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ANNEX

BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR THE FOOD, DRINK AND MILK INDUSTRIES

1. GENERAL BAT CONCLUSIONS

1.1. Environmental management systems

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

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

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

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

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

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

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

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

(viii) internal and external communication;

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

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

(xi) effective operational planning and process control;

(xii) implementation of appropriate maintenance programmes;

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

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

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

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

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

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

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

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

Specifically for the food, drink and milk sector, BAT is to also incorporate the following features in the EMS:

(i) noise management plan (see BAT 13);

(ii) odour management plan (see BAT 15);

(iii) inventory of water, energy and raw materials consumption as well as of waste water and waste gas streams (see BAT 2);

(iv) energy efficiency plan (see BAT 6a).

Note

Regulation (EC) No 1221/2009 of the European Parliament and of the Council[(1)] establishes the Union eco-management and audit scheme (EMAS), which is an example of an EMS consistent with this BAT.

Applicability

The level of detail and the degree of formalisation of the EMS will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

BAT 2. In order to increase resource efficiency and to reduce emissions, BAT is to establish, maintain and regularly review (including when a significant change occurs) an inventory of water, energy and raw materials consumption as well as of waste water and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the following features:

I. Information about the food, drink and milk production processes, including:

(a) simplified process flow sheets that show the origin of the emissions;

(b) descriptions of process-integrated techniques and waste water/waste gas treatment techniques to prevent or reduce emissions, including their performance.

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II. Information about water consumption and usage (e.g. flow diagrams and water mass balances), and identification of actions to reduce water consumption and waste water volume (see BAT 7).

III. Information about the quantity and characteristics of the waste water streams, such as:

(a) average values and variability of flow, pH and temperature;

(b) average concentration and load values of relevant pollutants/parameters (e.g. TOC or COD, nitrogen species, phosphorus, chloride, conductivity) and their variability.

IV. Information about the characteristics of the waste gas streams, such as:

(a) average values and variability of flow and temperature;

(b) average concentration and load values of relevant pollutants/parameters (e.g. dust, TVOC, CO, NO_X, SO_X) and their variability;

(c) presence of other substances that may affect the waste gas treatment system or plant safety (e.g. oxygen, water vapour, dust).

V. Information about energy consumption and usage, the quantity of raw materials used, as well as the quantity and characteristics of residues generated, and identification of actions for continuous improvement of resource efficiency (see for example BAT 6 and BAT 10).

VI. Identification and implementation of an appropriate monitoring strategy with the aim of increasing resource efficiency, taking into account energy, water and raw materials consumption. Monitoring can include direct measurements, calculations or recording with an appropriate frequency. The monitoring is broken down at the most appropriate level (e.g. at process or plant/installation level).

Applicability

The level of detail of the inventory will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

1.2. **Monitoring**

BAT 3. For relevant emissions to water as identified by the inventory of waste water streams (see BAT 2), BAT is to monitor key process parameters (e.g. continuous monitoring of waste water flow, pH and temperature) at key locations (e.g. at the inlet and/or outlet of the pre-treatment, at the inlet to the final treatment, at the point where the emission leaves the installation).

BAT 4. BAT is to monitor emissions to water with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

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Substance/ parameter	Standard(s)	Minimum monitoring frequency [a]	Monitoring associated with
Chemical oxygen demand (COD) [bc]	No EN standard available	Once every day [d]	BAT 12
Total nitrogen (TN) [b]	Various EN standards available (e.g. EN 12260, EN ISO 11905-1)		
Total organic carbon (TOC) [bc]	EN 1484		
Total phosphorus (TP) [b]	Various EN standards available (e.g. EN ISO 6878, EN ISO 15681-1 and -2, EN ISO 11885)		
Total suspended solids (TSS) [b]	EN 872		
Biochemical oxygen demand (BOD_n) [b]	EN 1899-1	Once every month	
Chloride (Cl)	Various EN standards available (e.g. EN ISO 10304-1, EN ISO 15682)	Once every month	—

a The monitoring only applies when the substance concerned is identified as relevant in the waste water stream based on the inventory mentioned in BAT 2.

b The monitoring only applies in the case of a direct discharge to a receiving water body.

c TOC monitoring and COD monitoring are alternatives. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.

d If the emission levels are proven to be sufficiently stable, a lower monitoring frequency can be adopted but in any case at least once every month.

BAT 5. BAT is to monitor channelled emissions to air with at least the frequency given below and in accordance with EN standards.

Substance/ Parameter	Sector	Specific process	Standard(s)	Minimum monitoring frequency [a]	Monitoring associated with
Dust	Animal feed	Drying of green fodder	EN 13284-1	Once every three months [b]	BAT 17

a The measurements are carried out at the highest expected emission state under normal operating conditions.

b If the emission levels are proven to be sufficiently stable, a lower monitoring frequency can be adopted but in any case at least once every year.

c The measurement is carried out during a campaign of two days.

d The monitoring only applies when a thermal oxidiser is used.

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		Grinding and pellet cooling in compound feed manufacture		Once every year	BAT 17
		Extrusion of dry pet food		Once every year	BAT 17
	Brewing	Handling and processing of malt and adjuncts		Once every year	BAT 20
	Dairies	Drying processes		Once every year	BAT 23
	Grain milling	Grain cleaning and milling		Once every year	BAT 28
	Oilseed processing and vegetable oil refining	Handling and preparation of seeds, drying and cooling of meal		Once every year	BAT 31
	Starch production	Drying of starch, protein and fibre			BAT 34
	Sugar manufacturing	Drying of beet pulp		Once every month [b]	BAT 36
$PM_{2.5}$ and PM_{10}	Sugar manufacturing	Drying of beet pulp	EN ISO 23210	Once every year	BAT 36
TVOC	Fish and shellfish processing	Smoke chambers	EN 12619	Once every year	BAT 26
	Meat processing	Smoke chambers			BAT 29
	Oilseed processing and vegetable oil refining [c]	—			—
	Sugar manufacturing	High-temperature		Once every year	—

a The measurements are carried out at the highest expected emission state under normal operating conditions.

b If the emission levels are proven to be sufficiently stable, a lower monitoring frequency can be adopted but in any case at least once every year.

c The measurement is carried out during a campaign of two days.

d The monitoring only applies when a thermal oxidiser is used.

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		drying of beet pulp			
NO_X	Meat processing [d]	Smoke chambers	EN 14792	Once every year	—
	Sugar manufacturing	High-temperature drying of beet pulp			
CO	Meat processing [d]	Smoke chambers	EN 15058		
	Sugar manufacturing	High-temperature drying of beet pulp			
SO_X	Sugar manufacturing	Drying of beet pulp when natural gas is not used	EN 14791	Twice every year [b]	BAT 37

a	The measurements are carried out at the highest expected emission state under normal operating conditions.
b	If the emission levels are proven to be sufficiently stable, a lower monitoring frequency can be adopted but in any case at least once every year.
c	The measurement is carried out during a campaign of two days.
d	The monitoring only applies when a thermal oxidiser is used.

1.3. Energy efficiency

BAT 6. In order to increase energy efficiency, BAT is to use BAT 6a and an appropriate combination of the common techniques listed in technique b below.

Technique		Description
(a)	Energy efficiency plan	An energy efficiency plan, as part of the environmental management system (see BAT 1), entails defining and calculating the specific energy consumption of the activity (or activities), setting key performance indicators on an annual basis (for example for the specific energy consumption) and planning periodic improvement targets and related actions. The plan is adapted to the specificities of the installation.

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(b)	Use of common techniques	Common techniques include techniques such as: — burner regulation and control; — cogeneration; — energy-efficient motors; — heat recovery with heat exchangers and/or heat pumps (including mechanical vapour recompression); — lighting; — minimising blowdown from the boiler; — optimising steam distribution systems; — preheating feed water (including the use of economisers); — process control systems; — reducing compressed air system leaks; — reducing heat losses by insulation; — variable speed drives; — multiple-effect evaporation; — use of solar energy.

Further sector-specific techniques to increase energy efficiency are given in Sections 2 to 13 of these BAT conclusions.

1.4. **Water consumption and waste water discharge**

BAT 7. In order to reduce water consumption and the volume of waste water discharged, BAT is to use BAT 7a and one or a combination of the techniques b to k given below.

Technique		**Description**	**Applicability**
Common techniques			
(a)	Water recycling and/or reuse	Recycling and/or reuse of water streams (preceded or not by water treatment), e.g. for	May not be applicable due to hygiene and food safety requirements.

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		cleaning, washing, cooling or for the process itself.	
(b)	Optimisation of water flow	Use of control devices, e.g. photocells, flow valves, thermostatic valves, to automatically adjust the water flow.	
(c)	Optimisation of water nozzles and hoses	Use of correct number and position of nozzles; adjustment of water pressure.	
(d)	Segregation of water streams	Water streams that do not need treatment (e.g. uncontaminated cooling water or uncontaminated run-off water) are segregated from waste water that has to undergo treatment, thus enabling uncontaminated water recycling.	The segregation of uncontaminated rainwater may not be applicable in the case of existing waste water collection systems.
Techniques related to cleaning operations			
(e)	Dry cleaning	Removal of as much residual material as possible from raw materials and equipment before they are cleaned with liquids, e.g. by using compressed air, vacuum systems or catchpots with a mesh cover.	Generally applicable.
(f)	Pigging system for pipes	Use of a system made of launchers, catchers, compressed air equipment, and a projectile (also referred to as a ‘pig’, e.g. made of plastic or ice slurry) to clean out pipes. In-line valves are in place to allow the	

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		pig to pass through the pipeline system and to separate the product and the rinsing water.	
(g)	High-pressure cleaning	Spraying of water onto the surface to be cleaned at pressures ranging from 15 bar to 150 bar.	May not be applicable due to health and safety requirements.
(h)	Optimisation of chemical dosing and water use in cleaning-in-place (CIP)	Optimising the design of CIP and measuring turbidity, conductivity, temperature and/or pH to dose hot water and chemicals in optimised quantities.	Generally applicable.
(i)	Low-pressure foam and/or gel cleaning	Use of low-pressure foam and/or gel to clean walls, floors and/or equipment surfaces.	
(j)	Optimised design and construction of equipment and process areas	The equipment and process areas are designed and constructed in a way that facilitates cleaning. When optimising the design and construction, hygiene requirements are taken into account.	
(k)	Cleaning of equipment as soon as possible	Cleaning is applied as soon as possible after use of equipment to prevent wastes hardening.	

Further sector-specific techniques to reduce water consumption are given in Section 6.1 of these BAT conclusions.

1.5. **Harmful substances**

BAT 8. In order to prevent or reduce the use of harmful substances, e.g. in cleaning and disinfection, BAT is to use one or a combination of the techniques given below.

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Technique		Description
(a)	Proper selection of cleaning chemicals and/or disinfectants	Avoidance or minimisation of the use of cleaning chemicals and/or disinfectants that are harmful to the aquatic environment, in particular priority substances considered under the Water Framework Directive 2000/60/EC of the European Parliament and of the Council[a] When selecting the substances, hygiene and food safety requirements are taken into account.
(b)	Reuse of cleaning chemicals in cleaning-in-place (CIP)	Collection and reuse of cleaning chemicals in CIP. When reusing cleaning chemicals, hygiene and food safety requirements are taken into account.
(c)	Dry cleaning	See BAT 7e.
(d)	Optimised design and construction of equipment and process areas	See BAT 7j.

a Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (OJ L327, 22.12.2000, p. 1).

BAT 9. In order to prevent emissions of ozone-depleting substances and of substances with a high global warming potential from cooling and freezing, BAT is to use refrigerants without ozone depletion potential and with a low global warming potential.
Description

Suitable refrigerants include water, carbon dioxide or ammonia.

1.6. **Resource efficiency**

BAT 10. In order to increase resource efficiency, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
(a)	Anaerobic digestion	Treatment of biodegradable residues by microorganisms in the absence of oxygen, resulting in biogas and digestate. The biogas is used as a fuel, e.g. in a gas	May not be applicable due to the quantity and/or nature of the residues.

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		engine or in a boiler. The digestate may be used, e.g. as a soil improver.	
(b)	Use of residues	Residues are used, e.g. as animal feed.	May not be applicable due to legal requirements.
(c)	Separation of residues	Separation of residues, e.g. using accurately positioned splash protectors, screens, flaps, catchpots, drip trays and troughs.	Generally applicable.
(d)	Recovery and reuse of residues from the pasteuriser	Residues from the pasteuriser are fed back to the blending unit and are thereby reused as raw materials.	Only applicable to liquid food products.
(e)	Phosphorus recovery as struvite	See BAT 12g.	Only applicable to waste water streams with a high total phosphorus content (e.g. above 50 mg/l) and a significant flow.
(f)	Use of waste water for land spreading	After appropriate treatment, waste water is used for land spreading in order to take advantage of the nutrient content and/or to use the water.	Only applicable in the case of a proven agronomic benefit, a proven low level of contamination and no negative impact on the environment (e.g. on the soil, the groundwater and surface water). The applicability may be restricted due to the limited availability of suitable land adjacent to the installation. The applicability may be restricted by the soil and local climatic conditions (e.g. in the case of wet or frozen fields) or by legislation.

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Further sector-specific techniques to reduce waste sent for disposal are given in Sections 3.3, 4.3 and 5.1 of these BAT conclusions.

1.7. Emissions to water

BAT 11. In order to prevent uncontrolled emissions to water, BAT is to provide an appropriate buffer storage capacity for waste water.

Description

The appropriate buffer storage capacity is determined by a risk assessment (taking into account the nature of the pollutant(s), the effects of these pollutants on further waste water treatment, the receiving environment, etc.).

The waste water from this buffer storage is discharged after appropriate measures are taken (e.g. monitoring, treatment, reuse).

Applicability

For existing plants, the technique may not be applicable due to lack of space and/or due to the layout of the waste water collection system.

BAT 12. In order to reduce emissions to water, BAT is to use an appropriate combination of the techniques given below.

	Technique [a]	**Typical pollutants targeted**	**Applicability**
Preliminary, primary and general treatment			
(a)	Equalisation	All pollutants	Generally applicable.
(b)	Neutralisation	Acids, alkalis	
(c)	Physical separation, e.g. screens, sieves, grit separators, oil/fat separators, or primary settlement tanks	Gross solids, suspended solids, oil/grease	
Aerobic and/or anaerobic treatment (secondary treatment)			
(d)	Aerobic and/or anaerobic treatment (secondary treatment), e.g. activated sludge process, aerobic lagoon, upflow anaerobic sludge blanket (UASB) process, anaerobic contact process, membrane bioreactor	Biodegradable organic compounds	Generally applicable.
Nitrogen removal			
(e)	Nitrification and/or denitrification	Total nitrogen, ammonium/ammonia	Nitrification may not be applicable in the

a The descriptions of the techniques are given in Section 14.1.

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			case of high chloride concentrations (e.g. above 10 g/l). Nitrification may not be applicable when the temperature of the waste water is low (e.g. below 12 °C).
(f)	Partial nitritation — Anaerobic ammonium oxidation		May not be applicable when the temperature of the waste water is low.
Phosphorus recovery and/or removal			
(g)	Phosphorus recovery as struvite	Total phosphorus	Only applicable to waste water streams with a high total phosphorus content (e.g. above 50 mg/l) and a significant flow.
(h)	Precipitation		Generally applicable.
(i)	Enhanced biological phosphorus removal		
Final solids removal			
(j)	Coagulation and flocculation	Suspended solids	Generally applicable.
(k)	Sedimentation		
(l)	Filtration (e.g. sand filtration, microfiltration, ultrafiltration)		
(m)	Flotation		

a The descriptions of the techniques are given in Section 14.1.

The BAT-associated emission levels (BAT-AELs) for emissions to water given in Table 1 apply to direct emissions to a receiving water body.

The BAT-AELs apply at the point where the emission leaves the installation.

TABLE 1

BAT-associated emission levels (BAT-AELs) for direct emissions to a receiving water body

Parameter	**BAT-AEL [ab] (daily average)**
Chemical oxygen demand (COD) [cd]	25-100 mg/l [e]
Total suspended solids (TSS)	4-50 mg/l [f]

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Total nitrogen (TN)	2-20 mg/l [gh]
Total phosphorus (TP)	0,2-2 mg/l [i]

a	The BAT-AELs do not apply to emissions from grain milling, green fodder processing, and the production of dry pet food and compound feed.
b	The BAT-AELs may not apply to the production of citric acid or yeast.
c	No BAT-AEL applies for biochemical oxygen demand (BOD). As an indication, the yearly average BOD_5 level in the effluent from a biological waste water treatment plant will generally be ≤ 20 mg/l.
d	The BAT-AEL for COD may be replaced by a BAT-AEL for TOC. The correlation between COD and TOC is determined on a case-by-case basis. The BAT-AEL for TOC is the preferred option because TOC monitoring does not rely on the use of very toxic compounds.
e	The upper end of the range is: — 125 mg/l for dairies; — 120 mg/l for fruit and vegetable installations; — 200 mg/l for oilseed processing and vegetable oil refining installations; — 185 mg/l for starch production installations; — 155 mg/l for sugar manufacturing installations; as daily averages only if the abatement efficiency is ≥ 95 % as a yearly average or as an average over the production period.
f	The lower end of the range is typically achieved when using filtration (e.g. sand filtration, microfiltration, membrane bioreactor), while the upper end of the range is typically achieved when using sedimentation only.
g	The upper end of the range is 30 mg/l as a daily average only if the abatement efficiency is ≥ 80 % as a yearly average or as an average over the production period.
h	The BAT-AEL may not apply when the temperature of the waste water is low (e.g. below 12 °C) for prolonged periods.
i	The upper end of the range is: — 4 mg/l for dairies and starch installations producing modified and/or hydrolysed starch; — 5 mg/l for fruit and vegetable installations; — 10 mg/l for oilseed processing and vegetable oil refining installations carrying out soap-stock splitting; as daily averages only if the abatement efficiency is ≥ 95 % as a yearly average or as an average over the production period.

The associated monitoring is given in BAT 4.

1.8. **Noise**

BAT 13. In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to set up, implement and regularly review a noise management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:

— a protocol containing actions and timelines;
— a protocol for conducting noise emissions monitoring;
— a protocol for response to identified noise events, e.g. complaints;
— a noise reduction programme designed to identify the source(s), to measure/estimate noise and vibration exposure, to characterise the contributions of the sources and to implement prevention and/or reduction measures.

Applicability

BAT 13 is only applicable to cases where a noise nuisance at sensitive receptors is expected and/or has been substantiated.

BAT 14. In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques given below.

Technique	**Description**	**Applicability**

***Changes to legislation:** There are currently no known outstanding effects for the Commission Implementing Decision (EU) 2019/2031, Division 1.. (See end of Document for details)*

(a)	Appropriate location of equipment and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver, by using buildings as noise screens and by relocating buildings' exits or entrances.	For existing plants, the relocation of equipment and buildings' exits or entrances may not be applicable due to lack of space and/or excessive costs.
(b)	Operational measures	These include: (i) improved inspection and maintenance of equipment; (ii) closing of doors and windows of enclosed areas, if possible; (iii) equipment operation by experienced staff; (iv) avoidance of noisy activities at night, if possible; (v) provisions for noise control, e.g. during maintenance activities.	Generally applicable.
(c)	Low-noise equipment	This includes low-noise compressors, pumps and fans.	
(d)	Noise control equipment	This includes: (i) noise reducers; (ii) insulation of equipment; (iii) enclosure of noisy equipment; (iv) soundproofing of buildings.	May not be applicable to existing plants due to lack of space.

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(e)	Noise abatement	Inserting obstacles between emitters and receivers (e.g. protection walls, embankments and buildings).	Applicable only to existing plants, as the design of new plants should make this technique unnecessary. For existing plants, the insertion of obstacles may not be applicable due to lack of space.

1.9. **Odour**

BAT 15. In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:

— A protocol containing actions and timelines.

— A protocol for conducting odour monitoring. It may be complemented by measurement/estimation of odour exposure or estimation of odour impact.

— A protocol for response to identified odour incidents, e.g. complaints.

— An odour prevention and reduction programme designed to identify the source(s); to measure/estimate odour exposure; to characterise the contributions of the sources; and to implement prevention and/or reduction measures.

Applicability

BAT 15 is only applicable to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.

(**1**) Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC (OJ L 342, 22.12.2009, p. 1).

Changes to legislation:
There are currently no known outstanding effects for the Commission Implementing Decision (EU) 2019/2031, Division 1..