

Best Available Techniques (BAT) Reference Document (BREF) for Waste Incineration

– Status and Last Steps of the Review –

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1.	The Waste Incineration (WI) BREF review	16
1.1.	Scope of the WI BREF review	16
1.2.	Data collection for the WI BREF review.....	17
1.3.	Data analysis and drafting of the revised WI BREF	21
1.4.	Conclusions of the Final TWG Meeting for the WI BREF review.....	22
1.4.1.	Energy efficiency	22
1.4.2.	Monitoring of emissions	22
1.4.3.	BAT-AELs for emissions to air	23
1.4.4.	Emissions to water	24
1.4.5.	Material efficiency.....	24
1.5.	Finalisation.....	24

Emissions (and resource consumption) from industrial and agro-industrial production processes are regulated at the EU level under Directive 2010/75/EU on the industrial emissions (IED), whose aim is to prevent or, where that is not practicable, to reduce pollution through an integrated approach. Approximately 50,000 installations are covered by the IED.

Operators of these installations are required to obtain an integrated permit from the competent authorities. Permit conditions, including emission limit values (ELVs), must be based on the use of Best Available Techniques (BAT).

To determine BAT, the European Commission organises an exchange of information within Technical Working Groups (TWG) comprising the EU Member States, the industries concerned, non-governmental organisations promoting environmental protection and the Commission. This work is steered by the European Commission's in-house science service, the Joint Research Centre (JRC), specifically by the JRC's European IPPC Bureau (EIPPCB) in Seville (Spain), and results in the publication of BAT conclusions and BAT reference documents (BREFs). The IED stipulates that the BAT conclusions shall be the reference for setting permit conditions.

BAT are defined in the IED as established techniques which are the most effective in achieving a high level of protection of the environment as a whole and which are developed on a scale that allows implementation in the relevant sector under economically and technically viable conditions taking into account the costs and advantages.

BAT conclusions are Commission implementing decisions under the IED legislation, therefore formally adopted by the Commission after a vote of the Member States. BAT conclusions are the basis for the Member States to update permit conditions and ensure compliance with the IED. BAT conclusions therefore constitute the environmental technical standards that European installations have to meet.

An initial BREF series comprising 33 documents was drawn up under the predecessor of the IED, the Integrated Pollution Prevention and Control (IPPC) Directive (2008/1/EC).

All of these documents are being reviewed taking into account both technical developments in the industries concerned and the new requirements of the IED.

1. The Waste Incineration (WI) BREF review

The review of the BREF on Waste Incineration (WI BREF, adopted in 2006) started in 2014 with the reactivation of the TWG. In September 2014, TWG members submitted their views on what should be included in the review. The EIPPCB assessed the documentation received from the TWG members and organised a kick-off meeting (KoM) for the TWG to decide on the scope of the review, on the necessary data and information that should support the review, and to set the general timeline for the review process.

The meeting took place in Seville from 19 to 22 January 2015. In three days of intense discussions, the experts effectively took stock of the environmental priorities of the waste incineration sector in the EU-28. The report of the KoM is publicly available through the EIPPCB website (<http://eippcb.jrc.ec.europa.eu/reference/>).

1.1. Scope of the WI BREF review

It was decided, in short, to include the following in the scope of the revised WI BREF:

- Waste incineration plants with a capacity of at least 3 tonnes per hour for non-hazardous waste or at least 10 tonnes per day for hazardous waste, the capacity thresholds being those listed in Annex I to the IED.
- Waste co-incineration plants with the same capacity thresholds as above that do not have as their main purpose the production of material products (thereby excluding co-incineration in cement kilns, blast furnaces, etc.) and that are not of the types covered by the recent BREF for Large Combustion Plants (LCP BREF). Complementarity with the LCP BREF restricts the coverage of co-incineration in the WI BREF to the cases where the plant co-incinerates waste exclusively (and none of it qualifies as clean biomass), or where a high share (more than 40 %) of the waste is hazardous, or where the waste includes mixed municipal waste.
- The treatment of incineration bottom ashes (IBA) in plants exceeding the thresholds listed in Annex I to the IED (50 tonnes or 75 tonnes per day respectively for the disposal or recovery of non-hazardous IBA and 10 tonnes per day for the treatment of hazardous IBA).

1.2. Data collection for the WI BREF review

The TWG also decided to create three subgroups to tackle issues of particular importance and complexity. TWG subgroups work according to the *BREF Guidance*, i.e. Commission Implementing Decision 2012/119/EU¹, and based on the mandate agreed in the KoM conclusions for the WI BREF review.

The first TWG subgroup was tasked with data collection and questionnaire development. Its main duty was to develop a questionnaire template for collecting plant-specific, representative data from well-performing waste incineration plants in operation in the EU. This subgroup held a face-to-face meeting in Seville on 23 and 24 September 2015, where the following decisions were taken:

- the structure of the first draft questionnaire template was discussed and a series of modifications agreed;
- the drafting and review agenda for the questionnaire template was agreed, including the testing of the questionnaire by volunteer plant operators.

For continuously monitored emissions to air, no agreement was reached on the precise definition of normal operating conditions (NOC) for the waste incineration sector, and consequently on which other operating conditions (other than normal operating conditions, OTNOC) should be excluded from the emission levels reported in the questionnaire. While this is a challenge common to more BREFs than just the WI BREF as identifying OTNOC is important to ensure that the collected data can be correctly interpreted in the subsequent data analysis, this was considered to be particularly sensitive for the WI sector in light of the detailed compliance assessment rules that are laid down in Chapter IV of and Annex VI to the IED (the IED's special provisions to which waste incineration plants and waste co-incineration plants are subject). For this reason, this TWG subgroup agreed to proceed without any a-priori exclusion of OTNOC at the data collection stage and instead do the following:

- To develop a separate annex to the plant-specific questionnaire, consisting of data tables where the entire series of the 17,520 half-hourly averages in the year would be collected for the pollutants subject to continuous monitoring, along with key operating parameters such as flow rate, furnace temperature, input of waste and of support fuel.
- In these data tables, plant operators would also be requested to identify as far as possible the periods of time when the reference line was operated in conditions that could potentially be considered OTNOC, such as when no waste was being burnt, when (part of) the abatement system was being bypassed, when a stoppage, breakdown or malfunction occurred, or when the plant was in a start-up or shutdown situation.

¹ 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 Directive 2010/75/EU of the European Parliament and of the Council on industrial emissions

These complete series of emission levels reported as half-hourly averages would then become the basis for the determination of emission levels expressed on different averaging periods (mainly as daily averages). The part of the data collection related to emissions to air was thus substantially more complex and demanding than in any previous BREF, and this additional complexity was eventually replicated and possibly amplified in the subsequent data analysis phase. On the other hand, this allowed a detailed analysis of the influence of including or excluding different categories of operating conditions when determining the emission levels representative of the performance of the plant expressed with different averaging periods, and to do this in a transparent and traceable manner.

The second subgroup was tasked with supporting the WI BREF review on energy issues. The *energy issues subgroup* worked on:

- determining the parameters important to the determination of BAT and BAT-associated energy efficiency levels (AEELs);
- advising the data collection and questionnaire development subgroup on the energy-related information to be collected, and developing a separate energy efficiency annex to the plant-specific questionnaire for the determination of the key energy efficiency indicators for the types of plants under the scope of the WI BREF review;
- in the final phase of the WI BREF review, proposing a draft annex to the WI BREF with examples on how the energy efficiency is determined for different types of WI plants, be they oriented towards the generation of heat, of electricity, or both of heat and electricity in different technical configurations (with a back-pressure turbine or with a condensation turbine where part of the steam is extracted or bypasses the turbine).

The third subgroup was tasked with supporting the WI BREF review on residues. The *residues subgroup* worked on:

- defining the parameters important to the determination of BAT and BAT-associated environmental performance levels (BAT-AEPLs) relevant for incineration residues (such as unburnt substances in bottom ashes);
- advising the data collection and questionnaire development subgroup on the residue-related information to be collected, and developing a separate questionnaire for the bottom-ash treatment plants under the scope of the WI BREF review;
- proposing draft general and descriptive text for insertion in the WI BREF related to residues.

The data collection was eventually launched in January 2016 and ran until the summer. The data collection covered 355 waste incineration lines in 15 Member States plus Norway, and 43 bottom-ash treatment plants in 12 Member States. The detailed and systematic analysis of the emission and consumption levels of such a large number of individual plants allowed the EIPPCB to propose BAT conclusions strongly underpinned by monitoring data from a large number of plants in operation today.



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The WI BREF review was also informed by a number of site visits open to the entire TWG. These were held in 2016 and 2017 in Austria, Sweden, France and Germany and covered 14 waste incineration plants incinerating municipal waste, sewage sludge, other non-hazardous waste and hazardous waste, as well as 4 bottom-ash treatment plants and several other facilities related to specific issues of the WI BREF review.

1.3. Data analysis and drafting of the revised WI BREF

A first draft of the data collection and analysis was presented to the TWG in a two-day interactive webinar on 24 and 25 November 2016 and constituted the basis for the EIPPCB to draw up the first draft (D1) of the revised WI BREF.

D1 was released to the TWG and made publicly available on the EIPPCB website on 24 May 2017, opening a period of 14 weeks for the TWG to provide their comments. D1 was also accompanied by a large number of Excel files that included the plant-specific data analysis and presented it in graphs where the data selection could be filtered by each TWG member according to their own needs. The data files covered the following:

- Emissions to air of the pollutants that are measured continuously, including: maxima and 97th percentiles of half-hourly averages; maxima, 97th, 98th and 99th percentiles of daily averages; yearly averages. Twelve different combinations of *potential OTNOC* filters were presented.
- Emissions to air of the pollutants that are measured periodically.
- Emissions to water from plants discharging waste water arising from wet flue-gas cleaning systems and from bottom ash treatment plants.
- Electrical and total energy efficiency for the recovery of energy from incineration plants.
- Loss on ignition and total organic content of bottom ashes arising from the incineration of waste.

The TWG submitted close to 3,000 comments on D1, around half of which were on the draft BAT conclusions chapter. On the basis of these comments, the EIPPCB prepared a revision of the draft BAT conclusions and a background paper summarising all the comments received on the BAT conclusions, the EIPPCB's assessment of those comments, and how those comments were eventually reflected in the revised draft BAT conclusions. These documents were released to the TWG on 23 February 2018, two months in advance of the final TWG meeting, which –as laid down in the BREF guidance– is the formal stage at which the final document, in particular the BAT conclusions, is discussed and agreed on.

An additional step, which is not foreseen in the BREF guidance, was however taken ahead of the release of the revised BAT conclusions and background paper. This was an informal TWG meeting held on 4 and 5 December 2017 and attended by around

60 TWG members. While no decisions are taken at informal meetings (the BREF guidance specifies that the final TWG meeting is the place where decisions on BAT are taken), an informal meeting ahead of the final meeting was considered to be a useful step to clarify some outstanding issues and make the final meeting more efficient by unburdening its agenda. The agenda of the informal meeting was proposed mainly by the EIPPCB on the basis of the comments received, and covered: the determination of energy efficiency in different categories of plants; the measurement of dioxins by long-term sampling; the approach used to derive the proposed BAT-AELs; considerations on the measurement uncertainty associated with (very) low emission levels; operating conditions to be considered as OTNOC, and management of OTNOC when they occur; specific aspects of hazardous waste incineration. As a result of this informal meeting, the TWG agreed to collect and submit additional targeted data to fill the outstanding gaps in the data collection, in particular regarding the emissions of dioxins and furans measured by long-term sampling. The TWG also agreed to revise the type of indicators to be used to represent the energy efficiency performance of incineration plants other than waste-to-energy plants (such as plants dedicated to the incineration of hazardous waste or of sewage sludge).

1.4. Conclusions of the Final TWG Meeting for the WI BREF review

The final TWG meeting was held in Seville over the full week between 23 and 27 April 2018 and was attended by around 90 TWG members. Some of the main features of the draft BAT conclusions for the waste incineration sector as agreed by the TWG are summarised in the following subsections by topic.

1.4.1. Energy efficiency

For the incineration of municipal solid waste, other non-hazardous waste, and hazardous wood waste, BAT-AEELs for energy recovery are expressed in terms of gross electrical efficiency or of gross energy efficiency, respectively for plants (or parts thereof) using condensing turbines and for either heat-only plants or cogeneration plants using a back-pressure turbine. BAT-AEELs for gross electrical efficiency are differentiated in the case of new plants and of existing plants.

For the incineration of sewage sludge and of hazardous waste other than hazardous wood waste, BAT-AEELs for energy recovery are expressed in terms of boiler efficiency. This reflects the fact that plants dedicated to the incineration of these types of waste are generally more oriented towards the efficient destruction of the waste than towards optimising recovery of the waste's energy content.

1.4.2. Monitoring of emissions

The following monitoring BATs were agreed:

- Mercury emissions to air are monitored by continuous measurement as a general case.
- PCDD/F emissions to air are monitored by continuous sampling as well as periodic measurements as a general case.

- Brominated dioxins and furans are monitored in the case of plants incinerating brominated flame retardants or injecting bromide.
- The POP content in the output streams is determined in the case of plants incinerating hazardous waste containing POPs.

1.4.3. BAT-AELs for emissions to air

It was agreed to take a differentiated and proportionate approach to different pollutants, recognising their different relevance for the waste incineration sector and the availability of techniques able to prevent or reduce their emissions. The pollutants for which the TWG considered that this BREF review could be a driver for improving emissions to air from WI plants include: mercury and other metals, NO₂ and ammonia, hydrogen chloride and sulphur dioxide, PCDD/F, and PCBs.

BAT-AELs for emissions to air of pollutants that are measured continuously are set as daily averages only. Compared with the 2006 BREF, a more detailed analysis, strongly underpinned by emission data reported by a large set of plants that are currently in operation, was carried out to set the BAT-AEL ranges, including both their higher and their lower ends. The intrinsic variability of the pollutant load contained in different kinds of waste as well as the limits of quantification of the measurement standards were

Table 1: Comparison of the BAT-AELs of the draft BAT conclusions of 2018 with the BAT-AELs of the 2006 BREF and with the applicable binding ELVs set in Annex VI to the IED

	BAT-AEL 2018 (draft)	BAT-AEL 2006	IED ELV
Dust (da) mg/Nm ³	< 2 – 5 (7)	1 – 5	10
Cd+Tl (sts) mg/Nm ³	0.005 – 0.02	0.005 – 0.05	0.05
Sb+As+Pb+Cr+co+Mn+Ni+V (sts) mg/Nm ³	0.01 – 0.3	0.005 – 0.5	0.5
HCl (da) mg/Nm ³	< 2 – 6 (N) < 2 – 8 (E)	1 – 8	10
HF (da or sts) mg/Nm ³	< 1	< 1	1
SO ₂ (da) mg/Nm ³	5 – 30 (N) 5 – 40 (E)	1 – 40	50
NO _x (da) mg/Nm ³	50 – 120 (N) 50 – 150 (180) (E)	40 – 100 (180)	200 (400)
CO (da) mg/Nm ³	10 – 50 (N)	5 – 30	50
NH ₃ (da) mg/Nm ³	2 – 10 (15)	10	
TVOC (da) mg/Nm ³	< 3 – 10	1 – 10	10
PCDD/F (sts) ng I-TEQ/Nm ³	< 0.01 – 0.04 (N) < 0.01 – 0.06 (E)	0.01 – 0.1	0.1
PCDD/F (lts) ng I-TEQ/Nm ³	< 0.01 – 0.06 (N) < 0.01 – 0.08 (E)	none	none
PCDD/F+dioxin-like PCBs (sts) ng WHO-TEQ/Nm ³	< 0.01 – 0.06 (N) < 0.01 – 0.08 (E)	none	none
PCDD/F+dioxin-like PCBs (lts) ng WHO-TEQ/Nm ³	< 0.01 – 0.08 (N) < 0.01 – 0.10 (E)	none	none
Hg (da) µg/Nm ³	< 5 – 20	1 – 20	none
Hg (sts) µg/Nm ³	< 5 – 20	< 50	50
Hg (lts) µg/Nm ³	1 – 10	none	none

da = daily average for continuous measurements; sts = short-term sampling for periodic measurements; lts = long-term sampling for periodic measurements. N = New plant; E = Existing plant (commissioned after or before the publication of the BAT conclusions). Values in brackets refer to increased higher ends of the BAT-AEL range or higher ELVs applicable in specific cases.

also assessed especially in setting the lower end of the BAT-AEL ranges. BAT-AELs are differentiated in the case of new plants and of existing plants. Table 1 compares the BAT-AELs of draft BAT conclusions with the BAT-AELs of the 2006 BREF and with the applicable binding ELVs set in Annex VI to the IED.

1.4.4. Emissions to water

BAT-AELs are set for emissions to water from wet flue-gas cleaning processes and from the storage and treatment of incineration slags and bottom ashes.

1.4.5. Material efficiency

BAT conclusions are included for the treatment of bottom ashes arising from the incineration of waste and for the efficient recovery of valuable materials from the bottom ashes.

1.5. Finalisation

The final draft of the BREF is expected to be presented to the IED Article 13 forum for its formal opinion around the first quarter of 2019, and the BAT conclusions could be adopted by the Commission after a vote of the Member States in the IED Article 75 Committee later in the same year.

Once the BAT conclusions are adopted and published in the Official Journal of the European Union, Member States have four years to update the permits and the plants to comply with those updated permit conditions.

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