

COMMISSION IMPLEMENTING DECISION

of 28 February 2012

establishing the best available techniques (BAT) conclusions under Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions for iron and steel production

(notified under document C(2012) 903)

(Text with EEA relevance)

(2012/135/EU)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) ⁽¹⁾, and in particular Article 13(5) thereof,

Whereas:

- (1) Article 13(1) of Directive 2010/75/EU requires the Commission to organise an exchange of information on industrial emissions between it and Member States, the industries concerned and non-governmental organisations promoting environmental protection in order to facilitate the drawing up of best available techniques (BAT) reference documents as defined in Article 3(11) of that Directive.
- (2) In accordance with Article 13(2) of Directive 2010/75/EU, the exchange of information is to address the performance of installations and techniques in terms of emissions, expressed as short- and long-term averages, where appropriate, and the associated reference conditions, consumption and nature of raw materials, water consumption, use of energy and generation of waste and the techniques used, associated monitoring, cross-media effects, economic and technical viability and developments therein and also the best available techniques and emerging techniques identified after considering the issues mentioned in points (a) and (b) of Article 13(2) of that Directive.
- (3) 'BAT conclusions' as defined in Article 3(12) of Directive 2010/75/EU are the key element of BAT reference documents and lay down the conclusions on best available techniques, their description, information to assess their applicability, the emission levels associated with the best available techniques, associated monitoring, associated consumption levels and, where appropriate, relevant site remediation measures.
- (4) In accordance with Article 14(3) of Directive 2010/75/EU, BAT conclusions are to be the reference for setting the permit conditions for installations covered by Chapter 2 of that Directive.
- (5) Article 15(3) of Directive 2010/75/EU requires the competent authority to set emission limit values that ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the decisions on BAT conclusions referred to in Article 13(5) of that Directive.
- (6) Article 15(4) of Directive 2010/75 provides for derogations from the requirement laid down in Article 15(3) only where the costs associated with the achievement of emissions levels disproportionately outweigh the environmental benefits due to the geographical location, the local environmental conditions or the technical characteristics of the installation concerned.
- (7) Article 16(1) of Directive 2010/75/EU provides that the monitoring requirements in the permit referred to in point (c) of Article 14(1) are to be based on the conclusions on monitoring as described in the BAT conclusions.
- (8) In accordance with Article 21(3) of Directive 2010/75/EU, within four years of publication of decisions on BAT conclusions, the competent authority is to reconsider and, if necessary, update all the permit conditions and ensure that the installation complies with those permit conditions.
- (9) Commission Decision of 16 May 2011 establishing a forum for the exchange of information pursuant to Article 13 of the Directive 2010/75/EU on industrial emissions ⁽²⁾ established a forum composed of representatives of Member States, the industries concerned and non-governmental organisations promoting environmental protection.

⁽¹⁾ OJ L 334, 17.12.2010, p. 17.

⁽²⁾ OJ C 146, 17.5.2011, p. 3.

- (10) In accordance with Article 13(4) of Directive 2010/75/EU, the Commission obtained the opinion ⁽¹⁾ of that forum on the proposed content of the BAT reference document for iron and steel production on 13 September 2011 and made it publicly available.
- (11) The measures provided for in this Decision are in accordance with the opinion of the Committee established by Article 75(1) of Directive 2010/75/EU,

HAS ADOPTED THIS DECISION:

Article 1

The BAT conclusions for iron and steel production are set out in the Annex to this Decision.

Article 2

This Decision is addressed to the Member States.

Done at Brussels, 28 February 2012.

For the Commission
Janez POTOČNIK
Member of the Commission

⁽¹⁾ http://circa.europa.eu/Public/irc/env/ied/library?l=/ied_art_13_forum/opinions_article

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SCOPE

These BAT conclusions concern the following activities specified in Annex I to Directive 2010/75/EU, namely:

- activity 1.3: coke production
- activity 2.1: metal ore (including sulphide ore) roasting and sintering
- activity 2.2: production of pig iron or steel (primary or secondary fusion) including continuous casting, with a capacity exceeding 2,5 tonnes per hour.

In particular, the BAT conclusions cover the following processes:

- the loading, unloading and handling of bulk raw materials
- the blending and mixing of raw materials
- the sintering and pelletisation of iron ore
- the production of coke from coking coal
- the production of hot metal by the blast furnace route, including slag processing
- the production and refining of steel using the basic oxygen process, including upstream ladle desulphurisation, downstream ladle metallurgy and slag processing
- the production of steel by electric arc furnaces, including downstream ladle metallurgy and slag processing
- continuous casting (thin slab/thin strip and direct sheet casting (near-shape))

These BAT conclusions do not address the following activities:

- production of lime in kilns, covered by the Cement, Lime and Magnesium Oxide Manufacturing Industries BREF (CLM)
- the treatment of dusts to recover non-ferrous metals (e.g. electric arc furnace dust) and the production of ferroalloys, covered by the Non-Ferrous Metals Industries BREF (NFM)
- sulphuric acid plants in coke ovens, covered by the Large Volume Inorganic Chemicals-Ammonia, Acids and Fertilisers Industries (LVIC-AAF BREF).

Other reference documents which are of relevance for the activities covered by these BAT conclusions are the following:

Reference documents	Activity
Large Combustion Plants BREF (LCP)	Combustion plants with a rated thermal input of 50 MW or more
Ferrous Metals Processing Industry BREF (FMP)	Downstream processes like rolling, pickling, coating, etc.
	Continuous casting to the thin slab/thin strip and direct sheet casting (near-shape)

Reference documents	Activity
Emissions from Storage BREF (EFS)	Storage and handling
Industrial Cooling Systems BREF (ICS)	Cooling systems
General Principles of Monitoring (MON)	Emissions and consumptions monitoring
Energy Efficiency BREF (ENE)	General energy efficiency
Economic and Cross-Media Effects (ECM)	Economic and cross-media effects of techniques

The techniques listed and described in these BAT conclusions are neither prescriptive nor exhaustive. Other techniques may be used that ensure at least an equivalent level of environmental protection.

GENERAL CONSIDERATIONS

The environmental performance levels associated with BAT are expressed as ranges, rather than as single values. A range may reflect the differences within a given type of installation (e.g. differences in the grade/purity and quality of the final product, differences in design, construction, size and capacity of the installation) that result in variations in the environmental performances achieved when applying BAT

EXPRESSION OF EMISSION LEVELS ASSOCIATED WITH THE BEST AVAILABLE TECHNIQUES (BAT-AELs)

In these BAT conclusions, BAT-AELs for air emissions are expressed as either:

- mass of emitted substances per volume of waste gas under standard conditions (273,15 K, 101,3 kPa), after deduction of water vapour content, expressed in the units g/Nm³, mg/Nm³, µg/Nm³ or ng/Nm³; or
- mass of emitted substances per unit of mass of products generated or processed (consumption or emission factors), expressed in the units kg/t, g/t, mg/t or µg/t.

and BAT-AELs for emissions to water are expressed as:

- mass of emitted substances per volume of waste water, expressed in the units g/l, mg/l or µg/l.

DEFINITIONS

For the purposes of these BAT conclusions:

- 'new plant' means: a plant introduced on the site of the installation following the publication of these BAT conclusions or a complete replacement of a plant on the existing foundations of the installation following the publication of these BAT conclusions
- 'existing plant' means: a plant which is not a new plant
- 'NO_x' means: the sum of nitrogen oxide (NO) and nitrogen dioxide (NO₂) expressed as NO₂
- 'SO_x' means: the sum of sulphur dioxide (SO₂) and sulphur trioxide (SO₃) expressed as SO₂
- 'HCl' means: all gaseous chlorides expressed as HCl
- 'HF' means: all gaseous fluorides expressed as HF

1.1. General BAT Conclusions

Unless otherwise stated, the BAT conclusions presented in this section are generally applicable.

The process specific BAT included in the Sections 1.2 – 1.7 apply in addition to the general BAT mentioned in this Section.

1.1.1. Environmental management systems

1. BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:

- I. commitment of management, including senior management;
- II. definition of an environmental policy that includes continuous improvement for the installation by the management;
- III. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;
- IV. implementation of the procedures paying particular attention to:
 - (i) structure and responsibility
 - (ii) training, awareness and competence
 - (iii) communication
 - (iv) employee involvement
 - (v) documentation
 - (vi) efficient process control
 - (vii) maintenance programmes
 - (viii) emergency preparedness and response
 - (ix) safeguarding compliance with environmental legislation;
- V. checking performance and taking corrective action, paying particular attention to:
 - (i) monitoring and measurement (see also the Reference Document on the General Principles of Monitoring)
 - (ii) corrective and preventive action
 - (iii) maintenance of records
 - (iv) independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;
- VI. review of the EMS and its continuing suitability, adequacy and effectiveness by senior management;
- VII. following the development of cleaner technologies;

VIII. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life;

IX. application of sectoral benchmarking on a regular basis.

Applicability

The scope (e.g. level of details) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

1.1.2. Energy management

2. BAT is to reduce thermal energy consumption by using a combination of the following techniques:

I. improved and optimised systems to achieve smooth and stable processing, operating close to the process parameter set points by using

(i) process control optimisation including computer-based automatic control systems

(ii) modern, gravimetric solid fuel feed systems

(iii) preheating, to the greatest extent possible, considering the existing process configuration.

II. recovering excess heat from processes, especially from their cooling zones

III. an optimised steam and heat management

IV. applying process integrated reuse of sensible heat as much as possible.

In the context of energy management, see the Energy Efficiency BREF (ENE).

Description of BAT Ii

The following items are important for integrated steelworks in order to improve the overall energy efficiency:

- optimising energy consumption
- online monitoring for the most important energy flows and combustion processes at the site including the monitoring of all gas flares in order to prevent energy losses, enabling instant maintenance and achieving an uninterrupted production process
- reporting and analysing tools to check the average energy consumption of each process
- defining specific energy consumption levels for relevant processes and comparing them on a long-term basis
- carrying out energy audits as defined in the Energy Efficiency BREF, e.g. to identify cost-effective energy savings opportunities.

Description of BAT II – IV

Process integrated techniques used to improve energy efficiency in steel manufacturing by improved heat recovery include:

- combined heat and power production with recovery of waste heat by heat exchangers and distribution either to other parts of the steelworks or to a district heating network
- the installation of steam boilers or adequate systems in large reheating furnaces (furnaces can cover a part of the steam demand)

- preheating of the combustion air in furnaces and other burning systems to save fuel, taking into consideration adverse effects, i.e. an increase of nitrogen oxides in the off-gas
- the insulation of steam pipes and hot water pipes
- recovery of heat from products, e.g. sinter
- where steel needs to be cooled, the use of both heat pumps and solar panels
- the use of flue-gas boilers in furnaces with high temperatures
- the oxygen evaporation and compressor cooling to exchange energy across standard heat exchangers
- the use of top recovery turbines to convert the kinetic energy of the gas produced in the blast furnace into electric power.

Applicability of BAT II – IV

Combined heat and power generation is applicable for all iron and steel plants close to urban areas with a suitable heat demand. The specific energy consumption depends on the scope of the process, the product quality and the type of installation (e.g. the amount of vacuum treatment at the basic oxygen furnace (BOF), annealing temperature, thickness of products, etc.).

3. BAT is to reduce primary energy consumption by optimisation of energy flows and optimised utilisation of the extracted process gases such as coke oven gas, blast furnace gas and basic oxygen gas.

Description

Process integrated techniques to improve energy efficiency in an integrated steelworks by optimising process gas utilisation include:

- the use of gas holders for all by-product gases or other adequate systems for short-term storage and pressure holding facilities
- increasing pressure in the gas grid if there are energy losses in the flares – in order to utilise more process gases with the resulting increase in the utilisation rate
- gas enrichment with process gases and different calorific values for different consumers
- heating fire furnaces with process gas
- use of a computer-controlled calorific value control system
- recording and using coke and flue-gas temperatures
- adequate dimensioning of the capacity of the energy recovery installations for the process gases, in particular with regard to the variability of process gases.

Applicability

The specific energy consumption depends on the scope of the process, the product quality and the type of installation (e.g. the amount of vacuum treatment at the BOF, annealing temperature, thickness of products, etc.).

4. BAT is to use desulphurised and dedusted surplus coke oven gas and dedusted blast furnace gas and basic oxygen gas (mixed or separate) in boilers or in combined heat and power plants to generate steam, electricity and/or heat using surplus waste heat for internal or external heating networks, if there is a demand from a third party.

Applicability

The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of the permit.

5. BAT is to minimise electrical energy consumption by using one or a combination of the following techniques:

- I. power management systems
- II. grinding, pumping, ventilation and conveying equipment and other electricity-based equipment with high energy efficiency.

Applicability

Frequency controlled pumps cannot be used where the reliability of the pumps is of essential importance for the safety of the process.

1.1.3. Material management

6. BAT is to optimise the management and control of internal material flows in order to prevent pollution, prevent deterioration, provide adequate input quality, allow reuse and recycling and to improve the process efficiency and optimisation of the metal yield.

Description

Appropriate storage and handling of input materials and production residues can help to minimise the airborne dust emissions from stockyards and conveyor belts, including transfer points, and to avoid soil, groundwater and runoff water pollution (see also BAT 11).

The application of an adequate management of integrated steelworks and residues, including wastes, from other installations and sectors allows for a maximised internal and/or external use as raw materials (see also BAT 8, 9 and 10).

Material management includes the controlled disposal of small parts of the overall quantity of residues from an integrated steelworks which have no economic use.

7. In order to achieve low emission levels for relevant pollutants, BAT is to select appropriate scrap qualities and other raw materials. Regarding scrap, BAT is to undertake an appropriate inspection for visible contaminants which might contain heavy metals, in particular mercury, or might lead to the formation of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB).

To improve the use of scrap, the following techniques can be used individually or in combination:

- specification of acceptance criteria suited to the production profile in purchase orders of scrap
- having a good knowledge of scrap composition by closely monitoring the origin of the scrap; in exceptional cases, a melt test might help characterise the composition of the scrap
- having adequate reception facilities and check deliveries
- having procedures to exclude scrap that is not suitable for use in the installation
- storing the scrap according to different criteria (e.g. size, alloys, degree of cleanliness); storing of scrap with potential release of contaminants to the soil on impermeable surfaces with a drainage and collection system; using a roof which can reduce the need for such a system
- putting together the scrap load for the different melts taking into account the knowledge of composition in order to use the most suitable scrap for the steel grade to be produced (this is essential in some cases to avoid the presence of undesired elements and in other cases to take advantage of alloy elements which are present in the scrap and needed for the steel grade to be produced)
- prompt return of all internally-generated scrap to the scrapyards for recycling
- having an operation and management plan
- scrap sorting to minimise the risk of including hazardous or non-ferrous contaminants, particularly polychlorinated biphenyls (PCB) and oil or grease. This is normally done by the scrap supplier but the operator inspects all scrap loads in sealed containers for safety reasons. Therefore, at the same time, it is possible to check, as far as practicable, for contaminants. Evaluation of the small quantities of plastic (e.g. as plastic coated components) may be required
- radioactivity control according to the United Nations Economic Commission for Europe (UNECE) Expert Group framework of recommendations

- implementation of the mandatory removal of components which contain mercury from End-of-Life Vehicles and Waste Electrical and Electronic Equipment (WEEE) by the scrap processors can be improved by:
 - fixing the absence of mercury in scrap purchase contracts
 - refusal of scrap which contains visible electronic components and assemblies.

Applicability

The selection and sorting of scrap might not be entirely within the control of the operator.

1.1.4. Management of process residues such as by-products and waste

8. BAT for solid residues is to use integrated techniques and operational techniques for waste minimisation by internal use or by application of specialised recycling processes (internally or externally).

Description

Techniques for the recycling of iron-rich residues include specialised recycling techniques such as the OxyCup® shaft furnace, the DK process, smelting reduction processes or cold bonded pelleting/briquetting as well as techniques for production residues mentioned in Sections 9.2 – 9.7.

Applicability

As the mentioned processes may be carried out by a third party, the recycling itself may not be within the control of the operator of the iron and steel plant, and therefore may not be within the scope of the permit.

9. BAT is to maximise external use or recycling for solid residues which cannot be used or recycled according to BAT 8, wherever this is possible and in line with waste regulations. BAT is to manage in a controlled manner residues which can neither be avoided nor recycled.

10. BAT is to use the best operational and maintenance practices for the collection, handling, storage and transport of all solid residues and for the hooding of transfer points to avoid emissions to air and water.

1.1.5. Diffuse dust emissions from materials storage, handling and transport of raw materials and (intermediate) products

11. BAT is to prevent or reduce diffuse dust emissions from materials storage, handling and transport by using one or a combination of the techniques mentioned below.

If abatement techniques are used, BAT is to optimise the capture efficiency and subsequent cleaning through appropriate techniques such as those mentioned below. Preference is given to the collection of the dust emissions nearest to the source.

I. General techniques include:

- the setting up within the EMS of the steelworks of an associated diffuse dust action plan;
- consideration of temporary cessation of certain operations where they are identified as a source of PM₁₀ causing a high ambient reading; in order to do this, it will be necessary to have sufficient PM₁₀ monitors, with associated wind direction and strength monitoring, to be able to triangulate and identify key sources of fine dust.

II. Techniques for the prevention of dust releases during the handling and transport of bulk raw materials include:

- orientation of long stockpiles in the direction of the prevailing wind
- installing wind barriers or using natural terrain to provide shelter
- controlling the moisture content of the material delivered
- careful attention to procedures to avoid the unnecessary handling of materials and long unenclosed drops
- adequate containment on conveyors and in hoppers, etc.

- the use of dust-suppressing water sprays, with additives such as latex, where appropriate
- rigorous maintenance standards for equipment
- high standards of housekeeping, in particular the cleaning and damping of roads
- the use of mobile and stationary vacuum cleaning equipment
- dust suppression or dust extraction and the use of a bag filter cleaning plant to abate sources of significant dust generation
- the application of emissions-reduced sweeping cars for carrying out the routine cleaning of hard surfaced roads.

III. Techniques for materials delivery, storage and reclamation activities include:

- total enclosure of unloading hoppers in a building equipped with filtered air extraction for dusty materials, or hoppers should be fitted with dust baffles and the unloading grids coupled to a dust extraction and cleaning system
- limiting the drop heights if possible to a maximum of 0,5 m
- the use of water sprays (preferably using recycled water) for dust suppression
- where necessary, the fitting of storage bins with filter units to control dust
- the use of totally enclosed devices for reclamation from bins
- where necessary, the storage of scrap in covered, and hard surfaced areas to reduce the risk of ground contamination (using just in time delivery to minimise the size of the yard and hence emissions)
- minimisation of the disturbance of stockpiles
- restriction of the height and a controlling of the general shape of stockpiles
- the use of in-building or in-vessel storage, rather than external stockpiles, if the scale of storage is appropriate
- the creation of windbreaks by natural terrain, banks of earth or the planting of long grass and evergreen trees in open areas to capture and absorb dust without suffering long-term harm
- hydro-seeding of waste tips and slag heaps
- implementation of a greening of the site by covering unused areas with top soil and planting grass, shrubs and other ground covering vegetation
- the moistening of the surface using durable dust-binding substances
- the covering of the surface with tarpaulins or coating (e.g. latex) stockpiles
- the application of storage with retaining walls to reduce the exposed surface
- when necessary, a measure could be to include impermeable surfaces with concrete and drainage.

IV. Where fuel and raw materials are delivered by sea and dust releases could be significant, some techniques include:

- use by operators of self-discharge vessels or enclosed continuous unloaders. Otherwise, dust generated by grab-type ship unloaders should be minimised through a combination of ensuring adequate moisture content of the material is delivered, by minimising drop heights and by using water sprays or fine water fogs at the mouth of the ship unloader hopper

- avoiding seawater in spraying ores or fluxes as this results in a fouling of sinter plant electrostatic precipitators with sodium chloride. Additional chlorine input in the raw materials may also lead to rising emissions (e.g. of polychlorinated dibenzodioxins/furans (PCDD/F)) and hamper filter dust recirculation
- storage of powdered carbon, lime and calcium carbide in sealed silos and conveying them pneumatically or storing and transferring them in sealed bags.

V. Train or truck unloading techniques include:

- if necessary due to dust emission formation, use of dedicated unloading equipment with a generally enclosed design.

VI. For highly drift-sensitive materials which may lead to significant dust release, some techniques include:

- use of transfer points, vibrating screens, crushers, hoppers and the like, which may be totally enclosed and extracted to a bag filter plant
- use of central or local vacuum cleaning systems rather than washing down for the removal of spillage, since the effects are restricted to one medium and the recycling of spilt material is simplified.

VII. Techniques for the handling and processing of slag include:

- keeping stockpiles of slag granulate damp for slag handling and processing since dried blast furnace slag and steel slag can give rise to dust
- use of enclosed slag-crushing equipment fitted with efficient extraction and bag filters to reduce dust emissions.

VIII. Techniques for handling scrap include:

- providing scrap storage under cover and/or on concrete floors to minimise dust lift-off caused by vehicle movements

IX. Techniques to consider during material transport include:

- the minimisation of points of access from public highways
- the employment of wheel-cleaning equipment to prevent the carryover of mud and dust onto public roads
- the application of hard surfaces to the transport roads (concrete or asphalt) to minimise the generation of dust clouds during materials transport and the cleaning of roads
- the restriction of vehicles to designated routes by fences, ditches or banks of recycled slag
- the damping of dusty routes by water sprays, e.g. at slag-handling operations
- ensuring that transport vehicles are not overfull, so as to prevent any spillage
- ensuring that transport vehicles are sheeted to cover the material carried
- the minimisation of numbers of transfers
- use of closed or enclosed conveyors
- use of tubular conveyors, where possible, to minimise material losses by changes of direction across sites usually provided by the discharge of materials from one belt onto another
- good practice techniques for molten metal transfer and ladle handling
- dedusting of conveyor transfer points.

1.1.6. Water and waste water management

12. BAT for waste water management is to prevent, collect and separate waste water types, maximising internal recycling and using an adequate treatment for each final flow. This includes techniques utilising, e.g. oil interceptors, filtration or sedimentation. In this context, the following techniques can be used where the prerequisites mentioned are present:

- avoiding the use of potable water for production lines
- increasing the number and/or capacity of water circulating systems when building new plants or modernising/re-vamping existing plants
- centralising the distribution of incoming fresh water
- using the water in cascades until single parameters reach their legal or technical limits
- using the water in other plants if only single parameters of the water are affected and further usage is possible
- keeping treated and untreated waste water separated; by this measure it is possible to dispose of waste water in different ways at a reasonable cost
- using rainwater whenever possible.

Applicability

The water management in an integrated steelworks will primarily be constrained by the availability and quality of fresh water and local legal requirements. In existing plants the existing configuration of the water circuits may limit applicability.

1.1.7. Monitoring

13. BAT is to measure or assess all relevant parameters necessary to steer the processes from control rooms by means of modern computer-based systems in order to adjust continuously and to optimise the processes online, to ensure stable and smooth processing, thus increasing energy efficiency and maximising the yield and improving maintenance practices.

14. BAT is to measure the stack emissions of pollutants from the main emission sources from all processes included in the Sections 1.2 – 1.7 whenever BAT-AELs are given and in process gas-fired power plants in iron and steel works.

BAT is to use continuous measurements at least for:

- primary emissions of dust, nitrogen oxides (NO_x) and sulphur dioxide (SO₂) from sinter strands
- nitrogen oxides (NO_x) and sulphur dioxide (SO₂) emissions from induration strands of pelletisation plants
- dust emissions from blast furnace cast houses
- secondary emissions of dust from basic oxygen furnaces
- emissions of nitrogen oxides (NO_x) from power plants
- dust emissions from large electric arc furnaces.

For other emissions, BAT is to consider using continuous emission monitoring depending on the mass flow and emission characteristics.

15. For relevant emission sources not mentioned in BAT 14, BAT is to measure the emissions of pollutants from all processes included in the Sections 1.2 – 1.7 and from process gas-fired power plants within iron and steel works as well as all relevant process gas components/pollutants periodically and discontinuously. This includes the discontinuous monitoring of process gases, stack emissions, polychlorinated dibenzodioxins/furans (PCDD/F) and monitoring the discharge of waste water, but excludes diffuse emissions (see BAT 16).

Description (relevant for BAT 14 and 15)

The monitoring of process gases provides information about the composition of process gases and about indirect emissions from the combustion of process gases, such as emissions of dust, heavy metals and SO_x.

Stack emissions can be measured by regular, periodic discontinuous measurements at relevant channelled emission sources over a sufficiently long period, to obtain representative emission values.

For monitoring the discharge of waste water a great variety of standardised procedures exist for sampling and analyzing water and waste water, including:

- a random sample which refers to a single sample taken from a waste water flow
- a composite sample, which refers to a sample taken continuously over a given period, or a sample consisting of several samples taken either continuously or discontinuously over a given period and blended
- a qualified random sample shall refer to a composite sample of at least five random samples taken over a maximum period of two hours at intervals of no less than two minutes, and blended.

Monitoring should be done according to the relevant EN or ISO standards. If EN or ISO standards are not available, national or other international standards should be used that ensure the provision of data of an equivalent scientific quality.

16. BAT is to determine the order of magnitude of diffuse emissions from relevant sources by the methods mentioned below. Whenever possible, direct measurement methods are preferred over indirect methods or evaluations based on calculations with emission factors.

- Direct measurement methods where the emissions are measured at the source itself. In this case, concentrations and mass streams can be measured or determined.
- Indirect measurement methods where the emission determination takes place at a certain distance from the source; a direct measurement of concentrations and mass stream is not possible.
- Calculation with emission factors.

Description*Direct or quasi-direct measurement*

Examples for direct measurements are measurements in wind tunnels, with hoods or other methods like quasi-emissions measurements on the roof of an industrial installation. For the latter case, the wind velocity and the area of the roofline vent are measured and a flow rate is calculated. The cross-section of the measurement plane of the roofline vent is subdivided into sectors of identical surface area (grid measurement).

Indirect measurements

Examples of indirect measurements include the use of tracer gases, reverse dispersion modelling (RDM) methods and the mass balance method applying light detection and ranging (LIDAR).

Calculation of emissions with emission factors

Guidelines using emission factors for the estimation of diffuse dust emissions from storage and handling of bulk materials and for the suspension of dust from roadways due to traffic movements are:

- VDI 3790 Part 3
- US EPA AP 42

1.1.8. Decommissioning

17. BAT is to prevent pollution upon decommissioning by using necessary techniques as listed below.

Design considerations for end-of-life plant decommissioning:

- I. giving consideration to the environmental impact from the eventual decommissioning of the installation at the stage of designing a new plant, as forethought makes decommissioning easier, cleaner and cheaper

II. decommissioning poses environmental risks for the contamination of land (and groundwater) and generates large quantities of solid waste; preventive techniques are process-specific but general considerations may include:

- (i) avoiding underground structures
- (ii) incorporating features that facilitate dismantling
- (iii) choosing surface finishes that are easily decontaminated
- (iv) using an equipment configuration that minimises trapped chemicals and facilitates drain-down or cleaning
- (v) designing flexible, self-contained units that enable phased closure
- (vi) using biodegradable and recyclable materials where possible.

1.1.9. Noise

18. BAT is to reduce noise emissions from relevant sources in the iron and steel manufacturing processes by using one or more of the following techniques depending on and according to local conditions:

- implementation of a noise-reduction strategy
- enclosure of the noisy operations/units
- vibration insulation of operations/units
- internal and external lining made of impact-absorbent material
- soundproofing buildings to shelter any noisy operations involving material transformation equipment
- building noise protection walls, e.g. the construction of buildings or natural barriers, such as growing trees and bushes between the protected area and the noisy activity
- outlet silencers on exhaust stacks
- lagging ducts and final blowers which are situated in soundproof buildings
- closing doors and windows of covered areas.

1.2. BAT Conclusions For Sinter Plants

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all sinter plants.

Air emissions

19. BAT for blending/mixing is to prevent or reduce diffuse dust emissions by agglomerating fine materials by adjusting the moisture content (see also BAT 11).

20. BAT for primary emissions from sinter plants is to reduce dust emissions from the sinter strand waste gas by means of a bag filter.

BAT for primary emissions for existing plants is to reduce dust emissions from the sinter strand waste gas by using advanced electrostatic precipitators when bag filters are not applicable.

The BAT-associated emission level for dust is $< 1 - 15 \text{ mg/Nm}^3$ for the bag filter and $< 20 - 40 \text{ mg/Nm}^3$ for the advanced electrostatic precipitator (which should be designed and operated to achieve these values), both determined as a daily mean value.

Bag Filter

Description

Bag filters used in sinter plants are usually applied downstream of an existing electrostatic precipitator or cyclone but can also be operated as a standalone device.

Applicability

For existing plants requirements such as space for a downstream installation to the electrostatic precipitator can be relevant. Special regard should be given to the age and the performance of the existing electrostatic precipitator.

Advanced electrostatic precipitator**Description**

Advanced electrostatic precipitators are characterised by one or a combination of the following features:

- good process control
- additional electrical fields
- adapted strength of the electric field
- adapted moisture content
- conditioning with additives
- higher or variably pulsed voltages
- rapid reaction voltage
- high energy pulse superimposition
- moving electrodes
- enlarging the electrode plate distance or other features which improves the abatement efficiency.

21. BAT for primary emissions from sinter strands is to prevent or reduce mercury emissions by selecting raw materials with a low mercury content (see BAT 7) or to treat waste gases in combination with activated carbon or activated lignite coke injection.

The BAT-associated emissions level for mercury is $< 0,03 - 0,05 \text{ mg/Nm}^3$, as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

22. BAT for primary emissions from sinter strands is to reduce sulphur oxide (SO_x) emissions by using one or a combination of the following techniques:

- I. lowering the sulphur input by using coke breeze with a low sulphur content
- II. lowering the sulphur input by minimisation of coke breeze consumption
- III. lowering the sulphur input by using iron ore with a low sulphur content
- IV. injection of adequate adsorption agents into the waste gas duct of the sinter strand before dedusting by bag filter (see BAT 20)
- V. wet desulphurisation or regenerative activated carbon (RAC) process (with particular consideration for the prerequisites for application).

The BAT-associated emission level for sulphur oxides (SO_x) using BAT I – IV is $< 350 - 500 \text{ mg/Nm}^3$, expressed as sulphur dioxide (SO_2) and determined as a daily mean value, the lower value being associated with BAT IV.

The BAT-associated emission level for sulphur oxides (SO_x) using BAT V is $< 100 \text{ mg/Nm}^3$, expressed as sulphur dioxide (SO_2) and determined as a daily mean value.

Description of the RAC process mentioned under BAT V

Dry desulphurisation techniques are based on an adsorption of SO_2 by activated carbon. When the SO_2 -laden activated carbon is regenerated, the process is called regenerated activated carbon (RAC). In this case, a high quality, expensive activated carbon type may be used and sulphuric acid (H_2SO_4) is yielded as a by-product. The bed is regenerated either with water or thermally. In some cases, for 'fine-tuning' downstream of an existing desulphurisation unit, lignite-based activated carbon is used. In this case, the SO_2 -laden activated carbon is usually incinerated under controlled conditions.

The RAC system can be developed as a single-stage or a two-stage process.

In the single-stage process, the waste gases are led through a bed of activated carbon and pollutants are adsorbed by the activated carbon. Additionally, NO_x removal occurs when ammonia (NH₃) is injected into the gas stream before the catalyst bed.

In the two-stage process, the waste gases are led through two beds of activated carbon. Ammonia can be injected before the bed to reduce NO_x emissions.

Applicability of techniques mentioned under BAT V

Wet desulphurisation: The requirements of space may be of significance and may restrict the applicability. High investment and operational costs and significant cross-media effects such as slurry generation and disposal and additional waste water treatment measures, have to be taken into account. This technique is not used in Europe at the time of writing, but might be an option where environmental quality standards are unlikely to be met through the application of other techniques.

RAC: Dust abatement should be installed prior to the RAC process to reduce the inlet dust concentration. Generally the layout of the plant and space requirements are important factors when considering this technique, but especially for a site with more than one sinter strand.

High investment and operational costs, in particular when high quality, expensive, activated carbon types may be used and a sulphuric acid plant is needed, have to be taken into account. This technique is not used in Europe at the time of writing, but might be an option in new plants targeting SO_x, NO_x, dust and PCDD/F simultaneously and in circumstances where environmental quality standards are unlikely to be met through the application of other techniques.

23. BAT for primary emissions from sinter strands is to reduce total nitrogen oxides (NO_x) emissions by using one or a combination of the following techniques:

I. process integrated measures which can include:

- (i) waste gas recirculation
- (ii) other primary measures, such as the use of anthracite or the use of low-NO_x burners for ignition

II. end-of-pipe techniques which can include

- (i) the regenerative activated carbon (RAC) process
- (ii) selective catalytic reduction (SCR).

The BAT-associated emission level for nitrogen oxides (NO_x) using process integrated measures is < 500 mg/Nm³, expressed as nitrogen dioxide (NO₂) and determined as a daily mean value.

The BAT-associated emission level for nitrogen oxides (NO_x) using RAC is < 250 mg/Nm³ and using SCR it is < 120 mg/Nm³, expressed as nitrogen dioxide (NO₂), related to an oxygen content of 15 % and determined as daily mean values.

Description of waste gas recirculation under BAT Ii

In the partial recycling of waste gas, some portions of the sinter waste gas are recirculated to the sintering process. Partial recycling of waste gas from the whole strand was primarily developed to reduce waste gas flow and thus the mass emissions of major pollutants. Additionally it can lead to a decrease in energy consumption. The application of waste gas recirculation requires special efforts to ensure that the sinter quality and productivity are not affected negatively. Special attention needs to be paid to carbon monoxide (CO) in the recirculated waste gas in order to prevent carbon monoxide poisoning of employees. Various processes have been developed such as:

- partial recycling of waste gas from the whole strand
- recycling of waste gas from the end sinter strand combined with heat exchange
 - recycling of waste gas from part of the end sinter strand and use of waste gas from the sinter cooler
 - recycling of parts of waste gas to other parts of the sinter strand.

Applicability of BAT I.i

The applicability of this technique is site specific. Accompanying measures to ensure that sinter quality (cold mechanical strength) and strand productivity are not negatively affected must be considered. Depending on local conditions, these can be relatively minor and easy to implement or, on the contrary, they can be of a more fundamental nature and may be costly and difficult to introduce. In any case, the operating conditions of the strand should be reviewed when this technique is introduced.

In existing plants, it may not be possible to install a partial recycling of waste gas due to space restrictions.

Important considerations in determining the applicability of this technique include:

- initial configuration of the strand (e.g. dual or single wind-box ducts, space available for new equipment and, when required, lengthening of the strand)
- initial design of the existing equipment (e.g. fans, gas cleaning and sinter screening and cooling devices)
- initial operating conditions (e.g. raw materials, layer height, suction pressure, percentage of quick lime in the mix, specific flow rate, percentage of in-plant reverts returned in the feed)
- existing performance in terms of productivity and solid fuel consumption
- basicity index of the sinter and composition of the burden at the blast furnace (e.g. percentage of sinter versus pellet in the burden, iron content of these components).

Applicability of other primary measures under BAT I.ii

The use of anthracite depends on the availability of anthracites with a lower nitrogen content compared to coke breeze.

Description and applicability of the RAC process under BAT II.i see BAT 22.

Applicability of the SCR process under BAT II.ii

SCR can be applied within a high dust system, a low dust system and as a clean gas system. Until now, only clean gas systems (after dedusting and desulphurisation) have been applied at sinter plants. It is essential that the gas is low in dust ($< 40 \text{ mg dust/Nm}^3$) and heavy metals, because they can make the surface of the catalyst ineffective. Additionally, desulphurisation prior to the catalyst might be required. Another prerequisite is a minimum off-gas temperature of about $300 \text{ }^\circ\text{C}$. This requires an energy input.

The high investment and operational costs, the need for catalyst revitalisation, NH_3 consumption and slip, the accumulation of explosive ammonium nitrate (NH_4NO_3), the formation of corrosive SO_3 and the additional energy required for reheating which can reduce the possibilities for recovery of sensible heat from the sinter process, all may constrain the applicability. This technique might be an option where environmental quality standards are unlikely to be met through the application of other techniques.

24. BAT for primary emissions from sinter strands is to prevent and/or reduce emissions of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) by using one or a combination of the following techniques:

- I. avoidance of raw materials which contain polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) or their precursors as much as possible (see BAT 7)
- II. suppression of polychlorinated dibenzodioxins/furans (PCDD/F) formation by addition of nitrogen compounds
- III. waste gas recirculation (see BAT 23 for description and applicability).

25. BAT for primary emissions from sinter strands is to reduce emissions of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) by the injection of adequate adsorption agents into the waste gas duct of the sinter strand before dedusting with a bag filter or advanced electrostatic precipitators when bag filters are not applicable (see BAT 20).

The BAT-associated emission level for polychlorinated dibenzodioxins/furans (PCDD/F) is $< 0,05 - 0,2 \text{ ng I-TEQ/Nm}^3$ for the bag filter and $< 0,2 - 0,4 \text{ ng-I-TEQ/Nm}^3$ for the advanced electrostatic precipitator, both determined for a 6 – 8 hour random sample under steady-state conditions.

26. BAT for secondary emissions from sinter strand discharge, sinter crushing, cooling, screening and conveyor transfer points is to prevent dust emissions and/or to achieve an efficient extraction and subsequently to reduce dust emissions by using a combination of the following techniques:

- I. hooding and/or enclosure
- II. an electrostatic precipitator or a bag filter.

The BAT-associated emission level for dust is $< 10 \text{ mg/Nm}^3$ for the bag filter and $< 30 \text{ mg/Nm}^3$ for the electrostatic precipitator, both determined as a daily mean value.

Water and waste water

27. BAT is to minimise water consumption in sinter plants by recycling cooling water as much as possible unless once-through cooling systems are used.

28. BAT is to treat the effluent water from sinter plants where rinsing water is used or where a wet waste gas treatment system is applied, with the exception of cooling water prior to discharge by using a combination of the following techniques:

- I. heavy metal precipitation
- II. neutralisation
- III. sand filtration.

The BAT-associated emission levels, based on a qualified random sample or a 24-hour composite sample, are:

- | | |
|--|----------------------|
| — suspended solids | $< 30 \text{ mg/l}$ |
| — chemical oxygen demand (COD ⁽¹⁾) | $< 100 \text{ mg/l}$ |
| — heavy metals | $< 0,1 \text{ mg/l}$ |

(sum of arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn)).

Production residues

29. BAT is to prevent waste generation within sinter plants by using one or a combination of the following techniques (see BAT 8):

- I. selective on-site recycling of residues back to the sinter process by excluding heavy metals, alkali or chloride-enriched fine dust fractions (e.g. the dust from the last electrostatic precipitator field)
- II. external recycling whenever on-site recycling is hampered.

BAT is to manage in a controlled manner sinter plant process residues which can neither be avoided nor recycled.

30. BAT is to recycle residues that may contain oil, such as dust, sludge and mill scale which contain iron and carbon from the sinter strand and other processes in the integrated steelworks, as much as possible back to the sinter strand, taking into account the respective oil content.

⁽¹⁾ In some cases, TOC is measured instead of COD (in order to avoid HgCl_2 used in the analysis for COD). The correlation between COD and TOC should be elaborated for each sinter plant case by case. The COD/TOC ratio may vary approximately between two and four.

31. BAT is to lower the hydrocarbon content of the sinter feed by appropriate selection and pretreatment of the recycled process residues.

In all cases, the oil content of the recycled process residues should be < 0,5 % and the content of the sinter feed < 0,1 %.

Description

The input of hydrocarbons can be minimised, especially by the reduction of the oil input. Oil enters the sinter feed mainly by addition of mill scale. The oil content of mill scales can vary significantly, depending on their origin.

Techniques to minimise oil input via dusts and mill scale include the following:

- limiting input of oil by segregating and then selecting only those dusts and mill scale with a low oil content
- the use of 'good housekeeping' techniques in the rolling mills can result in a substantial reduction in the contaminant oil content of mill scale
- de-oiling of mill scale by:
 - heating the mill scale to approximately 800 °C, the oil hydrocarbons are volatilised and clean mill scale is yielded; the volatilised hydrocarbons can be combusted.
 - extracting oil from the mill scale using a solvent.

Energy

32. BAT is to reduce thermal energy consumption within sinter plants by using one or a combination of the following techniques:

- I. recovering sensible heat from the sinter cooler waste gas
- II. recovering sensible heat, if feasible, from the sintering grate waste gas
- III. maximising the recirculation of waste gases to use sensible heat (see BAT 23 for description and applicability).

Description

Two kinds of potentially reusable waste energies are discharged from the sinter plants:

- the sensible heat from the waste gases from the sintering machines
- the sensible heat of the cooling air from the sinter cooler.

Partial waste gas recirculation is a special case of heat recovery from waste gases from sintering machines and is dealt with in BAT 23. The sensible heat is transferred directly back to the sinter bed by the hot recirculated gases. At the time of writing (2010), this is the only practical method of recovering heat from the waste gases.

The sensible heat in the hot air from the sinter cooler can be recovered by one or more of the following ways:

- steam generation in a waste heat boiler for use in the iron and steel works
- hot water generation for district heating
- preheating combustion air in the ignition hood of the sinter plant
- preheating the sinter raw mix
- use of the sinter cooler gases in a waste gas recirculation system.

Applicability

At some plants, the existing configuration may make costs of heat recovery from the sinter waste gases or sinter cooler waste gas very high.

The recovery of heat from the waste gases by means of a heat exchanger would lead to unacceptable condensation and corrosion problems.

1.3. BAT Conclusions For Pelletisation Plants

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all pelletisation plants.

Air emissions

33. BAT is to reduce the dust emissions in the waste gases from

- the raw materials pre-treatment, drying, grinding, wetting, mixing and the balling;
- from the induration strand; and
- from the pellet handling and screening

by using one or a combination of the following techniques:

- I. an electrostatic precipitator
- II. a bag filter
- III. a wet scrubber

The BAT-associated emission level for dust is $< 20 \text{ mg/Nm}^3$ for the crushing, grinding and drying and $< 10 - 15 \text{ mg/Nm}^3$ for all other process steps or in cases where all waste gases are treated together, all determined as daily mean values.

34. BAT is to reduce the sulphur oxides (SO_x), hydrogen chloride (HCl) and hydrogen fluoride (HF) emissions from the induration strand waste gas by using one of the following techniques:

- I. a wet scrubber
- II. semi-dry absorption with a subsequent dedusting system

The BAT-associated emission levels, determined as daily mean values, for these compounds are:

- sulphur oxides (SO_x), expressed as sulphur dioxide (SO_2) $< 30 - 50 \text{ mg/Nm}^3$
- hydrogen fluoride (HF) $< 1 - 3 \text{ mg/Nm}^3$
- hydrogen chloride (HCl) $< 1 - 3 \text{ mg/Nm}^3$.

35. BAT is to reduce NO_x emissions from the drying and grinding section and induration strand waste gases by applying process-integrated techniques.

Description

Plant design through tailor-made solutions should be optimised for low nitrogen oxides (NO_x) emissions from all firing sections. The reduction of the formation of thermal NO_x can be achieved by lowering the (peak) temperature in the burners and reducing the excess oxygen in the combustion air. Additionally, lower NO_x emissions can be achieved by a combination of low energy use and low nitrogen content in the fuel (coal and oil).

36. BAT for existing plants is to reduce NO_x emissions from the drying and grinding section and induration strand waste gases by applying one of the following techniques:

- I. selective catalytic reduction (SCR) as an end-of-pipe technique
- II. any other technique with a NO_x reduction efficiency of at least 80 %.

Applicability

For existing plants, both straight grate and grate kiln systems, it is difficult to obtain the operating conditions necessary to suit an SCR reactor. Due to high costs, these end-of-pipe techniques should only be considered in circumstances where environmental quality standards are otherwise not likely to be met.

37. BAT for new plants is to reduce NO_x emissions from the drying and grinding section and induration strand waste gases by applying selective catalytic reduction (SCR) as an end-of-pipe technique.

Water and waste water

38. BAT for pelletisation plants is to minimise the water consumption and discharge of scrubbing, wet rinsing and cooling water and reuse it as much as possible.

39. BAT for pelletisation plants is to treat the effluent water prior to discharge by using a combination of the following techniques:

I. neutralisation

II. flocculation

III. sedimentation

IV. sand filtration

V. heavy metal precipitation.

The BAT-associated emission levels, based on a qualified random sample or a 24-hour composite sample, are:

— suspended solids	< 50 mg/l
— chemical oxygen demand (COD ⁽¹⁾)	< 160 mg/l
— Kjeldahl nitrogen	< 45 mg/l
— heavy metals	< 0,55 mg/l

(sum of arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), zinc (Zn)).

Production residues

40. BAT is to prevent waste generation from pelletisation plants by effective on-site recycling or the reuse of residues (i.e. undersized green and heat-treated pellets)

BAT is to manage in a controlled manner pellet plant process residues, i.e. sludge from waste water treatment, which can neither be avoided nor recycled.

Energy

41. BAT is to reduce/minimise thermal energy consumption in pelletisation plants by using one or a combination of the following techniques:

I. process integrated reuse of sensible heat as far as possible from the different sections of the induration strand

II. using surplus waste heat for internal or external heating networks if there is demand from a third party.

⁽¹⁾ In some cases, TOC is measured instead of COD (in order to avoid HgCl₂ used in the analysis for COD). The correlation between COD and TOC should be elaborated for each pelletisation plant case by case. The COD/TOC ratio may vary approximately between two and four.

Description

Hot air from the primary cooling section can be used as secondary combustion air in the firing section. In turn, the heat from the firing section can be used in the drying section of the induration strand. Heat from the secondary cooling section can also be used in the drying section.

Excess heat from the cooling section can be used in the drying chambers of the drying and grinding unit. The hot air is transported through an insulated pipeline called a 'hot air recirculation duct'.

Applicability

Recovery of sensible heat is a process integrated part of pelletisation plants. The 'hot air recirculation duct' can be applied at existing plants with a comparable design and a sufficient supply of sensible heat.

The cooperation and agreement of a third party may not be within the control of the operator, and therefore may not be within the scope of the permit.

1.4. BAT Conclusions For Coke Oven Plants

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all coke oven plants.

Air emissions

42. BAT for coal grinding plants (coal preparation including crushing, grinding, pulverising and screening) is to prevent or reduce dust emissions by using one or a combination of the following techniques:

- I. building and/or device enclosure (crusher, pulveriser, sieves) and
- II. efficient extraction and use of a subsequent dry dedusting systems.

The BAT-associated emission level for dust is $< 10 - 20 \text{ mg/Nm}^3$, as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

43. BAT for storage and handling of pulverised coal is to prevent or reduce diffuse dust emissions by using one or a combination of the following techniques:

- I. storing pulverised materials in bunkers and warehouses
- II. using closed or enclosed conveyors
- III. minimising the drop heights depending on the plant size and construction
- IV. reducing emissions from charging of the coal tower and the charging car
- V. using efficient extraction and subsequent dedusting.

When using BAT V, the BAT-associated emission level for dust is $< 10 - 20 \text{ mg/Nm}^3$, as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

44. BAT is to charge coke oven chambers with emission-reduced charging systems.

Description

From an integrated point of view, 'smokeless' charging or sequential charging with double ascension pipes or jumper pipes are the preferred types, because all gases and dust are treated as part of the coke oven gas treatment.

If, however, the gases are extracted and treated outside the coke oven, charging with a land-based treatment of the extracted gases is the preferred method. Treatment should consist of an efficient extraction of the emissions with subsequent combustion to reduce organic compounds and the use of a bag filter to reduce particulates.

The BAT-associated emission level for dust from coal charging systems with land-based treatment of extracted gases is $< 5 \text{ g/t coke equivalent to } < 50 \text{ mg/Nm}^3$, as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

The duration associated with BAT of visible emissions from charging is < 30 seconds per charge as a monthly average using a monitoring method described in BAT 46.

45. BAT for coking is to extract the coke oven gas (COG) during coking as much as possible.
46. BAT for coke plants is to reduce the emissions through achieving continuous undisrupted coke production by using the following techniques:
- I. extensive maintenance of oven chambers, oven doors and frame seals, ascension pipes, charging holes and other equipment (a systematic programme should be carried out by specially-trained detection and maintenance personnel)
 - II. avoiding strong temperature fluctuations
 - III. comprehensive observation and monitoring of the coke oven
 - IV. cleaning of doors, frame seals, charging holes, lids and ascension pipes after handling (applicable at new and, in some cases, existing plants)
 - V. maintaining a free gas-flow in the coke ovens
 - VI. adequate pressure regulation during coking and application of spring-loaded flexible sealing doors or knife-edged doors (in cases of ovens ≤ 5 m high and in good working order)
 - VII. using water-sealed ascension pipes to reduce visible emissions from the whole apparatus which provides a passage from the coke oven battery to the collecting main, gooseneck and stationary jumper pipes
 - VIII. luting charging hole lids with a clay suspension (or other suitable sealing material), to reduce visible emissions from all holes
 - IX. ensuring complete coking (avoiding green coke pushes) by application of adequate techniques
 - X. installing larger coke oven chambers (applicable to new plants or in some cases of a complete replacement of the plant on the old foundations)
 - XI. where possible, using variable pressure regulation to oven chambers during coking (applicable to new plants and can be an option for existing plants; the possibility of installing this technique in existing plants should be assessed carefully and is subject to the individual situation of every plant).

The percentage of visible emissions from all doors associated with BAT is $< 5 - 10$ %.

The percentage of visible emissions for all source types associated with BAT VII and BAT VIII is < 1 %.

The percentages are related to the frequency of any leaks compared to the total number of doors, ascension pipes or charging hole lids as a monthly average using a monitoring method as described below.

For the estimation of diffuse emissions from coke ovens the following methods are in use:

- the EPA 303 method
- the DMT (Deutsche Montan Technologie GmbH) methodology
- the methodology developed by BCRA (British Carbonisation Research Association).
- the methodology applied in the Netherlands, based on counting visible leaks of the ascension pipes and charging holes, while excluding visible emissions due to normal operations (coal charging, coke pushing).

47. BAT for the gas treatment plant is to minimise fugitive gaseous emissions by using the following techniques:
- I. minimising the number of flanges by welding piping connections wherever possible
 - II. using appropriate sealings for flanges and valves
 - III. using gas-tight pumps (e.g. magnetic pumps)

IV. avoiding emissions from pressure valves in storage tanks by:

- connecting the valve outlet to the coke oven gas (COG) collecting main or
- collecting the gases and subsequent combustion.

Applicability

The techniques can be applied to both new and existing plants. In new plants, a gas tight design might be easier to achieve than in existing plants.

48. BAT is to reduce the sulphur content of the coke oven gas (COG) by using one of the following techniques:

- I. desulphurisation by absorption systems
- II. wet oxidative desulphurisation.

The residual hydrogen sulphide (H_2S) concentrations associated with BAT, determined as daily mean averages, are $< 300 - 1\ 000\ mg/Nm^3$ in the case of using BAT I (the higher values being associated with higher ambient temperature and the lower values being associated with lower ambient temperature) and $< 10\ mg/Nm^3$ in the case of using BAT II.

49. BAT for the coke oven underfiring is to reduce the emissions by using the following techniques:

- I. preventing leakage between the oven chamber and the heating chamber by means of regular coke oven operation
- II. repairing leakage between the oven chamber and the heating chamber (only applicable to existing plants)
- III. incorporating low-nitrogen oxides (NO_x) techniques in the construction of new batteries, such as staged combustion and the use of thinner bricks and refractory with a better thermal conductivity (only applicable to new plants)
- IV. using desulphurised coke oven gas (COG) process gases.

The BAT-associated emission levels, determined as daily mean values and relating to an oxygen content of 5 % are:

- sulphur oxides (SO_x), expressed as sulphur dioxide (SO_2) $< 200 - 500\ mg/Nm^3$
- dust $< 1 - 20\ mg/Nm^3$ ⁽¹⁾
- nitrogen oxides (NO_x), expressed as nitrogen dioxide (NO_2) $< 350 - 500\ mg/Nm^3$ for new or substantially revamped plants (less than 10 years old) and $500 - 650\ mg/Nm^3$ for older plants with well maintained batteries and incorporated low- nitrogen oxides (NO_x) techniques.

50. BAT for coke pushing is to reduce dust emissions by using the following techniques:

- I. extraction by means of an integrated coke transfer machine equipped with a hood
- II. using land-based extraction gas treatment with a bag filter or other abatement systems
- III. using a one point or a mobile quenching car.

The BAT-associated emission level for dust from coke pushing is $< 10\ mg/Nm^3$ in the case of bag filters and of $< 20\ mg/Nm^3$ in other cases, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

Applicability

At existing plants, lack of space may constrain the applicability.

⁽¹⁾ The lower end of the range has been defined based on the performance of one specific plant achieved under real operating conditions by the BAT obtaining the best environmental performance.

51. BAT for coke quenching is to reduce dust emissions by using one of the following techniques:

- I. using coke dry quenching (CDQ) with the recovery of sensible heat and the removal of dust from charging, handling and screening operations by means of a bag filter
- II. using emission-minimised conventional wet quenching
- III. using coke stabilisation quenching (CSQ).

The BAT-associated emission levels for dust, determined as the average over the sampling period, are:

- < 20 mg/Nm³ in case of coke dry quenching
- < 25 g/t coke in case of emission minimised conventional wet quenching ⁽¹⁾
- < 10 g/t coke in case of coke stabilisation quenching ⁽²⁾.

Description of BAT I

For the continuous operation of coke dry quenching plants, there are two options. In one case, the coke dry quenching unit comprises two to up to four chambers. One unit is always on stand by. Hence no wet quenching is necessary but the coke dry quenching unit needs an excess capacity against the coke oven plant with high costs. In the other case, an additional wet quenching system is necessary.

In case of modifying a wet quenching plant to a dry quenching plant, the existing wet quenching system can be retained for this purpose. Such a coke dry quenching unit has no excess processing capacity against the coke oven plant.

Applicability of BAT II

Existing quenching towers can be equipped with emissions reduction baffles. A minimum tower height of at least 30 m is necessary in order to ensure sufficient draught conditions.

Applicability of BAT III

As the system is larger than that necessary for conventional quenching, lack of space at the plant may be a constraint.

52. BAT for coke grading and handling is to prevent or reduce dust emissions by using the following techniques in combination:

- I. use of building or device enclosures
- II. efficient extraction and subsequent dry dedusting.

The BAT-associated emission level for dust is < 10 mg/Nm³, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

Water and waste water

53. BAT is to minimise and reuse quenching water as much as possible.

54. BAT is to avoid the reuse of process water with a significant organic load (like raw coke oven waste water, waste water with a high content of hydrocarbons, etc.) as quenching water.

55. BAT is to pretreat waste water from the coking process and coke oven gas (COG) cleaning prior to discharge to a waste water treatment plant by using one or a combination of the following techniques:

- I. using efficient tar and polycyclic aromatic hydrocarbons (PAH) removal by using flocculation and subsequent flotation, sedimentation and filtration individually or in combination
- II. using efficient ammonia stripping by using alkaline and steam.

⁽¹⁾ This level is based on the use of the non-isokinetic Mohrhauer method (former VDI 2303)

⁽²⁾ This level is based on the use of an isokinetic sampling method according to VDI 2066

56. BAT for pretreated waste water from the coking process and coke oven gas (COG) cleaning is to use biological waste water treatment with integrated denitrification/nitrification stages.

The BAT-associated emission levels, based on a qualified random sample or a 24-hour composite sample and referring only to single coke oven water treatment plants, are:

— chemical oxygen demand (COD ⁽¹⁾)	< 220 mg/l
— biological oxygen demand for 5 days (BOD ₅)	< 20 mg/l
— sulphides, easily released ⁽²⁾	< 0,1 mg/l
— thiocyanate (SCN ⁻)	< 4 mg/l
— cyanide (CN ⁻), easily released ⁽³⁾	< 0,1 mg/l
— polycyclic aromatic hydrocarbons (PAH) (sum of Fluoranthene, Benzo[b]fluoranthene, Benzo[k]fluoranthene, Benzo[a]pyrene, Indeno[1,2,3-cd]pyrene and Benzo[g,h,i]perylene)	< 0,05 mg/l
— phenols	< 0,5 mg/l
— sum of ammonia-nitrogen (NH ₄ ⁺ -N), nitrate-nitrogen (NO ₃ ⁻ -N) and nitrite-nitrogen (NO ₂ ⁻ -N)	< 15 – 50 mg/l.

Regarding the sum of ammonia-nitrogen (NH₄⁺-N), nitrate-nitrogen (NO₃⁻-N) and nitrite-nitrogen (NO₂⁻-N), values of < 35 mg/l are usually associated with the application of advanced biological waste water treatment plants with predenitrification/nitrification and post-denitrification.

Production residues

57. BAT is to recycle production residues such as tar from the coal water and still effluent, and surplus activated sludge from the waste water treatment plant back to the coal feed of the coke oven plant.

Energy

58. BAT is to use the extracted coke oven gas (COG) as a fuel or reducing agent or for the production of chemicals.

1.5. BAT Conclusions For Blast Furnaces

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all blast furnaces.

Air emissions

59. BAT for displaced air during loading from the storage bunkers of the coal injection unit is to capture dust emissions and perform subsequent dry dedusting.

The BAT-associated emission level for dust is < 20 mg/Nm³, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

60. BAT for burden preparation (mixing, blending) and conveying is to minimise dust emissions and, where relevant, extraction with subsequent dedusting by means of an electrostatic precipitator or bag filter.

⁽¹⁾ In some cases, TOC is measured instead of COD (in order to avoid HgCl₂ used in the analysis for COD). The correlation between COD and TOC should be elaborated for each coke oven plant case by case. The COD/TOC ratio may vary approximately between two and four.

⁽²⁾ This level is based on the use of the DIN 38405 D 27 or any other national or international standard that ensures the provision of data of an equivalent scientific quality.

⁽³⁾ This level is based on the use of the DIN 38405 D 13-2 or any other national or international standard that ensures the provision of data of an equivalent scientific quality.

61. BAT for casting house (tap holes, runners, torpedo ladles charging points, skimmers) is to prevent or reduce diffuse dust emissions by using the following techniques:

- I. covering the runners
- II. optimising the capture efficiency for diffuse dust emissions and fumes with subsequent off-gas cleaning by means of an electrostatic precipitator or bag filter
- III. fume suppression using nitrogen while tapping, where applicable and where no collecting and dedusting system for tapping emissions is installed.

When using BAT II, the BAT-associated emission level for dust is $< 1 - 15 \text{ mg/Nm}^3$, determined as a daily mean value.

62. BAT is to use tar-free runner linings.

63. BAT is to minimise the release of blast furnace gas during charging by using one or a combination of the following techniques:

- I. bell-less top with primary and secondary equalising
- II. gas or ventilation recovery system
- III. use of blast furnace gas to pressurise the top bunkers.

Applicability of BAT II

Applicable for new plants. Applicable for existing plants only where the furnace has a bell-less charging system. It is not applicable to plants where gases other than blast furnace gas (e.g. nitrogen) are used to pressurise the furnace top bunkers.

64. BAT is to reduce dust emissions from the blast furnace gas by using one or a combination of the following techniques:

I. using dry predestusting devices such as:

- (i) deflectors
- (ii) dust catchers
- (iii) cyclones
- (iv) electrostatic precipitators.

II. subsequent dust abatement such as:

- (i) hurdle-type scrubbers
- (ii) venturi scrubbers
- (iii) annular gap scrubbers
- (iv) wet electrostatic precipitators
- (v) disintegrators.

For cleaned blast furnace (BF) gas, the residual dust concentration associated with BAT is $< 10 \text{ mg/Nm}^3$, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

65. BAT for hot blast stoves is to reduce emissions by using desulphurised and dedusted surplus coke oven gas, dedusted blast furnace gas, dedusted basic oxygen furnace gas and natural gas, individually or in combination.

The BAT-associated emission levels, determined as daily mean values related to an oxygen content of 3 %, are:

- sulphur oxides (SO_x) expressed as sulphur dioxide (SO₂) < 200 mg/Nm³
- dust < 10 mg/Nm³
- nitrogen oxides (NO_x), expressed as nitrogen dioxide (NO₂) < 100 mg/Nm³.

Water and waste water

66. BAT for water consumption and discharge from blast furnace gas treatment is to minimise and to reuse scrubbing water as much as possible, e.g. for slag granulation, if necessary after treatment with a gravel-bed filter.

67. BAT for treating waste water from blast furnace gas treatment is to use flocculation (coagulation) and sedimentation and the reduction of easily released cyanide, if necessary.

The BAT-associated emission levels, based on a qualified random sample or a 24-hour composite sample, are:

- suspended solids < 30 mg/l
- iron < 5 mg/l
- lead < 0,5 mg/l
- zinc < 2 mg/l
- cyanide (CN⁻), easily released (1) < 0,4 mg/l.

Production residues

68. BAT is to prevent waste generation from blast furnaces by using one or a combination of the following techniques:

- I. appropriate collection and storage to facilitate a specific treatment
- II. on-site recycling of coarse dust from the blast furnace (BF) gas treatment and dust from the cast house dedusting, with due regard for the effect of emissions from the plant where it is recycled
- III. hydrocyclonage of sludge with subsequent on-site recycling of the coarse fraction (applicable whenever wet dedusting is applied and where the zinc content distribution in the different grain sizes allows a reasonable separation)
- IV. slag treatment, preferably by means of granulation (where market conditions allow for it), for the external use of slag (e.g. in the cement industry or for road construction).

BAT is to manage in a controlled manner blast furnace process residues which can neither be avoided nor recycled.

69. BAT for minimising slag treatment emissions is to condense fume if odour reduction is required.

Resource management

70. BAT for resource management of blast furnaces is to reduce coke consumption by directly injected reducing agents, such as pulverised coal, oil, heavy oil, tar, oil residues, coke oven gas (COG), natural gas and wastes such as metallic residues, used oils and emulsions, oily residues, fats and waste plastics individually or in combination.

Applicability

Coal injection: The method is applicable to all blast furnaces equipped with pulverised coal injection and oxygen enrichment.

Gas injection: Tuyère injection of coke oven gas (COG) is highly dependent upon the availability of the gas that may be effectively used elsewhere in the integrated steelworks.

(1) This level is based on the use of the DIN 38405 D 13-2 or any other national or international standard that ensures the provision of data of an equivalent scientific quality.

Plastic injection: It should be noted that this technique is highly dependent on the local circumstances and market conditions. Plastics can contain Cl and heavy metals like Hg, Cd, Pb and Zn. Depending on the composition of the wastes used (e.g. shredder light fraction), the amount of Hg, Cr, Cu, Ni and Mo in the BF gas may increase.

Direct injection of used oils, fats and emulsions as reducing agents and of solid iron residues: The continuous operation of this system is reliant on the logistical concept of delivery and the storage of residues. Also, the conveying technology applied is of particular importance for a successful operation.

Energy

71. BAT is to maintain a smooth, continuous operation of the blast furnace at a steady state to minimise releases and to reduce the likelihood of burden slips.

72. BAT is to use the extracted blast furnace gas as a fuel.

73. BAT is to recover the energy of top blast furnace gas pressure where sufficient top gas pressure and low alkali concentrations are present.

Applicability

Top gas pressure recovery can be applied at new plants and in some circumstances at existing plants, albeit with more difficulties and additional costs. Fundamental to the application of this technique is an adequate top gas pressure in excess of 1.5 bar gauge.

At new plants, the top gas turbine and the blast furnace (BF) gas cleaning facility can be adapted to each other in order to achieve a high efficiency of both scrubbing and energy recovery.

74. BAT is to preheat the hot blast stove fuel gases or combustion air using the waste gas of the hot blast stove and to optimise the hot blast stove combustion process.

Description

For optimisation of the energy efficiency of the hot stove, one or a combination of the following techniques can be applied:

- the use of a computer-aided hot stove operation
- preheating of the fuel or combustion air in conjunction with insulation of the cold blast line and waste gas flue
- use of more suitable burners to improve combustion
- rapid oxygen measurement and subsequent adaptation of combustion conditions.

Applicability

The applicability of fuel preheating depends on the efficiency of the stoves as this determines the waste gas temperature (e.g. at waste gas temperatures below 250 °C, heat recovery may not be a technically or economically viable option).

The implementation of computer-aided control could require the construction of a fourth stove in the case of blast furnaces with three stoves (if possible) in order to maximise benefits.

1.6. BAT Conclusions For Basic Oxygen Steelmaking And Casting

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all basic oxygen steelmaking and casting.

Air emissions

75. BAT for basic oxygen furnace (BOF) gas recovery by suppressed combustion is to extract the BOF gas during blowing as much as possible and to clean it by using the following techniques in combination:

- I. use of a suppressed combustion process
- II. prededusting to remove coarse dust by means of dry separation techniques (e.g. deflector, cyclone) or wet separators

III. dust abatement by means of:

- (i) dry dedusting (e.g. electrostatic precipitator) for new and existing plants
- (ii) wet dedusting (e.g. wet electrostatic precipitator or scrubber) for existing plants.

The residual dust concentrations associated with BAT, after buffering the BOF gas, are:

- 10 – 30 mg/Nm³ for BAT III.i
- < 50 mg/Nm³ for BAT III.ii.

76. BAT for basic oxygen furnace (BOF) gas recovery during oxygen blowing in the case of full combustion is to reduce dust emissions by using one of the following techniques:

- I. dry dedusting (e.g. ESP or bag filter) for new and existing plants
- II. wet dedusting (e.g. wet ESP or scrubber) for existing plants.

The BAT-associated emission levels for dust, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour), are:

- 10 – 30 mg/Nm³ for BAT I
- < 50 mg/Nm³ for BAT II.

77. BAT is to minimise dust emissions from the oxygen lance hole by using one or a combination of the following techniques:

- I. covering the lance hole during oxygen blowing
- II. inert gas or steam injection into the lance hole to dissipate the dust
- III. use of other alternative sealing designs combined with lance cleaning devices.

78. BAT for secondary dedusting, including the emissions from the following processes:

- reladling of hot metal from the torpedo ladle (or hot metal mixer) to the charging ladle
- hot metal pretreatment (i.e. the preheating of vessels, desulphurisation, dephosphorisation, deslagging, hot metal transfer processes and weighing)
- BOF-related processes like the preheating of vessels, slopping during oxygen blowing, hot metal and scrap charging, tapping of liquid steel and slag from BOF and
- secondary metallurgy and continuous casting,

is to minimise dust emissions by means of process integrated techniques, such as general techniques to prevent or control diffuse or fugitive emissions, and by using appropriate enclosures and hoods with efficient extraction and a subsequent off-gas cleaning by means of a bag filter or an ESP.

The overall average dust collection efficiency associated with BAT is > 90 %

The BAT-associated emission level for dust, as a daily mean value, for all dedusted off-gases is < 1 – 15 mg/Nm³ in the case of bag filters and < 20 mg/Nm³ in the case of electrostatic precipitators.

If the emissions from hot metal pretreatment and the secondary metallurgy are treated separately, the BAT-associated emission level for dust, as a daily mean value, is < 1 – 10 mg/Nm³ for bag filters and < 20 mg/Nm³ for electrostatic precipitators.

Description

General techniques to prevent diffuse and fugitive emissions from the relevant BOF process secondary sources include:

- independent capture and use of dedusting devices for each subprocess in the BOF shop
- correct management of the desulphurisation installation to prevent air emissions
- total enclosure of the desulphurisation installation
- maintaining the lid on when the hot metal ladle is not in use and the cleaning of hot metal ladles and removal of skulls on a regular basis or alternatively apply a roof extraction system
- maintaining the hot metal ladle in front of the converter for approximately two minutes after putting the hot metal into the converter if a roof extraction system is not applied
- computer control and optimisation of the steelmaking process, e.g. so that slopping (i.e. when the slag foams to such an extent that it flows out of the vessel) is prevented or reduced
- reduction of slopping during tapping by limiting elements that cause slopping and the use of anti-slopping agents
- closure of doors from the room around the converter during oxygen blowing
- continuous camera observation of the roof for visible emission
- the use of a roof extraction system.

Applicability

In existing plants, the design of the plant may restrict the possibilities for proper evacuation.

79. BAT for on-site slag processing is to reduce dust emissions by using one or a combination of the following techniques:

- I. efficient extraction of the slag crusher and screening devices with subsequent off-gas cleaning, if relevant
- II. transport of untreated slag by shovel loaders
- III. extraction or wetting of conveyor transfer points for broken material
- IV. wetting of slag storage heaps
- V. use of water fogs when broken slag is loaded.

The BAT-associated emission level for dust in the case of using BAT I is $< 10 - 20 \text{ mg/Nm}^3$, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

Water and waste water

80. BAT is to prevent or reduce water use and waste water emissions from primary dedusting of basic oxygen furnace (BOF) gas by using one of the following techniques as set out in BAT 75 and BAT 76:

- dry dedusting of basic oxygen furnace (BOF) gas;
- minimising scrubbing water and reusing it as much as possible (e.g. for slag granulation) in case wet dedusting is applied.

81. BAT is to minimise the waste water discharge from continuous casting by using the following techniques in combination:

- I. the removal of solids by flocculation, sedimentation and/or filtration
- II. the removal of oil in skimming tanks or any other effective device

III. the recirculation of cooling water and water from vacuum generation as much as possible.

The BAT-associated emission levels, based on a qualified random sample or a 24-hour composite sample, for waste water from continuous casting machines are:

— suspended solids	< 20 mg/l
— iron	< 5 mg/l
— zinc	< 2 mg/l
— nickel	< 0,5 mg/l
— total chromium	< 0,5 mg/l
— total hydrocarbons	< 5 mg/l.

Production residues

82. BAT is to prevent waste generation by using one or a combination of the following techniques (see BAT 8):

- I. appropriate collection and storage to facilitate a specific treatment
- II. on-site recycling of dust from basic oxygen furnace (BOF) gas treatment, dust from secondary dedusting and mill scale from continuous casting back to the steelmaking processes with due regard for the effect of emissions from the plant where they are recycled
- III. on-site recycling of BOF slag and BOF slag fines in various applications
- IV. slag treatment where market conditions allow for the external use of slag (e.g. as an aggregate in materials or for construction)
- V. use of filter dusts and sludge for external recovery of iron and non-ferrous metals such as zinc in the non-ferrous metals industry
- VI. use of a settling tank for sludge with the subsequent recycling of the coarse fraction in the sinter/blast furnace or cement industry when grain size distribution allows for a reasonable separation.

Applicability of BAT V

Dust hot briquetting and recycling with recovery of high zinc concentrated pellets for external reuse is applicable when a dry electrostatic precipitation is used to clean the BOF gas. Recovery of zinc by briquetting is not applicable in wet dedusting systems because of unstable sedimentation in the settling tanks caused by the formation of hydrogen (from a reaction of metallic zinc and water). Due to these safety reasons, the zinc content in the sludge should be limited to 8 – 10 %.

BAT is to manage in a controlled manner basic oxygen furnace process residues which can neither be avoided nor recycled.

Energy

83. BAT is to collect, clean and buffer BOF gas for subsequent use as a fuel.

Applicability

In some cases, it may not be economically feasible or, with regard to appropriate energy management, not feasible to recover the BOF gas by suppressed combustion. In these cases, the BOF gas may be combusted with the generation of steam. The kind of combustion (full or suppressed combustion) depends on local energy management.

84. BAT is to reduce energy consumption by using ladle-lid systems.

Applicability

The lids can be very heavy as they are made out of refractory bricks and therefore the capacity of the cranes and the design of the whole building may constrain the applicability in existing plants. There are different technical designs for implementing the system into the particular conditions of a steel plant.

85. BAT is to optimise the process and reduce energy consumption by using a direct tapping process after blowing.

Description

Direct tapping normally requires expensive facilities like sub-lance or DROP IN sensor-systems to tap without waiting for a chemical analysis of the samples taken (direct tapping). Alternatively, a new technique has been developed to achieve direct tapping without such facilities. This technique requires a lot of experience and developmental work. In practice, the carbon is directly blown down to 0,04 % and simultaneously the bath temperature decreases to a reasonably low target. Before tapping, both the temperature and oxygen activity are measured for further actions.

Applicability

A suitable hot metal analyser and slag stopping facilities are required and the availability of a ladle furnace facilitates implementation of the technique.

86. BAT is to reduce energy consumption by using continuous near net shape strip casting, if the quality and the product mix of the produced steel grades justify it.

Description

Near net shape strip casting means the continuous casting of steel to strips with thicknesses of less than 15 mm. The casting process is combined with the direct hot rolling, cooling and coiling of the strips without an intermediate reheating furnace used for conventional casting techniques, e.g. continuous casting of slabs or thin slabs. Therefore, strip casting represents a technique for producing flat steel strips of different widths and thicknesses of less than 2 mm.

Applicability

The applicability depends on the produced steel grades (e.g. heavy plates cannot be produced with this process) and on the product portfolio (product mix) of the individual steel plant. In existing plants, the applicability may be constrained by the layout and the available space as e.g. retrofitting with a strip caster requires approximately 100 m in length.

1.7. BAT Conclusions For Electric Arc Furnace Steelmaking And Casting

Unless otherwise stated, the BAT conclusions presented in this section can be applied to all electric arc furnace steelmaking and casting.

Air emissions

87. BAT for the electric arc furnace (EAF) process is to prevent mercury emissions by avoiding, as much as possible, raw materials and auxiliaries which contain mercury (see BAT 6 and 7).

88. BAT for the electric arc furnace (EAF) primary and secondary dedusting (including scrap preheating, charging, melting, tapping, ladle furnace and secondary metallurgy) is to achieve an efficient extraction of all emission sources by using one of the techniques listed below and to use subsequent dedusting by means of a bag filter:

- I. a combination of direct off-gas extraction (4th or 2nd hole) and hood systems
- II. direct gas extraction and doghouse systems
- III. direct gas extraction and total building evacuation (low-capacity electric arc furnaces (EAF) may not require direct gas extraction to achieve the same extraction efficiency).

The overall average collection efficiency associated with BAT is > 98 %.

The BAT-associated emission level for dust is < 5 mg/Nm³, determined as a daily mean value.

The BAT-associated emission level for mercury is < 0,05 mg/Nm³, determined as the average over the sampling period (discontinuous measurement, spot samples for at least four hours).

89. BAT for the electric arc furnace (EAF) primary and secondary dedusting (including scrap preheating, charging, melting, tapping, ladle furnace and secondary metallurgy) is to prevent and reduce polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB) emissions by avoiding, as much as possible, raw materials which contain PCDD/F and PCB or their precursors (see BAT 6 and 7) and using one or a combination of the following techniques, in conjunction with an appropriate dust removal system:

- I. appropriate post-combustion
- II. appropriate rapid quenching
- III. injection of adequate adsorption agents into the duct before dedusting.

The BAT-associated emission level for polychlorinated dibenzodioxins/furans (PCDD/F) is $< 0,1 \text{ ng I-TEQ/Nm}^3$, based on a 6 – 8 hour random sample during steady-state conditions. In some cases, the BAT-associated emission level can be achieved with primary measures only.

Applicability of BAT I

In existing plants, circumstances like available space, given off-gas duct system, etc. need to be taken into consideration for assessing the applicability.

90. BAT for on-site slag processing is to reduce dust emissions by using one or a combination of the following techniques:

- I. efficient extraction of the slag crusher and screening devices with subsequent off-gas cleaning, if relevant
- II. transport of untreated slag by shovel loaders
- III. extraction or wetting of conveyor transfer points for broken material
- IV. wetting of slag storage heaps
- V. use of water fogs when broken slag is loaded.

In the case of using BAT I, the BAT-associated emission level for dust is $< 10 - 20 \text{ mg/Nm}^3$, determined as the average over the sampling period (discontinuous measurement, spot samples for at least half an hour).

Water and waste water

91. BAT is to minimise the water consumption from the electric arc furnace (EAF) process by the use of closed loop water cooling systems for the cooling of furnace devices as much as possible unless once-through cooling systems are used.

92. BAT is to minimise the waste water discharge from continuous casting by using the following techniques in combination:

- I. the removal of solids by flocculation, sedimentation and/or filtration
- II. the removal of oil in skimming tanks or in any other effective device
- III. the recirculation of cooling water and water from vacuum generation as much as possible.

The BAT-associated emission levels, for waste water from continuous casting machines, based on a qualified random sample or a 24-hour composite sample, are:

— suspended solids	$< 20 \text{ mg/l}$
— iron	$< 5 \text{ mg/l}$
— zinc	$< 2 \text{ mg/l}$
— nickel	$< 0,5 \text{ mg/l}$
— total chromium	$< 0,5 \text{ mg/l}$
— total hydrocarbons	$< 5 \text{ mg/l}$

Production residues

93. BAT is to prevent waste generation by using one or a combination of the following techniques:

- I. appropriate collection and storage to facilitate a specific treatment
- II. recovery and on-site recycling of refractory materials from the different processes and use internally, i.e. for the substitution of dolomite, magnesite and lime
- III. use of filter dusts for the external recovery of non-ferrous metals such as zinc in the non-ferrous metals industry, if necessary, after the enrichment of filter dusts by recirculation to the electric arc furnace (EAF)
- IV. separation of scale from continuous casting in the water treatment process and recovery with subsequent recycling, e.g. in the sinter/blast furnace or cement industry
- V. external use of refractory materials and slag from the electric arc furnace (EAF) process as a secondary raw material where market conditions allow for it.

BAT is to manage in a controlled manner EAF process residues which can neither be avoided nor recycled.

Applicability

The external use or recycling of production residues as mentioned under BAT III – V depend on the cooperation and agreement of a third party which may not be within the control of the operator, and therefore may not be within the scope of the permit.

Energy

94. BAT is to reduce energy consumption by using continuous near net shape strip casting, if the quality and the product mix of the produced steel grades justify it.

Description

Near net shape strip casting means the continuous casting of steel to strips with thicknesses of less than 15 mm. The casting process is combined with the direct hot rolling, cooling and coiling of the strips without an intermediate reheating furnace used for conventional casting techniques, e.g. continuous casting of slabs or thin slabs. Therefore, strip casting represents a technique for producing flat steel strips of different widths and thicknesses of less than 2 mm.

Applicability

The applicability depends on the produced steel grades (e.g. heavy plates cannot be produced with this process) and on the product portfolio (product mix) of the individual steel plant. In existing plants, the applicability may be constrained by the layout and the available space as e.g. retrofitting with a strip caster requires approximately 100 m in length.

Noise

95. BAT is to reduce noise emissions from electric arc furnace (EAF) installations and processes generating high sound energies by using a combination of the following constructional and operational techniques depending on and according to local conditions (in addition to using the techniques listed in BAT 18):

- I. construct the electric arc furnace (EAF) building in such a way as to absorb noise from mechanical shocks resulting from the operation of the furnace
 - II. construct and install cranes destined to transport the charging baskets to prevent mechanical shocks
 - III. special use of acoustical insulation of the inside walls and roofs to prevent the airborne noise of the electric arc furnace (EAF) building
 - IV. separation of the furnace and the outside wall to reduce the structure-borne noise from the electric arc furnace (EAF) building
 - V. housing of processes generating high sound energies (i.e. electric arc furnace (EAF) and decarburisation units) within the main building.
-