# Key environmental Issues (KEI) and BAT-associated emission levels (BAT-AEls) for Composting

## General framework conditions

Within the BAT Conclusions (C5) and when this derives from the data collection, emission limit values (ELVs) for identified KEI shall be defined in order to ensure that, under normal operating conditions, emissions do not exceed BAT-associated emission levels (BAT-AELs). Once defined, derogation from BAT-AELs is only allowed in specific and justified cases, i.e.

* It must be demonstrated that costs are disproportionately higher than benefits due to local/installation-specific situations; and
* Member States have to report to the public/the Commission on the use of such derogations.

### Here some important definitions:

* Where **emission and consumption levels “associated with best available techniques”** are presented, this is to be understood as meaning that those levels represent the environmental performance that could be anticipated as a result of the application, in this sector, of the techniques described, bearing in mind the balance of costs and advantages inherent within the definition of BAT.
* However, they are neither emission nor consumption limit values and should not be understood as such. In some cases, it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross- media considerations, they are not considered to be appropriate as BAT for the sector as a whole. However, such levels may be considered to be justified in more specific cases where there are special driving forces…
* …The concept of **‘levels associated with BAT’** described above is to be distinguished from the term **‘achievable level’** used elsewhere in this document. Where a level is described as ‘achievable’ using a particular technique or combination of techniques, this should be understood to mean that the level may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using those techniques…
* BAT AELs are not ‘statistically based’, however they can be ‘statistically-informed’ (provided the necessary data is available); **BAT-AELs are derived based on** **expert judgement => empirical determination**

Another source is the data collection through the questionnaire. Existing emission limits as set by national regulations should be used rather as a reference relative to achievable (best) performance.

Also other than normal operating conditions (ONOC) must be taken into account.

**Conclusions for biological treatment based on data collection**

The detailed analyses of the results of the questionnaires (see document Federal Environment Agency Austria) for biological treatment showed the following shortcomings in order to serve as a trustworthy source for identifying Key Environmental Indicators (KEI) as well as BAT-AEL and ELV respectively:

* A wide range of performance data
* No clear and sufficiently detailed description of processing/operational framework conditions behind the reported emission data (e.g. composition of feedstock, specific measurement method applied, timing of measurement)
* Wide range of limit setting

As regards ***emissions to water*** the current observation is that direct and indirect discharge of any waste water from biological treatment facilities for source separated biowaste is sufficiently addressed by national regulations based on the EU Water Framework Directive. Thus, no specific European KEIs or ELVs have been identified or specified for the purpose of regular monitoring.

In case of ***emissions to air*** for the debate on the relevance of KEI it is of general importance to distinguish between channelled emissions from an abatement system (e.g. from reception building, Biofilter, RTO etc.) and diffuse emissions which have to be related to the complete treatment facility, in specific to all open/ outdoor facilities and processes.

In case of *Outdoor composting*, diffuse emissions are the only type of emission produced, hence making focus on general design (location, orientation of stored and processed biowaste etc.) as well as operation (e.g. material selection and manipulation and timing) is key to prevent uncontrolled emissions to air. This has been extensively elaborated in C4 and is an important element of BAT-C.

Three different aspects must be considered as regards the type of impact of a KEI and its importance for functioning of the process and techniques:

* Environment protection objectives like e.g. GHG emissions, potential impacts on ground and surface water: general environmental indicator (G)
* Nuisance related emissions: perception in the vicinity of the plant / complaints and specific health protection, such as odour, dust: local perception /nuisance precaution (L)
* Indicators for a best available performance of the plant: key process parameter to be monitored (P)

Following this, the Tables below addressing the monitoring requirements for identified KEIs are divided into

1. Parameters to be monitored aiming at the optimised process management (P)
2. Parameters with direct relevance for emission control (L/G)

## Outdoor Composting

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| **Criteria related predominantly to PROCESS management and optimisation** |
| **Parameter** | **Type of Impact** | **Rationale** | **Monitoring** | **Orientation values** |
| **Temperature** | P | Besides the indication of the thermal hygienisation process (>55/60/65 °C over a certain time priod as defined by national legislation), regular temperature monitoring indicates the achieved progress of biological transformation (decomposition and stabilization into humus compounds)Prolonged periods of sustained temperatures > 70 °C may lead to the formation of odorous compounds. | **Timing:**During hygienisation and intensive, high temperature phase (> 55 °C) according to national legislation, but at least once per working day.**Methods:*** Calibrated continuous sen­sors with cable or radio trans­mission or data logger
* Calibrated analogue or digital sensors for discontinuous measure­ments.
 | **Hygienisation**: >55/60/65 °C**Reducing odours and improving biological complexation**: <70 °C |
| **H2O** | P | Sufficient humidity is an important criterion for a continuous and optimised microbial decomposition and humus formation process. It has to be adjusted according to the rotting stage. Over supply as well as deficiency may lead to anaerobic conditions, related odour problems and increased dust and bioaerosol formastion respectively. | **Timing:**At every turning date, during intensive decomposition pahse (> 45°C) at least every 2nd day), during maturation at least weekly **Method:**Visual control with squeeze test or moisture probes. Results from squeeze test and moisture probe techniques should be verified at regular, stated intervals by comparison with quantitative results (% mass/mass) oven drying method. | **Intensive decomposition phase (> ca. 45 °C):** 50 – 65 % f.m.**Maturation phase phase (< ca. 45 °C):** 35 – 50 % f.m. |
| **O2 / CO2 / CH4** | P | Proper proportions of O2, CO2 and CH4 in the pore air of composting material are reliable indicators for a sufficient oxidative decomposition process.  | **Timing:**During main/high temperature rotting phase once / 2 working days**Method:**Digital test probes  | **Orientation values in pore air:**Ʃ O2 + CO2: < 21%CH4: < 5% |
| **Criteria related to PROCESS management and optimisation as well as to possible nuisance impacts in the vicinity of the composting plant**  |
| **Odours** | Odour is an important process related parameter indicating process management is performed in a way that the biological decomposition specifically in the primary first intensive composting phase provides optimised aerobic conditions for the microbiological transformation (Feedstock composition, humidity, windrow size, turning frequency, C:N ratio, bulking/structure materials, porosity, optional: aeration). However, a possible impact of diffuse odorous emissions releases depend very much on the location of the composting plant, i.e. dispersion dynamics relative to sensitive receptors in the vicinity of the installation, potentially causing nuisance and complaints. Hence, odour has to be addressed as mainly a LOCAL issue to be managed – at first instance by means of adjustment of operational criteria (see C5). Measuring odour e.g. by means of Olfactometry does not give reliable results in case of pure diffuse (not channelled) sources. Hence, the following measures are proposed: * For *new plants*
	+ BAT is to apply a dispersion modelling in order to assess the potential strength and timely distribution of odour events that are likely to cause considerable nuisance to nearby sensitive receptors.
* For *plants in operation* in case of repeated complaints by the neighbourhood
	+ BAT is to
		- implement a documented adjustment of the process management (operation) in order to reduce odour emissions which may create nuisance to sensitive receptors in the vicinity of the composting plant.
		- In case the adjustment measures did not provide the desired improvement, apply a dispersion modelling in order to assess the potential strength and timely distribution of odour events that are likely to cause the reported nuisance to complaining sensitive receptors.
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| **Criteria related to possible nuisance or health impacts in the vicinity of the composting plant** |
| **Parameter** | **Type of Impact** | **Rationale** | **Monitoring** | **AEL** | **ELV** |
| **Dust** | L | Dust emissions may be associated with all outdoor mechanical manipulation of organic or mineral material. Usually, depending on particle size, sedimentation takes place between 20 and 500 m | **Timing:**Once in 3 years**Method:**P10 & P 2.5 ???, to be completed! | --- | Assessment of achieved values and measures to be set by competent authority |

## Indoor Composting

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| **Criteria related predominantly to PROCESS management and optimisation** |
| **Parameter** | **Type of Impact** | **Rationale** | **Monitoring** | **Orientation values** |
| **Temperature** | P | Besides the indication of the thermal hygienisation process (>55/60/65 °C over a certain time priod as defined by national legislation), regular temperature monitoring indicates the achieved progress of biological transformation (decomposition and stabilization into humus compounds)Prolonged periods of sustained temperatures > 70 °C may lead to the formation of odorous compounds. | **Timing:**During hygienisation and intensive, high temperature phase (> 55 °C) according to national legislation, but at least once per working day.**Methods:*** Continuous sensors with cable or radio trans­mission
 | **Hygienisation**: >55/60/65 °C**Reducing odours and improving biological complexation**: <70 °C |
| **H2O** | P | Sufficient humidity is an important criterion for a continuous and optimised microbial decomposition and humus formation process. It has to be adjusted according to the rotting stage. Over supply as well as deficiency may lead to anaerobic conditions, related odour problems and increased dust and bioaerosol formastion respectively. | **Timing:**Before loading the material into the enclosed composting reactor or hall, at every turning date and when extracted from the enclosed composting reactor or hall **Method:**Moisture can be assessed before and amending and adjusting when it comes out of the indoor composting stage. Visual control; Squeeze test (if feasible in case of intermediate extraction from closed vessel/reactor); optimal moisture content inside the enclosed composting unit can be maintained based on the operator’s experience; OR by calculation of the water balance (water addition / water evaporation in waste air) tbc | **Intensive decomposition phase (> ca. 45 °C):** 50 – 65 % f.m.**Maturation phase phase (< ca. 45 °C):** 35 – 50 % f.m. |
| **O2 / CO2 / CH4** | P  | Proper proportions of O2, CO2 and CH4 in the pore air of composting material are reliable indicators for a sufficient oxidative decomposition process. Alternatively the CO2 concentration in the raw gas (off gas from aerated rotting reactors) can be measured | **Timing:**During main/high temperature rotting phase once / 2 working days**Method:**Digital test probes  | **Orientation values in pore air:**Ʃ O2 + CO2: < 21%CH4: < 5%**Orientation values in in raw gas:**CO2: < 14% |
| **Criteria related to PROCESS management and optimisation as well as to possible nuisance impacts in the vicinity of the composting plant**  |
| **Parameter** | **Type of Impact** | **Rationale** | **Monitoring** | **AEL** | **ELV** |
| **Odours** | L/ P | Odour is an important process related parameter indicating process management is performed in a way that the biological decomposition specifically in the primary first intensive composting phase provides optimised aerobic conditions for the microbiological transformation (Feedstock composition, humidity, volume of rotting batches, turning frequency, C:N ratio, bulking/structure materials, porosity, aeration, existence and functioning of a wet/acid scrubber for stripping out NH3, functioning of the biofilter). However, odour emissions are restricted to waste reception, mechanical pre-treatment/ preparation for composting, intensive rotting phase at high temperatures); during maturation (at temperatures below 40/45 °C) odour emissions usually are neglectable.* For *new plants*
	+ BAT is to apply a dispersion modelling in order to assess the potential strength and timely distribution of odour events that are likely to cause considerable nuisance to nearby sensitive receptors.
	+ For *plants in operation* BAT is
		- in case of repeated complaints by the neighbourhood, to implement a documented adjustment of the process management (operation) including the odour abatement techniques in place in order to reduce odour emissions which may create nuisance to sensitive receptors in the vicinity of the composting plant.
		- In case the adjustment measures did not provide the desired improvement, to apply a dispersion modelling in order to assess the potential strength and timely distribution of odour events that are likely to cause the reported nuisance to complaining sensitive receptors.
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|  |  | I indoor composting channel odour emissions origin from treated waste air out lets like biofilters. The functioning of the odour abatement technique in place (e.g. biofilter) can be assessed via regular sampling and measurements of odour concentrations. | **Timing:**Once in 3 years or in case of reported odour problems**Method:**EN 13725: “Air Quality-Determination of Odour Concentration by Dynamic Olfactometry”; at the point of channelled emission (e.g. open or closed biofilter) | 200 – 1500 OU/m³ | 500 / 1500 OU/m³ tbc |
| **Criteria related to global impacts as well as possible nuisance impacts in the vicinity of the composting plant** |
| **Dust** | L | Dust emissions may be associated with all outdoor mechanical manipulation of organic or mineral material. Usually, depending on particle size, sedimentation takes place between 20 and 500 m | **Timing:**Once in 3 years**Method:**P10 & P 2.5 ???,  | --- | Assessment of achieved values and measures to be set by competent authority |
| **NH3** | L/G/P | Ammonia can be transformed into nitrous oxide in the biofilter and also inhibit the function of the biofilter. Ammonia concentration in the raw gas shall not exceed levels which would prevent the optimum performance of the biofilter and would trigger increased N2O emissions. | **Timing:**Once in 3 years or in case of reported odour problems **Method:**Orientation measurement in the untreated exhaust gas before the biofilter …tbc | tbc 10 – 50 mg/m³ | tbc 50 mg/m³ in raw gas before biofilter |