Transformation of the BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS for WASTE INCINERATION from the current BREF

[Note to TWG: This transformation of the BAT Conclusions from the current WI BREF has been written to give an indication of how the BAT Conclusions would look like if no changes were made to the BREF. They are therefore intended as a ***starting point*** *for the BREF review, to assist the TWG to identify priority areas for the upcoming WI BREF review.*

'BAT conclusions' are defined in Article 3(12) of Directive 2010/75/EU as meaning 'a document containing the parts of a BAT reference document laying 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'.

See also the Commission implementing decision (2012/119/EU) of 10 February 2012 laying down rules concerning guidance on the collection of data and on the drawing up of BAT reference documents and on their quality assurance referred to in the Industrial Emissions Directive 2010/75/EU (IED): http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:063:FULL:EN:PDF]

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Scope

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

5.2 Disposal or recovery of waste in waste incineration or 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.

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

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

Note 1: where waste pre-treatment is carried out on the same site as the waste incineration or co-incineration plant, then these processes fall within the scope of activity 5.2. Off-site waste treatment is covered in the Waste Treatment (WT) BREF. These BAT conclusions do not address waste pre-treatment outside the incineration plant.

Note 2: where the treatment of slags and ashes is carried out on the same site as the waste incineration or co-incineration plant, then these processes also fall within the scope of activity 5.2. Off-site treatment of slags and ashes is part of the scope of the WI BREF. These BAT conclusions therefore address the treatment of slags and ashes on-site and off-site of the waste incineration plant.

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

Reference documents	**Activity**
Large Combustion Plants (LCP)	Combustion of fuels
Waste Treatment (WT)	Pre-treatment and post treatment of wastes and residues
Emissions from Storage (EFS)	Storage and handling of materials
Energy efficiency (ENE)	General energy efficiency at the installation and in energy using systems, processes, activities or equipment.
Monitoring of emissions to air and water from IED-installations (ROM)	Monitoring of emissions to air and water
Industrial Cooling Systems (ICS)	Indirect cooling with water
Economics and Cross-Media Effects (ECM)	Economic and cross media effects of techniques

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 BAT

Unless stated otherwise, emission levels associated with the best available techniques (BAT-AELs) for emissions to air given in these BAT conclusions refer to:

- 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 mg/Nm^3 or ng/Nm^3; or
- mass of emitted substances per unit of mass of waste incinerated, expressed in the units kg/t, g/t, mg/t or µg/t.

Unless otherwise states, the averaging periods associated with the BAT-AELs for emissions to air are as defined below:

Average over the sampling period	At least three consecutive periodic measurements ([1]) of at least 30 minutes each taken at least once per year at the time of the highest expected emissions under normal operating conditions
Half-hour average	A period of 30 minutes of continuous measurements ([2])
Daily average	A period of 24 hours of continuous measurements ([2])
Annual average	Mass of emitted substances per unit of waste incinerated

([1]) Periodic measurement means, according to EN 15259:2007, determination of a measure at specified time intervals using manual or automated reference methods.
([2]) Continuous measurement means, according to EN 14181:2004, measurements with an automated measuring system (AMS) permanently installed on site for continuous monitoring of emissions.

In some special cases there may be a need to apply a different sampling procedure (e.g. shorter or longer sampling duration, higher frequency). This will be addressed in the specific BAT conclusion, where essential.

For incineration and other processes, the following reference conditions for oxygen and/or other specific reference conditions are applied.

Activities	**Unit**	**Reference conditions**
Incineration process	mg/Nm^3	11% oxygen by volume
Non-combustion processes	mg/Nm^3	As emitted. No correction for oxygen and/or for humidity

Conversion to reference oxygen concentration

The formula for calculating the emissions concentration at a reference oxygen level is shown below.

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

Where:
E_R (mg/Nm^3): emissions concentration corrected to the reference oxygen level O_R
O_R (vol %): reference oxygen level
E_M (mg/Nm^3): emissions concentration referred to the measured oxygen level O_M
O_M (vol %): measured oxygen level.

Unless stated otherwise, emission levels associated with the best available techniques (BAT-AELs) for waste water emissions given in these BAT conclusions refer to mass of emitted substances per volume of waste water, expressed in the units g/l, mg/l or µg/l based on a 24-hour flow-proportional average sample.

Unless otherwise states, the averaging periods associated with the BAT-AELs for emissions to water are as defined below:

Daily average	Unless stated otherwise, measurement of a 24-hour flow-proportional sample.
6-month average	Average of measurements from 24-hour flow-proportional samples taken monthly over a period of 6 months

In some special cases, there may be a need to apply a different sampling procedure (e.g. two-hour spot samples). This will be addressed in the specific BAT conclusion, where essential.

Definitions

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

Term	**Definition**
New plant	A plant first permitted at 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	A plant that is not a new plant

1. BAT CONCLUSIONS

1.1 General BAT conclusions

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

[Note to TWG: - the original numbering of BAT conclusions from the current Waste Incineration BREF has been retained wherever possible, except BAT 1 which is the standard EMS conclusion for all BREFs, and BAT 2 on Monitoring. Some adaptation of the wording of the original conclusions has been made so that it better fits the current BAT conclusions template. However, these adaptations have been kept to a minimum.]

The process-specific BAT included in Sections 1.2 to 1.6 apply in addition to the general BAT conclusions mentioned in this section.

1.1.1 ENVIRONMENTAL MANAGEMENT SYSTEMS

[Note to TWG: BAT 1, 2 and 3 in the current BREF are considered subsumed in BAT 1 described below.]

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

i. commitment of the management, including senior management;
ii. definition of an environmental policy that includes the continuous improvement of 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 procedures paying particular attention to:
   (a) structure and responsibility;
   (b) recruitment, training, awareness and competence;
   (c) communication;
   (d) employee involvement;
   (e) documentation;
   (f) effective process control;
   (g) maintenance programmes;
   (h) emergency preparedness and response;
   (i) safeguarding compliance with environmental legislation;
v. checking performance and taking corrective action, paying particular attention to:
   (a) monitoring and measurement (see also the Reference Report on Monitoring);
   (b) corrective and preventive action;
   (c) maintenance of records;
   (d) 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.

Specifically for the Waste Incineration sector, it is also important to consider the following potential features of the EMS:

- the selection of an installation design that is suited to the characteristics of the waste received;
- the development and use of procedures for the commissioning stages of new installations, generally including:
    - the prior preparation of a detailed programme of works describing the commissioning programme;
    - where the plant commissioning and tuning period may give rise to emissions outside the normal regulatory controls.

Three further features, which can complement the above stepwise, are considered as supporting measures. However, their absence is generally not inconsistent with BAT. These three additional steps are as follows.

- Having the management system and audit procedure examined and validated by an accredited certification body or an external EMS verifier.
- Preparation and publication (and possibly external validation) of a regular environmental statement describing all the significant environmental aspects of the installation, allowing for year-by-year comparison against environmental objectives and targets as well as with sector benchmarks as appropriate.
- Implementation and adherence to an internationally accepted voluntary system such as EMAS and EN ISO 14001:1996. This voluntary step could give higher credibility to the
  EMS. EMAS in particular, which embodies all the above-mentioned features, gives increased credibility. However, non-standardised systems can, in principle, be equally effective provided that they are properly designed and implemented.

Applicability
The scope (e.g. level of detail) 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.

BAT 4. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to establish and maintain quality controls over the waste input to the incinerator by applying all of the techniques given below.

	Technique	**Description**	**Applicability**
a.	Defining limits	Establishing installation limitations on waste input and identifying key risks	Generally applicable
b.	Quality assurance	Communication with waste suppliers to improve incoming waste quality control	Generally applicable
c.	Quality control	• Controlling waste feed quality on the incinerator site • Checking, sampling and testing incoming wastes • Detectors for radioactive materials	Generally applicable

BAT 5/6/8/9. In order to minimise the pollution risk from the storage of incoming waste, BAT is to apply all of the techniques given below.

	Technique	Description	Applicability
a.	Segregated storage	Segregate storage of waste according to a risk assessment of its chemical and physical characteristics	Generally applicable
b.	Sealed areas or segregated drainage	Store waste in areas that have sealed and resistant surfaces, with controlled and separated drainage	Generally applicable
c.	Limit volumes	Limit the volumes of waste stored from becoming too large for the storage provided	Generally applicable
d.	Control deliveries	As far as is practicable, control and manage deliveries by communication with waste suppliers	Generally applicable
e.	Clear labelling	Clear labelling of wastes that are stored in containers such that they may be continually identified	Generally applicable

[Note to TWG: BAT 10 is largely focused on safety; therefore it may not be appropriate to retain it. In any event such a plan might reasonably be expected to form part of the EMS.]

BAT 10. In order to prevent and minimise fire hazards, BAT is to develop a plan for the prevention, detection and control of fire hazards at the installation, in particular for: waste storage and pretreatment areas; furnace loading areas; electrical control systems; bag house filters and static bed filters. It is BAT for the plan implemented to include the use of: automatic fire detection and warning systems, and either a manual or automatic fire intervention and control system as required according to the risk assessment carried out.

All incineration installations, and in particular for those receiving hazardous wastes, personnel training programs are considered an important part of all safety management systems, especially training for:

- explosion and fire prevention;
- fire extinguishing;
- knowledge of chemical risks (labelling, carcinogenic substances, toxicity, corrosion, fire) and transportation.

BAT 11. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to produce a more homogenous feed to the incinerator, by mixing (e.g. using bunker crane mixing) or applying further pretreatment to (e.g. the blending of some liquid and paste type wastes, or the shredding of some solid wastes) heterogeneous wastes to the degree required to meet the design specifications of the receiving installation.

Applicability
When considering the degree of use of mixing/pre-treatment it is of particular importance to consider the cross-media effects (e.g. energy consumption, noise, odour or other releases) of the more extensive pre-treatments (e.g. shredding). Pre-treatment is most likely to be a requirement where the installation has been designed for a narrow specification, homogeneous waste.

BAT 13. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to visually monitor from the control room, either directly or indirectly using television screens or similar, the waste storage and loading areas.

[Note to TWG: BAT 16 can probably be subsumed into BAT 1.]

BAT 16. In order to reduce overall emissions, BAT is to adopt operational regimes and implement procedures (e.g. continuous rather than batch operation, preventative maintenance systems) in order to minimise as far as practicable planned and unplanned shutdown and start-up operations.

1.1.2 Monitoring

BAT 2. BAT is to monitor emissions to air before release to the atmosphere, and to water at the point of discharge at the boundary of the installation, including indirect discharges for the pollutants given in each BAT-AEL table of these BAT conclusions, with at least the frequency indicated in the same table 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.

1.1.3 Emissions to air

[Note to TWG: Some of the BAT conclusions in this section repeat requirements of Chapter IV of the IED. The TWG is asked to consider whether the repetition of these requirements within the BAT conclusions is necessary given that the IED is the primary legislation.]

BAT 7. In order to minimise the release of odour (and other potential fugitive releases) from bulk waste storage areas (including tanks and bunkers, but excluding small volume wastes stored in containers) and waste pre-treatment areas, BAT is to pass the extracted air to the incinerator for combustion. When the incinerator is not available (e.g. during maintenance), BAT is to use one or both of the techniques given below.

	Technique	**Description**	**Applicability**
a.	Avoid waste storage overload	Minimise amount of waste in storage	Generally applicable
b.	Odour abatement	Extract the relevant air via an alternative odour control system	Generally applicable

BAT 14. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to maintain the effective combustion performance of the incineration plant, by minimising the uncontrolled ingress of air into the combustion chamber via waste loading or other routes.

BAT 15. In order to minimise emissions to air, BAT is to use flow modelling to optimise furnace and boiler geometry so as to improve combustion performance; to optimise combustion air injection so as to improve combustion performance, and where SNCR or SCR is used, to optimise reagent injection points so as to improve the efficiency of NO_X abatement whilst minimising the generation of nitrous oxide, ammonia and the consumption of reagent.

<u>Applicability</u>
New plants or existing plants where concerns exist regarding the combustion or FGT performance.

BAT 17. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to maintain the effective combustion performance of the incineration plant, by implementing a combustion control philosophy, including the use of key combustion criteria, and a combustion control system to monitor and maintain these criteria within appropriate boundary conditions.

Description
Techniques to consider for combustion control may include the use of infrared cameras or others such as ultrasound measurement or differential temperature control.

BAT 18. In order to minimise emissions to air, BAT is to optimise and control combustion conditions, including the control of air (oxygen) supply, distribution and temperature, including gas and oxidant mixing; the combustion temperature level and distribution, and raw gas residence time.

BAT 19. In order to minimise emissions to air, BAT is to maintain the effective combustion performance of the incineration plant, by using the operating conditions (i.e. temperatures, residence times and turbulence) specified in Article 50 of Directive 2010/75/EU.

Applicability
The use of operating conditions in excess of those that are required for efficient destruction of the waste should generally be avoided. The use of other operating conditions may also be BAT – if they provide for a similar or better level of overall environmental performance. For example, where the use of operational temperatures below 1100 °C (as specified for certain hazardous waste in 2010/75/EC) has been demonstrated to provide a similar or better level of overall environmental performance, the use of such lower temperatures is considered to be BAT.

BAT 20. In order to minimise emissions to air, BAT is to preheat the primary combustion air by using heat recovered within the installation to improve combustion performance (e.g. where low LCV / high moisture wastes are burned).

Applicability
This technique may not be applicable to hazardous waste incinerators.

BAT 21. In order to minimise emissions to air, BAT is to use auxiliary burner(s) to maintain the required combustion temperature (according to the waste concerned) during start-up and shutdown and at all times when unburnt waste is in the combustion chamber.

BAT 23. In order to achieve low and stable CO and VOC emissions from the incineration process, BAT is to use a furnace (including secondary combustion chambers etc.) whose dimensions are large enough to provide for an effective combination of gas residence time and temperature such that combustion reactions may approach completion.

BAT-associated emission levels (BAT-AELs) – see Table 1.1.

BAT 34. In order to minimise the formation of PCDD/F in the boiler, BAT is to use a combination of on-line and off-line boiler-cleaning techniques to reduce dust residence and accumulation in the boiler.

BAT 36/37. In order to prevent or minimise emissions to air of acid gases (HCl, HF and SO_2), BAT is to apply one or a combination of the flue-gas treatment techniques given below.

	Technique (1)	**Description**	**Applicability**
a.	Dry lime flue-gas treatment	See section 1.7	Applicability may be limited by requirement for high reagent dosage
b.	Dry sodium bicarbonate flue-gas treatment	See section 1.7	Generally applicable
c.	Semi-wet flue-gas treatment	See section 1.7	Generally applicable
d.	Wet flue-gas treatment	See section 1.7	Applicability may be limited by the need for effluent treatment
(1) Each of the systems are usually combined with addition dust and PCFF/F control equipment.			

BAT-associated emission levels (BAT-AELs) – see Table 1.1.

BAT 40. In order to minimise emissions of NO_X to air, BAT is to use primary (combustion-related) NO_X reduction measures to reduce NO_X production, together with one of the techniques given below.

	Technique	**Description**	**Applicability** (1)
a.	Selective Catalytic Reduction (SCR)	See Section 1.7	Applicability may be restricted by need for flue-gas reheat
b.	Selective Non-Catalytic Reduction (SNCR)	See Section 1.7	Generally applicable
(1) In general SCR is considered BAT where higher NO_X reduction efficiencies are required (i.e. raw flue-gas NO_X levels are high) and where low final flue-gas emission concentrations of NO_X are desired.			

BAT-associated emission levels (BAT-AELs) – see Table 1.1.

BAT 41. In order to reduce overall PCDD/F emissions to all environmental media from the incineration process, BAT is to use all of the prevention techniques given below.

	Technique	**Description**	**Applicability**
a.	Control of waste feed	Techniques for improving knowledge of and control of the waste, including in particular its combustion characteristics	Generally applicable
b.	Maintenance of sufficient combustion temperature and residence time	Primary (combustion-related) techniques to destroy PCDD/F in the waste and possible PCDD/F precursors	
c.	Prevention of de-novo synthesis	The use of installation designs and operational controls that avoid those conditions that may give rise to PCDD/F reformation or generation, in particular to avoid the abatement of dust in the temperature range of 250–400 °C (1)	
(1) Some additional reduction of de-novo synthesis is reported where the dust abatement operational temperature has been further lowered from 250 °C to below 200 °C.			

BAT 41d. In order to control emissions to air of PCDD/F, BAT is to use one or more of the abatement measures given below.

	Technique	Description	Applicability
a.	Carbon injection	Adsorption by the injection of activated carbon or other reagents at a suitable reagent dose rate, with bag filtration ([1])	Generally applicable
b.	Fixed bed adsorption	Adsorption using fixed beds with a suitable adsorbent replenishment rate	Generally applicable
c.	Multi-layer SCR	Multi-layer SCR adequately sized to provide for PCDD/F control	Limited to where SCR is used for NO_X abatement
d.	Catalytic bag filters	Incorporation of catalyst into the fabric of the bag filter.	Only where other provision is made for effective metallic and elemental Hg control
([1]) Applied in combination with flue-gas treatment, see BAT 36/37.			

BAT-associated emission levels (BAT-AELs) – see Table 1.1.

BAT 42. In order to prevent the build-up of PCDD/F where wet scrubbers are used, BAT is to carry out an assessment and adopt suitable measures to deal with this build-up and prevent scrubber breakthrough releases. Particular consideration should be given to the possibility of memory effects during shutdown and start-up periods

BAT 43. In order to prevent and minimise Hg emissions where the re-burning of FGT residues is applied, BAT is to take suitable measures to avoid the recirculation and accumulation of Hg in the installation.

BAT 44. In order to prevent and minimise Hg emissions where wet scrubbers are applied as the only or main effective means of total Hg emission control, BAT is to use a low pH first stage with the addition of specific reagents for ionic Hg removal in combination with one of the techniques given below.

	Technique	Description	Applicability
a.	Carbon injection	Adsorption by the injection of activated carbon or other reagents at a suitable reagent dose rate, with bag filtration ([1])	Generally applicable
b.	Fixed bed adsorption	Adsorption using fixed beds with a suitable adsorbent replenishment rate	Generally applicable
([1]) Applied in combination with flue-gas treatment, see BAT 36/37.			

BAT-associated emission levels (BAT-AELs) – see Table 1.1.

BAT 45. In order to prevent and minimise Hg emissions where semi-wet and dry FGT systems are applied, BAT is to use activated carbon or other effective adsorptive reagents for the adsorption of PCDD/F and Hg, with the reagent dose rate controlled so that final air emissions are within the BAT-AEL emission range for Hg.

BAT-associated emission levels (BAT-AELs) – see Table 1.1.

Table 1.1 - BAT-AELs for emissions to air

Parameter	**BAT-AEL (mg/Nm^3)** Data are standardised at 11 % oxygen, dry gas, 273K and 101.3kP	**Averaging period for continuous monitoring / minimum frequency of periodic monitoring**
Total dust	1 – 20 (2)	Half-hour average
	1 – 5 (2)	Daily average
Hydrogen chloride (HCl)	1 – 50 (3)	Half-hour average
	1 – 8 (3)	Daily average
Hydrogen fluoride (HF)	< 2	Half-hour average
	< 1	Daily average
Sulphur dioxide (SO_2)	1 – 150 (3)	Half-hour average
	1 – 40 (3)	Daily average
Oxides of nitrogen (NO) and (NO_2) expressed as NO_2	30 – 350 (4)	Half-hour average
	40 – 180 (4)	Daily average
TOC	1 – 20	Half-hour average
	1 – 10	Daily average)
Carbon monoxide (CO)	5 – 100	Half-hour average
	5 – 30	Daily average)
Mercury and its compounds (Hg)	< 0.05	Average over the sampling period – min of 2 /year (7)
	0.001 – 0.03	Half-hour average (6)
	0.001 – 0.02	Daily average (6)
Total cadmium and thallium (and their compounds expressed as the metals)	0.005 – 0.05	Average over the sampling period – min of 2 /year (7)
Sum of other metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V)	0.005 – 0.5	Average over the sampling period – min of 2 /year (7)
Dioxins and furans	0.01 – 0.1 (1)	Average over the sampling period – min of 2 /year (7)
Ammonia (NH_3)	< 10	Average over the sampling period – min of 2 /year
	1 – 10 (5)	Half-hour average (6)
	< 10	Daily average (6)
Benz(a)pyrene	No BAT-AEL	Average over the sampling period – min of 2 /year
PCBs	No BAT-AEL	Average over the sampling period – min of 2 /year
PAHs	No BAT-AEL	Average over the sampling period – min of 2 /year
Nitrous oxide (N_2O)	No BAT-AEL	Average over the sampling period – min of 2 /year

(1) Figure is expressed in ngTEQ/Nm^3 – TEQ factors are defined in Directive 2010/75/EU.
(2) The use of fabric filters gives the lower levels within the emission range.
(3) The use of wet flue-gas treatment systems gives the lower levels within the emission range.
(4) The use of SNCR is associated with operation at the higher end of the range; the use of SCR is associated with operation at the lower end of the range.
(5) Effective control of NO_X abatement is associated with the upper end of the range; wet scrubbing is associated with the lower end of the range.
(6) Continuous monitoring is not required by Directive 2010/75/EU.
(7) Minimum of 4 times in first year of operation.

1.1.4 Emissions to water

BAT 46/47. In order to minimise the quantity of waste water generated at the installation, BAT is to recirculate and reuse waste water arising on the site within the installation using one or a combination of the techniques given below.

	Technique	Description	Applicability
a.	Reuse of boiler drain water	The use of boiler drain water as a water supply for the wet scrubber in order to reduce scrubber water consumption by replacing scrubber feed water	Generally applicable
b.	Surface water segregation	The use of separate systems for the drainage, treatment and discharge of rainwater that falls on the site, including roof water, so that it does not mix with potential or actual contaminated waste water streams	Generally applicable

BAT 48. In order to minimise the emission of pollutants to water where wet flue-gas treatment is used, BAT is to apply all of the techniques given below.

	Technique	Description	Applicability
a.	Physico-chemical treatment	The use of on-site physical /chemical treatment of the scrubber effluents prior to their discharge from the site	Generally applicable
b.	Separate treatment of acid and alkali waste water	The separate treatment of the acid and alkaline waste water streams arising from the scrubber stages, when there are particular drivers for the additional reduction of releases to water that result, and/or where HCl and/or gypsum recovery is to be carried out	Generally applicable
c.	Recirculation of scrubber liquor	The recirculation of wet scrubber effluent within the scrubber system, and the use of the electrical conductivity (mS/cm) of the recirculated water as a control measure, so as to reduce scrubber water consumption by replacing scrubber feed water	Generally applicable
d.	Flow and load balancing	The provision of storage /buffering capacity for scrubber effluents, to provide for a more stable waste water treatment process	Generally applicable
e.	Mercury removal	The use of sulphides (e.g. M-trimercaptotriazine) or other Hg binders to reduce Hg (and other heavy metals) in the final effluent	Generally applicable
f.	Ammonia stripping	Ammonia stripping with the recovered ammonia recirculated for use as a NO_X reduction reagent	Where SNCR is used in combination with wet scrubbing

BAT-associated emission levels (BAT-AELs) – see Table 1.2.

Table 1.2 – BAT-AELs for emissions to water

Parameter	BAT-AEL (mg/l) (Daily average)	Sampling period and minimum frequency
Total suspended solids (TSS)	10 – 30 (1) 10 – 45 (2)	Based on spot daily or daily 24-hour flow-proportional sample
Chemical oxygen demand	50 – 250	Based on spot daily or daily 24-hour flow-proportional sample
pH	6.5 – 11	Continuous measurement
Hg and its compounds, expressed as Hg	0.001 – 0.03	Based on the measurements from a 24-hour flow-proportional sample, taken at least monthly. One measurement per year can exceed the values given, or no more than 5 % where more than 20 samples are assessed per year
Cd and its compounds, expressed as Cd	0.01 – 0.05	
Tl and its compounds, expressed as Tl	0.01 – 0.05	
As and its compounds, expressed as As	0.01 – 0.15	
Pb and its compounds, expressed as Pb	0.01 – 0.1	
Cr and its compounds, expressed as Cr	0.01 – 0.5 (3)	
Cu and its compounds, expressed as Cu	0.01 – 0.5	
Ni and its compounds, expressed as Ni	0.01 – 0.5	
Zn and its compounds, expressed as Zn	0.01 – 1.0	
Sb and its compounds, expressed as Sb	0.005 – 0.85 (4)	
Co and its compounds, expressed as Co	0.005 – 0.05	
Mn and its compounds, expressed as Mn	0.02 – 0.2 (4)	
V and its compounds, expressed as V	0.03 – 0.5 (4)	
Sn and its compounds, expressed as Sn	0.02 – 0.5 (4)	
PCDD/F (TEQ)	0.01 – 0.1 ng TEQ/l (5)	Average of 6 monthly measurements of a flow-proportional representative sample of the discharge over a period of 24 hours

(1) <95% removal.
(2) 95-100% removal.
(3) Total Cr levels below 0.2 mg/l provides for control of Chromium VI.
(4) Sb, Mn, V and Sn are not included in Directive 2010/75/EU.
(5) 6-month average

1.1.5 Raw material and water consumption

BAT 39. In order to optimise the consumption of FGT reagents in dry, semi-wet and intermediate FGT systems, BAT is to apply a combination of the techniques given below.

	Technique	Description	Applicability ([1])
a.	Optimise reagent dosage	Adjustment and control of the quantity of reagent(s) injected in order to meet the requirements for the treatment of the flue-gas such that the target final operational emission levels are met	Generally applicable
b.	Automatic control	The use of the signal generated from fast response upstream and/or downstream monitors of raw HCl and/or SO_2 levels (or other parameters that may prove useful for this purpose) for the optimisation of FGT reagent dosing rates	Generally applicable
c.	Recirculation	The recirculation of a proportion of the FGT residues collected	Generally applicable
([1]) The applicability and degree of use of the above techniques that represent BAT will vary according to, in particular: the waste characteristics and consequential flue-gas nature, the final emission level required, and technical experience from their practical use at the installation.			

1.1.6 Energy efficiency

BAT 25. In order to achieve good energy recovery, BAT is to avoid operational problems that may be caused by higher temperature sticky fly ashes by using a boiler design that allows gas temperatures to reduce sufficiently before the convective heat exchange bundles (e.g. the provision of sufficient empty passes within the furnace/boiler and/or water walls or other techniques that aid cooling).

<u>Applicability</u>
The actual temperature above which fouling is significant is dependent on the waste type and the boiler steam parameters. In general for MSW it is usually 600–750 ºC, lower for Hazardous Waste and higher for Sewage Sludge.

BAT 26. In order to optimise the overall energy efficiency and energy recovery of the installation, BAT is to minimise energy losses from flue-gases and to use a boiler to transfer the flue-gas energy for the subsequent production of electricity and/or the supply of steam/heat.

BAT-associated environmental performance levels (BAT-AEPLs) – see Table 1.3.

Table 1.3 – BAT-AEPLs for energy transfer from flue-gas

Parameter	BAT-AEPL
Energy transferred to the boiler from the flue-gas for subsequent energy production	> 80 % for mixed municipal waste
	80 % to 90 % for pretreated municipal wastes or similar in fluidised bed furnaces
	60 % to 70 % for those hazardous wastes with higher boiler corrosion risks
	60 % to 90 % for other wastes.
	> 80 % for gasification and pyrolysis plants *
* For pyrolysis / gasification plants that are combined with a subsequent combustion stage,(gas engines or other electrical generation technology may also be used).	

BAT 27. In order to maximise energy recovery from the incineration process, BAT is to secure, where practicable, long-term base-load heat/steam supply contracts with large heat/steam users so that a more regular demand for the recovered energy exists and therefore a larger proportion of the energy value of the incinerated waste may be used.

BAT 28. In order to maximise energy recovery from the incineration process, BAT is to locate new installations so that the use of the heat and/or steam generated in the boiler can be maximised through one or a combination of the techniques given below.

	Technique	Description	Applicability
a.	Combined heat and power	Electricity generation with heat or steam supply for use (i.e. use CHP)	New installations ([1])
b.	District heating	The supply of heat or steam for use in district heating distribution networks	New installations ([1])
c.	Process steam	The supply of process steam for various, mainly industrial, uses (see BAT 27)	New installations ([1])
d.	District cooling/ air conditioning	The supply of heat or steam for use as the driving force for cooling/air conditioning systems	New installations ([1])
([1]) Selection of a location for a new installation is a complex process involving many local factors. The generation of electricity may only provide the most energy-efficient option for the recovery of the energy from the waste in specific cases where local factors prevent heat/steam recovery.			

BAT-associated environmental performance levels (BAT-AEPLs) – see Tables 1.5 and 1.8.

BAT 29-31. In order to maximise energy recovery in cases where electricity is generated, BAT is to use one or a combination of the techniques given below.

	Technique	Description	Applicability
a.	High steam pressure	The use of higher steam parameters to increase electricity generation, and the protection of boiler materials using suitably resistant materials	Applicability may be restricted by the requirements of other users of heat and steam in CHP systems
b.	Efficient turbines	Use of high efficiency steam turbines	
c.	Efficient condensers	Minimisation of condenser pressure	

BAT-associated environmental performance levels (BAT-AEPLs) – see Tables 1.5, 1.6, 1.8 and 1.9.

BAT 32&38. In order to minimise the consumption of energy at the incineration facility and so improve its overall energy efficiency, BAT is to use a combination of the techniques given below.

	Technique	Description	Applicability
a.	Low energy flue-gas treatment	The selection of flue-gas treatment techniques with lower overall energy demand in preference to those with higher energy demand	Generally applicable
b.	Avoid flue-gas reheat	Wherever possible, order flue-gas treatment systems in such a way that flue-gas reheating is avoided	Generally applicable
c.	Low SCR operating temperatures	Select the SCR system that, for the performance level required, has the lower operating temperature; and use heat exchangers to heat the SCR inlet flue-gas with the flue-gas energy at the SCR outlet	Systems using SCR
d.	Use of recovered energy	Avoid the use of primary fuels by using self-produced energy in preference to imported sources. Where flue-gas reheating is necessary, use heat exchange systems to minimise flue-gas reheating energy demand	Generally applicable
e.	Single bag filter	Unless there is a specific local driver, avoid the use of two bag filters in one FGT line	Generally applicable

BAT-associated environmental performance levels (BAT-AEPLs) – see Tables 1.5, 1.6, 1.8 and 1.9.

BAT 33. In order to minimise the impact of cooling on energy recovery, BAT is to select the steam condenser cooling system technical option that is best suited to the local environmental conditions, taking particular account of potential cross-media impacts.

BAT-associated environmental performance levels (BAT-AEPLs) – see Tables 1.5, 1.6, 1.8 and 1.9.

1.1.7 Residues

BAT 12/52. In order to maximise the recovery of ferrous and non-ferrous metals from the incineration process, BAT is to remove ferrous and non-ferrous recyclable metals for their recovery after incineration from the bottom ash residues. Where the waste is pretreated, e.g. shredded, BAT is to remove ferrous and non-ferrous recyclable metals from the shredded wastes before the incineration stage.

BAT 22. In order to minimise the carbon content of the bottom ash, BAT is to ensure good combustion of the waste in the incinerator by using a combination of heat removal close to the furnace (e.g. the use of water walls in grate furnaces and/or secondary combustion chambers) and furnace insulation (e.g. refractory areas or other lined furnace walls) that, according to the NCV and corrosiveness of the waste incinerated provides for adequate heat retention in the furnace.

Applicability

Low NCV wastes require higher retention of heat in the furnace; and additional heat to be transferred for energy recovery. Higher NCV wastes may allow/require heat removal from earlier furnace stages.

BAT-associated emission levels (BAT-AELs) – see Table 1.4.

BAT 24. In order to avoid the generation of waste when pyrolysis or gasification is used, BAT is to apply one or both of the techniques given below.

	Technique	**Description**	**Applicability**
a.	Energy recovery from syngas	Combine the gasification or pyrolysis stage with a subsequent combustion stage with energy recovery and flue-gas treatment	Generally applicable
b.	Materials recovery from syngas	Recover or supply for use of the substances (solid, liquid or gaseous) that are not combusted	Generally applicable

BAT 49. In order to improve the waste burnout in the incinerator, BAT is to apply a suitable combination of the techniques given below.

	Technique	**Description**	**Applicability**
a.	Furnace design	The use of a combination of furnace design, operation and waste throughput rate that: • provides sufficient agitation and residence time of the waste in the furnace at sufficiently high temperatures, including any ash burnout areas • physically retains the waste within the combustion chamber (e.g. narrow grate bar spacing for grates, rotary or static kilns for appreciably liquid wastes) to allow its combustion • the return of early grate riddlings to the combustion chamber for re-burn may provide a means to improve overall burnout where they contribute significantly to the deterioration of burnout	Generally applicable
b.	Mixing and or pretreating of waste	The use of techniques for mixing and pretreatment of the waste, as described in BAT 11, according to the type(s) of waste received at the installation	Generally applicable
c.	Optimise combustion control	The optimisation and control of combustion conditions, including air (oxygen) supply and distribution, as described in BAT 18	Generally applicable

BAT-associated emission levels (BAT-AELs) – see Table 1.4.

Table 1.4 – BAT-AEL for bottom ash residues

Parameter	BAT-AEL
TOC	1 – 3 wt%

BAT 50/51. In order to safely manage the residues from the incineration process and minimise the amount for disposal, BAT is the separate management of bottom ash from fly ash and other FGT residues, so as to avoid contamination of the bottom ash and thereby improve the potential for bottom ash recovery.

Boiler ash may exhibit similar or very different levels of contamination to that seen in bottom ash (according to local operational, design and waste-specific factors) – it is therefore also BAT to assess the levels of contaminants in the boiler ash, and to assess whether separation or mixing with bottom ash is appropriate. It is BAT to assess each separate solid waste stream that arises for its potential for recovery either alone or in combination.

Where a pre-dedusting stage is in use, an assessment of the composition of the fly ash collected should be carried out to assess whether it may be recovered, either directly or after treatment, rather than disposed of.

BAT 53. In order to safely manage incinerator bottom ash and minimise the amount for disposal, BAT is to treat bottom ash (either on or off site) using one or a combination of the techniques given below, to the extent that is required to meet the specifications set for its use or at the receiving treatment or disposal site, e.g. to achieve a leaching level for metals and salts that is in compliance with the local environmental conditions at the place of use.

	Technique	Description	Applicability
a.	Dry bottom ash treatment, with or without ageing	See Section 1.7	Generally applicable
b.	Wet bottom ash treatment, with or without ageing	See Section 1.7	Generally applicable
c.	Thermal treatment	See Section 1.7	Generally applicable
d.	Screening and crushing	See Section 1.7	Generally applicable

BAT 54. In order to safely manage FGT residues and minimise the amount for disposal, BAT is to treat FGT residues (on or off site) to the extent required to meet the acceptance requirements for the waste management option selected for them, including consideration of the use of FGT residue treatment techniques.

1.1.8 Noise and vibration

BAT 55. In order to prevent noise pollution from the incinerator site, BAT is to implement noise reduction measures to meet local noise requirements.

1.2 BAT conclusions for municipal waste incineration

In addition to the generic measures given in Section 1.1, for municipal waste incineration BAT is also in general considered to be as follows.

1.2.1 Management

BAT 57. In order to minimise the pollution risk from the storage of incoming waste, BAT is to store all waste, (with the exception of wastes specifically prepared for storage or bulk items with low pollution potential e.g. furniture), on sealed surfaces with controlled drainage inside covered and walled buildings.

BAT 58. In order to minimise the pollution risk from the storage of incoming waste when the incinerator is not available, BAT is to bale or otherwise prepare for longer term storage so that it may be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled.

BAT 59. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to produce a more homogenous feed to the incinerator to smooth its combustion characteristics and burnout, by pretreating the waste using one or both of the techniques given below.

	Technique	**Description**	**Applicability**
a.	Mixing in the bunker	See BAT 11	Generally applicable
b.	Pretreatment	The use of shredding or crushing for bulky wastes, e.g. furniture that is to be incinerated, to the extent that is beneficial according to the combustion system used.	In general, grates and rotary kilns (where used) require lower levels of pretreatment (e.g. waste mixing with bulky waste crushing) whereas fluidised bed systems require greater waste selection and pretreatment, usually including full shredding of the MSW

1.2.2 Emissions to air

BAT 60. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to ensure good combustion of the waste in the incinerator by using a grate design that incorporates sufficient cooling of the grate such that it permits the variation of the primary air supply for the main purpose of combustion control, rather than for the cooling of the grate itself.

Applicability
Air-cooled grates with well-distributed air cooling flow are generally suitable for wastes with an average NCV of up to approximately 18 MJ/kg. Higher NCV wastes may require water (or other liquid) cooling in order to prevent the need for excessive primary air levels (i.e. levels that result in a greater air supply than the optimum for combustion control) to control grate temperature and length/position of fire on the grate.

1.2.3 Energy efficiency

BAT 61/62. In order to maximise energy recovery from the incineration process, BAT is to locate new installations so that the use of the heat and/or steam generated in the boiler can be maximised.

BAT-associated environmental performance levels (BAT-AEPLs) – see Tables 1.5 and 1.6.

Table 1.5 – BAT-AEPLs for energy recovery from new municipal waste incinerators

Parameter	**BAT-AEPL** (annual average)
Energy exported from the installation as electricity, and/or stream or heat	> 1.9 MWh/tonne of MSW (1)
(1) Based on an average NCV of 10.4 MJ/kg.	

Table 1.6 – BAT-AEPLs for energy recovery from existing municipal waste incinerators

Parameter	**BAT-AEPL** (annual average)
Energy exported from the installation as electricity, and/or stream or heat	> 1.9 MWh/tonne of MSW (1)
Electricity generated at the installation	0.4–0.65 MWh/tonne of MSW (1)(2)(3)
	Greater than the electricity demand for the whole installation including (where used) on-site waste pretreatment and on-site residue treatment operations (4)
(1) Based on an average NCV of 10.4 MJ/kg. (2) Does not apply where energy exported exceeds 1.9 MWh/tonne of MSW. (3) With additional heat/steam supply as far as practicable in local circumstances. (4) Where the electricity demand exceeds 0.65 MWh/tonne of MSW.	

BAT 63. In order to minimise the consumption of energy at the incineration facility and so improve its overall energy efficiency, BAT is to reduce electrical demand at the installation.

BAT-associated environmental performance levels (BAT-AEPLs) – see Table 1.7.

Table 1.7 – BAT-AEPLs for energy demand at municipal waste incinerators

Parameter	**BAT-AEPL** (annual average)
Electricity demand at the installation (1)	< 0.15 MWh/tonne of MSW (2)
(1) Excluding pretreatment or residue treatment. (2) Based on an average NCV of 10.4 MJ/kg.	

1.3 BAT conclusions for pretreated or selected municipal waste incineration

In addition to the generic measures given in Section 1.1, for pretreated or selected municipal waste (including municipal refuse-derived fuels) incineration BAT is in general considered to be as follows.

1.3.1 Management

BAT 64. In order to minimise the pollution risk from the storage of incoming waste, BAT is to store all waste in enclosed hoppers or on sealed surfaces with controlled drainage inside covered and walled buildings.

BAT 65. In order to minimise the pollution risk from the storage of incoming waste when the incinerator is not available, BAT is to bale or otherwise prepare for longer term storage so that it may be stored in such a manner that risks of odour, vermin, litter, fire and leaching are effectively controlled.

1.3.2 Energy efficiency

BAT 66/67. In order to maximise energy recovery from the incineration process, BAT is to locate new installations so that the use of the heat and/or steam generated in the boiler can be maximised.

BAT-associated environmental performance levels (BAT-AEPLs) – see Tables 1.8 and 1.9.

Table 1.8 – BAT-AEPLs for energy recovery from new pretreated or selected municipal waste incinerators

Parameter	**BAT-AEPL** (annual average)
Energy exported from the installation as electricity, and/or stream or heat	> 3.0 MWh/tonne of waste (1)(2)
	0.6–1.0 MWh electricity /tonne of waste + 0.5–1.25 MWh heat /tonne of waste (1)(3)

(1) Based on an average NCV of 15.1 MJ/kg.
(2) Heat only, i.e. no electricity is produced.
(3) Combined heat and power.

Table 1.9 – BAT-AEPLs for energy recovery from existing pretreated or selected municipal waste incinerators

Parameter	**BAT-AEPL** (annual average)
Electricity generated at the installation	0.6–1.0 MWh/tonne of waste (1)(2)
	Greater than the electricity demand for the whole installation including (where used) on-site waste pretreatment and on-site residue treatment operations (3)

(1) Based on an average NCV of 15.1 MJ/kg.
(2) With additional heat/steam supply as far as practicable in local circumstances.
(3) Where the electricity demand exceeds 1.0 MWh/tonne of MSW.

BAT 68. In order to minimise the consumption of energy at the incineration facility and so improve its overall energy efficiency, BAT is to reduce electrical demand at the installation.

BAT-associated environmental performance levels (BAT-AEPLs) – see Table 1.10.

Table 1.10 – BAT-AEPLs for energy demand at pretreated or selected municipal waste incinerators

Parameter	**BAT-AEPL** (annual average)
Electricity demand at the installation (1)	< 0.2 MWh/tonne of waste (2)
(1) Excluding pretreatment or residue treatment. (2) Based on an average NCV of 15.1 MJ/kg.	

1.4 BAT conclusions for hazardous waste incineration

In addition to the generic measures given in Section 1.1, for hazardous waste incineration BAT is in general considered to be as follows.

1.4.1 Management

BAT 69. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to establish and maintain quality controls over the waste input to the incinerator, in addition to the quality controls outlined in BAT 4, by using specific systems and procedures and a risk-based approach according to the source of the waste, for the labelling, checking, sampling and testing of waste to be stored/treated.

Description

Analytical procedures should be managed by suitably qualified personnel and using appropriate procedures. In general, equipment is required to test:

- the calorific value
- the flashpoint
- PCBs
- halogens (e.g. Cl, Br, F) and sulphur
- heavy metals
- waste compatibility and reactivity
- radioactivity
- knowledge of the process or origin of the waste (this is important as certain hazardous characteristics, e.g. toxicity or infectiousness, are difficult to determine analytically).

BAT 70-72. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to produce a more homogenous feed to the incinerator by using one or a combination of the techniques given below.

	Technique	**Description**	**Applicability**
a.	Mixing and blending	The mixing, blending and pretreating of the waste in order to improve its homogeneity, combustion characteristics and burnout to a suitable degree with due regard to safety considerations. Examples are the shredding of drummed and packaged hazardous wastes. If shredding is carried out then blanketing with an inert atmosphere should be carried out	Generally applicable
b.	Feed equalisation	The use of a feed equalisation system for solid hazardous wastes in order to improve the combustion characteristics of the input waste and to improve the stability of flue-gas composition including the improved control of short-term peak CO emissions	Generally applicable
c.	Direct injection	The direct injection of liquid and gaseous hazardous wastes, where those wastes require specific reduction of exposure, releases or odour risk	Generally applicable

1.4.2 Emissions to air

BAT 73. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to maintain the effective combustion performance of the incineration plant by using a combustion chamber design that provides for containment, agitation and transport of the waste, for example rotary kilns - either with or without water cooling.

Applicability
Water cooling for rotary kilns may be favourable in situations where the LHV of the fed waste is higher (e.g. > 15–17 GJ/tonne) or higher temperatures (e.g. > 1100 °C) are used, e.g. for ash slagging or destruction of specific wastes.

BAT 75. In order to minimise emissions to air from the HWI and other hazardous waste incinerators feeding wastes of highly varying composition and sources, BAT is generally to use wet FGT to provide for improved control of short-term air emissions (see BAT 37 regarding FGT system selection). Specific techniques for the reduction of elemental iodine and bromine emissions may be required where such substances exist in the waste at appreciable concentrations.

1.4.3 Energy efficiency

BAT 74. In order to minimise the consumption of energy at the incineration facility and so improve its overall energy efficiency, BAT is to reduce electrical demand at the installation.

BAT-associated environmental performance levels (BAT-AEPLs) – see Table 1.11.

Table 1.11 – BAT-AEPLs for energy demand at hazardous waste incinerators

Parameter	**BAT-AEPL** (annual average)
Electricity demand at the installation ([1])	0.3–0.5 MWh/tonne of waste ([2])
([1]) Excluding pretreatment or residue treatment. ([2]) Smaller installations generally result in consumption levels at the upper end of this range. Weather conditions may have a significant impact on consumption owing to heating requirements etc.	

1.5 BAT conclusions for sewage sludge incineration

In addition to the generic measures given in Section 1.1, for sewage sludge incineration BAT is in general considered to be as follows.

1.5.1 Emissions to air

BAT 76. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to maintain the effective combustion performance of the sewage sludge incineration plant by using fluidised bed technology because of the higher combustion efficiency and lower flue-gas volumes that generally result from such systems.

Applicability
Applicability may be restricted by the risk of bed clogging with some sewage sludge compositions.

1.5.2 Energy efficiency

BAT 77. In order to improve the energy efficiency of the sewage sludge incineration plant, BAT is to dry the sewage sludge, preferably using heat recovered from the incineration, to the extent that additional combustion support fuels are not generally required for the normal operation of the installation.

Applicability
In this case, normal operation excludes start-up, shutdown and the occasional use of support fuels for maintaining combustion temperatures.

1.6 BAT conclusions for clinical waste incineration

In addition to the generic measures given in Section 1.1, for clinical waste incineration BAT is in general considered to be as follows.

1.6.1 Management

BAT 78-80. In order to minimise the pollution risk from the storage of incoming waste, BAT is to apply, where appropriate, all of the techniques given below.

	Technique	Description	Applicability
a.	No manual handling	The use of non-manual waste handling and loading systems	Generally applicable
b.	Suitable containers	The receipt and storage of clinical wastes in closed containers that are suitably resistant to leaks and punctures	Generally applicable
c.	Designated washing and disinfection facilities	The washing out of waste containers that are to be reused in a specifically designed, designated washing facility, with disinfection as required, and the feeding of any accumulated solids to the waste incinerator	Generally applicable

1.6.2 Emissions to air

BAT 80. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT us to ensure good combustion of the waste in the incinerator by using a grate design that incorporates sufficient cooling of the grate such that it permits the variation of the primary air supply for the main purpose of combustion control, rather than for the cooling of the grate itself.

Applicability
Air-cooled grates with well-distributed air cooling flow are generally suitable for wastes with an average NCV of up to approximately 18 MJ/kg. Higher NCV wastes may require water (or other liquid) cooling in order to prevent the need for excessive primary air levels (i.e. levels that result in a greater air supply than the optimum for combustion control) to control grate temperature and length/position of fire on the grate.

BAT 82. In order to maintain good operational control over the incinerator and thereby minimise and control its emissions and residues, BAT is to maintain the effective combustion performance of the incineration plant by using a combustion chamber design that provides for containment, agitation and transport of the waste, for example rotary kilns - either with or without water cooling.

Applicability
Water cooling for rotary kilns may be favourable in situations where the LHV of the fed waste is higher (e.g. > 15–17 GJ/tonne) or higher temperatures (e.g. > 1100 °C) are used, e.g. for ash slagging or destruction of specific wastes.

1.7 Descriptions of techniques

Technique	Description
Dry lime flue-gas treatment Dry sodium bicarbonate flue-gas treatment	A dry sorption agent (e.g. lime, sodium bicarbonate) is added to the flue-gas flow. The reaction product is also dry
Selective Catalytic Reduction (SCR)	Selective Catalytic Reduction (SCR) is a catalytic process during which ammonia mixed with air (the reduction agent) is added to the flue-gas and passed over a catalyst, usually a mesh (e.g. platinum, rhodium, TiO_2, zeolites). When passing through the catalyst, ammonia reacts with NO_X to give nitrogen and water vapour.
Selective Non-Catalytic Reduction (SNCR)	In the Selective Non-Catalytic Reduction (SNCR) process, nitrogen oxides are removed by selective non-catalytic reduction. With this type of process the reducing agent (typically ammonia or urea) is injected into the furnace and reacts with the nitrogen oxides. The reactions occur at temperatures between 850 °C and 1000 °C, with zones of higher and lower reaction rate within this range.
Semi-wet flue-gas treatment	Also called semi-dry, the sorption agent added to the flue-gas flow is an aqueous solution (e.g. lime milk) or suspension (e.g. as a slurry). The water solution evaporates and the reaction products are dry. The residue may be recirculated to improve reagent utilisation. A subset of this technique is *flash-dry* processes which consist of injection of water (giving fast gas cooling) and reagent at the filter inlet.
Wet flue-gas treatment	Wet flue-gas cleaning processes use different types of scrubber design. For example: jet scrubbers, • rotation scrubbers, venturi scrubbers, dry tower scrubbers, spray scrubbers and packed tower scrubbers.
Dry bottom ash treatment, with or without ageing	Dry bottom ash treatment installations combine the techniques of metals separation, size reduction and screening, and ageing of the treated bottom ash. The product is a dry aggregate with controlled grain size (e.g. 0 - 4 mm, 0 - 10 mm, 4 - 10mm), which may be used as a secondary construction material.
Wet bottom ash treatment, with or without ageing	The use of a wet bottom ash treatment system allows the production of a material for recycling with minimal leachability of metals and anions (e.g. salts). The incineration ashes are treated by size reduction, sieving, washing and metals separation. The main feature of the treatment is the wet separation of a 0 - 2 mm fraction.
Thermal treatment of bottom ash	Thermal treatment can be grouped into three categories: vitrification, melting and sintering. Thermal treatment takes place mainly to reduce the volume of the residue, but also to reduce its organic and heavy metal content and to improve the leaching behaviour before landfilling.
Screening and crushing of bottom ash	Mechanical treatment operations intended to prepare materials for subsequent use e.g. road and earthworks construction.