Act 2003 |
| TEA | Triethylamine |
| TOC | Total Organic Carbon |
| US EPA | United States Environmental Protection Agency |
| WMA | Waste Management Act |
| VOC | Volatile Organic Compounds |