AfOR's protocol to measure physical contaminants in biowastes

1. Scope

The aim of this document is to provide operators with a methodology to measure the levels and the types of physical contaminants in delivered loads of biowastes. This will enable operators to:

1. Ascertain and monitor contamination levels in loads of biowaste delivered to organics recycling facilities.
2. Obtain evidence to support the specification or revision of maximum acceptance criteria in contractual arrangements with suppliers.
3. Check compliance with the acceptance criteria specified within existing contractual arrangements.
4. Provide biowaste suppliers with feedback on specific collection rounds that are routinely causing issues with respect to contamination. And
5. Justify the implementation of a differential pricing mechanism based on the results of the assessment carried out.

The assessment of the levels and types of physical contaminants in delivered loads will be of particular interest to sites receiving loads with excessive levels of physical contaminants, or where disputes arise concerning contamination levels.

It is important that this assessment is carried out at least quarterly to take into account any potential seasonal variation.

This methodology is based on the method recommended and successfully implemented by the Italian Composting Association (CIC)[1]. It describes:

- ✓ how a representative sample should be obtained from a load of biowaste delivered to a biowaste facility;
- ✓ how the sample should be sorted to differentiate compostable from non-compostable fractions; and
- ✓ how the results of the assessment should be reported.

The categories of physical contaminants described in section 3.1.3 are mainly suited to composting facilities. This methodology can also be used to assess biowaste delivered to anaerobic digestion facilities; however, for these types of facilities additional or different categories of physical contaminants may need to be identified and reported.

[1] CIC Position paper, Annex 1 – Qualitá dell'organico da RD, 2nd version, October 2009: '*Metodica per la determinazione della qualitá merceologica dello scarto organico di origine alimentare proveniente dalla raccolta differenziata (cfr: DGR Veneto n568 / 2006)'*

2. Sampling

2.1. Sample quantity and sampling methods

Table 1 below specifies the minimum quantity of sample on which the assessment should be carried out. This is based on the quantity of the load delivered. The final sample should be representative of the load delivered.

The sample should be taken according to one of the sampling methods listed in Table 2.

Table 1. Minimum quantity of sample to be subject to the assessment	
Delivered load quantity	**Minimum sample quantity for biowaste auditing**
>15 tonnes	1000 Kg
7 – 15 tonnes	500 Kg
1.5 – 7 tonnes	200 Kg
1 - 1.5 tonnes	150 Kg
< 1 tonne	150 Kg

Table 2. Summary of sampling methods	
Method A ('Loading shovel' method)	Paragraph 2.1.1. Recommended for co-mingled green and food waste and food waste only, whether bagged or not.
Method B ('Quartering')	Paragraph 2.1.2. Recommended for co-mingled green and food waste and food waste only, whether bagged or not.
Method C ('Random sampling')	Paragraph 2.1.3. Only suitable for bagged biowaste.

AfOR recommends that digital photographs are taken of the original load and sample to be analysed.

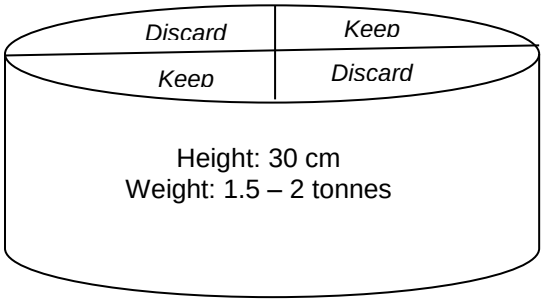
2.1.1 Method A ('Loading shovel' method)

With a loading shovel, three to four full or part-bucket loads of biowaste should be taken from the tipped load, piled and thoroughly mixed on a designated area of the site. The bucket loads should be taken from points distributed throughout the sampled load. From the resulting pile, one full or part-bucket load should be subsequently taken, to obtain the minimum quantity to be subjected to the assessment, as per Table 1.

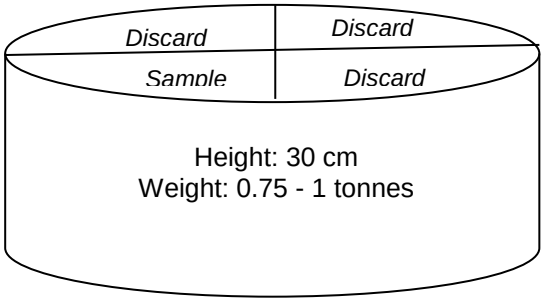
2.2.2 Method B ('Quartering')

With a loading shovel, the biowaste load should be evenly spread on a designated area of the site to form a 30 cm high 'cake'. The 'cake' should then be divided into equally sized quarters. The material of two opposite quarters should be discarded and the two remaining quarters should be combined to form a new 'cake', as high as the previous one. The new' cake' should be quartered again, following the same procedure. One of the resulting quarters will represent the sample for the assessment. The weight of the obtained sample should equal the appropriate quantity as per Table 1.

First quartering



Second quartering



2.2.4 Method C ('Random sampling')

This method is best suited when biowastes are delivered in bags (e.g. polyethylene bags or compostable kitchen caddy liners). In this case a number of bags can be randomly taken from the delivered load and progressively weighed, until the minimum sample quantity required is reached (as per quantities shown in Table 1).

AfOR recommends this method is only used when the delivered load is 100% bagged. However, should this method be used when loose biowaste is also included within the load, it is recommended that the sample is taken using a shovel or a fork rather than by handpicking, to ensure a proportion of loose biowaste is represented in the final sample. This ensures a more representative sample is taken.

Finally, this method is best suited for taking samples from small loads, given the potential high number of bags needed to be taken to make a representative sample.

Example of a load of food waste bagged in compostable liners

3. Biowaste qualitative and quantitative analysis

The assessment should be carried out promptly after the sample has been taken.

The final sample that will be subjected to the assessment should be accurately weighed. Depending on the quantity of sample, this can be either done by weighing the loading shovel's bucket with the sample on the weighbridge, or by filling a number of wheeled bins (as many as needed) with the material sampled according to one of the methodologies described in section 2 and weigh them on a digital scale.

3.1 Sorting

3.1.1 Garden waste and mixed food / garden waste delivered loose

Physical contaminants shall be picked from the sample through the use of litter pickers and differentiated into the categories described in section 3.1.3. Appropriate PPE should be worn to carry out this activity, including a hi-viz jacket, suitable sharp resistant gloves, safety boots and a dust mask if working within a confined space.

It is estimated that, for a 500 Kg sample, this type of sorting will take:

1 hour, if carried out by 3 experienced operatives; or
2 hours, if carried out by 2 experienced operatives

The above times are only approximate and will vary according to the size of the load being sampled.

3.1.2 Bagged food or food / garden waste or loose food waste only

A sorting table should be set up to facilitate sorting in the case of bagged biowaste. A way to do this is to place two open wheeled bins opposite each other and to lay a sheet of wood between them to act a sorting table. Appropriate PPE should be worn to carry out this activity including, a hi-viz jacket, suitable sharp resistant gloves, safety boots and a dust mask if working within a confined space. When the bags have been manually split and contaminants removed from their content, the biowaste can then be directly scraped into the wheeled bins

It is estimated that, for a 500 Kg sample, this type of sorting will take:

2 hours, if carried out by 3 experienced operatives; or
3 hours, if carried out by 2 experienced operatives

The above times are only approximate and will vary according to the size of the load being sampled.

3.1.3 Physical contaminant categories

The sample should be sorted into two classes, which are:

- Material suitable for composting (compostable material, CM)
- Material unsuitable for composting (non-compostable material, NCM)

The first class (CM) includes:

1. plant-tissue wastes (e.g. garden wastes)
2. food scraps
3. paper and cardboard of the plain types such as paper tissues, paper napkins and paper towels, toilet roll and kitchen roll tubes; egg boxes with labels removed, and brown/plain corrugated cardboard
4. newspapers[2] and shredded or unshredded office white paper
5. plastic- and paper-based bags, liners independently certified compostable to one of the relevant standards[3]
6. plastic-, or card-based packaging and other items independently certified compostable to one of the relevant standards[2]

The second class (NCM) includes:

1 Glass
2 Metal
3 Plastic bags: plastic carrier bags and collection sacks that are not certified 'compostable' and/or 'home compostable' in compliance with of the relevant standards[2]
4 Other plastic items: plastic packaging or any other plastic items that are not certified 'compostable' and/or 'home compostable' in compliance with one of the relevant standards[2]
5 Paper (bags / liners and any other items that are not plain or are bright, glossy, shiny, pigment coloured, and/or printed with ink and that are not certified 'compostable' and/or 'home compostable' in compliance with one of the relevant standards[2]; this includes:
   - plastic-lined paper bags,
   - plastic-coated paper plates,
   - glossy magazines and catalogues,
   - foil-coated paper, any other shiny / glossy paper or printed with inks.
6 Cardboard packaging or any other card items that are not plain or are bright, glossy, shiny, pigment coloured, and/or printed with ink and that are not certified 'compostable' and/or 'home compostable' in compliance with one of the relevant standards[2]; this includes:

[2] AfOR regards newspaper (a type of non-plain paper) as suitable for composting because the UK's newspaper industry widely uses inks that are soya based or that contain low concentrations of potentially toxic elements.
[3] Independently certified compostable to the "compostable" criteria within BS EN 13432, BS EN 14995, DIN V 54900, ASTM D6400, or AIB-Vinçotte International S.A.'s 'Program OK 2' criteria for "home compostable" packaging, plastics or equivalent. See here for guidance on how to check certification:
http://www.organics-recycling.org.uk/page.php?article=1991&name=Short+guide+to+compostable+products

- plastic-or foil-coated cardboard,
- milk / juice cartons,
- cereal boxes,
- washing powder boxes,
- frozen food containers,
- take-away containers,
- other shiny / glossy cardboard, printed with inks or coloured with dyes.

7 **Inert materials** such as stones, pieces of brick, concrete, ceramics, and tiles
8 **Textiles**
9 **'Other'**: anything that is not included in categories 1 to 8 above and is not included in the CM class.

If appropriate, any additional item that is classed as a contaminant in the contractual arrangements with the waste supplier or within the operator's permit should be added to the above list and reported.

When this operation has been completed, the two different categories should be weighed in wheeled bins or bags, and the final weights recorded. The weight of the wheeled bin or the bag should be subtracted from the total.

The final results will be expressed as follows:

$$\%NCM = \frac{W_{NCM}}{W_T} \times 100$$

Where:

- ✓ %NCM is the percentage by weight of non-compostable materials in the assessed load;
- ✓ W_{NCM} is the weight of the non-compostable fraction, and
- ✓ W_T is the weight of the sample subjected to the assessment.

$$\%CM = \frac{W_{CM}}{W_T} \times 100$$

Where:

- ✓ % CM is the percentage by weight of compostable materials in the assessed load;
- ✓ W_{NCM} is the weight of the non-compostable fraction, and
- ✓ W_T is the weight of the sample subjected to the assessment.

% NCM and % CM should be reported into 'AfOR biowaste assessment report template' (see Annex A).

% NCM and % CM add to 100.

If appropriate, the single contaminant categories 1 to 9 should also be weighed and the associated percentages by weight reported into 'AfOR biowaste assessment report template' (see Annex A to this protocol).

Due to the fact that plastic bags and packaging weigh relatively little, the cost of removal (pickers or wind-sifters) and the stringent plastic limit in PAS100, operators may find it useful to also count the

number of plastic bags in the sample. This can be a useful tool when discussing feedstock quality with biowaste providers, e.g. 3% plastic bags by weight does not sound much but equates to approximately 3,500 bags / tonne and provides a reference which biowaste providers can easily understand.

As mentioned above, Annex A to this protocol shows AfOR's templates that can be used to report the results and other relevant information about the assessment. These templates are available in a excel-based format.

Annex B shows an example of a 'contamination chart' that can be drawn from the results of biowaste assessments. This can be used to monitor the results related to a specific source over time. The chart is also available as an excel-based template.

AfOR, TEG Environmental and Novamont staff sorting non-compostable and compostable materials from a sample of bagged food wastes.

Acknowledgements

The expert contributions of the following organisations, who kindly worked with AfOR to trial and finalise this protocol, are gratefully acknowledged:

- CIC
- Novamont
- TEG Environmental
- Agrivert

AfOR would also like to thank Viridor, Vital Earth and all other interested parties that provided useful feedback on the protocol.

ANNEX A: AfOR Biowaste assessment report template (versions 'a' and 'b')

Version 'a' is for assessments where only the total NCM has been determined; version b is for assessments where the single categories of contaminants have also been determined.

Association for Organics Recycling

Template issued on <insert date> | Template issued by: <insert name>

BIOWASTE ASSESSMENT REPORT TEMPLATE (a)

Assessment reference number:	<insert reference number>
Assessment date:	<insert audit date>
Operator:	<insert organisation name>
Assessment location:	<insert location name & address>
Load delivery date:	< insert delivery date>
Biowaste supplier:	<insert biowaste supplier name>
Waste transfer note / weighbridge ticket no:	<insert WTN/weighbrigde ticket number/s>
EWC delivered biowaste:	<insert EWC e.g. 20 01 08>
Biowaste description: *please also inlcude whether the biowaste is bagged or loose, or a mixture of bagged and loose*	<insert biowaste description e.g. food waste only, bagged in compostable liners>
Biowaste source (if different from supplier):	<insert biowaste source>
Biowaste collection date:	<insert biowaste collection date>
Biowaste collection method:	<insert biowaste collection method e.g. kerbside, food waste only, or co-mingled food/green wastes>
Biowaste assessment method:	<insert method e.g. AfOR biowaste audit protocol, method 2.2.1
The assessment has been undertaken by:	<insert name of individual/s who has/have carried out the assessment>
The assessment has been supervised by:	<insert name of individual who has supervised the assessment>

Total load/s amount (t):	14.00	*Example*
Sample amount (Kg):	500.00	*Example*
CM (Kg):	467.00	*Example*
NCM (Kg):	33.00	*Example*
Fraction of non-compostable material as a percentage by weight of the total amount (% NCM w/w):	**6.6%**	*Example*
Biowaste quality grade (based on table A)	**<insert grade *e.g. Grade C*>**	

Table A: Biowaste quality grade

Parameter	Grade A	Grade B	Grade C	Grade D
Non-compostable material (NCM)	<insert range of % by weight *e.g. 2 % by weight*>	<insert range of % by weight e.g. *2 - 5 % by weight*>	<insert range of % by weight e.g. *5 - 10 % by weight*>	<insert range of % by weight *e.g. > 10 % by weight*>

The biowaste operator can, in agreement with the biowaste supplier if appropriate, specify a system of quality grades that can be assigned to the delivered biowaste loads based on the level of NCM (% by weight) returned by the biowaste assessment.

Association for Organics Recycling

Template issued on <insert date> | Template issued by: <insert name>

BIOWASTE ASSESSMENT REPORT TEMPLATE (b)

Assessment reference number:	<insert reference number>
Assessment date:	<insert audit date>
Operator:	<insert organisation name>
Assessment location:	<insert location name & address>
Load delivery date:	< insert delivery date>
Biowaste supplier:	<insert biowaste supplier name>
Waste transfer note / weighbridge ticket no:	<insert WTN/weighbrigde ticket number/s>
EWC delivered biowaste:	<insert EWC e.g. 20 01 08>
Biowaste description: *please also inlcude whether the biowaste is bagged or loose, or a mixture of bagged and loose*	<insert biowaste description e.g. food waste only, bagged in compostable liners>
Biowaste source (if different from supplier):	<insert biowaste source>
Biowaste collection date:	<insert biowaste collection date>
Biowaste collection method:	<insert biowaste collection method e.g. kerbside, food waste only, or co-mingled food/green wastes>
Biowaste assessment method:	<insert method e.g. AfOR biowaste audit protocol, method 2.2.1
The assessment has been undertaken by:	<insert name of individual/s who has/have carried out the assessment>
The assessment has been supervised by:	<insert name of individual who has supervised the assessment>

Total load/s amount (t):	14.00	*Example*
Sample amount (Kg):	500.00	*Example*
CM (Kg):	467.00	*Example*
NCM (Kg):	33.00	*Example*
Fraction of non-compostable material as a percentage by weight of the total amount (% NCM w/w):	**6.6%**	*Example*
Biowaste quality grade (based on table A)	**<insert grade *e.g. Grade C*>**	

Of which:	**Kg**	**% of NCM**	**% of total sample**	**Notes**
Glass	0.15	0.45%	0.03%	*Example*
Metal	2.00	6.06%	0.40%	*Example*
Plastic bags	7.00	21.21%	1.40%	*Example*
Other plastics	9.00	27.27%	1.80%	*Example*
Paper	6.00	18.18%	1.20%	*Example*
Card	4.10	12.42%	0.82%	*Example*
Inert Materials	3.00	9.09%	0.60%	*Example*
Textiles	0.20	0.61%	0.04%	*Example*
Other (please specify)	1.50	4.55%	0.30%	*Example*

Table A: Biowaste quality grade

Parameter	**Grade A**	**Grade B**	**Grade C**	**Grade D**
Non-compostable material (NCM)	<insert range of % by weight *e.g. 2 % by weight* >	<insert range of % by weight e.g. *2 - 5 % by weight* >	<insert range of % by weight e.g. *5 - 10 % by weight* >	<insert range of % by weight *e.g. > 10 % by weight* >

The biowaste operator can, in agreement with the biowaste supplier if appropriate, specify a system of quality grades that can be assigned to the delivered biowaste loads based on the level of NCM (% by weight) returned by the biowaste assessment.

ANNEX B: Contamination chart example