



**Key environmental indicators for biological treatment**

**(BREF review)**

**Joint ECN-EBA-EEB-FEAD-MWE input**

Version 22 April 2014Introduction

For the BREF review on the waste treatment industries it is relevant to know the present landscape and best practices in biological treatment over Europe. The European Compost Network and European Biogas Association, with support of FEAD, EEB and MWE, have conducted a preliminary survey of biological treatment installations operated in the EU and the abatement techniques in place to deal with emissions of pollutants to air and water. It should be recognised that the biological treatment facilities aim at different outputs, e.g. compost production, biogas production, production of stabilised material that fulfils criteria to be landfilled, (bio)drying, Refuse Derived Fuels (RDF) production, etc. These different objectives impact emission control and requirements.

ECN represents more than 2,000 treatment plants (large and small) with more than 20 million tonnes per year of treatment capacity in 24 European countries. The European Biogas Association (EBA) comprises national biogas associations, institutes and companies from over 20 countries all across Europe. EEB is Europe's largest federation of environmental organisations with 140+ member organisations who gain their membership from the general public. FEAD is the European federation representing the EU's waste management industry. Municipal Waste Europe (MWE) is the European association representing municipalities responsible for waste management and their publicly owned waste management companies.

This paper presents the results of the preliminary survey. The goal of the paper is to give the EIPPCB a realistic overview of emission abatement techniques and emission monitoring practices that are currently applied by biological treatment facilities within Europe falling within the BREF WT scope. This EU-wide survey gives the EIPPCB evidence-based input on key environmental indicators that are currently considered for biological treatment.

# Type of installations in place

We received response to the questionnaire from 8 countries. These countries and the number of IED installations covered are displayed in Table 1. In total, we received information from 267 installations. Some locations (installation) have more than one biological treatment facility on site. This is the reason why table 1 and table 2 differ (on totals for bio-waste and mixed waste). This has no impact on the conclusions.

We estimate that this response covers a significant amount of all the European biological treatment installations falling within the scope of this BREF.

Table 1. Number of responses per country and input material

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Country** | **Total** | **Green waste1** | **Bio-waste2** | **Sewage sludge3** | **Mixed waste4** |
| Germany | 88 | 10 | 50 | 1 | 27 |
| Austria | 18 | 0 | 12 | 6 | 0 |
| Ireland | 8 | 1 | 6 | 0 | 1 |
| United Kingdom | 24 | 7 | 13 | 1 | 3 |
| Slovenia | 12 | 1 | 11 | 0 | 0 |
| Flanders-Belgium | 27 | 6 | 21 | 0 | 0 |
| Netherlands | 50 | 24 | 22 | 2 | 2 |
| France | 40 | 5 | 4 | 19 | 12 |
| **Total** | 267 | 54 | 139 | 29 | 45 |

1 green waste only

2 bio-waste: bio-waste only or mixed with garden and green waste

3 sewage sludge: sewage sludge only or sludge mixed with green waste and/or bio-waste

4 mixed municipal waste from households and commercial enterprises (not industry)

For this survey, bio-waste represents source separated organic waste, in any case including food and kitchen waste or former food stuff (definition of bio-waste in WFD: biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers, retail premises and comparable waste from food processing plants).

Table 1 shows that Germany, the Netherlands, Austria and Flanders are the regions where biological treatment of green waste and bio-waste is dominant, as separate collection of green- and bio-waste is widely established here. France is the country where most of the sewage sludge treatments installations are operated.

As shown in table 2 biological treatment plants are differentiated with respect to the type of biological process / technologies and the type of input material. The numbers are slightly different from Table 1 as some locations have more than one facility treating different organic waste streams.

Table 2. Type of biological treatment facilities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Plant type** | Green waste | Bio-waste | Sewage sludge | Mixed waste |
| Outdoor composting | **50** | 24 | **19** | 3 |
| Indoor composting | 4 | **50** | 8 | **14** |
| Aerobic biological stabilisation | 0 | **3** | 0 | **11** |
| Bio-drying | 0 | **1** | 0 | **7** |
| Anaerobic digestion (AD) | 0 | **34** | 1 | **7** |
| AD + indoor post-composting | 0 | **30** | 0 | **13** |
| AD + outdoor composting | 0 | 11 | **1** | 1 |
| Total | 54 | 153 | 29 | 56 |

Table 2 shows, according to the returned questionnaires, that green waste is predominantly composted in outdoor facilities (**50**/54 = 93%). Bio-waste is mostly treated in indoor facilities, i.e. indoor composting and/or anaerobic digestion (77%) and a sizeable part is treated in outdoor composting facilities (23%). Sewage sludge is to a large extent treated in outdoor composting plants (69%), which are mainly attributed to the outdoor activities in France and also Austria. In the other countries, sewage sludge is processed indoors (31%). Mixed waste is almost completely treated in indoor facilities (93%) and in this survey by 4 facilities outdoors ( 7%).

# Management systems

Table 3 shows the environmental management systems (EMS) and quality management systems (QMS) in place, differentiated for the type of input material. The EMS and QMS that are reported are the following:

* EMS: ISO 14001, ISO 9001, EMAS
* QMS: ISO 9001, Dutch Keurcompost QAS, Vlaco QAS, ECN-QAS, PAS 100, Irish compost QAS, KGVÖ/ÖNORM S 2206, BGK RAL Gütezeichen (German quality label for compost)

Table 3. Management systems in place for biological treatment plants

|  |  |  |  |
| --- | --- | --- | --- |
| **Input material** | **Plants** | **EMS** | **QMS** |
| Green waste | 54 | 14 | 35 |
| Bio-waste | 139 | 58 | 121 |
| Sewage sludge | 29 | 19 | 23 |
| Mixed waste | 45 | 24 | 24 |

Table 3 demonstrates that on average 43% (115/267) of the installations have an environmental management system in place, ranging from 26% for green waste to 66% for sewage sludge. Most installations have a quality management system in place (203/267 = 76%) ranging from 53% for mixed waste to 87% for bio-waste.

# Emissions to air

Gaseous emissions from biological treatment are generated during storage of the input and output materials and during the biological treatment process. For the reported outdoor composting plants no treatment of air is possible by definition. This is due to the fact that the composting piles are in the open air and thus the air cannot be collected and treated. For outdoor composting, the treatment of the air is only possible if a negative forced aeration is installed and the waste gas is collected and led through a biofilter. An alternative option is to cover the compost pile with a semi-permeable membrane which can reduce the emissions of odour and ammonia to air.

Enclosed plants for indoor composting and anaerobic digestion have the possibility to collect off-gases from storage (if also done in a closed facility) and biological processing which, subsequently is treated in a cleaning step.

## Abatement techniques

The abatement techniques reported for the different input materials are given in Table 4.

Table 4. Air abatement in biological treatment plants

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Input material** | **Plants** | **Air treatment** | **Air treated** | **Type of treatment** |
| Green waste | 54 | 4 | Storage of input, biological treatment process | Biofilter |
| Bio-waste | 139 | 118 | Storage of input, biological treatment process | Biofilter, humidifier, wet scrubber, acid scrubber |
| Sewage sludge | 29 | 12 | Storage of input, biological treatment process | Wet scrubber, acid scrubber, biofilter |
| Mixed waste | 45 | 43 | Storage, biological treatment process | Biofilter, humidifier, wet scrubber, acid scrubber, dust filter, Regenerative Thermal Oxidizer (RTO) |

As reported before green waste is predominantly processed in outdoor composting plants, where air is directly released to the atmosphere. Therefore no collection and specific treatment of air is applied. The four green waste plants that have air treatment installed are all indoor composting plants.

For sewage sludge we see that air treatment is in place for closed plants and that outdoor plants have no air treatment. For almost all mixed waste biological treatment installations (96%) air treatment is in place.

Of the abatement techniques applied, biofilters are widespread. Open and closed biofilters are installed to reduce air emissions like odour and ammonia from the waste gases of the biological treatment plants. For input materials that generate higher emission levels of ammonia such as sewage sludge, the waste gases are frequently treated by a wet or acid scrubber to remove ammonia before the waste gas is treated in a biofilter. The RTO (Regenerative Thermal Oxidizer) technology is not common practise within Europe (mainly used is Germany to treat air from mixed waste facilities).

Emission levels for the engine combustion of biogas should be regulated with sewage gas, landfill gas, mining gas and gas from renewable energy sources in the directive on the limitation of emissions of certain pollutants into the air from medium combustion plants and not inside the WT BREF for only one specific gas type: biogas.

## Monitoring

Table 5 shows the air parameters that are monitored at biological treatment plants. For green waste almost no monitoring of air emissions is present, sometimes monitoring of odours is reported (11/54 = 20% of the reported green waste composting plants). For the other input materials additional monitoring requirements were reported. For bio-waste monitoring of odour is done in > 50 % (70/139) of the reported plants. Ammonia is sometimes monitored (15% of the plants). For sewage sludge monitoring odour is often required (76% of the plants) and of ammonia occasionally (7% of the plants).

For mixed waste, odours are nearly always monitored (91%) and sometimes ammonia (14%). For the other parameters, dust is monitored in bio-waste and mixed waste facilities but essentially inside the facilities to guarantee safe working conditions. Finally, in the UK and Ireland the monitoring of Bio-aerosols is reported (the regulator in the UK requires monitoring of bio aerosols when sites are within 250 meters from sensitive receptors).

Table 5. Monitoring of air parameters biological treatment facilities (n = 267)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Input material** | **Odour** | **NH3** | **Bio-aerosols** | **Dust** | **Other** |
| Green waste | 11 | 0 | 5 | 1 | 4 |
| Bio-waste | 70 | 21 | 16 | 20 | 19 |
| Sewage sludge | 22 | 4 | 1 | 0 | 2 |
| Mixed waste | 41 | 12 | 3 | 23 | 32 |

# Emissions to water

The generation rate of wastewater depends on the type of activity and the type of input material. In composting, water is evaporated from the material by heat production through aerobic activity. Generated wastewater is generally collected in a sealed basin or tank. For input materials where water evaporation equals the amount of water to be removed, no wastewater is produced. In other cases, part of the water can be reused to irrigate the compost piles and the surplus has to be discharged.

As anaerobic digestion is a closed system,  no water can be lost via evaporation. Wastewater discharge can be minimized by proper water management, i.e. temporary storage and recirculation of water in the process. However, recirculation is limited and the liquid digestate can be used as fertiliser if all legal requirements are fulfilled. In some cases part of the wastewater has to be discharged.

## Abatement techniques

As shown in Table 6 almost all facilities require a hard standing surface and a sealed base for their activities. Working on open grounds is generally not allowed.

Table 6. Working floor for biological treatment plants

|  |  |  |  |
| --- | --- | --- | --- |
| **Input material** | **impermeable hard standing surface** | **sealed base** | **open ground** |
| Green waste | 30 | 22 | 2 |
| Bio-waste | 95 | 41 | 8 |
| Sewage sludge | 21 | 7 | 2 |
| Mixed waste | 32 | 3 | 0 |

Table 7 shows how wastewater is handled for the different input materials. Wastewater is sometimes treated onsite for green waste (11/54= 20%), bio-waste (18%) and sewage sludge (7%) and regularly for mixed waste (44%). Wastewater is mostly directly discharged to the sewer system.

Table 7. Wastewater production and handling in biological treatment facilities

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Green waste** | **Bio-waste** | **Sewage sludge** | **Mixed waste** |
| Wastewater produced | 28 | 94 | 18 | 23 |
| WWTP onsite | 11 | 25 | 2 | 20 |
| Wastewater discharge to sewer | 25 | 71 | 7 | 13 |
| Wastewater application in agriculture | 0 | 12 | 8 | 1 |

## Monitoring

Table 8 shows that monitoring of wastewater emissions is not widespread for biological treatment facilities. Moreover, emission limits for discharge to the sewer are not common. In general, competent authorities in Europe do not have uniform rules governing wastewater generated by biological treatment installations. If wastewater is generated, it is mostly discharged on the sewer after which it is treated in a centralised wastewater treatment plant.

Table 8. Monitoring of wastewater at biological treatment plants

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Green waste** | **Bio-waste** | **Sewage sludge** | **Mixed waste** |
| Monitoring of emissions mandatory | 11 | 59 | 8 | 15 |
| Emissions limits in permits | 5 | 33 | 14 | 7 |

Looking at the different pollutants that are monitored when wastewater is discharged to the sewer, the picture is complex even within a single country. Some authorities have strict monitoring requirements and some have not. This is related to the size of the WWTP and the water body (surface water) where the treated water is discharged. Limit values are less strict when the cleaned water is discharged on large rivers or the sea compared to the limits for discharge to small streams and creeks following the Water Framework Directive

The survey shows that the following parameters are monitored:

* pH, COD, TSS, total nitrogen: more often
* heavy metals: sometimes
* organic pollutants: rarely

In general, competent authorities do not have any specific or uniform rules governing wastewater generated by biological treatment installations. Requirements are very case specific and depend on the location. Mostly, the generated wastewater is discharged to the sewer after which it is treated in an industrial or municipal wastewater treatment plant (WWTP). Direct discharge to surface waters after on-site wastewater treatment is rarely in place. Only rainwater from roofs and clean surfaces can be directly discharged to surface water.

# Conclusions

The ECN survey covered 8 regions and included most of the countries where biological treatment for the various organic waste streams has been an established industrial activity for 20-30 years. This survey gives a general overview of to date practices in biological treatment of organic waste across Europe as we estimate that a significant amount of the plants that fall under the IED regime are covered by this survey.

The survey differentiates installations based on the type of input material and biological process. For green waste, 97% of the plants are outdoor composting, whereas for bio-waste and mixed waste, indoor processing indoor composting and anaerobic digestion are predominant (77% and 95%). For sewage sludge outdoor composting is widely established in France (and also Austria) and indoor composting in other countries.

Green waste is in many cases processed in smaller facilities, with less environmental management systems in place. The quality of the process and end-products are mainly controlled via quality management systems. Bio-waste and mixed waste are processed in larger facilities. In these facilities, EMS and QMS are more commonly applied.

## Air emissions

Open and closed biofilters are installed in indoor facilities to reduce odours and ammonia from the exhaust air. For input materials that generate high emissions levels of ammonia, the exhaust air is frequently pre-treated by an acid scrubber to remove ammonia before the gas enters a biofilter. The survey shows that odours is more generally monitored (144/267 = 54% of the total reported plants). Ranging from 20% of the total outdoor composting plants to 91 % of the reported mixed waste treatment plants. Ammonia monitoring is limited (37 of 267 plants = 14%). No other environmental air indicators were reported being monitored in relevant numbers.

Based on these results we suggest to take into account ammonia and odour for designing the EIPPCB questionnaire for plant operators in order to obtain more information on key environmental parameters which are related to the performance of the (operation and/ or configuration) of the installation. We suggest to delete all other parameters to air (please also read our input to template 4).

## Water emissions

In most cases, competent authorities do not have specific or uniform rules governing wastewater generated by biological treatment installations. If wastewater is generated, it is mostly directly discharged on the sewer after which it is treated in a centralised wastewater treatment plant.

Consequently, it does not seem appropriate to set requirements for the quality of wastewater generated by biological treatment installations unless this water is discharged directly to surface water. If a plant is not wastewater-free, the wastewater is sent to the local sewage sludge treatment plant through the sewer network. It is also possible that the wastewater treatment step takes place in landfill leachate treatment units (e.g. in some German MBT plants). Thus the wastewater treatment plants are generally not part of waste treatment installations. Wastewater treatment is hence not used as a criterion to decide whether an installation applies a best available technique.