# SEPA Technical Guidance

# BAT for Composting

## Contents

## Schedule 1

## Scope

1.1 This document aims to provide clear guidance on what SEPA considers to be the best available techniques (BAT) for the composting of waste.

1.2 It lays out a variety of issues which will require consideration during the initial permitting of a composting facility. It is aimed at operators preparing applications and officers determining applications and preparing permits. It is not the intention to apply this guidance to the consequential offsite storage or use of compost although elements may be regarded as best practice.

1.3 Any application must clearly demonstrate how the requirements laid out in this guidance will be met and any deviations from these should be justified. Failure to provide adequate justification may result in delays in determination (duly made process) and processing of the application. Ultimately SEPA may reject the application if the operator cannot demonstrate that they will be able to comply with the requirements.

1.4 It is recognised that a number of composting facilities may fall under the Waste Management Licensing (Scotland) Regulations 2011 (as amended) and for those sites this guidance document should also be considered as what SEPA regards as best practice.

1.5 In preparing this document SEPA has made extensive reference to a number of best available technique reference documents (BREFs)[1]. The BREFs contain conditions that SEPA must have regard to when permitting installations. The current Waste Treatment Industries BREF contains few references to composting but this is in the process of being reviewed. Until it is updated and adopted by Member States SEPA is required to produce indicative BAT guidance, where it is not stated clearly in the BREF document.

1.6 This guidance provides indicative environmental standards for BAT for the composting of waste. The indicative standards include techniques as well as emission levels. New installations will normally be expected, as a minimum, to comply with BAT indicative environmental standards. However if a particular installation is capable of better performance, then that will be BAT and the appropriate emission limit value (ELV) will be set in the permit.

1.7 Existing installations will be required to comply with the requirements in this document by 01 January 2016. Where it has been established that a particular technique is BAT within a sector, then we will normally impose conditions that correspond to the use of that technique in all permits for that sector, unless the balance of costs and benefits is different at the installation level.

1.8 SEPA will continue to review what it regards as BAT for the process and will update this guidance when necessary in consultation with industry.

[1] Waste Treatment Industries (August 2006) and Slaughterhouses and Animal By Product Industries (May 2005)

## Schedule 2

## Background

2.1 Composting is defined as the autothermic and thermophilic biological decomposition and stabilisation of biodegradable waste under controlled aerobic conditions that results in a stable, sanitised material that can be applied to land for the benefit of agriculture, horticulture or ecological improvement (Waste Management Licensing (Scotland) Regulations 2011, as amended).

2.2 Composting is a natural process in which micro-organisms break down organic matter in the presence of air to form a humus-like product. This product is the compost, which may be suitable for use as a soil conditioner. Good quality compost is a proven organic supplement that can improve yields from poor quality soils through the provision of nutrients and humus. Humus is a complex, stable, non-cellular, long lasting naturally occurring organic material found within soils. It is beneficial in soil due to its moisture and nutrient retention properties.

2.3 The composting process relies on aerobic micro-organisms, which require oxygen and produce carbon dioxide and water. During the process a large amount of energy is released in the form of heat; this leads to elevated temperatures within the composting material.

2.4 Feedstocks for composting have traditionally included manures, garden and parks waste, sewage sludge and industrial sludges. Recent changes in legislation have lead to an increase in the use of composting for source segregated food waste and by-products from industrial food preparation.

2.5 The composting process uses micro-organisms to degrade organic material. The range of micro-organisms is vast and populations are sensitive to temperature changes. The phases of composting result in a range of temperatures which gives rise to a succession of microbial populations. An increase in temperature affects the microbial population through changes in mesophilic and thermophilic organisms. Microbes of importance include bacteria and fungi.

## Schedule 3

## 3.1 The Composting Process

Typically, the phases of composting at a site consist of:

- Pre-acceptance and acceptance of waste
- Pre-processing;
- Sanitisation
- Stabilisation
- Curing/maturation; and
- Post processing.

### 3.1.1 Pre-acceptance and acceptance of waste

In order to prevent the acceptance of unsuitable wastes which may lead to adverse reactions, uncontrolled emissions or poor compost quality, systems and procedures should be in place to ensure that wastes are subject to appropriate technical control and appraisal. There should be a contract for supply of the material or a written input specification to provide a standard for the quality and types of input materials that can be delivered for composting. This should include a list of the target input materials, prohibited materials and maximum acceptable criteria for contamination such as paper and plastic packaging. When drawing up contracts or specifying input criteria, the operator must have a clear understanding of the capability of the processing equipment, especially with respect to contamination removal, and ensure that waste which does not meet these specifications is not accepted into the process.

The operator must have an understanding of the differing characteristics of the feedstock materials they propose to use and how they may interact. This includes variation in both quality and quantity of the different waste types which will be accepted. Operators should be reactive to managing certain feedstock wastes to help to limit odour and bioaerosol releases during processing and composting.

Checks in the form of upstream audits are advised before any waste is agreed or accepted. This requires a system that has, as an initial stage, a screening step or pre-acceptance procedure, involving the provision of information and representative samples of the waste. If not dealing directly with the waste producer, the Operator should carefully verify the information received at the pre-acceptance stage, which, in addition to the minimum Duty of Care information, should include the contact details for the waste producer and a full description of the waste.

The second stage, acceptance procedures when the waste arrives at the site, should serve to confirm the characteristics of the waste, without the time pressure and potential hazard of checking a waste at the gate. A system of diversion should be established allowing for rejection of malodorous waste, and for process maintenance or failure. These points should be considered prior to agreeing contracts.

At both stages, the level and frequency of testing should be done on a risk basis. Wastes such as manures and slurries arising on the farm where they will be treated will require very little assessment and Local Authority green waste may only require a visual assessment to check for contamination. However, commercial food wastes and industrial sludges where there is a high degree of variability will require more rigorous testing against strict quality criteria.

This information should be recorded and referenced to the waste stream so that traceability is clear. The information must be regularly reviewed and kept up to date with any changes to the waste stream. The producer must complete the waste characterisation and agree this with the operator.

Once accepted on site, putrescible materials should be incorporated into the composting process within 24 hours to avoid uncontrolled decomposition of the waste. Where this is not possible then the feedstock should be diverted in the first instance. The process should be designed to meet compliance with this timescale.

### 3.1.2 Pre-processing

Feedstock is pre-processed to;

- remove packaging material from food waste (de-packaging)
- remove other non-biodegradable materials e.g. grit & metal
- provide a uniform small particle size feedstock for efficient composting
- protect the downstream plant components that may cause physical damage

Pre-processing usually consists of reception and storage, shredding, blending of materials and/or amendment of moisture balance. Depending on the feedstock materials, this may include mechanical depackaging of foodstuffs.

Best practice for effective odour management is to ensure that wastes are transported from the producer to the treatment facility without undue delay since the more degraded the waste ism, the more odorous it tends to be. This is difficult where contracts take kerb side collected waste which may contain waste in an advanced stage of decomposition. The amount of decomposition will depend on factors such as collection frequency and source.

### 3.1.3 Sanitisation

The aim of the sanitisation phase is to eradicate pathogens and kill weed seeds. It is characterised by an increase in temperature (to between 55° and 70°C), high oxygen demand and significant reductions in volatile solids. This temperature rise is autothermic, i.e. the microbes in the composting mass generate heat as they break down readily available organic matter.

Where temperature profiles are allowed to increase to 70-80°C the production of ammonia will be unavoidable and therefore can produce poor organic stabilisation and objectionable odours. Above this temperature chemical decomposition takes place which can produce undesirable malodorous materials and increase the risk of fire. Therefore, if a temperature of 70°C or above is required at sanitisation phase, the operator should ensure that the compost is only held at this temperature for the minimum period required.

The duration of the sanitisation period depends on the material being treated, the process that it is subjected to and the management by the operator.

### 3.1.4 Stabilisation

Once the sanitisation stage has been completed the waste will still be highly biodegradable and a further period of active composting is required; this stage is known as stabilisation. This is carried out at temperatures that would support growth of thermophilic organisms (43ºC to 65ºC).

In order to reduce the formation of odorous substances and ammonia it is recommended to avoid temperatures greater than 65°C after sanitisation phase. Active management of the stabilisation phase is also required to prevent the generation of dust and bioaerosols. There is also a risk of reheating, fires and leachate breakout.

The compost is said to be stable when microbial respiration will not significantly resurge under altered conditions e.g. changes of moisture, oxygen levels or temperature. The rate of carbon dioxide and heat release decreases with increased stability.

The stabilisation period will typically last between 1-12 weeks.

### 3.1.5 Curing/Maturation

Once the majority of the easily digestible organic material (available carbon and nitrogen) has been used up, the rate of heat release will drop and the material will move into the curing/maturation phase. During this phase the oxygen demand is reduced and temperatures will be approximately 35° - 45°C, and the material will continue to cool. Additional reactions take place which reduce the level of nitrate within the compost and this stage will also need to be managed to prevent odours, dust and bioaerosols. There is also a risk of reheating, fires and leachate breakout.

### 3.1.6 Post Processing

The post processing phase generally involves a combination of screening, blending and bagging to produce a quality, saleable product. The timing and processing applied will depend on the requirements of the finished product markets.

The final screening stage normally produces an oversize fraction which can be re-incorporated to the start of the process. This oversize fraction can be important for maintaining pore size.

## 3.2 Process Types

There are many different processes and classification methods for composting but these can essentially be split into open (non-vessel) processes and enclosed (in-vessel) processes and with different levels of mechanical intervention.

### 3.2.1 Open Composting Processes

The most commonly encountered form of open composting is windrow composting. The physical process is relatively simple with limited engineered infrastructure needed. Source materials are mixed and formed into long piles, known as windrows. The process can be operated in the open or enclosed within a building.

### 3.2.2 In-vessel Composting Processes

Reactor based or in-vessel composting, encloses the composting process. Depending on site design this provides opportunity for a significantly greater degree of control over the process. They require a greater degree of infrastructure than windrow composting. Most involve a short period of reactor sanitisation followed by treatment in an open windrow.

Enclosed systems can be divided into 6 types, namely;

- Containers;
- Tunnels;
- Rotating drums;
- Silos or Towers;
- Enclosed halls; and
- Agitated bays

One distinction to make is that containers, tunnels, rotating drums and silos or towers are individually contained processes whereas enclosed halls and agitated bays are carried out in individual units within an overall building that contains the emissions.

## 3.3 Key Parameters affecting the Composting Process

The most important composting condition is that the raw materials should be appropriately mixed to provide the correct nutrients needed for microbial growth and activity, which includes a balanced supply of carbon and nitrogen. There should be sufficient moisture to permit biological activity without hindering aeration; oxygen should be at levels that support aerobic organisms and temperatures should encourage active microbial activity from thermophilic micro-organisms. Active process control and management of the whole composting process should maintain optimum conditions for the process and product.

The following factors influence microbial activity within a compost pile:

- **Carbon to Nitrogen Ratio**: Raw materials influence the ratio of carbon to nitrogen in the initial feedstock and have a major impact upon the composting process. The preferred ratio of carbon to nitrogen in a feedstock mixture falls between 25-30:1. Where the C:N ratio is below 25:1, composting will proceed rapidly and excess nitrogen will readily form ammonia and other odorous compounds. In these mixtures, oxygen will be consumed rapidly, generating excess heat both of which may result in anaerobic conditions. Intensive management will be required at these mixtures to prevent odour problems. C:N ratios of above 40:1 tend to compost slowly and the mixture may not achieve sufficient temperatures to support thermophilic organisms.
- **Moisture Content**: This has an important effect upon the efficiency of the composting process. The optimum moisture content for composting will very much depend upon the water holding capacity of the composting mixture. Typical levels are between 50% and 70%. If the moisture level is too high for a particular mixture, the void spaces may be filled with water which compromises aeration. Unacceptable levels of leachate may also be produced with associated odour and water pollution problems. Considerable quantities of nitrogen and other nutrients may be lost as leachate. If the moisture level is too low microorganism activity will slow down.
- **Pore Space**: Particle size and structure is important in terms of the ability of air to penetrate the composting mass and in supplying the maximum amount of surface area on which microorganisms can act. If the average particle size is too great, composting can be slow because the available surface area is proportionally small. If the particle size is too small, composting can again be slow because of the difficulty of supplying sufficient quantities of air and in certain circumstances can result in the processes turning anaerobic.

- **Oxygen Content**: Providing an adequate supply of oxygen is vital for the composting process. 5%-15% oxygen within the compost mass is normally recommended. Should the raw material or the composting process ever become anaerobic, that is should the supply of oxygen become insufficient, the process is compromised in a number of ways and there is a considerable risk of offensive odours being generated. The provision of adequate aeration depends upon two components: the structure of the composting waste, and the mechanism for the supply of air.
- **Process Temperature and Distribution**: This varies throughout the composting process and can vary throughout the compost batch. *Thermophilic* treatment takes place at temperatures over 40ºC and is responsible for killing pathogens in the raw material. *Mesophilic* treatment takes place at temperatures between 10 to 40ºC. Different microorganisms will be active under these conditions. It is generally accepted that maintaining temperatures between 43ºC and 65ºC allows for effective composting. When temperatures rise above 65ºC the microorganisms suffer the effects of high temperatures and the process slows down. Excessive temperatures can increase the rate of emission of volatile odorants from the compost mass. To ensure thorough treatment and to produce quality compost, the entire batch must reach the required time/temperature combination.
- **pH**: The pH of a composting mixture will depend upon the nature and proportions of the components of the feedstock and will vary throughout the composting process, typically within the limits of 6 and 8.5. The pH of a composting mixture influences the activity of composting microorganism and will determine the solubility and availability of nutrients utilised by the microorganisms. The pH influences the release of odorants: low pH may result in the emission of acid species (e.g. hydrogen sulphide and mercaptans) if present while high pH may result in the emission of alkaline species (e.g. ammonia and amines). The pH of a composting mixture is not normally actively controlled.

The microbial population within the composting matrix will continue to grow until one or more of the above factors becomes limiting.

| Factor | Optimal Range |
|---|---|
| C : N Ratio | 25 – 30 : 1 |
| Oxygen content | 5 – 15 % in compost mass |
| Moisture | 50 – 70% |
| Pore Space | Must be adequate to allow air to move freely within compost mass |
| Temperature | 43ºC - 65ºC |
| pH | 6 to 8.5 |

- **Windrow Construction**

In open windrow composting systems, the size and dimensions of the windrows and the porosity within the waste types can affect the efficiency of the process. The application must clearly detail the capacity of the plant and how this was calculated, the maximum throughput and the design and construction of windrows.

The dimensions of a windrow pile are feedstock material dependent and are dictated by the aeration requirements of the pile. Seasonal variations may be required to manage the properties of the feedstock. The rate of aeration depends on the porosity of the windrow. Feedstock materials such as manure and grass cuttings are composed of small particles, which tend to be dense and wet and have poor porosity.

Dense or wet materials should be managed in small windrows to minimise compaction and allow sufficient passive aeration. Combination with bulking agents such as brash, clean oversize and clean grade A woodchip may help open up pore space to allow natural ventilation to provide sufficient oxygen to the core of the windrow and prevent anaerobic conditions from developing. Laying a bed of oversize wood material at the base aids passive aeration and convection through the pile.

For coarser materials taller windrows may be necessary as the additional porosity would result in a greater heat loss meaning the windrow may not maintain temperatures required for sanitisation. It is suggested that the optimal height for this type of material would be 3 metres tall.

If the windrow is too small then it may not reach appropriate temperatures to allow sanitisation. If the windrow is too large then air will be unable to penetrate sufficiently into the composting mass and may result in anaerobic conditions within the centre. This will result in odours when the material is turned or processed. Large windrows cannot be monitored effectively due to the inability of temperature probes to reach the middle of the windrow.

In both instances care must be taken in the preparation of these windrows as they will be susceptible to settlement, impinging the air flow in the pile potentially leading to anaerobic conditions developing within the pile.

Recommended windrow dimensions are outlined below but these will depend on the feedstock materials and may need to be smaller, for example where the feedstock contains dense or wet material or material that has a high nitrogen content.

| **Windrow System** | **Aerated Static Pile** | **Turned Windrow** |
|---|---|---|
| Height of pile (m) | 1.5 – 2.5 | 1.5 – 3 |
| Width of pile (m) | 3 – 6 | 2.4 – 2.7 |
| **Overall Volume ($m^3$)** | **75 – 375** | **131 – 221** |

In addition to windrow dimensions, clear space between the base of each windrow is essential to allow passive aeration to take place and to identify and control batches. The area between windrows needs to be sufficient to allow machinery to operate and turn windrows without the risk of vehicles driving over composting materials and causing compaction and cross contamination. Adequate areas also allow surface water and leachate to drain away and prevent cross contamination of batches.

## 3.4 Key Emissions from Composting Processes

The principal output from the composting process is the composted material itself. Additionally there will be leachate, various gases (including methane and carbon dioxide), particulate and bioaerosol emissions and low grade heat.

| Stage in Process | Key emissions to Air | Key emissions to water | Key emissions to land | Key noise sources |
|---|---|---|---|---|
| 1 Reception / processing | Odour, particulates/dust and bioaerosols | Leachate from incoming waste streams | Contaminants and oversize material | Shredding/ depackaging equipment, vehicle movements and reversing alarms and door alarms |
| 2 Composting Process (sanitisation and stabilisation) | Odour from open windrows or from abatement equipment. Bioaerosols and particulates generated during turning operations | Leachate | N/A | Noise from door alarms, turning and aeration machinery and from odour abatement equipment. |
| 6 Compost maturation and storage | Odour, ammonia | Effluent will contain high levels of ammonia, BOD/COD and suspended solids. | N/A | Noise from door alarms, vehicle engines moving compost and from fans/blowers on odour abatement equipment. |
| 7 Leachate collection, storage and treatment | Odour potential | Groundwater pollution<br><br>Ammonia, BOD/COD and suspended solids Generation of odorous sludges | Soil pollution | Pumps, fans, blowing equipment, compressed air. |
| 8. Compost screening and bagging | Particulates, dust, bioaerosols, odour | | Contamination, oversize | Noise from machinery and bagging equipment |

## 3.5 Bioaerosols

Bioaerosols are defined as aerosols, allergens or particulate matter of microbiological, plant or animal origin. They include pathogenic and non-pathogenic spores, viable and non-viable bacteria, fungi, viruses and bacterial endotoxins.

Bioaerosols are generally <10 µm in size and are not typically intercepted by hairs and specialised cells that line the human nose and upper respiratory system.

Exposure to bioaerosols has been associated with human health effects and symptoms usually manifest as inflammation of the respiratory system, coughs and fever. Inhalation of bioaerosols may cause or exacerbate respiratory diseases, for example Farmers Lung. Farmers Lung is a form of extrinsic allergic alveolitis, which is a lung disease that can develop after exposure to certain substances. It is the outcome of an allergic response to a group of microbes, which form mould on vegetable matter. Bioaerosols have been also known to cause gastrointestinal illness, eye irritation and dermatitis.

They are emitted from composting operations from any part of the process that moves the compost such as screening, shredding and windrow turning. They may also be emitted from biofilters.

There is no information available at the moment to state with any certainty that exposure to a given concentration of bioaerosols will result in a particular health impact. This is because of the number of types of bioaerosols as well as the complexities associated with human responses to different micro-organisms. In the absence of dose response relationships in the community, SEPA will take a precautionary approach in the regulation of these sites in relation to the location and operation of composting plants, to minimise any potential health impacts from these sites.

For new PPC applications for composting operations within 250m of a sensitive receptor SEPA will expect the operator to put in place all measures necessary to restrict the emissions of bioaerosols outwith the site boundary unless the operator can demonstrate that such measures are not required. Such measures may include negative aeration or enclosure of the process.

If an operator wishes to vary an existing permit that relates to a site located within 250m of a sensitive receptor and the change to the process may result in an increase in the emission of bioaerosols, they should discuss with SEPA the information which they should submit with the variation.

### 3.5.1 Bioaerosol Abatement

At open windrow compost facilities, the primary abatement measures for bioaerosol release are to remove the pathways between the source and the receptor:

- reducing point source releases;
- containing emissions;
- abate emissions and
- enhance dispersion.

Site position in relation to prevailing wind conditions can play an important role and should be considered at the design stages. Altering or reducing composting turning activity, particularly during strong winds, is recommended particularly if wind direction is towards sensitive receptors. However, reliance on wind direction and cessation of activity can result in other issues such as odour etc. Active interpretation of monitoring can ensure that turning is undertaken only when necessary.

Windrows should be orientated to take into account the direction of the prevailing wind, where site design allows this. The smallest possible area of composting mass should be exposed to the prevailing winds to avoid 'stripping' of windrow surface and preferably at the lowest elevation within the overall site layout.

Biofilters remove bioaerosols by physical mechanisms such as inertial impaction unlike odour removal which requires contact time with the media. Research suggests that optimal operating parameters for bioaerosol removal differ to those for odour removal. Research presented in the Final Report of Sniffer Project ER36 "Understanding biofilter performance and determining emission concentrations under operational conditions"[2] has found that biofilters do not provide consistent reductions of bioaerosols.

The data suggested that biofilters may be consistently emitting *Aspergillus fumigatus* and that this can only be observed when the inlet concentration is low. The application of a downstream scrubber appeared beneficial in reducing emissions of *Aspergillus fumigatus*. The proximity of biofilters to sensitive receptors should therefore be taken into consideration and additional bioaerosol abatement may be required.

### 3.5.2 Bioaerosol Monitoring

Bioaerosol monitoring will be required at composting sites with sensitive receptors within 250m. The current standard for monitoring ambient levels of bioaerosols is detailed in the AfOR Standardised Protocol for the Monitoring of Bioaerosols at Open Composting Facilities (AfOR 2009) available on the Organics Recycling web page[3].

The frequency of sampling for bioaerosols should be determined by the level of risk from a particular site. Where the level of bioaerosol emissions will initially be unknown, e.g. for new sites, frequent sampling (quarterly) should be undertaken, until the emissions and controls are well understood.

## 3.6 Odour

BAT is the prevention of odour generation and as such the design of the process must clearly demonstrate that the odour hierarchy is being followed (see SEPA's Odour Guidance 2010[4]).

Operators must employ the appropriate measures necessary to prevent potential odour pollution or minimise it when prevention is not practicable. These will depend on the process, feedstocks and the site-specific circumstances.

Biodegradable waste materials generate odour as they biodegrade**.** Four main sources of odorous compounds from composting activities are identified in specific odour guidance:

- Most feedstock materials naturally contain odorous compounds such as limonene from citrus fruits or pinene from woody materials. Individually these chemicals are not considered particularly offensive; however in mixture,

[2] http://www.sniffer.org.uk/files/3214/0291/5397/ER36_Final_Report_for_publication.pdf
[3] http://www.organics-recycling.org.uk/page.php?article=1750&name=Standardised+Protocol+for+Monitoring+Bioaerosols
[4] SEPA Odour Guidance is available on our website: http://www.sepa.org.uk/air/idoc.ashx?docid=5e8cdae4-0771-4fe7-8ff6-ad159f2ac19a&version=-1

particularly with the smell of putrefaction, the results can be a "rotting food" smell.

- Odours are produced during the natural breakdown process occurring in aerobic composting. This can begin during storage. In particular large molecules (fats, proteins) break down into smaller molecules and some of these breakdown products are intrinsically highly odorous for example amines and fatty acids which are the result of complex by products of degradation.
- Odours are produced when anaerobic conditions prevail in the composting material due to poor structure, wet materials, too much compaction or insufficient aeration. When oxygen becomes metabolised and depleted, some micro organisms adapt their metabolism (facultative anaerobes) whilst other, truly anaerobic micro-organisms will become active. The result of this process is that the micro-organisms metabolise compounds other than oxygen, for example sulphates, which regularly result in hydrogen sulphide being generated which has a very recognisable offensive smell.
- Odours can also be produced when batch temperature is mismanaged. High temperatures can be caused by overly large batches, windrows that are too tall or where there is insufficient aeration for heat removal. This can lead to the generation of ammonia or sulphur containing compounds and associated odour.

Whilst prevention of malodours through good operational management must be the priority for composting facilities, treatment of odour emissions will be a requirement for most enclosed facilities. The exact type of odour control systems will depend on the scale and type of odours that are anticipated. They can include biofilters, chemical scrubbers and thermal oxidation. The efficiency of different options is discussed in SEPA's Odour Guidance.

Operators must demonstrate that their proposed odour abatement system is the right one for each site / composting operation, for example in terms of proximity to sensitive receptors, compatibility with existing processes, site layout and space constraints. It is also important to be sure that the technology selected will achieve the required removal efficiency with regard to the range of wastes to be treated at the site and the range of emission levels over all operational conditions.

The use of deodorisers or the use of odour masking agents is not considered to be BAT.

Based on current industry practice the most prevalent abatement used for composting operations is the biofilter (open or enclosed). Regardless of the technology, operators must be able to demonstrate the efficiency of the chosen system to prevent offensive odour outwith the site boundary.

### 3.6.1 Use of Biofilters in Composting Processes to Control Odour

Biofilters are "filtration" systems, comprised of a substrate and micro-organisms that "filter" odorous air. They are used in the waste and composting industry as a primary mechanism for converting odorous compounds into less odorous or odour free compounds.

Extracted air passes through the biofilter where odorous compounds dissolve or associate with the water layer on the substrate, where the micro-organisms within the substrate biofilm mass metabolise the odour molecules, before the air is discharged to atmosphere. That is, the micro-organism population within the biofilter feeds off the odorous compounds passing through the biofilter. The odour removal efficiency of a biofilter is determined by the gas residence time in the media bed. Effective residence times typically range from 30 to 60 seconds for most aerobic applications.

Biofilters design is based on the nominal volume of process air that they are required to filter. However biofilters will require active management to keep them operating optimally. If a biofilter is accustomed to coping with moderate loadings on a continuous basis, it may struggle to cope with the occurrence of a sudden load, potentially resulting in a release of odorous gas. The ability of the biofilter to cope with this type of event will depend on its design characteristics, filter media and microbial populations. Operators should consider the potential loadings prior to site development in order to optimise operation of the biofilter.

Biofilters are the most common method of odour scrubbing at compost sites and with careful design and sizing are an efficient method of treating air with relatively low levels of pollution loading. Biofilter costs are relatively low in comparison to other physical or chemical treatment methods, but they can have a high space or footprint requirement.

Any biofilters will also require routine monitoring for temperature, moisture and thatching/compaction.

If the input air contains ammonia, pre-treatment should be considered since even low/ moderate concentrations of ammonia (45ppmv and 100ppmv) have been reported to inhibit microbial decomposition in biofilters. The use of acid scrubbers to remove ammonia prior to biofiltration should be considered.

### 3.6.2 Recommended Operational Conditions for Biofilters

The Final Report of Sniffer Project ER36 has identified indicative ranges for the key operational parameters for odour removal that can be used for the basis of BAT. Fundamentally, biofilters are considered to provide a viable solution for treatment of odorous gases from biowaste plants, providing they are designed to meet the emission characteristics that have been defined in terms of total odour and monitored in accordance with those criteria. The application of a scrubber is a component of Best Available Techniques (BAT) where the concentrations of potential gases or toxic constituents such as, but not limited to, ammonia and hydrogen sulphide, may impact on biofilter performance. Scrubbers may also be required for control of temperature and particulate load. This should be evaluated on a site by site basis during design and commissioning.

Well designed, operated and maintained biofilters are capable of achieving significant and sustainable reductions in biowaste odours up to 94%. Typical outlet concentrations range from 200 to 5500 $OU_E/m^3$.

Biofilters can achieve reductions in bioaerosols though performance is variable with time and from site to site. At low inlet concentrations biofilters may be net emitters of bioaerosols in particular fungi.

The impact of biofilter design and operating parameters varies and the key variables do not appear to be the same for odour and bioaerosols which may reflect the different removal mechanisms involved.

Upstream scrubbers are beneficial in terms of removing bioaerosols, dust and potentially toxic pollutants that may adversely affect biofilter performance. The requirement for scrubbing needs to be evaluated on the basis of site specific conditions.

Suggested operational criteria for biofilters treating biowaste emissions[5]

| Operating parameter | Typical value |
|---|---|
| **Media type** | A wide variety of materials are available which are suitable for construction of biofilters. Media should be selected with reference to the following criteria:<br>• Biologically active, but reasonably stable<br>• Organic matter content >60 %<br>• Porous and friable with 75 – 90 % void volume<br>• Resistant to water logging and compaction<br>• Relatively low fines content to reduce gas head loss<br>• Relatively free of residual odour. |
| **Media height** | 1 to 1.5 m for peat and compost biofilters.<br>Up to 3m for woodchip.<br>>2m for inorganic and synthetic media |
| **Surface loading** | <500 $m^3/m^2/hr$ |
| **Volumetric loading** | 5 – 500 $m^3/m^3/hr$ |
| **Mean effective gas residence time** | 40 - 100 seconds |
| **Inlet odour concentration** | 500 – 350,000 $OU_E/m^3$ |
| **Inlet ammonia concentration** | <5 $mg/m^3$ |
| **Inlet hydrogen sulphide concentration** | <10 $mg/m^3$ |
| **Inlet air temperature** | 15 – 30°C |
| **Outlet air temperature** | <50°C |
| **Inlet air relative humidity** | > 95% (Devinny et al (1999)<br>> 98% (VDI) |
| **Media moisture content** | 60% - 80% |
| **Media pH** | 6 to 8.5 Stability of pH is important. Variations should be avoided. |
| **Air distribution** | Air should be distributed uniformly through the media using a plenum chamber or distributed pipe work.<br>Up-flow and down-flow systems can be considered. |

Criteria for assessing biofilter media health:

| Parameter | Indication of the quality of biofilter media | | |
|---|---|---|---|
| | Optimal | Intermediate | Negative |
| EC (µS/cm) | < 1000 | 1000 – 3000 | > 3000 |
| $NH_4^+$-$NO_x$-N | 0.25 – 3.5 | 3.5 – 5 and 0.15 – 0.25 | > 5 and < 0.15 |
| $SO_4$2- | <1000 mg/kg | NA | >1000 mg/kg |
| Moist Cont (%) | 60 - 75 | 75 - 80 and 50 - 60 | > 50 and < 80 |

### 3.6.3 Biofilter Operational Issues

Biofilters are complex biological systems that require careful monitoring and maintenance. The effectiveness of the biofilter depends on the presence of a healthy and viable microbial population. If the environmental conditions are not optimum then the microbial community will not thrive, consequently the biofilter will become less efficient at treating the incoming odorous process air. Therefore in order to maintain biofilter efficacy, the following should be considered:

[5] From SNIFFER Report ER36

- incoming air must have a relative humidity of >90 % (this may require the use of a pre-humidifier);
- particulates must be removed (this will prevent blockages and development of preferential pathways which will reduce residency time);
- hot gases may need to be cooled closer to the optimal activity temperature for aerobic micro-organisms, generally 25 to 35 °C and the potential temperature rise across the bed of up to 20 °C needs to be taken into account;
- the major operating parameters such as the off-gas temperature and the back-pressure, need to be checked daily;
- the moisture content in the filters needs to be monitored regularly;
- a low temperature alarm needs to be fitted to warn of freezing, which can damage the filter and could affect the growth of the microbes;
- the packing media must be supported to allow a fast, even airflow without any pressure drop;
- the media needs to be removed when it starts to disintegrate, thus affecting the airflow (bark is less resistant than, for example, heather);
- the choice of media and supporting system affects the power requirement for maintaining the airflow, with the power needed to overcome the bed resistance being the largest operational cost; and
- consideration needs to be given to the effect of a loss of biomass due to the introduction of toxic compounds and a stand-by procedure needs to be developed for such an event.
- A rolling program of filter media replacement will be required, where the frequency depends upon the individual media and operating performance. The filter media replacement will require a robust plan including consideration of re-commissioning the new filter media.

## 3.7 Other Issues

### 3.7.1 Fires

Combustible dry material and oversize waste material have their own potential risk of fire. On-site storage of materials such as liquid petroleum gas (LPG) and secondary liquid fuels (SLF) require construction containment built to an appropriate standard (CIRA 164).

Fire outbreaks are more common in feedstock piles and separated physical contaminant piles but can occur in actual composting piles. The operator must also be aware of the risk of fire when stockpiling a product which is not fully matured and is still producing heat as part of the stabilisation phase or during storage of oversize material. Operators should take appropriate measures to guard against this, such as reducing the size of the pile and monitoring the temperature and moisture content of the material.

Any site design must take risk of fire into account and install appropriate fire detection, management plan and fire fighting equipment. In addition the layout of the site should allow the visual inspection and monitoring of the piles of physical contaminants until the piles are removed for disposal from site. In addition the site design will need to include for the containment of fire fighting water i.e. means of blocking drains, storage lagoons and tanks, and the testing and removal of fire fighting water from site.

The incident management plan should consider risk and impact of fires including the containment of fire waters. Clear guidance should be available on how each accident scenario might best be managed (e.g. containment or dispersion, to extinguish fires or to let them burn).

### 3.7.2 Dust

Dust emissions may arise from composting activity or vehicle movements associated with the process. Dust formation from the compost generally occurs in material with a moisture content lower that 30%. This level is below the ranges discussed in Section 3.3.

### 3.7.3 Vermin

Compost facilities, particularly open windrow operations, can attract vermin and in particular flies, rodents and birds. It is possible for flies and birds to enter the building during waste delivery and accumulate in hot weather. Rats and other similar vermin may also gain access to the waste reception and pre-treatment building. These vermin, if not managed, can affect operations and create a negative perception of a composting facility. They pose an environmental and health hazard as a potential vector for pathogens, and can result in cross contamination between clean and dirty areas of a composting site, which could result in noncompliance with the ABP Regulations.

The presence of vermin and other vectors should be mitigated through effective housekeeping and on-site management of storage, tipping and processing areas. Animal by-product waste feedstock reception areas should be enclosed, except for when receiving deliveries as this can limit the entry of vermin.

If vermin are detected then immediate action needs to be taken to control the situation. This may be by instigating better housekeeping, clearing spillages etc. Where an infestation is likely, or occurs, it is recommended that professional pest control contractors are brought in to eradicate the problem immediately. Appropriate control measures need to be implemented to prevent a reoccurrence. All action taken must be recorded.

The Environment Agency has produced additional guidance for control of flies which is available on their website. It gives detail on:

- common types of fly species and their impacts
- monitoring, management and control techniques
- investigating and resolving fly infestations
- fly management plans

### 3.7.4 Noise

Excessive noise levels have the potential to impact on nearby residents due to loss of amenity or sleep disturbance. Aerobic compost operations present potential emissions from noise in respect of mechanical handling equipment such as shredders, turning equipment and front end loaders. In the case of certain In-vessel forced air blowers/driers and forced air compost systems, and, in the case of enclosed composting systems, active air extraction systems and loading and unloading of compost feedstock and product can all cause excessive noise. Alarms from doors, hoppers and vehicles[6] will contribute to the noise from the site. In the case of increased capacity or new facilities there may also be additional noise from traffic.

"Noise" should be taken to refer to "noise and/or vibration" as appropriate, detectable beyond the site boundary. Where noise issues are likely to be relevant, the Operator will be required, to provide information on the extent of noise impact and any improvements proposed to demonstrate BAT.

For advice on what SEPA expect to see in a noise submission and how noise and/or vibration related limits and conditions will be determined please refer to SEPA's "Noise: summary guide for PPC applicants[7], or SEPA's "Guidance on Control of Noise from PPC Installations[8]".

### 3.7.5 Energy Efficiency

Energy efficiency measures are required for composting and aerobic treatment processes subject to regulation as a PPC activity. A number of these measures will also be relevant to sites regulated as a waste operation. Operators should take proportional steps to ensure that the facility is designed and operated in such a way as to optimise energy efficiency, e.g. buildings are designed to minimise the amount of air handling required.

Operators should refer to Horizontal Guidance H1 and H2[9] for further information on the details to be submitted and the methodologies to be used.

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[6] SEPA's Environmental Best Practice Guidance Note – noise emissions from vehicle reversing alarms is available on the website: (http://www.sepa.org.uk/air/process_industry_regulation/pollution_prevention__control/sepa_guidance.aspx )

[7] This document is available on the SEPA website: http://www.sepa.org.uk/air/process_industry_regulation/pollution_prevention__control/sepa_guidance.aspx

[8] This document is available on the SEPA website: http://www.sepa.org.uk/air/process_industry_regulation/pollution_prevention__control/idoc.ashx?docid=261ce7df-eeb9-417f-9115-c43212c82e36&version=-1

[9] These documents are available on the SEPA website: http://www.sepa.org.uk/air/process_industry_regulation/pollution_prevention__control/uk_technical_guidance/uk_horizontal_guidance.aspx

## Schedule 4

### Permitting/licensing considerations

### 4.1 Waste Acceptance

4.1.1 In order to ensure that the feed to a composting plant is as stable and homogenous as possible operators should establish site specific waste acceptance criteria which will include appropriate waste validation procedures.

4.1.2 The Operator should obtain the following information in writing prior to the waste arriving on site:

- the nature of the process producing the waste, including the expected quantity and variability of the waste
- the composition of the waste and ensure that:
  - a system of representative sample(s) of the waste should be taken from the production process and analysed
  - for each new waste enquiry, a comprehensive characterisation of the waste and identification of collection, pre-storage and age of the waste is obtained

4.1.3 There should be a system of booking in wastes to ensure that the site has the capacity to accept the material and that the material arrives in time for it to be treated within the operational hours of the permit.

4.1.4 Waste should not be accepted onto the site unless it is suitable for composting and there is sufficient capacity available to handle the load.

4.1.5 Validation monitoring to ensure compliance with waste acceptance criteria should be carried out. The number of samples and period of sampling should reflect the set of data that are representative of the specific feedstock taking account of potential variation. If the process producing the waste stream changes then it may be appropriate to reassess the material on a more regular basis until satisfied that the material which is being received is constant.

4.1.6 All waste should be visually inspected on arrival to the plant, and where possible before offloading, to ensure that it complies with the acceptance criteria and Duty of Care documentation.

4.1.7 There should be a clear procedure for dealing with wastes that do not fulfil the acceptance criteria or that do not fit with the waste description, including temporary storage and rejection. This shall include notification to the customer/waste producer. Written/computerised records should form part of the waste tracking system information. The operator should also have a clear and unambiguous procedure for the subsequent storage and disposal of such rejected wastes. This procedure should achieve the following:

- identifies the hazards posed by the rejected wastes
- labels rejected wastes with all information necessary to allow proper storage and segregation
- disposal arrangements to be put in place
- segregates and stores rejected wastes safely pending removal

4.1.8 Excessively malodorous wastes should be rejected unless there are effective systems in place to control and contain odours.

4.1.9 Putrescible wastes should be stored no longer than 24 hours from initial acceptance onsite prior to introduction into the composting process unless held in tanks or storage bays connected to effective abatement.

4.1.10 Where waste is accepted from a third party operation e.g. a site has mechanical or processing difficulties, all information regarding contracts and upstream auditing should be supplied by the third party operator before the waste is accepted on site.

- The age of the waste should be clearly stated prior to acceptance on site
- The nature of the waste and process that gave rise to the waste should be given.
- EWC codes and all transfer notes should accompany the waste and should be on the receiving sites permit
- Additional clearance may be necessary if the waste contains ABPR waste

4.1.11 Waste should be quarantined until it has been assessed as suitable for the process.

4.1.12 If it is found that waste contains contamination or unsuitable waste the operator should remove from site within 5 days.

4.1.13 If waste is assessed as suitable then it should be processed within 24hrs for putrescible or as a maximum within 5 days.

## 4.2 Tracking and Traceability of Waste

4.2.1 The operator should establish systems and procedures to track and trace waste received and treated by the site. The system should be capable of reporting all of the following:

- total quantity of waste present on site at any one time, in appropriate units;
- waste inputs to the plant by waste type
- composition of each batch by waste type and quantity
- breakdown of waste quantities being stored pending on-site treatment, classified by treatment route where appropriate;
- breakdown of waste quantities on site for storage only, that is, awaiting onward transfer;
- indicate where the waste is located on site relative to a site plan;
- compare the quantity on site against total permitted quantity; and
- compare the time the waste has been on site against the permitted time limit.

4.2.2 Techniques which should be applied to increase the traceability of a waste in a waste treatment installation include:

- to record and reference the information on waste characteristics, and the source of the waste stream, so that it is available at all times. A reference number needs to be given to the waste and needs to be obtainable at any time in the process for the operator to identify where a specific waste is in the installation, the length of time it has been there and the proposed or actual treatment route. If a waste has been mixed with another then the new batch of mixed waste should be given a reference number which maintains a clear audit trail. This is an important component in the management of the installation.

- to put in place an internal tracking system and stock control procedure for all wastes, cross referenced to the unique reference number raised at the pre-acceptance stage
- to apply a tracking system to hold all the information generated during pre-acceptance, acceptance, storage, treatment and/or removal off site. Records should be made and kept up-to date on an ongoing basis to reflect deliveries, on-site treatment and dispatches. Records typically need to be held for two years after the waste has been treated or removed off site.

### 4.3 Process Control and Management

4.3.1 Operators should provide a process control monitoring strategy to demonstrate control of the key parameters in section 3.3 to maintain aerobic conditions within the compost. This shall include identification of the parameters to be monitored, the method to be used, the frequency of monitoring, and an acceptable range of levels/limits with actions to be taken in the event of obtaining results outwith the acceptable range. As a minimum the operator should monitor oxygen content and temperature throughout the process to demonstrate that the required values are met across the entire batch.

4.3.2 The application must provide adequate process descriptions of the activities and of the applied abatement and control equipment. This shall include:

- Process flow diagrams clearly showing the movement of waste throughout the site. This should clearly state maximum throughputs of equipment and maximum storage tonnages.
- Site plans/schematics of the odour/bioaerosol abatement system and the site drainage. These should detail all system components including sumps, storage tanks pumps, ducting, sampling points, etc.
- an equipment inventory, detailing plant type and design parameters, for example, flashpoints
- details on the waste types to be subjected to the process
- a control system philosophy and how the control system incorporates the environmental monitoring information
- details of the venting and emergency relief provisions
- operating and maintenance procedures
- details on how protection is provided during abnormal operating conditions such as momentary stoppages, start-up, and shutdowns.

4.3.3 Windrow construction should take into account the following factors:

- It is expected that there should be a gap between the base of each windrow to prevent cross contamination and mixing of batches, and to allow the flow of air through the pile.
- The windrows should be positioned so as to enable proper access for forming and turning
- The provision of kerbed, impermeable hard standing over a sufficient area to allow machinery movements to turn windrows and also to provide space for leachate collection drainage
- depending on feedstocks and structure of the material, introducing a high permeability drainage layer, such as wood chips or oversize material, at the base of the windrow to allow leachate drainage and airflow into the windrows
- making provisions for leachate collection with recirculation systems, in order to feed the leachate back into the windrows to maintain the optimum moisture content and also to facilitate the leachate treatment
- For windrows incorporating ABP waste, windrows should be arranged so that leachate from more recently formed windrows does not drain onto other windrows which have gone through the sanitisation phase.
- In all cases leachate should drain away from the waste to prevent the base of the windrow becoming waterlogged.

4.3.4 Where aerated static piles are used, the air delivery system should be of a sufficient size to deliver adequate air to the waste. This should be adjustable to suit the conditions in the pile. Where the air system is fixed in situ there should be a cleaning and maintenance schedule in place. Air removal systems should take exhaust air to abatement systems which are designed to treat the systems flow of air. All systems should be cleaned after each batch and air delivery checked.

4.3.5 Where odour-generating activities take place in the open, (or potentially odorous materials are stored outside), a high level of management control and use of best practice to prevent odours should be implemented. Processing activities that have a high risk of producing odour during unfavourable meteorological conditions such as turning, screening and shredding should be avoided.

## 4.4 Process Buildings

4.4.1 Where there are sensitive receptors within 250m of the process boundary the operator should put in place all measures necessary to restrict the emissions of dust, odour and bioaerosols outwith the site boundary. Such measures may include enclosure of the process, negative aeration or extractive ventilation linked to abatement equipment. Control methods should be discussed and agreed at the permit application stage.

4.4.2 The process building dealing with waste acceptance should be fitted with an airlock system. Where airlock facilities are not feasible air curtains in combination with automated fast acting doors are considered BAT for the control of fugitive odour emissions during access and egress. Such systems should be installed on all vehicle entry points to buildings requiring negative pressure.

4.4.3 Access and egress from process buildings should be carefully managed to ensure door openings and durations are minimised.

4.4.4 All process buildings (including pre-treatment, sanitisation, maturation etc) should be appropriately sized, air tight and be held under negative pressure with a minimum of 3 air changes per hour vented to a suitable abatement system. Higher extraction rates may be appropriate for certain feedstocks or sensitive locations. Assessments should be carried out annually demonstrating the effectiveness of negative pressure e.g. smoke testing.

4.4.5 All process buildings should have impermeable, kerbed flooring laid to a fall (to prevent ponding) and directed to a sealed drainage system. The internal drainage system should preferably be an open channelled drainage system, designed to be readily accessible for inspection and cleaning.

4.4.6 All vehicle entry points to process buildings should be via fast acting roller shutter doors which open / close on a pressure switch. Said doors should be connected to an alarm system which alerts operators in the event of doors being left open.

4.4.7 Hoppers and storage bins used to store incoming wastes should be fitted with lids. In areas with sensitive receptors in close proximity to the installation these lids should be interlocked to the door entry system and prevent access to the relevant building when these hoppers / storage bins are open.

4.4.8 Air handling ducting should be made of plastic to prevent damage by corrosion. There should be vapour-liquid separators or knock-out pots fitted to collect any condensate and allow it to be removed from the system.

4.4.9 Where particulates are likely to be generated within the building, air handling systems should be fitted with particulate pre-filters.

4.4.10 The use of odour masking or neutralisation sprays is not considered to be BAT.

## 4.5 Impermeable Paving

4.5.1 The operator should ensure that all treatment, composting and storage activities, including shredding and maturation, should take place on areas equipped with an impervious surface, spill containment kerbs, sealed construction joints, and connected to a sealed drainage system or such alternative requirements as approved by the regulator. There should be enough containment infrastructure to capture all possible run-off, drainage and leachate factored on worst case rainfall events. This should be constructed so as to prevent ponding of liquid.

4.5.2 The condition of the impervious surface should be checked regularly and the results of inspections and intended maintenance arising should be recorded.

## 4.6 Storage of Liquids

4.6.1 Tanks for newly constructed sites should be above ground; however there may be site specific reasons requiring underground or partially submerged tanks such as spatial constraints. Where this is the case the applicant should make a detailed BAT justification providing details as to the mitigation measures / design considerations to be installed for all subsurface pipe work and vessels such that an equivalent level of environmental protection is afforded. This should include as a minimum secondary containment and inspection / maintenance regimes pressure testing, leak detection etc

4.6.2 For all newly constructed sites it is BAT for all tanks containing liquids whose spillage could be harmful to the environment to be bunded. This should include liquid/slurried waste storage and chemical/oil storage (including micro nutrients). For new sites it is insufficient to be reliant on double skinned tanks as the sole containment treatment.

4.6.3 Bunds should:

- Be impermeable and resistant to the stored materials;
- Have no outlet and drain to a blind collection point;
- Have pipe work routed within bunded areas with no penetration of contained surfaces;
- Be designed to catch leaks from tanks and fittings;
- Have a capacity greater than 110 percent of the largest tank or 25 percent of the total tankage, whichever is the larger;
- Be subject to visual inspection for damage, deterioration, leakage or liquid accumulation. Any contents should be pumped out or otherwise removed under manual control after checking for contamination;
- Where not frequently inspected, be fitted with a high level probe and an alarm, as appropriate;
- Where possible, have tanker connection points within the bund, otherwise provide adequate containment; and
- Be subject to programmed engineering inspection.

4.6.4 Bunds should be designed and constructed in accordance with CIRIA guidance C736: Containment systems for the prevention of pollution[10].

## 4.7 Odour Abatement/Dust/ Bioaerosols/ biofilters

4.7.1 All odorous areas should be vented to appropriate abatement which should be designed to take into consideration the Odour Abatement Hierarchy outlined in SEPA's Odour Guidance 2010[11].

4.7.2 Odour abatement systems should be designed to meet $1.5OU_E/m^3$ (or $1OU_E/m^3$ for a hypersensitive population) standard at the site boundary. Demonstration of meeting the $1.5OU_E/m^3$ standard should be provided within the application via full ADMS or AERMOD dispersion modelling. Further information on this subject is available within SEPA's 2010 odour guidance.

4.7.3 The site should have an odour management plan which should detail the type of material the site will be treating, the type of odours that are likely to arise from various parts of the process and the mitigations that have been put in place to reduce or prevent these odours from impacting on local sensitive receptors.

[10] http://www.ciria.org/Resources/Free_publications/c736.aspx
[11] SEPA Odour Guidance is available on our website:
http://www.sepa.org.uk/air/idoc.ashx?docid=5e8cdae4-0771-4fe7-8ff6-ad159f2ac19a&version=-1

4.7.4 Validation of the abatement plant performance should be carried out at least annually via extractive odour monitoring, or more frequently during commissioning.

4.7.5 The process and activities should be actively managed in order to reduce dust including initiating dust suppression techniques such as water mists and sprays and windbreaks, wetting and washing techniques i.e. damping down frequently during dry weather and washing wheels of vehicles and roadways.

4.7.6 Scrubbers and biofilters should be designed, commissioned and monitored to ensure optimum performance, In addition performance indicators (such as biofilter pressure differential, temperature, liquor pH, filter media moisture content, scrubber liquor pH/redox/flow) should be established relevant to the abatement technology to monitor continuous performance against design criteria. Such performance indicators should be monitored regularly to assess the operation of the abatement system.

4.7.7 All external liquid/slurried/containerised waste storage should be connected to abatement to control breathing losses.

4.7.8 For composting operations within 250m of a sensitive receptor the operator should put in place all measures necessary to restrict the emissions of bioaerosols outwith the site boundary unless the operator can demonstrate that such measures are not required. Such measures may include negative aeration or enclosure of the process.

4.7.9 The permit application shall demonstrate that the most appropriate odour abatement technology has been used in relation to the constituents and volumes of the odorous gas stream being treated.. Pre-treating the air prior to a biofilter should be considered where the gas stream is likely to be high in ammonia.

4.7.10 Biofilter media must be replaced on a rolling program of at least every 3 years or more frequently according to manufacturer's specification. Re-commissioning is usually necessary for new biofilter media and contingency for down time periods needs to be considered at the design stage. The Operator must submit a plan on how the filter media will be replaced and the biofilter recommissioned.

## 4.8 Compost and effluent/leachate

4.8.1 It is BAT, where feasible to do so (dependent on waste types accepted) to produce compost to PAS100 (or the equivalent European End of Waste standard).

4.8.2 Screened material must be stored upon an impermeable surface supplied with a sealed drainage system where risk to the environment is identified.

4.8.3 Compost must be stored in a manner that will minimise odour and bioaerosols and not give rise to pollution.

4.8.4 The storage capacity for finished compost should take into account the closed season for spreading to land and the likelihood of adverse weather conditions that may affect the ability to spread for example, where the land is waterlogged or frozen.

4.8.5 The site should be designed to minimise the ingress of surface water to the windrow and therefore to minimise the volume and load of leachate formed.

4.8.6 Run off and leachate should be collected in an engineered system and collected in a sump or lagoon with sufficient piping and drainage collection capacity to contain the maximum run-off anticipated. All sumps should be impermeable and resistant to the stored materials.

4.8.7 The effluent/ leachate hierarchy is as follows:

- recirculated into the process
- discharged to sewer in compliance with a relevant Scottish Water trade effluent consent
- discharged to the water environment in accordance with a SEPA CAR consent

4.8.8 Where effluent is discharged directly to the sewer environment it may require to be treated to reduce BOD, COD, suspended solids, ammonia and pH.

4.8.9 The operator should have a clear diagrammatic record of the routing of all installation drains, subsurface pipe work, sumps and storage vessels including the type and broad location of the receiving environment.

4.8.10 The operator should identify the potential risk to the environment from drainage systems and should devise an inspection and maintenance programme having regard to the nature and volume of waste waters, groundwater vulnerability and proximity of drainage systems to surface waters.

## 4.9 Monitoring

4.9.1 Appropriately qualified sampling staff should carry out all extractive emissions monitoring with analysis undertaken by appropriately certified laboratories, e.g. UKAS and MCERTS.

4.9.2 All monitoring should be carried out in accordance with methodologies specified within the latest version of the Environment Agency’s M2 document.

## 4.10 Maintenance/ incident prevention

4.10.1 A list, or register, of plant infrastructure integral to preventing or limiting pollution of the environment or harm to human health must be submitted with the application. This list should include, amongst other things, details of planned preventative maintenance which will be undertaken on the identified plant, and what critical spares will be kept on site. Such critical items include, but are not limited to, abatement equipment and associated plant, aerators for leachate treatment and monitoring equipment.

4.10.2 An incident prevention and mitigation plan shall be submitted with the application. This plan shall set out the actions to be taken and measures required to prevent incidents and where an incident occurs the appropriate mitigation action to be taken. Any amendments required in light of commissioning work should be implemented prior to the operation of the plant. As a minimum the plan should consider the following scenarios:

- Not being able to receive waste onto the site i.e. a waste diversion plan indicating alternative storage or treatment sites and the procedure for refusal of loads;
- Any leaks being detected from bunds or within pipelines;

- Emptying or filling of any vessels associated with the composting process for both routine maintenance and non routine purposes;
- Any failure of containment or overflow situation from parts of the plant associated with the compost process i.e. high level alarms, interlocks, actions to be taken;
- Failure / unavailability of an environmentally critical plant item;
- Operation of a pressure relief valve;
- Release of bioaerosols or odour expected to be detectable outwith the site boundary; and
- Outbreak of fire including the handling and containment of fire waters.

## 4.11 Noise

4.11.1 Where there is potential for noise and/or vibration to affect nearby receptors, the Operator must submit a noise and vibration assessment or noise management plan with the application. This will identify the main sources of noise and vibration from the composting process and how the control of these will ensure there is no unacceptable impact upon nearby receptors.

4.11.2 The Operator should have regard to the SEPA documents "Noise: summary guide for PPC applicants", "Environmental Best Practice Guidance Note – noise emissions from vehicle reversing alarms" and "Guidance on the Control of Noise at PPC Activities". This guidance describes the principles of noise measurement and prediction and the control of noise by design, by operational and management techniques and abatement technologies. The guidance assists in determining if proposals are BAT for a given installation.

## 4.12 Training, competence and awareness

4.12.1 The operator should ensure that all personnel who are involved in the sampling, checking and analysis procedures are suitably qualified and adequately trained, and that the training is updated on a regular basis.

4.12.2 The operator should determine the required competency of personnel and put in place an appropriate training programme. This shall include identifying training needs to ensure that all personnel whose work may significantly affect the environmental impacts of the activity have received appropriate training.

## 4.13 Energy Efficiency

4.13.1 The Operator should provide the energy consumption information in terms of delivered energy and consumption. All this information should be submitted in the application. The Operator should also provide energy flow information (such as "Sankey" diagrams or energy balances) showing how the energy is used throughout the process.

4.13.2 The Operator should provide the following Specific Energy Consumption (SEC) information: define and calculate the SEC of the activity (or activities) based on primary energy consumption for the products or raw material inputs that most closely match the main purpose or production capacity of the facility. Provide a comparison of SEC against any relevant benchmarks available for the sector (see H2 Horizontal Guidance Note: Energy Efficiency[12]).

4.13.3 The Operator should provide associated environmental emissions. This is dealt with in the Operator's response to the emissions inventory using the H1 software tool.

4.13.4 Energy management techniques should be in place, in particular the need for monitoring of energy flows and targeting of areas for reductions.

4.13.5 An energy efficiency plan should be provided that:

• identifies all techniques relevant to the facility,

• estimates the $CO_2$ savings that would be achieved by each measure over its lifetime

[12] This document is available on the SEPA website: http://www.sepa.org.uk/air/process_industry_regulation/pollution_prevention__control/uk_technical_guidance/uk_horizontal_guidance/h2.aspx