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Guidance on monitoring of MBT and other treatment processes for the landfill allowances schemes (LATS and LAS) for England and Wales

Better Regulation Science Programme

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Steve Killeen

Head of Science

Executive summary

This document summarises the requirements for monitoring the treatment processes being used to bring about landfill diversion of biodegradable municipal waste (BMW). It provides the information needed for Waste Disposal Authorities (WDAs) to fulfil the data reporting requirements of the landfill allowance schemes of England and Wales.

The Landfill Directive (31/1999/EC) sets tough targets for reducing the amount of biodegradable municipal waste sent to landfill. In England and Wales, landfill diversion of BMW is monitored by the Environment Agency via the Landfill Allowance and Trading Scheme (LATS) for England and the Landfill Allowance Scheme (LAS) for Wales. Waste Disposal Authorities may employ mechanical biological treatment (MBT) and other processes to treat and divert BMW from landfill. Many treatment outputs are ultimately still landfilled and contain varying levels of biodegradable material depending on the processes undertaken. Under the landfill allowance schemes, WDAs should collect information on municipal waste arisings, quantify the reduction in the BMW content affected by treatment and calculate the final amount of BMW going for landfill disposal. The data is submitted to the Environment Agency electronically via WasteDataFlow.

This document presents guidance on monitoring MBT or similar processes in order to estimate the adjustment factor achieved by the treatment process. It is produced in two parts: summary guidance (part A) and detailed guidance (part B) so that those with different responsibilities can use the part with the appropriate level of detail.

The summary guidance in part A outlines what needs to be done by whom, the approach to monitoring an MBT or similar process with respect to LATS and LAS and explains why. Part B sets out when and how this needs to be implemented and includes technical details on monitoring plan design, sampling and sample testing, and the calculation of MBT performance. Annexes A to C set out the different test methods and an example sampling plan .

The guidance sets out how the WDA, or anyone acting on its behalf, should develop and put into practice monitoring plans to establish the performance of the treatment process. At all plants there will be an initial high intensity three-month (quarter) monitoring period following start-up of the plant. From data gathered during this period, the adjustment factor achieved by treatment will be calculated for all outputs landfilled in this initial quarter. The second phase allows for a potential reduction in monitoring in subsequent quarters, but this is dependent on the level of variability in the adjustment factor that was measured in the first monitoring quarter. At the end of the first year of monitoring the variability in the adjustment factor will dictate the monitoring frequency in the following year. It is therefore in the interests of plant operators to keep sampling and testing variability to a minimum to reduce monitoring effort and costs.

The adjustment factor may be based on either the reduction in the amount of organic matter (measured as loss on ignition (LOI)) or potential biogas production of the biodegradable waste between the input and landfilled outputs of the MBT.

Execution of the monitoring plans specified in this guidance will provide the necessary data to allow calculation of the BMW landfilled following treatment. This figure can then be used in WasteDataFlow for LATS or LAS purposes by Waste Disposal Authorities.

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Part B containing sections 5-8 is published in a separate document: SCHO1009BREA-E-P.

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Glossary of terms and concepts

Term	Description
A_f	adjustment factor. This is a measure of the change in biodegradable waste (material or content) between the input and landfilled outputs of a treatment process and is used to calculate the tonnes of BMW landfilled.
Bias	Bias is a quantification of trueness; that is, the difference between the average value of the series of measurements and the true value. A positive bias indicates an over-estimate and a negative bias indicates an under-estimate of the true value. Bias is thus equivalent to the total systematic error in the measurement.
Biodegradability	Biodegradability of a waste is a measure of the degree to which the plant- or animal- derived organic matter is decomposed by microbes during biological treatments such as aerobic composting, anaerobic digestion or following disposal in a landfill.
BMc	Biodegradability under methanogenic conditions at effective completion. Anaerobic test for methanogenic biodegradability monitored for biogas (CO_2 + CH_4) until biogas production effectively ceases (previously known as the BM100 test).This may take less or more than 100 days. Test results are expressed as l/kg LOI.
BMW	Biodegradable municipal waste. This is the biodegradable waste fraction in untreated municipal waste and comprises the components capable of undergoing anaerobic or aerobic decomposition. It includes materials such as paper, cardboard, wood, green waste, kitchen waste, textiles and fine/soil-like material. The biodegradable waste in each input is referred to as BMW_I and output from a treatment process as BMW_O. We distinguish BMW_O from BMW_I because treatment changes the characteristics of the input BMW, for example by removal of moisture, the separation of some components or by microbial decomposition.
Composite sample	A sample that is produced by mixing a specified number of smaller incremental samples taken from the same primary sample.
Confidence interval	The interval within which a particular population parameter may be stated to lie at a specified confidence level. The bounds of the confidence interval are termed the upper and lower confidence limits.
DM	Dry matter. The sample is initially dried to facilitate shredding and this moisture loss must be recorded. A portion of the sample is then dried to constant weight at 105°C. These two moisture losses must be combined to give an overall dry matter expressed as percentage wet weight. This is the value used in all calculations.
DR4	Dynamic respiration test. Aerobic biodegradability test carried out over four days. Measured as g O / kg LOI.

Term	Description
Grab sample	A large sample taken from nominated loads or at regular intervals during the day that are placed in a single pile and mixed to form a primary sample. The size of the grab sample means that this will be most effectively collected using mechanical scoop or bucket.
Increment	Individual portions of waste that are collected from a primary sample and are combined to form the (composite) sample to send to the laboratory. This would commonly be undertaken manually using a large spade or shovel.
Laboratory sample	Sample sent to the laboratory for testing, produced by taking increments from a mixed primary sample.
LAS	Landfill Allowance Scheme (Wales).
LATS	Landfill Allowance Trading Scheme (England).
LOI	Loss on ignition. A measure of the quantity of organic matter in the sample that can be combusted at 550°C. The loss in weight during combustion equates to the mass of organic matter in the sample. It is expressed as a percentage of dry matter content.
MSW	Municipal solid waste referred to here as municipal waste. Waste from households and other sources collected by or on behalf of Waste Collection Authorities (WCA). The components of municipal waste include biodegradable municipal waste (BMW), and essentially non-biodegradable materials such as plastics, glass, stones and metal objects.
Mass flow	Weight of the waste going into, or coming out from, an MBT process.
Plastics	Plastics are composed of organic matter but the timescales for degradation are many decades. For the purpose of biological treatment in the timescales of MBT and anaerobic digestion, they are considered to be non-biodegradable and are therefore categorised as a constituent of the non-BMW fraction of municipal waste.
Population	The population represents the total volume of waste about which information is required. In this case, this is the full year input to or output from the MBT plant.
Precision	The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. A lower precision is reflected by a larger standard deviation. The precision of a result is half the confidence interval.
Primary sample	Represents any large sample taken at the scale of sampling, that is, one day. The primary sample should consist of a number of large grab samples, which are combined and mixed and a representative sample taken for analysis – the laboratory sample.
RSD	Relative standard deviation – the positive square root of the variability of a dataset.
Sampling event	The sampling event describes the actions required to take a sample. For an MBT plant, each sampling event should take place on a separate day unless information on within-day sample

Term	Description
	variability is specifically required.
Sample weight	The sample weight defines the mass (in kilogrammes) of the sample taken to the laboratory for analysis.
Scale of sampling	The scale defines the total volume of waste from which the sample is to be taken. In this case, this is a day's input or output to the MBT.
Sub-sample	Any portion of material taken from the sample as part of laboratory tests.
SRF	Solid Recovered Fuel, also known as RDF or refuse derived fuel. A waste containing mainly the combustible fractions of municipal waste, such as paper, card and plastc.
Variability	Variability is a characteristic of the waste that cannot be changed without intensive manipulation of the waste. Its investigation is important because the more that is understood about the causes of variability affecting the material under investigation, the greater will be the opportunity for that knowledge to be exploited in designing the sampling programme.
WCA	Waste Collection Authority.
WDA	Waste Disposal Authority.
WDF	WasteDataFlow. A web-based tool for local authorities (both WCAs and WDAs) to input data on municipal waste. In this context it calculates the tonnes of BMW sent to the treatment plant.

Part A

Summary guidance on monitoring MBT and other treatment processes for the landfill allowances schemes in England and Wales (LATS and LAS)

1 Introduction

This guidance sets out the sampling and monitoring regime to generate acceptable evidence for the Environment Agency to estimate the diversion of biodegradable municipal waste from landfill achieved by mechanical biological treatment (MBT) and other waste treatment processes used to treat residual municipal waste prior to landfill.

The Landfill Allowance Schemes in both England and Wales set out the amount of biodegradable municipal waste that all local authorities are permitted to landfill. Biodegradable municipal waste (BMW) is the sum of the biodegradability of the different fractions in municipal waste. Both schemes are monitored by the Environment Agency, which calculates the net BMW content of any residual waste using a mass balance approach from the information reported on WasteDataFlow. Any biodegradable outputs that are landfilled will be subtracted from a local authority's landfill allowance, and therefore monitoring the amount of biodegradable waste that is diverted from landfill by any treatment process is key.

Part A summarises what needs to be done by whom and explains why. Part B sets out when and how this needs to be implemented and includes technical details on monitoring plan design, sampling and sample testing, and the calculation of MBT performance.

2 Monitoring a treatment process for LATS or LAS

2.1 Principles

Mechanical biological treatment changes the amounts and/or basic characteristics of biodegradable waste either through separation of some components (such as paper and plastic for solid recovered fuel (SRF)) or through biodegradation. The input and output BMW will therefore be different because:

- each stream landfilled may only be composed of some of the input BMW;
- it may have been dried and/or wetted; and
- it may have lost some of its organic matter content due to microbial decomposition during the biological stage of the treatment process (composting or anaerobic digestion).

To estimate the amount of BMW landfilled, the input to, and any outputs from, the MBT process need to be sampled and tested to determine their biodegradability. Figure 2.1 shows the calculation for a hypothetical MBT plant. These data can then be used with mass flow data to calculate the total amount of BMW that was landfilled.

There are currently two methods accepted by the Environment Agency for determining the reduction in BMW between the biodegradable waste in the input and outputs landfilled from the MBT process. These are:

- the change in loss on ignition (LOI); and
- the change in potential biogas production.

Detailed test methods for measuring these and associated parameters are provided in annex A. The Environment Agency may accept other tests subject to evidence that they are sufficiently correlated with either of the accepted methods. Further details are given in section 2.2.4 and annex B. The change in BMW achieved is referred to as the adjustment factor (A_f) and this is used with the tonnage sent to landfill to calculate the tonnage of BMW landfilled from the MBT outputs.

Tonnes BMW landfilled in MBT outputs (t BMW_L) = Σ tonnes $landfilled_{all\ outputs}$ x Mean A_F[1] x (%RB[2]/100).

[1] Mean A_F is the quarterly average of the A_F values derived for each linked batch of input(s) and output(s).

[2] RB% is the residual biodegradable percentage of municipal waste after recycling and composting calculated in WasteDataFlow.

The calculation of the A_f is based on dry weight, to ensure that any loss in moisture from the process is not counted as diversion of BMW.

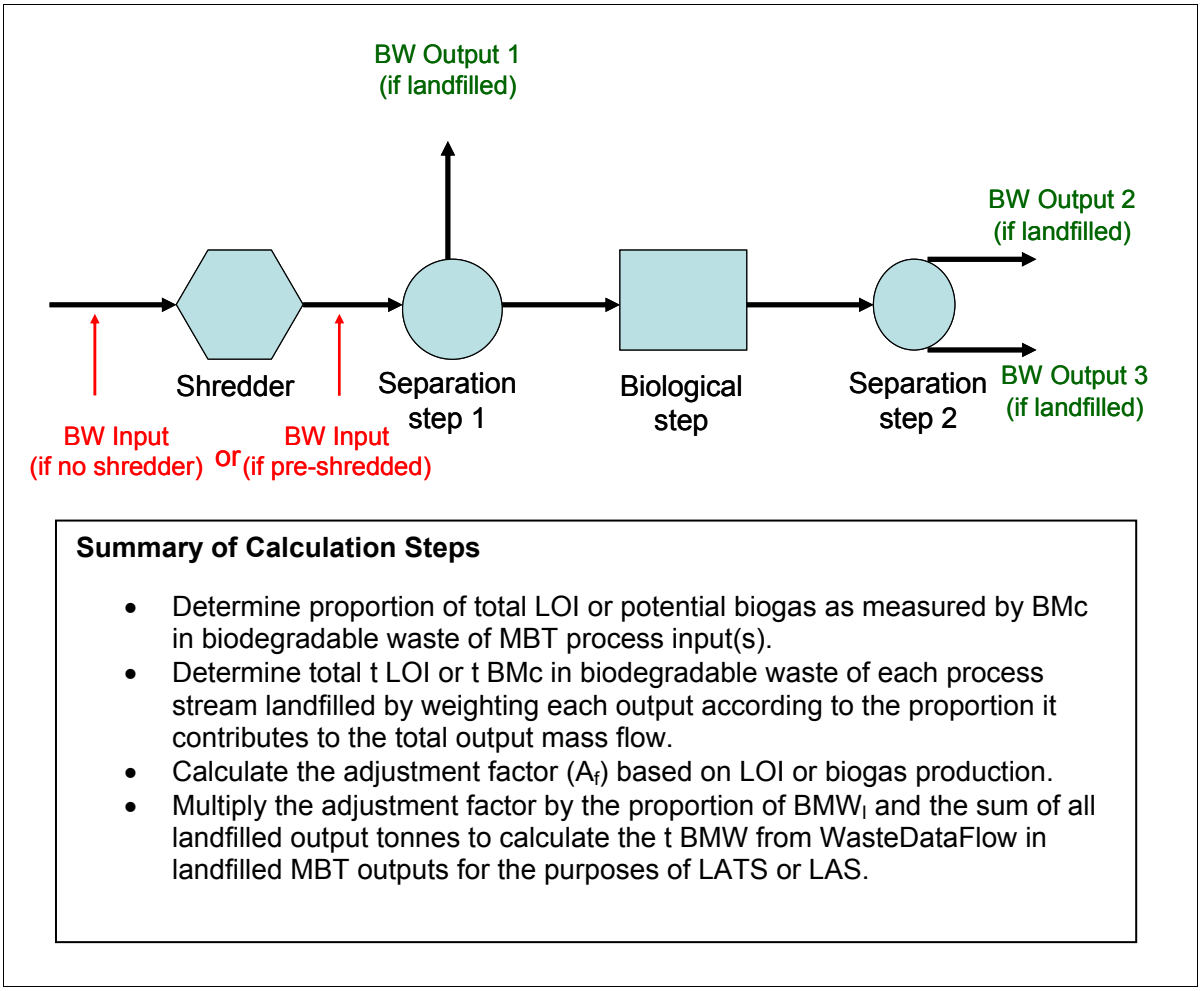

Figure 2.1 Schematic of typical MBT monitoring points for estimating BMW landfilled.

2.2 Calculating BMW diversion

2.2.1 Introduction

The LOI test does not differentiate between readily biodegradable organic matter and organic waste components that are resistant to microbial decomposition or non-biodegradable. The LOI test for landfilled outputs will report the loss of these resistant organics along with the loss of those that are readily degradable, therefore using the LOI method will typically give a smaller reduction than that measured by potential biogas reduction. A biological test only measures the biodegradability of the degradable fraction, so if all biodegradable matter is removed by processing, it is in theory possible to get a 100 per cent reduction.

2.2.2 Using the change in loss on ignition (LOI)

Loss on ignition (LOI) is the amount of organic carbonaceous matter lost from a dried waste when it is combusted in a furnace at 550°C. This removes all organic carbonaceous materials (readily and slowly degradable and non-biodegradable,such as plastics). The combustion of untreated and treated biodegradable waste produces an ash from the non-combustible inorganic and mineral components in the biodegradable waste. The reduction in BMW landfilled is based on measuring the change in LOI between the inputs and landfilled outputs of the BMW fractions. The change in LOI is measured on a dry weight basis to ensure that the effects of any loss of moisture due to drying are excluded from the calculation. Full details of the test methods used are provided in annex A.

The adjustment factor for LOI based monitoring is calculated from:

$$A_f = \Sigma \text{ weighted LOI of all outputs} / \Sigma \text{ } LOI_I \text{ all inputs}$$

If there is only one input and output, the adjustment factor is calculated as: $A_f = LOI_O / LOI_I$

This is illustrated in figure 2.2 for a simple scenario where there is initial separation of a SRF containing biodegradable waste followed by biological treatment of the residual waste with all the output from the biological treatment landfilled.

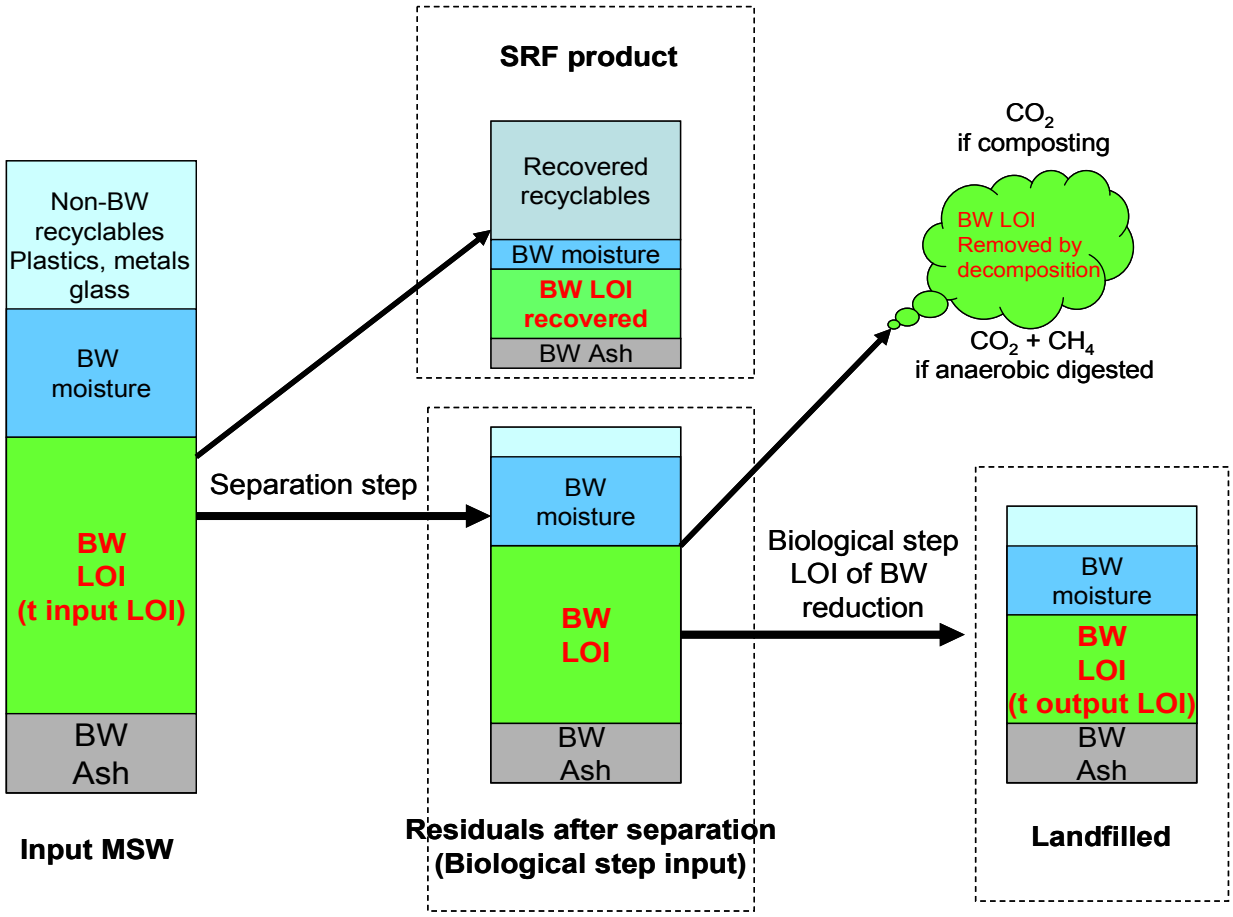

Figure 2.2 Monitoring MBT: adjustment factor based on LOI reduction.

2.2.3 Using the change in potential biogas production

The potential biogas production method for determining the adjustment factor differentiates between the readily biodegradable and recalcitrant or non-biodegradable organic matter. This method will therefore usually estimate a greater diversion of BMW than the LOI reduction alone. This is illustrated in figure 2.3.

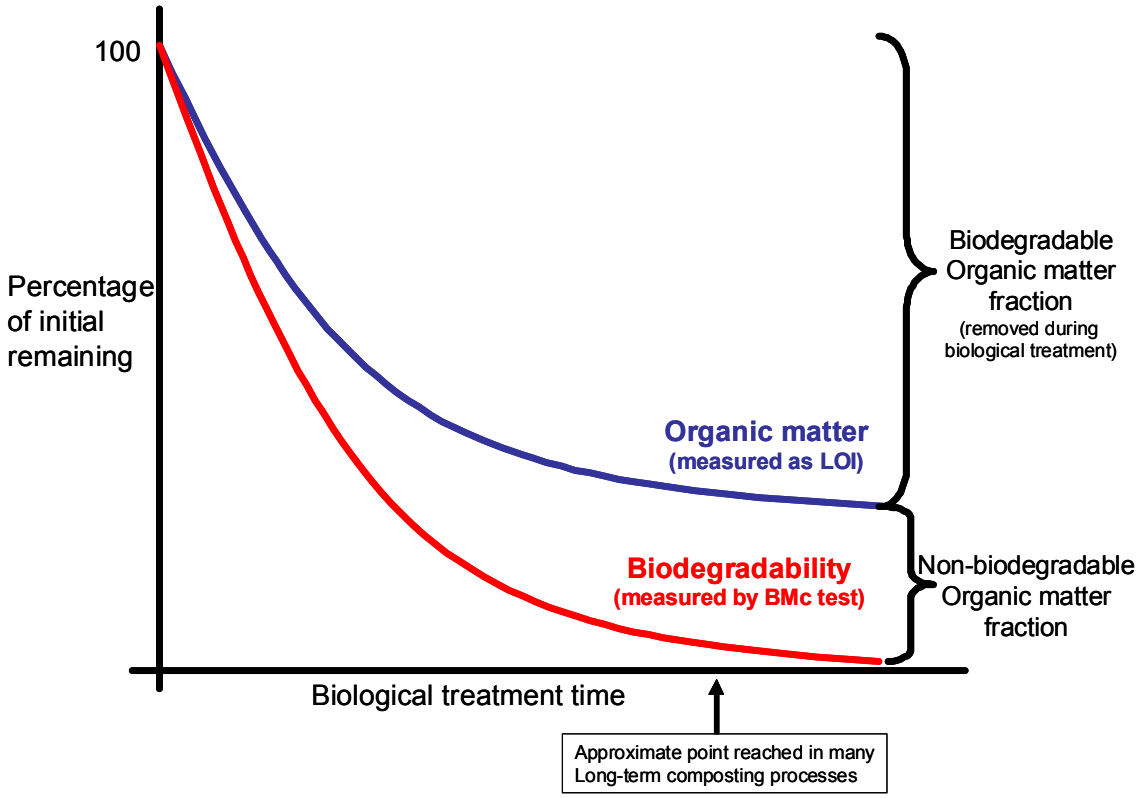

Figure 2.3 Use of LOI and BMc to calculate BMW diversion.

The assessment method is similar to monitoring by the LOI reduction approach except that the biodegradability of the biodegradable waste is also determined using the anaerobic biodegradation test BMc (formerly the BM100 test). The amount of BMW landfilled is measured in terms of the reduction in potential biogas production. The adjustment factor (A_f) is calculated by:

$$A_f = \Sigma \text{ (weighted BMc of all outputs landfilled)} / \Sigma \text{ BMc of all inputs}$$

The BMc test reports biodegradability as litres of biogas per kg LOI and may take 100 days or more to complete, that is, until biogas production ceases.

2.2.4 Alternative biodegradability tests

The BMc test provides important baseline data during initial characterisation of the process, however it may not be preferable for routine, onward monitoring of an MBT plant if more rapid reporting of performance is required. Alternative tests which are sufficiently correlated with the BMc test can be used. Where another test for biodegradability is proposed, both the alternative test and the BMc test should be

used during the initial monitoring until sufficient data are obtained for a site-specific correlation between the two tests. The correlation coefficient (R) between the two test methods should be demonstrated to the satisfaction of the Environment Agency, and should be in excess of 0.9 over the period of dual monitoring which will require parallel testing of 12 or more samples. Further information on correlation is provided in annex B.

2.3 Monitoring requirements for MBT for LATS and LAS

2.3.1 Introduction

The approach in this guidance is based on the principles described in the European Standard BS EN14899:2005 (British Standards, 2005). A monitoring plan (and sampling plan) should be developed prior to or during commissioning and should be submitted to the Environment Agency prior to commencing sampling and testing. Following commissioning, when the plant is operating at full capacity, the process should be monitored according to this guidance to establish the total amount of BMW landfilled each quarter for LATS or LAS. Monitoring MBT processes for LATS or LAS should be consistent with the three principal levels of testing laid out in the Landfill Directive (for more detail see part B, section 5.3.2):

- Level 1 (Basic characterisation): an initial phase of comprehensive monitoring to provide a baseline of plant performance to calculate the adjustment factor for the first quarter and (if an alternative biogas production assessment option is proposed) sufficient samples to determine an acceptable correlation with the BMc test. The Level 1 monitoring plan should demonstrate that consideration has been given to points in section 5.3.

- Level 2/3 monitoring ('Level 3' is used to refer to data that can be collected at a plant without recourse to analytical testing): Level 1 monitoring data produced during the first three months of routine operation should be used to calculate the variability in the A_f and estimate the ongoing sampling frequency required for Level 2/3 monitoring for the remainder of the 12-month period. The more variable the outputs, the more frequently the plant will need to be sampled. Following the guidance on sample collection in part B, sections 6 and 7.2.2 will help to reduce the variability. The procedure for calculating the number and frequency of samples is summarised in section 3.3.1. The frequency of sampling in subsequent years will be based on the variability in data observed over the previous year's monitoring.

The various activities undertaken as part of monitoring should be defined in the monitoring plan. The contents of a monitoring plan are defined in section 3.2, along with the recommended procedure for defining sampling frequencies in the first year and subsequent years, sample size and sample collection procedures (section 3.3). This information is discussed in more detail in sections 6 and 7 in part B.

3 The monitoring regime

3.1 Principles

This guidance is based on the European Standard BS EN 14899:2005. Additional guidance has been published for plant operators by the Environment Agency (2005) and the Environmental Services Association Research Trust (ESART) (2004).

Any monitoring activity should be planned thoroughly and the monitoring plan for determining the BMW landfilled from an MBT plant should cover:

- Start-up monitoring for the first quarter of full-scale operation after the commissioning period. The period over which commissioning is required will depend on the timescale required to optimise the process and the period of monitoring needed to capture and characterise seasonal changes and variability in the input wastes and process outputs. This could commonly be a year or more.

- Onward monitoring applying a rolling assessment approach which looks at changes in the quarterly A_f and annual reassessment of the monitoring frequency.

The Environment Agency will review any monitoring plans submitted to determine whether they meet the requirements of this guidance.

A key element of a monitoring plan will be the development of a sampling plan for each waste stream (inputs and outputs) to be sampled. Obtaining suitably representative samples is an implicit requirement of the sampling plans.

All monitoring data should be submitted to the Environment Agency, together with a calculation of the tonnes of BMW landfilled in MBT outputs, and notification of any change in plant operation and the action being taken.

Detailed guidance on the development of monitoring plans is given in part B, section 5.

3.2 The monitoring plan

The key elements required for the monitoring plan are:

- A description of process including MBT outputs landfilled.

- The objectives of monitoring.

- The test on which the adjustment factor will be calculated (by change in LOI or biogas production) and the process parameters and waste characteristics to be monitored.

- Details of any proposed alternative test to the BMc. All samples taken under Level 1 comprehensive monitoring should be analysed both by the BMc and the alternative tests to provide a site-specific correlation. If the DR4 test is the proposed alternative test then the default DR4-BMc correlation (annex B) can be applied until results from the Level 1 monitoring are available. Monitoring data obtained during commissioning may also be submitted to the Environment Agency as evidence in support of the correlation.

- The calculation proposed for determining the adjustment factor, based on the principles shown in the examples in section 8.

- The ongoing process monitoring proposed, for example, monitoring the weights of all inputs and outputs on a monthly basis.

The sampling plan will identify the specific details of the intended sampling activities and should include details of:

- Process streams proposed to be sampled (as a minimum, the inputs and any outputs landfilled). This is to establish the adjustment factor for the plant for outputs that are landfilled. This is further described in section 6.2. The output samples should correspond to the same waste streams as the input samples; that is, output sampling will need to take account of the residence time in the process. If the output that may be landfilled is not known, all outputs should be sampled and analysed.

- How representative samples will be collected, in accordance with the sampling plan (further guidance is provided in part B, section 7.2), and how they will be stored and transported.

- Who will carry out independent sampling of the plant. How many samples would be collected by the independent sampler(s) and how many by the plant operators (see section 7.4).

- How many samples will be taken and when (for Level 1 and Level 2/3 monitoring). Initially the process should be monitored for one quarter with a minimum of 10 linked BMW input and BMW output samples to be landfilled.

- The sample size (weight or volume) to be taken and what studies have been carried out to determine the precision provided by the sample size. Default sample sizes for typical MBT waste streams are provided in section 3.3.2 and part B, section 7.3.

- What the samples will be analysed for.

- The quality assurance/quality control (QA/QC) procedures for the monitoring activity, including record keeping.

- How the monitoring data will be reported to the Environment Agency, including how the adjustment factor will be calculated using the approach described in more detail in sections 7.4 and 6.3 respectively.

- Provision for annual review, using a full 12 months of data to re-calculate the variability of the data using the approach detailed in section 6.3.

3.3 Guidance on sample collection

3.3.1 Sampling frequencies

At start-up there is limited (from plant commissioning data) or no information about the variability in the A_f over time and a default sampling frequency is therefore used to provide an initial characterisation of the plant in the first quarter (Level 1 monitoring).

Level 1 monitoring, quarter 1: During the first three months, samples should be collected and the A_f calculated for every working day over two consecutive weeks at a randomly chosen start time during the first three months, when the plant is running under 'standard' conditions. This will produce either 10 or 12 estimates of the A_f that together should reflect some of the day-to-day and week-to-week variation in the A_f.

For each day's sampling, the operator should analyse the input to determine its biodegradable content and subsequently take linked[3] samples for each output stream. All wastes sampled should be analysed for DM and LOI. If biodegradability is being measured using biogas production, the BMc test and any alternative test proposed for onward monitoring should be carried out. In addition, the total weights of each waste stream should be recorded at least monthly. This first three months of monitoring represents an initial intensive Level 1 characterisation exercise which will be followed by three quarters of Level 2 compliance monitoring.

Level 2/3 monitoring, quarters 2 to 4: The frequency of Level 2 monitoring will be based on the variability of the dataset produced in the first quarter monitoring. In subsequent years the level of monitoring will be set following a review of the previous year's monitoring data and will be the same for each quarter.

The initial variability in BMW content for each output will be determined from the results of the first quarter of Level 1 comprehensive monitoring. This variability[4] can be pooled to calculate the ongoing sampling frequency required to complete Level 2 monitoring in the remainder of the first year of compliance monitoring. The guidelines on sample collection (see section 6) will help to ensure that the variability is as low as possible. A ceiling on the number of samples has been set at 12 per quarter. The more variable the A_f, the more frequently the plant will need to be sampled during Level 2 monitoring for the remainder of the year. Having established the sampling frequency, samples should be collected on randomly selected working days throughout each quarter.

[3] In the linked samples the outputs are sampled from the same batch as the inputs but after treatment.

[4] The variability between the samples is measured by a statistical function, the relative standard deviation, (RSD).

3.3.2 Sample size

Municipal waste is both heterogeneous and variable. Large samples are required to ensure the results are representative and to reduce sampling error to an acceptable level. Sample weights of more than 500 kg are not unusual. Table 3.1 gives guideline values to calculate recommended *minimum* sample weights (in kilogrammes) for typical MBT inputs and outputs. These weights are based partly on empirical studies and partly on practical experience with the type of materials associated with MBT processes.

To determine the guideline minimum sample size, the reference value for a given type of waste needs to be multiplied by the appropriate factors, depending on particle size, BMW and moisture content. The reference values in table 3.1 are the sample weights for materials with a BMW content of <30% or >70% with a moisture content of less than 50 per cent. Sample weights for materials with other characteristics can be calculated using the multipliers. For example, a batch of large screening reject material with a BMW content of 60 per cent, a moisture content >50 per cent and a particle size >100 mm would require a sample weight of 50kg x 2 x 2 x 2 = 400 kg.

The guideline *minimum* sample weights given in table 3.1 relate to the recommended sampling frequency outlined above. This table and the explanation are repeated in Section 7.3.1 and more detail on sampling generally and the statistics of sampling are given in Section 7 and Section 6 respectively.

Table 3.1 Default minimum sample weights (kg) for materials of varying characteristics.

Material	Reference Value (kg)	BMW (%)			Moisture (%)		Particle size (mm)		
		<30	30-70	>70	<50	>50	<20	20-100	>100
Black bag input municipal waste	**100**	x1	x2	x1	x1	x2	NA	NA	NA
Shredded input municipal waste	**50**	x1	x2	x1	x1	x2	NA	NA	NA
Large Screening Reject	**50**	x1	x2	x1	x1	x2	NA	x1	x2
Small screening reject/fines	**5.0**	x1	x2	x1	x1	x2	x1	x2	NA
Solid Recovered Fuels (SRF)	**2.5**	x1	x2	x1	x1	x2	x1	x2	x4
Compost like output (CLO)	**2.5**	x1	x2	x1	x1	x2	x1	x2	NA

NA = not applicable

3.4 Reporting monitoring data to the Environment Agency

Table 3.2 provides a summary of the results of the comprehensive Level 1 and onward Level 2/3 monitoring, together with calculated adjustment factors and subsequent calculated tonnages of equivalent BMW landfilled. All the results for samples in that quarter and the mean values should be reported to the Environment Agency.

The results for the waste inputs and their associated outputs will be used to determine the adjustment factor which we will enter in WasteDataFlow to calculate the tonnes of BMW landfilled from that input.

A discussion of other information reporting requirements for the site monitoring plan are discussed in section 3.2 and in further detail in section 7.4.

Table 3.2 Data required for monitoring MBT and other similar processes.

Data required	Units	Process input	Outputs landfilled
Data required for LOI reduction option			
Tonnes wet weight of municipal waste	t municipal waste	tM_I	tM_O
Percentage wet weight of biodegradable waste (BMW) fraction of the municipal waste	%BMW	$\%BMW_I$	$\%BMW_O$
% BMW input (from WasteDataFlow)	%BMW	RB%	
Percentage dry matter (DM) content of BMW fraction	%DM	$\%DM_I$	$\%DM_O$
Percentage organic matter (LOI) of the dry matter content of the BMW fraction	%LOI	$\%LOI_I$	$\%LOI_O$
Additional data required for biogas reduction option by direct BMc testing			
Anaerobic biodegradability (BMc) of the BMW fraction	Litres biogas /kg LOI	$BMc_{(I)}$	$BMc_{(O)}$
Additional data required for biogas reduction option by alternative biodegradability test correlating with BMc (BMc data required as well to develop site specific correlation)			
Alternative biodegradability test (e.g. DR4) of the BMW fraction	various	Bio_I	Bio_O
Correlation between alternative and BMc test (optional)			

Notes: BMW for input municipal waste is the %BMW content measured as a percentage of the whole wet weight. There may be more than one MBT output stream landfilled. The data above is required for each output landfilled.

For England, enquiries, proposed monitoring plans and quarterly monitoring data should be sent to: LATS@Environment-Agency.gov.uk. For Wales the relevant contact details are: LAS@Environment-Agency.gov.uk.
Or telephone the National Customer Contact Centre (NCCC) 08708 506 506 and ask for a member of the LATS or LAS team as appropriate.

4 References

British Standards (2005), Characterisation of wastes. Sampling of waste materials: Framework for the preparation and application of a sampling plan, BS EN 14889:2005.

Environment Agency (2005). Guidance on the sampling and testing of wastes.

Environmental Services Association Research Trust (ESART) (2004). A Practitioner's guide to testing waste for onward use, treatment or disposal acceptance.

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