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COMMISSION IMPLEMENTING DECISION (EU) 2019/2010

of 12 November 2019

establishing the best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for waste incineration

(notified under document C(2019) 7987)

(Text with EEA relevance)

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) Best available techniques (BAT) conclusions are the reference for setting permit conditions for installations covered by Chapter II of Directive 2010/75/EU and competent authorities should set emission limit values which ensure that, under normal operating conditions, emissions do not exceed the emission levels associated with the best available techniques as laid down in the BAT conclusions.

(2) The forum composed of representatives of Member States, the industries concerned and non-governmental organisations promoting environmental protection, established by Commission Decision of 16 May 2011 ([2]), provided the Commission on 27 February 2019 with its opinion on the proposed content of the BAT reference document for waste incineration. That opinion is publicly available.

(3) The BAT conclusions set out in the Annex to this Decision are the key element of that BAT reference document.

(4) 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 best available techniques (BAT) conclusions for waste incineration, as set out in the Annex, are adopted.

Article 2

This Decision is addressed to the Member States.

Done at Brussels, 12 November 2019.

For the Commission

Karmenu VELLA

Member of the Commission

(1) OJ L 334, 17.12.2010, p. 17.

(2) Commission Decision of 16 May 2011 establishing a forum for the exchange of information pursuant to Article 13 of Directive 2010/75/EU on industrial emissions (OJ C 146, 17.5.2011, p. 3).

ANNEX

BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR WASTE INCINERATION

SCOPE

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

5.2. Disposal or recovery of waste in waste incineration plants:

(a) for non-hazardous waste with a capacity exceeding 3 tonnes per hour;

(b) for hazardous waste with a capacity exceeding 10 tonnes per day.

5.2. Disposal or recovery of waste in waste co-incineration plants:

(a) for non-hazardous waste with a capacity exceeding 3 tonnes per hour;

(b) for hazardous waste with a capacity exceeding 10 tonnes per day;

whose main purpose is not the production of material products and where at least one of the following conditions is fulfilled:

— only waste, other than waste defined in Article 3(31)(b) of Directive 2010/75/EU, is combusted;

— more than 40 % of the resulting heat release comes from hazardous waste;

— mixed municipal waste is combusted.

5.3. (a) Disposal of non-hazardous waste with a capacity exceeding 50 tonnes per day involving the treatment of slags and/or bottom ashes from the incineration of waste.

5.3. (b) Recovery, or a mix of recovery and disposal, of non-hazardous waste with a capacity exceeding 75 tonnes per day involving the treatment of slags and/or bottom ashes from the incineration of waste.

5.1. Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day involving the treatment of slags and/or bottom ashes from the incineration of waste.

These BAT conclusions do not address the following:

— Pre-treatment of waste prior to incineration. This may be covered by the BAT conclusions for Waste Treatment (WT).

— Treatment of incineration fly ashes and other residues resulting from flue-gas cleaning (FGC). This may be covered by the BAT conclusions for Waste Treatment (WT).

— Incineration or co-incineration of exclusively gaseous waste, other than that resulting from the thermal treatment of waste.

— Treatment of waste in plants covered by Article 42(2) of Directive 2010/75/EU.

Other BAT conclusions and reference documents which could be relevant for the activities covered by these BAT conclusions are the following:

— Waste Treatment (WT);

— Economics and Cross-Media Effects (ECM);

— Emissions from Storage (EFS);

— Energy Efficiency (ENE);

— Industrial Cooling Systems (ICS);

— Monitoring of Emissions to Air and Water from IED Installations (ROM);

— Large Combustion Plants (LCP);

— Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector (CWW).

DEFINITIONS

For the purposes of these BAT conclusions, the following general definitions apply:

Term	Definition
General terms	
Boiler efficiency	Ratio between the energy produced at the boiler output (e.g. steam, hot water) and the waste's and auxiliary fuel's energy input to the furnace (as

	lower heating values).
Bottom ash treatment plant	Plant treating slags and/or bottom ashes from the incineration of waste in order to separate and recover the valuable fraction and to allow the beneficial use of the remaining fraction. This does not include the sole separation of coarse metals at the incineration plant.
Clinical waste	Infectious or otherwise hazardous waste arising from healthcare institutions (e.g. hospitals).
Channelled emissions	Emissions of pollutants into the environment through any kind of duct, pipe, stack, chimney, funnel, flue, etc.
Continuous measurement	Measurement using an automated measuring system

	permanently installed on site.
Diffuse emissions	Non-channelled emissions (e.g. of dust, volatile compounds, odour) into the environment, which can result from ‘area’ sources (e.g. tankers) or ‘point’ sources (e.g. pipe flanges).
Existing plant	A plant that is not a new plant.
Fly ashes	Particles from the combustion chamber or formed within the flue-gas stream that are transported in the flue-gas.
Hazardous waste	Hazardous waste as defined in Article 3(2) of Directive 2008/98/EC of the European Parliament and of the Council ([1]).
Incineration of waste	The combustion of waste, either alone or in combination with fuels, in an

	incineration plant.
Incineration plant	Either a waste incineration plant as defined in Article 3(40) of Directive 2010/75/EU or a waste co-incineration plant as defined in Article 3(41) of Directive 2010/75/EU, covered by the scope of these BAT conclusions.
Major plant upgrade	A major change in the design or technology of a plant with major adjustments or replacements of the process and/or abatement technique(s) and associated equipment.
Municipal solid waste	Solid waste from households (mixed or separately collected) as well as solid waste from other sources that is comparable to household waste in nature and composition.

New plant	A plant first permitted following the publication of these BAT conclusions or a complete replacement of a plant following the publication of these BAT conclusions.
Other non-hazardous waste	Non-hazardous waste that is neither municipal solid waste nor sewage sludge.
Part of an incineration plant	For the purposes of determining the gross electrical efficiency or the gross energy efficiency of an incineration plant, a part of it may refer for example to: — an incineration line and its steam system in isolation; — a part of the steam system, connected to one or more boilers,

	routed to a condensing turbine; — the rest of the same steam system that is used for a different purpose, e.g. the steam is directly exported.
Periodic measurement	Measurement at specified time intervals using manual or automated methods.
Residues	Any liquid or solid waste which is generated by an incineration plant or by a bottom ash treatment plant.
Sensitive receptor	Area which needs special protection, such as: — residential areas; — areas where human activities are carried out (e.g.

	neighbouring workplaces, schools, daycare centres, recreational areas, hospitals or nursing homes).
Sewage sludge	Residual sludge from the storage, handling and treatment of domestic, urban or industrial waste water. For the purposes of these BAT conclusions, residual sludges constituting hazardous waste are excluded.
Slags and/or bottom ashes	Solid residues removed from the furnace once wastes have been incinerated.
Valid half-hourly average	A half-hourly average is considered valid when there is no maintenance or malfunction of the automated measuring system.

Term	Definition
Pollutants and parameters	
As	The sum of arsenic and its compounds, expressed as As.
Cd	The sum of cadmium and its compounds, expressed as Cd.
Cd+Tl	The sum of cadmium, thallium and their compounds, expressed as Cd+Tl.
CO	Carbon monoxide.
Cr	The sum of chromium and its compounds, expressed as Cr.
Cu	The sum of copper and its compounds, expressed as Cu.
Dioxin-like PCBs	PCBs showing a similar toxicity to the 2,3,7,8-substituted PCDD/PCDF according to the World Health Organization (WHO).
Dust	Total particulate matter (in air).
HCl	Hydrogen chloride.
HF	Hydrogen fluoride.
Hg	The sum of mercury and its compounds, expressed as Hg.
Loss on ignition	Change in mass as a result of heating a sample under specified conditions.
N_2O	Dinitrogen monoxide (nitrous

	oxide).
NH_3	Ammonia.
NH_4-N	Ammonium nitrogen, expressed as N, includes free ammonia (NH_3) and ammonium (NH_4^{+}).
Ni	The sum of nickel and its compounds, expressed as Ni.
NO_X	The sum of nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2.
Pb	The sum of lead and its compounds, expressed as Pb.
PBDD/F	Polybrominated dibenzo-*p*-dioxins and –furans.
PCBs	Polychlorinated biphenyls.
PCDD/F	Polychlorinated dibenzo-*p*-dioxins and -furans.
POPs	Persistent Organic Pollutants as listed in Annex IV to Regulation (EC) No 850/2004 of the European Parliament and of the Council [2] and its amendments.
Sb	The sum of antimony and its compounds, expressed as Sb.
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	The sum of antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel, vanadium and their compounds, expressed as Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V.
SO_2	Sulphur dioxide.

Sulphate (SO_4^{2-})	Dissolved sulphate, expressed as SO_4^{2-}.
TOC	Total organic carbon, expressed as C (in water); includes all organic compounds.
TOC content (in solid residues)	Total organic carbon content. The quantity of carbon that is converted into carbon dioxide by combustion and which is not liberated as carbon dioxide by acid treatment.
TSS	Total suspended solids. Mass concentration of all suspended solids (in water), measured via filtration through glass fibre filters and gravimetry.
Tl	The sum of thallium and its compounds, expressed as Tl.
TVOC	Total volatile organic carbon, expressed as C (in air).
Zn	The sum of zinc and its compounds, expressed as Zn.

ACRONYMS

For the purposes of these BAT conclusions, the following acronyms apply:

Acronym	Definition
EMS	Environmental management system
FDBR	Fachverband Anlagenbau (from the previous name of the organisation: Fachverband

	Dampfkessel-, Behälter- und Rohrleitungsbau)
FGC	Flue-gas cleaning
OTNOC	Other than normal operating conditions
SCR	Selective catalytic reduction
SNCR	Selective non-catalytic reduction
I-TEQ	International toxic equivalent according to the North Atlantic Treaty Organization (NATO) schemes
WHO-TEQ	Toxic equivalent according to the World Health Organization (WHO) schemes

GENERAL CONSIDERATIONS

Best Available 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.

Unless otherwise stated, these BAT conclusions are generally applicable.

Emission levels associated with the best available techniques (BAT-AELs) for emissions to air

Emission levels associated with the best available techniques (BAT-AELs) for emissions to air given in these BAT conclusions refer to concentrations, expressed as mass of emitted substances per volume of flue-gas or of extracted air under the following standard conditions: dry gas at a temperature of 273,15 K and a pressure of 101,3 kPa, and expressed in mg/Nm^3, $\mu g/Nm^3$, ng I-TEQ/Nm^3 or ng WHO-TEQ/Nm^3.

The reference oxygen levels used to express BAT-AELs in this document are shown in the table below.

Activity	**Reference oxygen level (OR)**
Incineration of waste	11 dry vol-%
Bottom ash treatment	No correction for the oxygen level

The equation for calculating the emission concentration at the reference oxygen level is:

$$E_R = \frac{21 - O_R}{21 - O_M} \times E_M$$

Where:

E_R : emission concentration at the reference oxygen level O_R;

O_R : reference oxygen level in vol-%;

E_M : measured emission concentration;

O_M : measured oxygen level in vol-%.

For averaging periods, the following definitions apply:

Type of measurement	**Averaging period**	**Definition**
Continuous	Half-hourly average	Average value over a period of 30 minutes

	Daily average	Average over a period of one day based on valid half-hourly averages
Periodic	Average over the sampling period	Average value of three consecutive measurements of at least 30 minutes each (3)
	Long-term sampling period	Value over a sampling period of 2 to 4 weeks

When waste is co-incinerated together with non-waste fuels, the BAT-AELs for emissions to air given in these BAT conclusions apply to the entire flue-gas volume generated.

Emission levels associated with the best available techniques (BAT-AELs) for emissions to water

Emission levels associated with the best available techniques (BAT-AELs) for emissions to water given in these BAT conclusions refer to concentrations (mass of emitted substances per volume of waste water), expressed in mg/l or ng I-TEQ/l.

For waste water from FGC, the BAT-AELs refer either to spot sampling (for TSS only) or to daily averages, i.e. 24-hour flow-proportional composite samples. Time-proportional composite sampling can be used provided that sufficient flow stability is demonstrated.

For waste water from bottom ash treatment, the BAT-AELs refer to either of the following two cases:

— in the case of continuous discharges, daily average values, i.e. 24-hour flow-proportional composite samples;

— in the case of batch discharges, average values over the release duration taken as flow-proportional composite samples, or, provided that the effluent is appropriately mixed and homogeneous, a spot sample taken before discharge.

The BAT-AELs for emissions to water apply at the point where the emission leaves the installation.

Energy efficiency levels associated with the best available techniques (BAT-AEELs)

The BAT-AEELs given in these BAT conclusions for the incineration of non-hazardous waste other than sewage sludge and of hazardous wood waste are expressed as:

— gross electrical efficiency in the case of an incineration plant or part of an incineration plant that produces electricity using a condensing turbine;

— gross energy efficiency in the case of an incineration plant or part of an incineration plant that:

  — produces only heat, or

  — produces electricity using a back-pressure turbine and heat with the steam leaving the turbine.

This is expressed as follows:

Gross electrical efficiency	$\eta_e = \frac{W_e}{Q_{th}} \times (Q_b/(Q_b - Q_i))$
Gross energy efficiency	$\eta_h = \frac{W_e + Q_{he} + Q_{de} + Q_i}{Q_{th}}$

Where:

— W_e	:	electrical power generated, in MW;
— Q_{he}	:	thermal power supplied to the heat exchangers on the primary side, in MW;
— Q_{de}	:	directly exported thermal power (as steam or hot water) less the thermal power of the return flow, in MW;
— Q_b	:	thermal power produced by the boiler, in MW;
— Q_i	:	thermal power (as steam or hot water) that is used internally (e.g. for flue-gas reheating), in MW;
— Q_{th}	:	thermal input to the thermal treatment units (e.g. furnaces), including the waste and auxiliary fuels that are used continuously (excluding for example for start-up), in MW_{th} expressed as the lower heating value.

The BAT-AEELs given in these BAT conclusions for the incineration of sewage sludge and of hazardous waste other than hazardous wood waste are expressed as boiler efficiency.

BAT-AEELs are expressed as a percentage.

The monitoring associated with the BAT-AEELs is given in BAT 2.

Content of unburnt substances in bottom ashes/slags

The content of unburnt substances in the slags and/or bottom ashes is expressed as a percentage of the dry weight, either as the loss on ignition or as the TOC mass fraction.

1. BAT CONCLUSIONS

1.1. Environmental management systems

BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an environmental management system (EMS) that incorporates all of the following features:

(i) commitment, leadership and accountability of the management, including senior management, for the implementation of an effective EMS;

(ii) an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment;

(iii) development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;

(iv) establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;

(v) planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;

(vi) determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed;

(vii) ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training);

(viii) internal and external communication;

(ix) fostering employee involvement in good environmental management practices;

(x) establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records;

(xi) effective operational planning and process control;

(xii) implementation of appropriate maintenance programmes;

(xiii) emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;

(xiv)when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning;

(xv)implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations;

(xvi)application of sectoral benchmarking on a regular basis;

(xvii)periodic independent (as far as practicable) internal auditing and periodic independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;

(xviii)evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur;

(xix)periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;

(xx)following and taking into account the development of cleaner techniques.

Specifically for incineration plants and, where relevant, bottom ash treatment plants, BAT is also to incorporate the following features in the EMS:

(xxi)for incineration plants, waste stream management (see BAT 9);

(xxii)for bottom ash treatment plants, output quality management (see BAT 10);

(xxiii)a residues management plan including measures aiming to:

(a) minimise the generation of residues;

(b) optimise the reuse, regeneration, recycling of, and/or energy recovery from the residues;

(c) ensure the proper disposal of residues;

(xxiv)for incineration plants, an OTNOC management plan (see BAT 18);

(xxv)for incineration plants, an accident management plan (see Section 2.4);

(xxvi)for bottom ash treatment plants, diffuse dust emissions management (see BAT 23);

(xxvii)an odour management plan where an odour nuisance at sensitive receptors is expected and/or has been substantiated(see Section 2.4);

(xxviii)a noise management plan (see also BAT 37) where a noise nuisance at sensitive receptors is expected and/or has been substantiated (see Section 2.4).

Note

Regulation (EC) No 1221/2009 establishes the European Union eco-management and audit scheme (EMAS), which is an example of an EMS consistent with this BAT.

Applicability

The level of detail and the degree of formalisation of the EMS will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have (determined also by the type and the amount of waste processed).

1.2. Monitoring

BAT 2.BAT is to determine either the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency of the incineration plant as a whole or of all the relevant parts of the incineration plant.

Description

In the case of a new incineration plant or after each modification of an existing incineration plant that could significantly affect the energy efficiency, the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency is determined by carrying out a performance test at full load.

In the case of an existing incineration plant that has not carried out a performance test, or where a performance test at full load cannot be carried out for technical reasons, the gross electrical efficiency, the gross energy efficiency, or the boiler efficiency can be determined taking into account the design values at performance test conditions.

For the performance test, no EN standard is available for the determination of the boiler efficiency of incineration plants. For grate-fired incineration plants, the FDBR guideline RL 7 may be used.

BAT 3. BAT is to monitor key process parameters relevant for emissions to air and water including those given below.

Stream/Location	Parameter(s)	Monitoring
Flue-gas from the incineration of waste	Flow, oxygen content, temperature, pressure, water vapour content	Continuous measurement
Combustion chamber	Temperature	
Waste water from wet FGC	Flow, pH, temperature	
Waste water from bottom ash treatment plants	Flow, pH, conductivity	

BAT 4. BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or

other international standards that ensure the provision of data of an equivalent scientific quality.

Substance/ Parameter	Process	Standard(s) (4)	Minimum monitoring frequency (5)	Monitoring associated with
NO_X	Incineration of waste	Generic EN standards	Continuous	BAT 29
NH_3	Incineration of waste when SNCR and/or SCR is used	Generic EN standards	Continuous	BAT 29
N_2O	— Incineration of waste in fluidised bed furnace — Incineration of waste when SNCR is operated with urea	EN 21258 (6)	Once every year	BAT 29
CO	Incineration of waste	Generic EN standards	Continuous	BAT 29
SO_2	Incineration of waste	Generic EN standards	Continuous	BAT 27
HCl	Incineration of waste	Generic EN standards	Continuous	BAT 27
HF	Incineration of waste	Generic EN standards	Continuous (7)	BAT 27
Dust	Bottom ash treatment	EN 13284-1	Once every year	BAT 26
	Incineration of waste	Generic EN standards and EN 13284-2	Continuous	BAT 25

Metals and metalloids except mercury (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Tl, V)	Incineration of waste	EN 14385	Once every six months	BAT 25
Hg	Incineration of waste	Generic EN standards and EN 14884	Continuous ([8])	BAT 31
TVOC	Incineration of waste	Generic EN standards	Continuous	BAT 30
PBDD/F	Incineration of waste ([9])	No EN standard available	Once every six months	BAT 30
PCDD/F	Incineration of waste	EN 1948-1, EN 1948-2, EN 1948-3	Once every six months for short-term sampling	BAT 30
		No EN standard available for long-term sampling, EN 1948-2, EN 1948-3	Once every month for long-term sampling ([10])	BAT 30
Dioxin-like PCBs	Incineration of waste	EN 1948-1, EN 1948-2, EN 1948-4	Once every six months for short-term sampling ([11])	BAT 30
		No EN standard available for long-term sampling, EN 1948-2, EN 1948-4	Once every month for long-term sampling ([10]) ([11])	BAT 30
Benzo[*a*]pyrene	Incineration of waste	No EN standard available	Once every year	BAT 30

BAT 5. BAT is to appropriately monitor channelled emissions to air from the incineration plant during OTNOC.

Description

The monitoring can be carried out by direct emission measurements (e.g. for the pollutants that are monitored continuously) or by monitoring of surrogate parameters if this proves to be of equivalent or better scientific quality than direct emission measurements. Emissions during start-up and shutdown while no waste is being incinerated, including emissions of PCDD/F, are estimated based on measurement campaigns, e.g. every three years, carried out during planned start-up/shutdown operations.

BAT 6. BAT is to monitor emissions to water from FGC and/or bottom ash treatment with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Substance/Parameter	Process	Standard(s)	Minimum monitoring frequency	Monitoring associated with
Total organic carbon (TOC)	FGC	EN 1484	Once every month	BAT 34
	Bottom ash treatment		Once every month (12)	
Total suspended solids (TSS)	FGC	EN 872	Once every day (13)	
	Bottom ash treatment		Once every month (12)	
As	FGC	Various EN standards available (e.g. EN ISO 11885, EN ISO 15586 or EN ISO 17294-2)	Once every month	
Cd	FGC			
Cr	FGC			
Cu	FGC			
Mo	FGC			
Ni	FGC			

Pb	FGC		Once every month	
	Bottom ash treatment		Once every month [12]	
Sb	FGC		Once every month	
Tl	FGC			
Zn	FGC			
Hg	FGC	Various EN standards available (e.g. EN ISO 12846 or EN ISO 17852)		
Ammonium-nitrogen (NH_4-N)	Bottom ash treatment	Various EN standards available (e.g. EN ISO 11732, EN ISO 14911)	Once every month [12]	
Chloride (Cl^-)	Bottom ash treatment	Various EN standards available (e.g. EN ISO 10304-1, EN ISO 15682)		
Sulphate (SO_4^{2-})	Bottom ash treatment	EN ISO 10304-1		
PCDD/F	FGC	No EN standard available	Once every month [12]	
	Bottom ash		Once every six months	

	treatment			

BAT 7. BAT is to monitor the content of unburnt substances in slags and bottom ashes at the incineration plant with at least the frequency given below and in accordance with EN standards.

Parameter	Standard(s)	Minimum monitoring frequency	Monitoring associated with
Loss on ignition [14]	EN 14899 and either EN 15169 or EN 15935	Once every three months	BAT 14
Total organic carbon [14] [15]	EN 14899 and either EN 13137 or EN 15936		

BAT 8. For the incineration of hazardous waste containing POPs, BAT is to determine the POP content in the output streams (e.g. slags and bottom ashes, flue-gas, waste water) after the commissioning of the incineration plant and after each change that may significantly affect the POP content in the output streams.

Description

The POP content in the output streams is determined by direct measurements or by indirect methods (e.g. the cumulated quantity of POPs in the fly ashes, dry FGC residues, waste water from FGC and related waste water treatment sludge may be determined by monitoring the POP contents in the flue-gas before and after the FGC system) or based on studies representative of the plant.

Applicability

Only applicable for plants that:

— incinerate hazardous waste with POP levels prior to incineration exceeding the concentration limits defined in Annex IV to Regulation (EC) No 850/2004 and amendments; and

— do not meet the process description specifications of Chapter IV.G.2 point (g) of the UNEP technical guidelines UNEP/CHW.13/6/Add.1/Rev.1.

1.3. General environmental and combustion performance

BAT 9. In order to improve the overall environmental performance of the incineration plant by waste stream management (see BAT 1), BAT is to use all of the techniques (a) to (c) given below, and, where relevant, also techniques (d), (e) and (f).

	Technique	Description
(a)	Determination of the types of waste that can be incinerated	Based on the characteristics of the incineration plant, identification of the types of waste which can be incinerated in terms of, for example, the physical state, the chemical characteristics, the hazardous properties, and the acceptable ranges of calorific value, humidity, ash content and size.
(b)	Set-up and implementation of waste characterisation and pre-acceptance procedures	These procedures aim to ensure the technical (and legal) suitability of waste treatment operations for a particular waste prior to the arrival of the waste at the plant. They include procedures to collect information about the waste input and may

		include waste sampling and characterisation to achieve sufficient knowledge of the waste composition. Waste pre-acceptance procedures are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).
(c)	Set-up and implementation of waste acceptance procedures	Acceptance procedures aim to confirm the characteristics of the waste, as identified at the pre-acceptance stage. These procedures define the elements to be verified upon the delivery of the waste at the

		plant as well as the waste acceptance and rejection criteria. They may include waste sampling, inspection and analysis. Waste acceptance procedures are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s). The elements to be monitored for each type of waste are detailed in BAT 11.
(d)	Set-up and implementation of a waste tracking system and inventory	A waste tracking system and inventory aims to track the location and quantity of waste in the plant. It holds

		all the information generated during waste pre-acceptance procedures (e.g. date of arrival at the plant and unique reference number of the waste, information on the previous waste holder(s), pre-acceptance and acceptance analysis results, nature and quantity of waste held on site including all identified hazards), acceptance, storage, treatment and/or transfer off site. The waste tracking system is risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the

		information provided by the previous waste holder(s). The waste tracking system includes clear labelling of wastes that are stored in places other than the waste bunker or sludge storage tank (e.g. in containers, drums, bales or other forms of packaging) such that they can be identified at all times.
(e)	Waste segregation	Wastes are kept separated depending on their properties in order to enable easier and environmentally safer storage and incineration. Waste segregation relies on the physical separation of different wastes and on procedures that identify when and where wastes are stored.

(f)	Verification of waste compatibility prior to the mixing or blending of hazardous wastes	Compatibility is ensured by a set of verification measures and tests in order to detect any unwanted and/or potentially dangerous chemical reactions between wastes (e.g. polymerisation, gas evolution, exothermal reaction, decomposition) upon mixing or blending. The compatibility tests are risk-based considering, for example, the hazardous properties of the waste, the risks posed by the waste in terms of process safety, occupational safety and environmental impact, as well as the information provided by the previous waste holder(s).

BAT 10. In order to improve the overall environmental performance of the bottom ash treatment plant, BAT is to include output quality management features in the EMS (see BAT 1).

Description

Output quality management features are included in the EMS, so as to ensure that the output of the bottom ash treatment is in line with expectations, using existing EN standards where available. This also allows the performance of the bottom ash treatment to be monitored and optimised.

BAT 11. In order to improve the overall environmental performance of the incineration plant, BAT is to monitor the waste deliveries as part of the waste acceptance procedures (see BAT 9(c)) including, depending on the risk posed by the incoming waste, the elements given below.

Waste type	Waste delivery monitoring
Municipal solid waste and other non-hazardous waste	—Radioactivity detection —Weighing of the waste deliveries —Visual inspection —Periodic sampling of waste deliveries and analysis of key properties/substances (e.g. calorific value, content of halogens and metals/metalloids). For municipal solid waste, this involves separate unloading.
Sewage sludge	—Weighing of the waste deliveries (or measuring the flow if the sewage sludge is delivered via pipeline) —Visual inspection, as far as technically possible —Periodic sampling and analysis of key

	properties/substances (e.g. calorific value, content of water, ash and mercury)
Hazardous waste other than clinical waste	— Radioactivity detection — Weighing of the waste deliveries — Visual inspection, as far as technically possible — Control and comparison of individual waste deliveries with the declaration of the waste producer — Sampling of the content of: — all bulk tankers and trailers — packed waste (e.g. in drums, intermediate bulk containers (IBCs) or smaller packaging) and analysis of: — combustion parameters (including calorific value and flashpoint) — waste compatibility, to detect possible hazardous

	reactions upon blending or mixing of wastes, prior to storage (BAT 9 f) — key substances including POPs, halogens and sulphur, metals/metalloids
Clinical waste	— Radioactivity detection — Weighing of the waste deliveries — Visual inspection of the packaging integrity

BAT 12. In order to reduce the environmental risks associated with the reception, handling and storage of waste, BAT is to use both of the techniques given below.

	Technique	Description
(a)	Impermeable surfaces with an adequate drainage infrastructure	Depending on the risks posed by the waste in terms of soil or water contamination, the surface of the waste reception, handling and storage areas is made impermeable to the liquids concerned and fitted with an adequate drainage infrastructure (see BAT 32). The integrity of this

		surface is periodically verified, as far as technically possible.
(b)	Adequate waste storage capacity	Measures are taken to avoid accumulation of waste, such as: — the maximum waste storage capacity is clearly established and not exceeded, taking into account the characteristics of the wastes (e.g. regarding the risk of fire) and the treatment capacity; — the quantity of waste stored is regularly monitored against the maximum allowed storage capacity; — for wastes that are not

		mixed during storage (e.g. clinical waste, packed waste), the maximum residence time is clearly established.

BAT 13. In order to reduce the environmental risk associated with the storage and handling of clinical waste, BAT is to use a combination of the techniques given below.

	Technique	**Description**
(a)	Automated or semi-automated waste handling	Clinical wastes are unloaded from the truck to the storage area using an automated or manual system depending on the risk posed by this operation. From the storage area the clinical wastes are fed into the furnace by an automated feeding system.
(b)	Incineration	Clinical waste

	of non-reusable sealed containers, if used	is delivered in sealed and robust combustible containers that are never opened throughout storage and handling operations. If needles and sharps are disposed of in them, the containers are puncture-proof as well.
(c)	Cleaning and disinfection of reusable containers, if used	Reusable waste containers are cleaned in a designated cleaning area and disinfected in a facility specifically designed for disinfection. Any leftovers from the cleaning operations are incinerated.

BAT 14. In order to improve the overall environmental performance of the incineration of waste, to reduce the content of unburnt substances in slags and bottom ashes, and to reduce emissions to air from the incineration of waste, BAT is to use an appropriate combination of the techniques given below.

	Technique	Description	Applicability

(a)	Waste blending and mixing	Waste blending and mixing prior to incineration includes for example the following operations: — bunker crane mixing; — using a feed equalisation system; — blending of compatible liquid and pasty wastes. In some cases, solid wastes are shredded prior to mixing.	Not applicable where direct furnace feeding is required due to safety considerations or waste characteristics (e.g. infectious clinical waste, odorous wastes, or wastes that are prone to releasing volatile substances). Not applicable where undesired reactions may occur between different types of waste (see BAT 9(f)).
(b)	Advanced control system	See Section 2.1	Generally applicable.
(c)	Optimisation of the incineration process	See Section 2.1	Optimisation of the design is not applicable to existing furnaces.

Table 1

BAT-associated environmental performance levels for unburnt substances in slags and bottom ashes from the incineration of waste

Parameter	Unit	BAT-

		AEPL
TOC content in slags and bottom ashes [16]	Dry wt-%	1–3 [17]
Loss on ignition of slags and bottom ashes [16]	Dry wt-%	1–5 [17]

The associated monitoring is in BAT 7.

BAT 15. In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement procedures for the adjustment of the plant's settings, e.g. through the advanced control system (see description in Section 2.1), as and when needed and practicable, based on the characterisation and control of the waste (see BAT 11).

BAT 16. In order to improve the overall environmental performance of the incineration plant and to reduce emissions to air, BAT is to set up and implement operational procedures (e.g. organisation of the supply chain, continuous rather than batch operation) to limit as far as practicable shutdown and start-up operations.

BAT 17. In order to reduce emissions to air and, where relevant, to water from the incineration plant, BAT is to ensure that the FGC system and the waste water treatment plant are appropriately designed (e.g. considering the maximum flow rate and pollutant concentrations), operated within their design range, and maintained so as to ensure optimal availability.

BAT 18. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions to air and, where relevant, to water from the incineration plant during OTNOC, BAT is to set up and implement a risk-based OTNOC management plan as part of the environmental management system (see BAT 1) that includes all of the following elements:

— identification of potential OTNOC (e.g. failure of equipment critical to the protection of the environment ('critical equipment')), of their root causes and of their potential consequences, and regular review and update of the list of identified OTNOC following the periodic assessment below;

— appropriate design of critical equipment (e.g. compartmentalisation of the bag filter, techniques to heat up the flue-gas and obviate the need to bypass the bag filter during start-up and shutdown, etc.);

— set-up and implementation of a preventive maintenance plan for critical equipment (see BAT 1(xii));

— monitoring and recording of emissions during OTNOC and associated circumstances (see BAT 5);

— periodic assessment of the emissions occurring during OTNOC (e.g. frequency of events, duration, amount of pollutants emitted) and implementation of corrective actions if necessary.

1.4. Energy efficiency

BAT 19. In order to increase the resource efficiency of the incineration plant, BAT is to use a heat recovery boiler.

Description

The energy contained in the flue-gas is recovered in a heat recovery boiler producing hot water and/or steam, which may be exported, used internally, and/or used to produce electricity.

Applicability

In the case of plants dedicated to the incineration of hazardous waste, the applicability may be limited by:

— the stickiness of the fly ashes;

— the corrosiveness of the flue-gas.

BAT 20. In order to increase the energy efficiency of the incineration plant, BAT is to use an appropriate combination of the techniques given below.

	Technique	**Description**	**Applicability**
(a)	Drying of sewage sludge	After mechanical dewatering, sewage sludge is further dried, using for example low-grade heat, before it is fed to the furnace. The extent to which sludge can be dried depends on the furnace feeding system.	Applicable within the constraints associated with the availability of low-grade heat.
(b)	Reduction of the flue-gas flow	The flue-gas flow is reduced through, e.g.: — improving the primary and secondary combustion air distribution;	For existing plants, the applicability of flue-gas recirculation may be limited due to technical constraints (e.g. pollutant load in the flue-gas,

		— flue-gas recirculation (see Section 2.2). A smaller flue-gas flow reduces the energy demand of the plant (e.g. for induced draught fans).	incineration conditions).
(c)	Minimisation of heat losses	Heat losses are minimised through, e.g.: — use of integral furnace-boilers, allowing for heat to also be recovered from the furnace sides; — thermal insulation of furnaces and boilers; — flue-gas recirculation (see Section 2.2); — recovery of heat from the cooling of slags and bottom ashes (see BAT 20(i)).	Integral furnace-boilers are not applicable to rotary kilns or to other furnaces dedicated to the high-temperature incineration of hazardous waste.
(d)	Optimisation of the boiler	The heat transfer in the boiler is	Applicable to new plants and to

	design	improved by optimising, for example, the: — flue-gas velocity and distribution; — water/steam circulation; — convection bundles; — on-line and off-line boiler cleaning systems in order to minimise the fouling of the convection bundles.	major retrofits of existing plants.
(e)	Low-temperature flue-gas heat exchangers	Special corrosion-resistant heat exchangers are used to recover additional energy from the flue-gas at the boiler exit, after an ESP, or after a dry sorbent injection system.	Applicable within the constraints of the operating temperature profile of the FGC system. In the case of existing plants, the applicability may be limited by a lack of space.
(f)	High steam conditions	The higher the steam conditions (temperature and pressure), the higher the electricity conversion	Applicable to new plants and to major retrofits of existing plants, where the plant is mainly oriented towards the

		efficiency allowed by the steam cycle. Working at high steam conditions (e.g. above 45 bar, 400 °C) requires the use of special steel alloys or refractory cladding to protect the boiler sections that are exposed to the highest temperatures.	generation of electricity. The applicability may be limited by: —the stickiness of the fly ashes; —the corrosiveness of the flue-gas.
(g)	Cogeneration	Cogeneration of heat and electricity where the heat (mainly from the steam that leaves the turbine) is used for producing hot water/steam to be used in industrial processes/activities or in a district heating/cooling network.	Applicable within the constraints associated with the local heat and power demand and/or availability of networks.
(h)	Flue-gas condenser	A heat exchanger or a scrubber with a heat exchanger, where the water vapour contained in the flue-gas condenses, transferring the latent heat to water at a sufficiently low temperature (e.g. return flow of a district heating network). The flue-gas condenser also	Applicable within the constraints associated with the demand for low-temperature heat, e.g. by the availability of a district heating network with a sufficiently low return temperature.

		provides co-benefits by reducing emissions to air (e.g. of dust and acid gases). The use of heat pumps can increase the amount of energy recovered from flue-gas condensation.	
(i)	Dry bottom ash handling	Dry, hot bottom ash falls from the grate onto a transport system and is cooled down by ambient air. Energy is recovered by using the cooling air for combustion.	Only applicable to grate furnaces. There may be technical restrictions that prevent retrofitting to existing furnaces.

Table 2

BAT-associated energy efficiency levels (BAT-AEELs) for the incineration of waste

				(%)
BAT-AEEL				
Plant	**Municipal solid waste, other non-hazardous waste and hazardous wood waste**		**Hazardous waste other than hazardous wood waste** ([18])	**Sewage sludge**
	Gross electrical efficiency ([19]) ([20])	**Gross energy efficiency** ([21])	**Boiler efficiency**	

The associated monitoring is in BAT 2.

1.5. Emissions to air

1.5.1. *Diffuse emissions*

BAT 21. In order to prevent or reduce diffuse emissions from the incineration plant, including odour emissions, BAT is to:

- store solid and bulk pasty wastes that are odorous and/or prone to releasing volatile substances in enclosed buildings under controlled subatmospheric pressure and use the extracted air as combustion air for incineration or send it to another suitable abatement system in the case of a risk of explosion;
- store liquid wastes in tanks under appropriate controlled pressure and duct the tank vents to the combustion air feed or to another suitable abatement system;
- control the risk of odour during complete shutdown periods when no incineration capacity is available, e.g. by:
  - sending the vented or extracted air to an alternative abatement system, e.g. a wet scrubber, a fixed adsorption bed;
  - minimising the amount of waste in storage, e.g. by interrupting, reducing or transferring waste deliveries, as a part of waste stream management (see BAT 9);
  - storing waste in properly sealed bales.

BAT 22. In order to prevent diffuse emissions of volatile compounds from the handling of gaseous and liquid wastes that are odorous and/or prone to releasing volatile substances at incineration plants, BAT is to introduce them into the furnace by direct feeding.

Description

For gaseous and liquid wastes delivered in bulk waste containers (e.g. tankers), direct feeding is carried out by connecting the waste container to the furnace feeding line. The container is then emptied by pressurising it with nitrogen or, if the viscosity is low enough, by pumping the liquid.

For gaseous and liquid wastes delivered in waste containers suitable for incineration (e.g. drums), direct feeding is carried out by introducing the containers directly in the furnace.

Applicability

May not be applicable to the incineration of sewage sludge depending, for example, on the water content and on the need for pre-drying or mixing with other wastes.

BAT 23. In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to include in the environmental management system (see BAT 1) the following diffuse dust emissions management features:

- identification of the most relevant diffuse dust emission sources (e.g. using EN 15445);

— definition and implementation of appropriate actions and techniques to prevent or reduce diffuse emissions over a given time frame.

BAT 24. In order to prevent or reduce diffuse dust emissions to air from the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques given below.

	Technique	Description	Applicability
(a)	Enclose and cover equipment	Enclose/encapsulate potentially dusty operations (such as grinding, screening) and/or cover conveyors and elevators. Enclosure can also be accomplished by installing all of the equipment in a closed building.	Installing the equipment in a closed building may not be applicable to mobile treatment devices.
(b)	Limit height of discharge	Match the discharge height to the varying height of the heap, automatically if possible (e.g. conveyor belts with adjustable heights).	Generally applicable.
(c)	Protect stockpiles against prevailing winds	Protect bulk storage areas or stockpiles with covers or wind barriers such as screening, walling or vertical greenery, as well as correctly orienting the stockpiles in relation to the prevailing wind.	Generally applicable.
(d)	Use water sprays	Install water spray systems at the main sources of diffuse	Generally applicable.

		dust emissions. The humidification of dust particles aids dust agglomeration and settling. Diffuse dust emissions at stockpiles are reduced by ensuring appropriate humidification of the charging and discharging points, or of the stockpiles themselves.	
(e)	Optimise moisture content	Optimise the moisture content of the slags/bottom ashes to the level required for efficient recovery of metals and mineral materials while minimising the dust release.	Generally applicable.
(f)	Operate under subatmospheric pressure	Carry out the treatment of slags and bottom ashes in enclosed equipment or buildings (see technique a) under subatmospheric pressure to enable treatment of the extracted air with an abatement technique (see BAT 26) as channelled emissions.	Only applicable to dry-discharged and other low-moisture bottom ashes.

1.5.2. *Channelled emissions*

1.5.2.1. Emissions of dust, metals and metalloids

BAT 25. In order to reduce channelled emissions to air of dust, metals and metalloids from the incineration of waste, BAT is to use one or a combination of the techniques given below.

	Technique	Description	Applicability
(a)	Bag filter	See Section 2.2	Generally applicable to new plants. Applicable to existing plants within the constraints associated with the operating temperature profile of the FGC system.
(b)	Electrostatic precipitator	See Section 2.2	Generally applicable.
(c)	Dry sorbent injection	See Section 2.2. Not relevant for the reduction of dust emissions. Adsorption of metals by injection of activated carbon or other reagents in combination with a dry sorbent injection system or a semi-wet absorber that is used to reduce acid gas emissions.	Generally applicable.

Table 3

BAT-associated emission levels (BAT-AELs) for channelled emissions to air of dust, metals and metalloids from the incineration of waste

		(mg/Nm3)
Parameter	**BAT-AEL**	**Averaging period**
Dust	< 2–5 ([24])	Daily average
Cd+Tl	0,005–0,02	Average over the sampling period
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	0,01–0,3	Average over the sampling period

The associated monitoring is in BAT 4.

BAT 26. In order to reduce channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air (see BAT 24(f)), BAT is to treat the extracted air with a bag filter (see Section 2.2).

Table 4

BAT-associated emission levels (BAT-AELs) for channelled dust emissions to air from the enclosed treatment of slags and bottom ashes with extraction of air

		(mg/Nm3)
Parameter	**BAT-AEL**	**Averaging period**
Dust	2–5	Average over the sampling period

The associated monitoring is in BAT 4.

1.5.2.2. Emissions of HCl, HF and SO_2

BAT 27. In order to reduce channelled emissions of HCl, HF and SO_2 to air from the incineration of waste, BAT is to use one or a combination of the techniques given below.

	Technique	Description	Applicability
(a)	Wet scrubber	See Section 2.2	There may be applicability restrictions due to low water availability, e.g. in arid areas.
(b)	Semi-wet absorber	See Section 2.2	Generally applicable.
(c)	Dry sorbent injection	See Section 2.2	Generally applicable.
(d)	Direct desulphurisation	See Section 2.2. Used for partial abatement of acid gas emissions upstream of other techniques.	Only applicable to fluidised bed furnaces.
(e)	Boiler sorbent injection	See Section 2.2. Used for partial abatement of acid gas emissions upstream of other techniques.	Generally applicable.

BAT 28. In order to reduce channelled peak emissions of HCl, HF and SO_2 to air from the

incineration of waste while limiting the consumption of reagents and the amount of residues generated from dry sorbent injection and semi-wet absorbers, BAT is to use technique (a) or both of the techniques given below.

	Technique	Description	Applicability
(a)	Optimised and automated reagent dosage	The use of continuous HCl and/or SO_2 measurements (and/or of other parameters that may prove useful for this purpose) upstream and/or downstream of the FGC system for the optimisation of the automated reagent dosage.	Generally applicable.
(b)	Recirculation of reagents	The recirculation of a proportion of the collected FGC solids to reduce the amount of unreacted reagent(s) in the residues. The technique is particularly relevant in the case of FGC techniques	Generally applicable to new plants. Applicable to existing plants within the constraints of the size of the bag filter.

		operating with a high stoichiometric excess.	

Table 5

BAT-associated emission levels (BAT-AELs) for channelled emissions to air of HCl, HF and SO2 from the incineration of waste

(mg/Nm3)			
Parameter	**BAT-AEL**		**Averaging period**
	New plant	**Existing plant**	
HCl	< 2–6 (25)	< 2–8 (25)	Daily average
HF	< 1	< 1	Daily average or average over the sampling period
SO_2	5–30	5–40	Daily average

The associated monitoring is in BAT 4.

1.5.2.3. Emissions of NO_X, N_2O, CO and NH_3

BAT 29. In order to reduce channelled NO_X emissions to air while limiting the emissions of CO and N_2O from the incineration of waste and the emissions of NH_3 from the use of SNCR and/or SCR, BAT is to use an appropriate combination of the techniques given below.

	Technique	**Description**	**Applicability**
(a)	Optimisation of the incineration	See Section 2.1	Generally applicable.

	process		
(b)	Flue-gas recirculation	See Section 2.2	For existing plants, the applicability may be limited due to technical constraints (e.g. pollutant load in the flue-gas, incineration conditions).
(c)	Selective non-catalytic reduction (SNCR)	See Section 2.2	Generally applicable.
(d)	Selective catalytic reduction (SCR)	See Section 2.2	In the case of existing plants, the applicability may be limited by a lack of space.
(e)	Catalytic filter bags	See Section 2.2	Only applicable to plants fitted with a bag filter.
(f)	Optimisation of the SNCR/SCR design and operation	Optimisation of the reagent to NO_X ratio over the cross-section of the furnace or duct, of the size of the reagent drops and of the temperature window in which the	Only applicable where SNCR and/or SCR is used for the reduction of NO_X emissions.

		reagent is injected.	
(g)	Wet scrubber	See Section 2.2. Where a wet scrubber is used for acid gas abatement, and in particular with SNCR, unreacted ammonia is absorbed by the scrubbing liquor and, once stripped, can be recycled as SNCR or SCR reagent.	There may be applicability restrictions due to low water availability, e.g. in arid areas.

Table 6

BAT-associated emission levels (BAT-AELs) for channelled NO_X and CO emissions to air from the incineration of waste and for channelled NH_3 emissions to air from the use of SNCR and/or SCR

			(mg/Nm3)
Parameter	**BAT-AEL**		**Averaging period**
	New plant	**Existing plant**	
NO_X	50–120 (26)	50–150 (26) (27)	Daily average
CO	10–50	10–50	

NH_3	2–10 ([26])	2–10 ([26]) ([28])	

The associated monitoring is in BAT 4.

1.5.2.4. Emissions of organic compounds

BAT 30. In order to reduce channelled emissions to air of organic compounds including PCDD/F and PCBs from the incineration of waste, BAT is to use techniques (a), (b), (c), (d), and one or a combination of techniques (e) to (i) given below.

	Technique	Description	Applicability
(a)	Optimisation of the incineration process	See Section 2.1. Optimisation of incineration parameters to promote the oxidation of organic compounds including PCDD/F and PCBs present in the waste, and to prevent their and their precursors' (re)formation.	Generally applicable.
(b)	Control of the waste feed	Knowledge and control of the combustion characteristics of the waste being fed into the furnace, to ensure optimal and, as far as possible,	Not applicable to clinical waste or to municipal solid waste.

		homogeneous and stable incineration conditions.	
(c)	On-line and off-line boiler cleaning	Efficient cleaning of the boiler bundles to reduce the dust residence time and accumulation in the boiler, thus reducing PCDD/F formation in the boiler. A combination of on-line and off-line boiler cleaning techniques is used.	Generally applicable.
(d)	Rapid flue-gas cooling	Rapid cooling of the flue-gas from temperatures above 400 °C to below 250 °C before dust abatement to prevent the *de novo* synthesis of PCDD/F. This is achieved by appropriate design of the boiler and/or with the use of a quench	Generally applicable.

		system. The latter option limits the amount of energy that can be recovered from the flue-gas and is used in particular in the case of incinerating hazardous wastes with a high halogen content.	
(e)	Dry sorbent injection	See Section 2.2. Adsorption by injection of activated carbon or other reagents, generally combined with a bag filter where a reaction layer is created in the filter cake and the solids generated are removed.	Generally applicable.
(f)	Fixed- or moving-bed adsorption	See Section 2.2.	The applicability may be limited by the overall pressure drop associated with the FGC system. In the

			case of existing plants, the applicability may be limited by a lack of space.
(g)	SCR	See Section 2.2. Where SCR is used for NO_X abatement, the adequate catalyst surface of the SCR system also provides for the partial reduction of the emissions of PCDD/F and PCBs. The technique is generally used in combination with technique (e), (f) or (i).	In the case of existing plants, the applicability may be limited by a lack of space.
(h)	Catalytic filter bags	See Section 2.2	Only applicable to plants fitted with a bag filter.
(i)	Carbon sorbent in a wet scrubber	PCDD/F and PCBs are adsorbed by carbon sorbent added to the wet scrubber, either in the scrubbing	Only applicable to plants fitted with a wet scrubber.

		liquor or in the form of impregnated packing elements. The technique is used for the removal of PCDD/F in general, and also to prevent and/or reduce the re-emission of PCDD/F accumulated in the scrubber (the so-called memory effect) occurring especially during shutdown and start-up periods.	

Table 7

BAT-associated emission levels (BAT-AELs) for channelled emissions to air of TVOC, PCDD/F and dioxin-like PCBs from the incineration of waste

Parameter	Unit	BAT-AEL		Averaging period
		New plant	Existing plant	
TVOC	mg/Nm^3	< 3–10	< 3–10	Daily average
PCDD/F [29]	ng I-TEQ/Nm^3	< 0,01–0,04	< 0,01–0,06	Average over the

				sampling period
		< 0,01–0,06	< 0,01–0,08	Long-term sampling period [30]
PCDD/F + dioxin-like PCBs [29]	ng WHO-TEQ/Nm^3	< 0,01–0,06	< 0,01–0,08	Average over the sampling period
		< 0,01–0,08	< 0,01–0,1	Long-term sampling period [30]

The associated monitoring is in BAT 4.

1.5.2.5. Emissions of mercury

BAT 31. In order to reduce channelled mercury emissions to air (including mercury emission peaks) from the incineration of waste, BAT is to use one or a combination of the techniques given below.

	Technique	Description	Applicability
(a)	Wet scrubber (low pH)	See Section 2.2. A wet scrubber operated at a pH value around 1. The mercury removal rate of the technique can be enhanced by adding reagents and/or adsorbents to the scrubbing liquor, e.g.: — oxidants such as	There may be applicability restrictions due to low water availability, e.g. in arid areas.

		hydrogen peroxide to transform elemental mercury to a water-soluble oxidised form; — sulphur compounds to form stable complexes or salts with mercury; — carbon sorbent to adsorb mercury, including elemental mercury. When designed for a sufficiently high buffer capacity for mercury capture, the technique effectively prevents the occurrence of mercury emission peaks.	
(b)	Dry sorbent injection	See Section 2.2.	Generally applicable.

		Adsorption by injection of activated carbon or other reagents, generally combined with a bag filter where a reaction layer is created in the filter cake and the solids generated are removed.	
(c)	Injection of special, highly reactive activated carbon	Injection of highly reactive activated carbon doped with sulphur or other reagents to enhance the reactivity with mercury. Usually, the injection of this special activated carbon is not continuous but only takes place when a mercury peak is detected. For this purpose, the technique can be used in combination with the continuous monitoring of mercury in the raw flue-gas.	May not be applicable to plants dedicated to the incineration of sewage sludge.

(d)	Boiler bromine addition	Bromide added to the waste or injected into the furnace is converted at high temperatures to elemental bromine, which oxidises elemental mercury to the water-soluble and highly adsorbable $HgBr_2$. The technique is used in combination with a downstream abatement technique such as a wet scrubber or an activated carbon injection system. Usually, the injection of bromide is not continuous but only takes place when a mercury peak is detected. For this purpose, the technique can be used in combination with the continuous monitoring of mercury in the	Generally applicable.

		raw flue-gas.	
(e)	Fixed- or moving-bed adsorption	See Section 2.2. When designed for a sufficiently high adsorption capacity, the technique effectively prevents the occurrence of mercury emission peaks.	The applicability may be limited by the overall pressure drop associated with the FGC system. In the case of existing plants, the applicability may be limited by a lack of space.

Table 8

BAT-associated emission levels (BAT-AELs) for channelled mercury emissions to air from the incineration of waste

			(µg/Nm3)
Parameter	**BAT-AEL** ([31])		**Averaging period**
	New plant	**Existing plant**	
Hg	< 5–20 ([32])	< 5–20 ([32])	Daily average or average over the sampling period
	1–10	1–10	Long-term sampling period

As an indication, the half-hourly average mercury emission levels will generally be:

— < 15–40 µg/Nm^3 for existing plants;

— < 15–35 µg/Nm^3 for new plants.

The associated monitoring is in BAT 4.

1.6. Emissions to water

BAT 32. In order to prevent the contamination of uncontaminated water, to reduce emissions to water, and to increase resource efficiency, BAT is to segregate waste water streams and to treat them separately, depending on their characteristics.

Description

Waste water streams (e.g. surface run-off water, cooling water, waste water from flue-gas treatment and from bottom ash treatment, drainage water collected from the waste reception, handling and storage areas (see BAT 12(a)) are segregated to be treated separately based on their characteristics and on the combination of treatment techniques required. Uncontaminated water streams are segregated from waste water streams that require treatment.

When recovering hydrochloric acid and/or gypsum from the scrubber's effluent, the waste waters arising from the different stages (acidic and alkaline) of the wet scrubbing system are treated separately.

Applicability

Generally applicable to new plants.

Applicable to existing plants within the constraints associated with the configuration of the water collection system.

BAT 33. In order to reduce water usage and to prevent or reduce the generation of waste water from the incineration plant, BAT is to use one or a combination of the techniques given below.

	Technique	**Description**	**Applicability**
(a)	Waste-water-free FGC techniques	Use of FGC techniques that do not generate waste water (e.g. dry sorbent injection or semi-wet absorber, see Section 2.2).	May not be applicable to the incineration of hazardous waste with a high halogen content.
(b)	Injection of	Waste water	Only applicable

	waste water from FGC	from FGC is injected into the hotter parts of the FGC system.	to the incineration of municipal solid waste.
(c)	Water reuse/recycling	Residual aqueous streams are reused or recycled. The degree of reuse/recycling is limited by the quality requirements of the process to which the water is directed.	Generally applicable.
(d)	Dry bottom ash handling	Dry, hot bottom ash falls from the grate onto a transport system and is cooled down by ambient air. No water is used in the process.	Only applicable to grate furnaces. There may be technical restrictions that prevent retrofitting to existing incineration plants.

BAT 34. In order to reduce emissions to water from FGC and/or from the storage and treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques given below, and to use secondary techniques as close as possible to the source in order to avoid dilution.

	Technique	**Typical pollutants targeted**
Primary techniques		
(a)	Optimisation of the	Organic compounds including PCDD/F,

	incineration process (see BAT 14) and/or of the FGC system (e.g. SNCR/SCR, see BAT 29(f))	ammonia/ammonium
Secondary techniques ([33])		
Preliminary and primary treatment		
(b)	Equalisation	All pollutants
(c)	Neutralisation	Acids, alkalis
(d)	Physical separation, e.g. screens, sieves, grit separators, primary settlement tanks	Gross solids, suspended solids
Physico-chemical treatment		
(e)	Adsorption on activated carbon	Organic compounds including PCDD/F, mercury
(f)	Precipitation	Dissolved metals/metalloids, sulphate
(g)	Oxidation	Sulphide, sulphite, organic compounds
(h)	Ion exchange	Dissolved metals/metalloids

(i)	Stripping	Purgeable pollutants (e.g. ammonia/ammonium)
(j)	Reverse osmosis	Ammonia/ammonium, metals/metalloids, sulphate, chloride, organic compounds
Final solids removal		
(k)	Coagulation and flocculation	Suspended solids, particulate-bound metals/metalloids
(l)	Sedimentation	
(m)	Filtration	
(n)	Flotation	

Table 9

BAT-AELs for direct emissions to a receiving water body

Parameter		Process	Unit	BAT-AEL ([34])
Total suspended solids (TSS)		FGC Bottom ash treatment	mg/l	10–30
Total organic carbon (TOC)		FGC Bottom ash treatment		15–40
Metals and metalloids	As	FGC		0,01–0,05
	Cd	FGC		0,005–0,03

	Cr	FGC		0,01–0,1
	Cu	FGC		0,03–0,15
	Hg	FGC		0,001–0,01
	Ni	FGC		0,03–0,15
	Pb	FGC Bottom ash treatment		0,02–0,06
	Sb	FGC		0,02–0,9
	Tl	FGC		0,005–0,03
	Zn	FGC		0,01–0,5
Ammonium-nitrogen (NH_4-N)		Bottom ash treatment		10–30
Sulphate (SO_4^{2-})		Bottom ash treatment		400–1 000
PCDD/F		FGC	ng I-TEQ/l	0,01–0,05

The associated monitoring is in BAT 6.

Table 10

BAT-AELs for indirect emissions to a receiving water body

Parameter		Process	Unit	BAT-AEL (35) (36)
Metals and metalloids	As	FGC	mg/l	0,01–0,05
	Cd	FGC		0,005–0,03

	Cr	FGC		0,01–0,1
	Cu	FGC		0,03–0,15
	Hg	FGC		0,001–0,01
	Ni	FGC		0,03–0,15
	Pb	FGC Bottom ash treatment		0,02–0,06
	Sb	FGC		0,02–0,9
	Tl	FGC		0,005–0,03
	Zn	FGC		0,01–0,5
PCDD/F		FGC	ng I-TEQ/l	0,01–0,05

The associated monitoring is in BAT 6.

1.7. Material efficiency

BAT 35. In order to increase resource efficiency, BAT is to handle and treat bottom ashes separately from FGC residues.

BAT 36. In order to increase resource efficiency for the treatment of slags and bottom ashes, BAT is to use an appropriate combination of the techniques given below based on a risk assessment depending on the hazardous properties of the slags and bottom ashes.

	Technique	Description	Applicability
(a)	Screening and sieving	Oscillating screens, vibrating screens and rotary screens are used for an initial classification of the bottom	Generally applicable.

		ashes by size before further treatment.	
(b)	Crushing	Mechanical treatment operations intended to prepare materials for the recovery of metals or for the subsequent use of those materials, e.g. in road and earthworks construction.	Generally applicable.
(c)	Aeraulic separation	Aeraulic separation is used to sort the light, unburnt fractions commingled in the bottom ashes by blowing off light fragments. A vibrating table is used to transport the bottom ashes to a chute, where the material falls through an air stream that blows uncombusted light materials,	Generally applicable.

		such as wood, paper or plastic, onto a removal belt or into a container, so that they can be returned to incineration.	
(d)	Recovery of ferrous and non-ferrous metals	Different techniques are used, including: — magnetic separation for ferrous metals; — eddy current separation for non-ferrous metals; — induction all-metal separation.	Generally applicable.
(e)	Ageing	The ageing process stabilises the mineral fraction of the bottom ashes by uptake of atmospheric CO_2 (carbonation), draining of excess water and oxidation. Bottom ashes,	Generally applicable.

		after the recovery of metals, are stored in the open air or in covered buildings for several weeks, generally on an impermeable floor allowing for drainage and run-off water to be collected for treatment. The stockpiles may be wetted to optimise the moisture content to favour the leaching of salts and the carbonation process. The wetting of bottom ashes also helps prevent dust emissions.	
(f)	Washing	The washing of bottom ashes enables the production of a material for recycling with minimal leachability of soluble substances (e.g. salts).	Generally applicable.

1.8. Noise

BAT 37. In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
(a)	Appropriate location of equipment and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens.	In the case of existing plants, the relocation of equipment may be restricted by a lack of space or by excessive costs.
(b)	Operational measures	These include: — improved inspection and maintenance of equipment; — closing of doors and windows of enclosed areas, if possible; — operation of equipment by experienced staff; — avoidance of noisy activities at night, if possible; — provisions for noise control during maintenance	Generally applicable.

		activities.	
(c)	Low-noise equipment	This includes low-noise compressors, pumps and fans.	Generally applicable when existing equipment is replaced or new equipment is installed.
(d)	Noise attenuation	Noise propagation can be reduced by inserting obstacles between the emitter and the receiver. Appropriate obstacles include protection walls, embankments and buildings.	In the case of existing plants, the insertion of obstacles may be restricted by a lack of space.
(e)	Noise-control equipment/ infrastructure	This includes: — noise-reducers; — equipment insulation; — enclosure of noisy equipment; — soundproofing of buildings.	In the case of existing plants, the applicability may be limited by a lack of space.

2. DESCRIPTIONS OF TECHNIQUES

2.1. General techniques

Technique	Description
Advanced control system	The use of a computer-based

	automatic system to control the combustion efficiency and support the prevention and/or reduction of emissions. This also includes the use of high-performance monitoring of operating parameters and of emissions.
Optimisation of the incineration process	Optimisation of the waste feed rate and composition, of the temperature, and of the flow rates and points of injection of the primary and secondary combustion air to effectively oxidise the organic compounds while reducing the generation of NO_X. Optimisation of the design and operation

	of the furnace (e.g. flue-gas temperature and turbulence, flue-gas and waste residence time, oxygen level, waste agitation).

2.2. Techniques to reduce emissions to air

Technique	Description
Bag filter	Bag or fabric filters are constructed from porous woven or felted fabric through which gases are passed to remove particles. The use of a bag filter requires the selection of a fabric suitable for the characteristics of the flue-gas and the maximum operating temperature.
Boiler sorbent injection	The injection of magnesium- or calcium-based absorbents at a high temperature in the boiler post-combustion area, to achieve partial abatement of acid gases. The technique is highly effective for the

	removal of SO_X and HF, and provides additional benefits in terms of flattening emission peaks.
Catalytic filter bags	Filter bags are either impregnated with a catalyst or the catalyst is directly mixed with organic material in the production of the fibres used for the filter medium. Such filters can be used to reduce PCDD/F emissions as well as, in combination with a source of NH_3, to reduce NO_X emissions.
Direct desulphurisation	The addition of magnesium- or calcium-based absorbents to the bed of a fluidised bed furnace.
Dry sorbent injection	The injection and dispersion of sorbent in the form of a dry powder in the flue-gas stream. Alkaline sorbents (e.g. sodium bicarbonate, hydrated lime) are injected to react with acid gases (HCl, HF and SO_X). Activated carbon is

	injected or co-injected to adsorb in particular PCDD/F and mercury. The resulting solids are removed, most often with a bag filter. The excess reactive agents may be recirculated to decrease their consumption, possibly after reactivation by maturation or steam injection (see BAT 28(b)).
Electrostatic precipitator	Electrostatic precipitators (ESPs) operate such that particles are charged and separated under the influence of an electrical field. Electrostatic precipitators are capable of operating under a wide range of conditions. The abatement efficiency may depend on the number of fields, residence time (size), and upstream particle removal devices. They generally include between two and five fields. Electrostatic precipitators can be

	of the dry or of the wet type depending on the technique used to collect the dust from the electrodes. Wet ESPs are typically used at the polishing stage to remove residual dust and droplets after wet scrubbing.
Fixed- or moving-bed adsorption	The flue-gas is passed through a fixed- or a moving-bed filter where an adsorbent (e.g. activated coke, activated lignite or a carbon-impregnated polymer) is used to adsorb pollutants.
Flue-gas recirculation	Recirculation of a part of the flue-gas to the furnace to replace a part of the fresh combustion air, with the dual effect of cooling the temperature and limiting the O_2 content for nitrogen oxidation, thus limiting the NO_X generation. It implies the supply of flue-gas from the furnace into the flame to reduce the oxygen content and therefore the temperature of the

	flame. This technique also reduces the flue-gas energy losses. Energy savings are also achieved when the recirculated flue-gas is extracted before FGC, by reducing the gas flow though the FGC system and the size of the required FGC system.
Selective catalytic reduction (SCR)	Selective reduction of nitrogen oxides with ammonia or urea in the presence of a catalyst. The technique is based on the reduction of NO_X to nitrogen in a catalytic bed by reaction with ammonia at an optimum operating temperature that is typically around 200–450 °C for the high-dust type and 170–250 °C for the tail-end type. In general, ammonia is injected as an aqueous solution; the ammonia source can also be anhydrous ammonia or a urea solution. Several layers of catalyst may be applied. A higher NO_X reduction is achieved with the

	use of a larger catalyst surface, installed as one or more layers. 'In-duct' or 'slip' SCR combines SNCR with downstream SCR which reduces the ammonia slip from SNCR.
Selective non-catalytic reduction (SNCR)	Selective reduction of nitrogen oxides to nitrogen with ammonia or urea at high temperatures and without catalyst. The operating temperature window is maintained between 800 °C and 1 000 °C for optimal reaction. The performance of the SNCR system can be increased by controlling the injection of the reagent from multiple lances with the support of a (fast-reacting) acoustic or infrared temperature measurement system so as to ensure that the reagent is injected in the optimum temperature zone at all times.

Semi-wet absorber	Also called semi-dry absorber. An alkaline aqueous solution or suspension (e.g. milk of lime) is added to the flue-gas stream to capture the acid gases. The water evaporates and the reaction products are dry. The resulting solids may be recirculated to reduce reagent consumption (see BAT 28(b)). This technique includes a range of different designs, including *flash-dry* processes which consist of injecting water (providing for fast gas cooling) and reagent at the filter inlet.
Wet scrubber	Use of a liquid, typically water or an aqueous solution/suspension, to capture pollutants from the flue-gas by absorption, in particular acid gases, as well as other soluble compounds and solids. To adsorb mercury and/or PCDD/F, carbon sorbent (as a

	slurry or as carbon-impregnated plastic packing) can be added to the wet scrubber. Different types of scrubber designs are used, e.g. jet scrubbers, rotation scrubbers, Venturi scrubbers, spray scrubbers and packed tower scrubbers.

2.3. Techniques to reduce emissions to water

Technique	Description
Adsorption on activated carbon	The removal of soluble substances (solutes) from the waste water by transferring them to the surface of solid, highly porous particles (the adsorbent). Activated carbon is typically used for the adsorption of organic compounds and mercury.
Precipitation	The conversion of dissolved pollutants into insoluble compounds by

	adding precipitants. The solid precipitates formed are subsequently separated by sedimentation, flotation or filtration. Typical chemicals used for metal precipitation are lime, dolomite, sodium hydroxide, sodium carbonate, sodium sulphide and organosulphides. Calcium salts (other than lime) are used to precipitate sulphate or fluoride.
Coagulation and flocculation	Coagulation and flocculation are used to separate suspended solids from waste water and are often carried out in successive steps. Coagulation is carried out by adding coagulants (e.g. ferric chloride) with charges opposite to those of the suspended

	solids. Flocculation is carried out by adding polymers, so that collisions of microfloc particles cause them to bond thereby producing larger flocs. The flocs formed are subsequently separated by sedimentation, air flotation or filtration.
Equalisation	Balancing of flows and pollutant loads by using tanks or other management techniques.
Filtration	The separation of solids from waste water by passing it through a porous medium. It includes different types of techniques, e.g. sand filtration, microfiltration and ultrafiltration.
Flotation	The separation of solid or liquid particles from

	waste water by attaching them to fine gas bubbles, usually air. The buoyant particles accumulate at the water surface and are collected with skimmers.
Ion exchange	The retention of ionic pollutants from waste water and their replacement by more acceptable ions using an ion exchange resin. The pollutants are temporarily retained and afterwards released into a regeneration or backwashing liquid.
Neutralisation	The adjustment of the pH of the waste water to a neutral value (approximately 7) by the addition of chemicals. Sodium hydroxide (NaOH) or calcium hydroxide ($Ca(OH)_2$) is generally used to increase the

	pH whereas sulphuric acid (H_2SO_4), hydrochloric acid (HCl) or carbon dioxide (CO_2) is used to decrease the pH. The precipitation of some substances may occur during neutralisation.
Oxidation	The conversion of pollutants by chemical oxidising agents to similar compounds that are less hazardous and/or easier to abate. In the case of waste water from the use of wet scrubbers, air may be used to oxidise sulphite (SO_3^{2-}) to sulphate (SO_4^{2-}).
Reverse osmosis	A membrane process in which a pressure difference applied between the compartments separated by the membrane causes water to

	flow from the more concentrated solution to the less concentrated one.
Sedimentation	The separation of suspended solids by gravitational settling.
Stripping	The removal of purgeable pollutants (e.g. ammonia) from waste water by contact with a high flow of a gas current in order to transfer them to the gas phase. The pollutants are subsequently recovered (e.g. by condensation) for further use or disposal. The removal efficiency may be enhanced by increasing the temperature or reducing the pressure.

2.4. Management techniques

Technique	Description

Odour management plan	The odour management plan is part of the EMS (see BAT 1) and includes: (a)a protocol for conducting odour monitoring in accordance with EN standards (e.g. dynamic olfactometry according to EN 13725 to determine the odour concentration); it may be complemented by measurement/estimation of odour exposure (e.g. according to EN 16841-1 or EN 16841-2) or estimation of odour impact; (b)a protocol for response to identified odour incidents, e.g. complaints; (c)an odour prevention and reduction programme designed to identify the source(s), to characterise the contributions of the sources, and to implement prevention and/or reduction measures.
Noise management plan	The noise management plan is part of the EMS (see BAT 1) and includes: (a)a protocol for conducting noise monitoring;

	(b)a protocol for response to identified noise incidents, e.g. complaints; (c)a noise reduction programme designed to identify the source(s), to measure/estimate noise exposure, to characterise the contributions of the source(s) and to implement prevention and/or reduction measures.
Accident management plan	An accident management plan is part of the EMS (see BAT 1) and identifies hazards posed by the installation and the associated risks and defines measures to address these risks. It considers the inventory of pollutants present or likely to be present which could have environmental consequences if they escape. It can be drawn up using for example FMEA (Failure Mode and Effects Analysis) and/or FMECA (Failure Mode, Effects and Criticality Analysis). The accident management plan includes the setting up and implementation of a fire prevention, detection and control plan, which is risk-based and includes the use of automatic fire detection and warning systems, and of manual and/or automatic fire

	intervention and control systems. The fire prevention, detection and control plan is relevant in particular for: — waste storage and pre-treatment areas; — furnace loading areas; — electrical control systems; — bag filters; — fixed adsorption beds. The accident management plan also includes, in particular in the case of installations where hazardous wastes are received, personnel training programmes regarding: — explosion and fire prevention; — fire extinguishing; — knowledge of chemical risks (labelling, carcinogenic substances, toxicity, corrosion, fire).

(1) Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L 312, 22.11.2008, p. 3).

(2) Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants and amending Directive 79/117/EEC (OJ L 158, 30.4.2004, p. 7).

(3) For any parameter where, due to sampling or analytical limitations, 30-minute sampling/measurement and/or an average of three consecutive measurements is inappropriate, a more suitable procedure may be employed. For PCDD/F and dioxin-like PCBs, one sampling period of 6 to 8 hours is used in the case of short-term sampling.

(4) Generic EN standards for continuous measurements are EN 15267-1, EN 15267-2, EN 15267-3 and EN 14181. EN standards for periodic measurements are given in the table or in the footnotes.

(5) For periodic monitoring, the monitoring frequency does not apply where plant operation would be for the sole purpose of performing an emission measurement.

(6) If continuous monitoring of N_2O is applied, the generic EN standards for continuous measurements apply.

(7) The continuous measurement of HF may be replaced by periodic measurements with a minimum frequency of once every six months if the HCl emission levels are proven to be sufficiently stable. No EN standard is available for the periodic

measurement of HF.

(8) For plants incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), the continuous monitoring of emissions may be replaced by long-term sampling (no EN standard is available for long-term sampling of Hg) or periodic measurements with a minimum frequency of once every six months. In the latter case the relevant standard is EN 13211.

(9) The monitoring only applies to the incineration of waste containing brominated flame retardants or to plants using BAT 31(d) with continuous injection of bromine.

(10) The monitoring does not apply if the emission levels are proven to be sufficiently stable.

(11) The monitoring does not apply where the emissions of dioxin-like PCBs are proven to be less than 0,01 ng WHO-TEQ/Nm^3.

(12) The monitoring frequency may be at least once every six months if the emissions are proven to be sufficiently stable.

(13) The daily 24-hour flow-proportional composite sampling measurements may be substituted by daily spot sample measurements.

(14) Either the loss on ignition or the total organic carbon is monitored.

(15) Elemental carbon (e.g. determined according to DIN 19539) may be subtracted from the measurement result.

(16) Either the BAT-AEPL for TOC content or the BAT-AEPL for the loss on ignition applies.

(17) The lower end of the BAT-AEPL range can be achieved when using fluidised bed furnaces or rotary kilns operated in slagging mode.

(18) The BAT-AEEL only applies where a heat recovery boiler is applicable.

(19) The BAT-AEELs for gross electrical efficiency only apply to plants or parts of plants producing electricity using a condensing turbine.

(20) The higher end of the BAT-AEEL range can be achieved when using BAT 20(f).

(21) The BAT-AEELs for gross energy efficiency only apply to plants or parts of plants producing only heat or producing electricity using a back-pressure turbine and heat with the steam leaving the turbine.

(22) A gross energy efficiency exceeding the higher end of the BAT-AEEL range (even above 100 %) can be achieved where a flue-gas condenser is used.

(23) For the incineration of sewage sludge, the boiler efficiency is highly dependent on the water content of the sewage sludge as fed into the furnace.

(24) For existing plants dedicated to the incineration of hazardous waste and for which a bag filter is not applicable, the higher end of the BAT-AEL range is 7 mg/Nm^3.

(25) The lower end of the BAT-AEL range can be achieved when using a wet scrubber; the higher end of the range may be associated with the use of dry sorbent injection.

(26) The lower end of the BAT-AEL range can be achieved when using SCR. The lower end of the BAT-AEL range may not be achievable when incinerating waste with a high nitrogen content (e.g. residues from the production of organic nitrogen compounds).

(27) The higher end of the BAT-AEL range is 180 mg/Nm^3 where SCR is not applicable.

(28) For existing plants fitted with SNCR without wet abatement techniques, the higher end of the BAT-AEL range is 15 mg/Nm^3.

(29) Either the BAT-AEL for PCDD/F or the BAT-AEL for PCDD/F + dioxin-like PCBs applies.

(30) The BAT-AEL does not apply if the emission levels are proven to be sufficiently stable.

(31) Either the BAT-AEL for daily average or average over the sampling period or the BAT-AEL for long-term sampling period applies. The BAT-AEL for long-term sampling may apply in the case of plants incinerating waste with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition).

(32) The lower end of the BAT-AEL ranges may be achieved when:

— incinerating wastes with a proven low and stable mercury content (e.g. mono-streams of waste of a controlled composition), or

— using specific techniques to prevent or reduce the occurrence of mercury peak emissions while incinerating non-hazardous waste.

The higher end of the BAT-AEL ranges may be associated with the use of dry sorbent injection.

([33]) The descriptions of the techniques are given in Section 2.3.

([34]) The averaging periods are defined in the General considerations.

([35]) The averaging periods are defined in the General considerations.

([36]) The BAT-AELs may not apply if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned, provided this does not lead to a higher level of pollution in the environment.