Impurities

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SUMMARY

EU directives require a reduction in landfill and where possible recycling of waste in the form of composted materials. Methods of test are required to indicate the amount of impurities.

In order to increase the use and repeated use of treated biowaste, customers must have confidence in the product. An adverse experience such as a cut hand on a glass shard will lead to customer rejection, adverse publicity and possibly financial liability.

No standard methods exist for the determination of impurities but several methods are used over the world.

The proposed draft standard is based on the German method for compost testing. After drying the material the fraction of coarse stones (>5 mm) and other impurities (>2 mm, glass, plastic, metal) are determined. It is a simple and robust method with a lot of experience.

1. INTRODUCTION

In order to increase the use and repeated use of treated biowaste, customers must have confidence in the product. An adverse experience such as a cut hand on a glass shard will lead to customer rejection, adverse publicity and possibly financial liability. The presence of such contaminants in material going to landfill is not a problem.

From the user's perspective, visual impurities in the compost and compost products are extremely off-putting, and have to be avoided as far as possible in order to guarantee a safe sale in the range of horticulture. (Brethouwer et al., 1995).

Impurities are all materials that are not wanted. These are in principal not organic materials e.g. Glass, Plastics, Metal, and Rubber etc. Stones, Lava and Clay granulate may not impurities.

Biological degradable Plastics are also impurities if they are visually recognisable.

2. EXISTING METHODOLOGY

Different methods are available for the determination of impurities in compost. Important factors when choosing a standard are, if possible; good characterisation, reproducibility, simplicity, low cost and experience level. In table 1 a short characterisation of the existing methods can be found. In table 2 the score concerning suitability for a European standard can be found.

The BK method originates from Germany and is used in The Netherlands. (Kehres and Pohle, 1998). After drying the compost, the fraction of coarse stones (>5 mm) and other impurities (>2 mm) are determined. It is a simple and robust method with a lot of experience. The fraction of impurities is however not further differentiated.

The PAS 100 method originates from the United Kingdom; it is not a British Standard (PAS 100, 2002). It is a Publicly Available Specification published by British Standards being written in the main by The Composting Association. It is a combined method for the determination of the particle size distribution and physical contaminants in composted materials. After drying, the fractions of glass, metal, plastic, stones and other impurities are determined. The method gives a good differentiation of the impurities but is more complex, more expensive than the BK method and also there is less experience with this method.

The French BNSCAO method, (CEN/TC 223 N264, 2002) has a bleach treatment included after the material has been dried to be able to easy distinction of the inert materials. After the destruction of the organic matter the material is densitometry sorted using water and concentrated calcium chloride solutions. The densitometry-sorted material is sieved and with the aid of a magnet sorted into its component parts Disadvantages of this method is the ‘dangerous’ additional work of the destruction and the costs and time involved.

Table 1: Characterisation of the existing methods for the determination of impurities.

Method	Drying	Treatment	Sieving	Differentiation
BK	105 °C	-	2, 5 mm	Stones >5mm, other impurities >2 mm
PAS 100	40 °C	-	31.5, 16, 8, 4, 2, 1 mm	Glass, metal, plastic, stones, other
BNSCAO	80 °C	Destruction with bleach and densitometric sorting	40, 25, 12.5, 5, 2 mm	Stones, Glass, Metals, Films and PSE, Other plastics

Table 2: Score concerning suitability for a European standard of the present methods for the determination of impurities.

Method	Good characterisation	Simplicity	Cost	Experience
BK	+	++	++	++
PAS 100	++	+	+	-
BNSCAO	++	--	-	-

A comparison of standards for compost throughout the world has been made by WRAP (Hogg et al., 2002). It appears that specification of the different impurities is important. The different types have also a different ‘value’ concerning the quality observed through customer’s eyes. The size of the different impurities is of lesser importance. A simple method with two sieves and characterisation is perfectly adequate. Destruction and densitometric sorting can be added to the procedure but it makes the method unnecessarily complex.

3. CONCLUSIONS

A method where the different impurities are sorted out in 2 fractions is proposed. The BK method as used in Germany (Kehres and Pohle, 1998) is the preferred option. An adaptation should be made concerning the differentiation of the types of impurity. If also the particle size distribution is wanted the method as being used in the United Kingdom (PAS 100, 2002) could be of use.

4. THE METHOD IS EVALUATION OF DRAFTING A HORIZONTAL STANDARD

4.1 Sample size

The range of samples received into the laboratory will vary from finely ground material as will be found in sewage sludges to very coarse materials for example composted bark. Within the UK composters are preparing products with a sample size range from 6mm up to 65mm. For landfill the particle size could be even greater. It would be advantageous if the recommended method were to be able to cope with this wide range of particle size.

The proposed method only deals with materials up to 40 mm in diameter. If a wider range of particles is wanted some research will have to be performed how to adapt the volumes in analyses. This will also have its influence on the method of sampling.

4.2 Drying temperature

In the proposed method a temperature of 105 ^{o}C is used. The temperature of drying can influence the properties of certain plastic materials i.e. they may melt or degrade. This is an area that needs research.

When the composted materials are used, for example as a soil improver or growing medium this temperature will never be reached.

4.3 Interpretation

Of the numerous papers published on the topic the WRAP (Waste and Resources Action Programme) in the UK made an overview (Hogg et al. 2002). In table 3 the requirements as being in operation can be found.

Law already regulates many requirements. A proposal for a European standard could be the proposal of Australia:

- Glass, metal and rigid plastics >2 mm ≤ 0.5% dm
- Plastics — light, flexible or film >5 mm, ≤ 0.05% dm
- Stones and lumps of clay ≤ 5% dm.

Table 3: Requirements concerning impurities throughout the world (Hogg et al., 2002).

Country	Requirement
Austria	Statutory, impurities >2mm, agric.: max. 0.5%; non-food: max. 1.0%
Belgium	Statutory, stones >5 mm, max. 2%, impurities >2mm, max. 0.5%
Denmark	Statutory – plastic, metal, glass portion >2 mm may not exceed 0.5% weight in dm
Finland	Statutory max 0.5% fm
France	Yes
Germany	Statutory, 0.5% weight/dm plastic, glass, metal; stones >5mm <5% weight – statutory
Greece	Plastic <0.3%dw; glass <0.5%dw
Ireland (licensing)	<1.5% of >25 mm in dry matter
Italy	Statutory, plastics (mesh size <10 mm): <0.5% weight/dm; Inert materials (mesh size <10 mm): <1% weight/dm Inert materials (mesh size >10 mm): absent
Luxembourg (licensing)	Statutory, plastic, glass, metal (>2mm) <0.5% weight/dm; stones (>5mm) <5% weight dm
Netherlands	Voluntary – glass (>2mm) <0.2% dm, stones (>5mm) <2% dm, glass (>16m) absent
Portugal	No
Spain	Statutory, plastic particles and other inert materials must not be over 10 mm
Sweden	Voluntary, plastics, glass and metals (>2mm) <0,5% dm
UK (Composting Association)	Voluntary, of total air-dried sample: ≤1% m/m glass, metal and plastic, of which plastic 0.5% m/m; and stones ≤5% m/m. (Impurity if >2 mm)
Canada	CCME (Statutory) and BNQ (Voluntary) – foreign matter is defined as aany matter over a 2 mm dimension that results from human intervention and having organic or inorganic constituents such as metal, glass and synthetic polymers (e.g. plastic and rubber) that may be present in the compost but excluding mineral soils, woody material and rocks.). Three classes specified in terms of % oven-dried mass
USA	No
Australia	Voluntary – Glass, metal and rigid plastics >2 mm ≤0.5%dm; Plastics — light, flexible or film >5 mm, ≤0.05% dm; Stones and lumps of clay ≤5% dm Suppliers and their customers are advised to agree upon an acceptable maximum level of visual contamination by light weight plastic
New Zealand	100% passes through 15mm x 15mm orifice

5. CRITICAL POINT AND RECOMMENDATIONS

5.1 Criteria for test methods

- The test methods should be simple to operate
- The test methods should be able to accommodate a wide range of sample types (The proposed method as written and tested is not applicable to samples > 40 mm but it could be adapted to take much larger sample volumes.)
- The cost of the method and apparatus used to be taken into account
- The method should give a good characterisation.
- If possible there should be some experience

5.2 Method Recommendations

- After drying the sample the fraction of coarse stones (>5 mm) and other impurities (>2 mm) are determined.
- Differentiation of the type of impurity.

5.3 Method Development

- The method as proposed deals only with materials unto 40 mm. If a wider range of particles is wanted some research will have to be performed how to adapt the volumes in analyses. This will also have its influence on the method of sampling.
- Influence of temperature on physical characteristics of plastic impurities.

DRAFT STANDARD

NOTE1 Where italics appear in the draft method indicates an area that requires additional work and confirmation.

NOTE 2 Whilst the title of the method and body of the text states 'wastes, soils and composted organic materials' it does not mean that the method may not be suitable for other sample types.

A method to determine the visual recognisable impurities in wastes, soils and composted organic materials

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Safety warning

Care should be taken when handling samples that may contain sharp fragments, chemical contaminants or possible pathogenic organisms.

1. Scope and field of application

A method to determine the visually recognisable impurities in wastes, soils and composted organic materials. The sample shall be obtained in accordance with SOIL IMPROVERS AND GROWING MEDIA - SAMPLING (EN 12579). The procedures described herein are not necessarily applicable to or suitable for all types of wastes and composted materials.

2. Normative references

This method incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this method only when incorporated in it by amendment or revision. For undated references the latest edition of the publications referred to apply.

ISO 5725:1994	Precision of test methods - determination of repeatability and reproducibility for a standard test method by inter-laboratory tests.
EN 12579:2000	Soil improvers and growing media - Sampling
EN 13040:1999	Soil improvers and growing media - Sample preparation for chemical and physical test, determination of dry matter content, moisture content and laboratory compacted bulk density

3. Principle

After drying the test material the fraction of coarse stones (>5 mm) and other impurities (>2 mm) are determined. The impurities are further differentiated into type.

4. Definitions

For the purpose of this standard the definitions given in PD CR 13456, EN 12579, EN13040 and PAS 100 apply.

5. Reagents

-None

6 Apparatus

6.1 Sieves, 2, 5, 12, 25 and 40 mm apertures

6.2 Analytical balance, with an accuracy of 0.01 g

6.3 Drying oven, ventilated, fan assisted, capable of holding sample trays *105 ±3 ^{o}C.*

6.4 Sample tray, constructed of material thermally stable up to 150 ^{o}C, surface approximately 1250 cm^2

6.5 Beaker, 100 ml or measuring spoon of similar dimension

6.6 Tweezers

7 Procedure

7.1 Sample preparation

7.1.1 Prepare the test sample in accordance with EN 13040:1999, clause 8.1, 8.2. Where 20% w/w or less of the laboratory sample has been retained the procedure can be continued. If not the method is not appropriate.

NOTE1 Larger quantities may be required for very coarse samples
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NOTE 2 The drying temperature may have to be adjusted to accommodate low melting point plastics.

7.1.2 Determine the test amount of test sample depending on the coarseness of the sample. For 0-40 mm 3 l is taken, for a sample with a fraction 0-25 mm 2 l is taken and for fine materials 0-12 mm 1 l is taken and put in the sample tray **(6.4)**.

NOTE the method is performed in duplicate.

7.1.3 Dry the materials for at least 16 hours until constant weight in the drying oven **(6.3)** and note the weight.

7.1.4 Determine the dry weight with the balance **(6.2)**.

7.3 Sieving

Using the beaker (**6.5) transfer** approximately 100 ml of the dried sample **(7.1.2)** onto the 5 mm sieve **(6.1)**. Spread the >5 mm fractions one by one on a flat surface and gather the stones > 5 mm with help of the tweezers **(6.6)**. Continue this procedure until the entire sample **(7.1.2)** has been sieved. Determine the total weight of separated stones using the balance **(6.2)**.

Recombine the stone free material. Repeat the sieving procedure using the 2 mm sieve **(6.1)**. Spread the fractions >2 mm one by one on a flat surface and search out all visually recognisable impurities using the tweezers **(6.6)**. Sort out the following materials: glass, rigid plastic, plastic light (flexible or film), metal. Determine the weight of the individual type of impurities using the balance **(6.2)**. With some samples it may be possible to combine the sieves and undertake a single sieving.

8 Calculations and expression of results

The mass of the impurities is expressed on the total dry weight (before sieving). The average results are calculated of the duplicates.

$$I_{S>5\ mm} = \frac{W_{S>5\ mm}}{T} \times 100\%$$

$$I_{G>2\ mm} = \frac{W_{G>2\ mm}}{T} \times 100\%$$

$$I_{P>2\ mm} = \frac{W_{P>2\ mm}}{T} \times 100\%$$

$$I_{R>2\ mm} = \frac{W_{R>2\ mm}}{T} \times 100\%$$

$$I_{M>2\ mm} = \frac{W_{M>2\ mm}}{T} \times 100\%$$

Where

I is the impurity part (%)
W is weight of impurity type
T is the total dry weight
S is stones
G is glass
P is rigid plastic
R is plastic light (flexible or film)
M is metal

Note and record any impurities that cannot be categorized as above e.g. plastic coated wire.

9 Precision

No data

10 Test report

The test report shall include the following information:

a) a reference to this Standard;
b) a complete identification of the sample;
c) the results of the different fractions expressed as % on dry matter basis on 2 decimal places
d) any details not specified in the Standard, or which are optional, as well as any other

factor, which may have affected the results.

Bibliography

Kehres, B. and A. Pohle red., 1998. Methodenbuch zur analyse von compost. Bundesgütegemeinschaft Kompost e.V., Köln Germany.

REFERENCES

Brethouwer, T. D., Van Tubergen, J. (1995) ‘Composting and the quality in the Netherlands’, in Bidlingmaier, W., (1995) Proceedings Tagungsband First International Symposium Biological Waste Management: A Wasted Chance? Bochum. Veranstaltet von der Universität Essen, Technische Universität von Hamburg-Harburg, Stegmann, R., S 53, pp.1 10.

CEN/TC 223 N264, 2002

Kehres, B. and A. Pohle red., 1998. Methodenbuch zur analyse von compost. Bundesgütegemeinschaft Kompost e.V., Köln Germany.

PAS 100, 2002. Specification for composted materials. Concept BSI, United Kingdom.

Hogg, D., J. Barth, E. Favoino, M. Centemero, V. Caimi, F. Amlinger, W. Devliegher, W. Brinton and S. Antler, 2002. Comparison of Compost Standards Within the EU, North America and Australasia, Main Report – Section 1, WRAP Oxon, United Kingdom.