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Solid materials – Determination of bulk density

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Foreword

This document is a working document.

This document TF WI has been prepared by CEN/BT/Task Force 151 – Horizontal Standards in the Field of Sludge, Biowaste and Soil, the secretariat of which is held by Danish Standards.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex A, B, C or D, which is an integral part of this document.

This standard is applicable and validated for several types of matrices. The table below indicates which ones.

[table to be filled and amended by the standards writer]

Material	Validated for (type of sample, e.g. municipal sludge, compost)	Document
Sludge	Not validated yet	(reference)
Soil	Validated for peat and mixture of peat and clay	
Soil improvers and growing media	Validated	
Sediment	Not validated yet	
Biowaste	Validated	
Waste	Not validated yet	

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Introduction

NOTE: This is a draft version; the introduction will need to be adjusted....

This document is developed in the project 'Horizontal'. It is the result of a desk study "Desk study on bulk density" and aims at evaluation of the latest developments in assessing ex-situ bulk density in sludge, soil, treated biowaste and neighbouring fields. After discussion with all parties concerned in CEN and selection of a number of test methods described in this study the standard has been developed further as an modular horizontal method and has been validated within in the project 'Horizontal'.

A horizontal modular approach is being investigated and developed in the project 'Horizontal'. 'Horizontal' means that the methods can be used for a wide range of materials and products with certain properties. 'Modular' means that a test standard developed in this approach concerns a specific step in a test procedure and not the whole test procedure (from sampling to analyses).

The use of modular horizontal standards implies the drawing of test schemes as well. Before executing a test on a certain material or product to determine certain characteristics it is necessary to draw up a protocol in which the adequate modules are selected and together form the basis for the test procedure.

The other horizontal modules that will be available in due time are to be found in the informative annex [xxx] which contains a brief overview of the modules that will be worked out in the project 'Horizontal.'

The texts of the chapters 1 to 10 are normative; annexes are normative or informative, as stated in the top lines of the annexes.

1 Scope

This European Standard specifies a method for the determination of bulk density of sediment, soil, sludge, bio waste, growing media and soil improvers in bulk and in packages.

This standard is applicable to material that is in solid form reconstituted if necessary, but not to blocks sold as such by dimension. This method is not applicable for material with more than 10 % (V/V) of particles greater than 60 mm in size.

NOTE The requirements of the standard may differ from the national legal requirements for the declaration of the products concerned.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at 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 European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN XXXXX: 200X. Determination of dry matter in sediment, sludge, soil, and waste – gravimetric method

EN XXXXX: 200X. Sample preparation.....

3 Terms and definitions

For the purpose of this standard, the following terms and definitions apply:

3.1 Bulk density

Density of material as received or reconstituted for use in accordance with the manufacturer's instructions, is determined by the method in this standard.

3.2 Volume

Out-turn volume determined by the method specified in this standard.

4 Principle

This material is weighed, its bulk density is determined and volume is then calculated from these values.

NOTE The structure of the material may change with time and handling and this may affect the volume of the material.

5 Apparatus

5.1 Measuring cylinder

Rigid, 20 l \pm 0,4 l with a height to diameter ratio between 0.9:1 and 1:1. The volume, V_1 , shall be known to the nearest 10 ml at 20 °C.

NOTE 1 A standard 300 mm internal diameter pipe of height 283 mm with an end cap may be suitable.

NOTE 2 The apparent weight of 1 l of water at 20 °C is 997.15 g. Therefore, no air buoyancy correction need be made.

5.2 Collar

Rigid, of the same diameter as the measuring cylinder (5.1) and with a height of 75 mm \pm 2 mm.

5.3 Fall controller

Of either 20 mm \pm 0.6 mm or 40 mm \pm 1.3 mm or 60 mm \pm 2 mm mesh size as required (see clause 7), held not more than 50 mm above the collar.

NOTE For example, test sieves according to ISO 3310-1 may be used.

5.4 Weighing machine

For packaged material, the scale shall conform to table 1 with class III tolerance as specified in EN 45501.

For bulk material, the weighing machine shall conform to class III tolerance as specified in of EN 45501

Table 1 – Maximum scale intervals for weighing machines

Mass	Maximum scale interval for analogue scales	Maximum scale interval for digital scales
Kg	g	g
>1 to 2.5	10	5
>2.5 to 5	20	10
>5 to 10	50	20
>10 to 40	100	50
>40	200	100

5.5 Straight-edge

Rigid, of rectangular cross-section, or a knife, and at least 200 mm longer than the diameter of the collar.

6 Sampling and sample pre-treatment

The following is applicable to growing media and soil improvers:

Sampling shall be carried out in accordance with the method specified in EN 12579 for bulk material, the final sample, at least 30 litres, shall be used for a bulk density determination.

Packaged material the content of a package as defined in EN 12579 under 6.4.2 shall be used, and if this is less than 30 l the content of the number of packages needed to give 30 l of material shall be used.

The following is applicable to sludge, soil and bio waste:

Sampling shall be carried out in accordance with the method specified in EN XXXX for sludge, soil and biowaste, the final sample, at least 30 litres, shall be used for a bulk density determination.

7 Procedure

Using the appropriate weighing machine (5.4), determine the gross weight of the material and note the mass m_1 . Determine the tare weight (e.g. of the bags, containers, truck or train) and note the mass m_2 . For packaged material where the quantity in each package of the final sample is being measured, weigh each package separately for both gross weight and tare weight. The net weight of the material is calculated as $(m_1 - m_2)$. Alternatively the net weight of the product can be determined directly.

- 7.2 Weigh the measuring cylinder (5.1), note the mass m_3 , and assemble the collar (5.2) on the cylinder. Place the equipment on a stable horizontal surface so that it does not rock.
- 7.3 Any material in the final sample, which has been compressed or dried shall be loosened or moistened for usage according to the manufacturer's instructions.
- 7.4 Determine which fall controller (5.3) to use. Using some of the material, see which is the smallest mesh which will retain less than about 10% (V/V) of the material, after the material has been moved about. If more than 10% (V/V) is retained on the 60 mm mesh this method is not suitable for the product.
- 7.5 The procedure as given in 7.6 to 7.8 inclusive shall be carried out without delay.
- 7.6 Tip a portion of not more than 5 litres of the final sample over the fall controller and move the material (without de-grading it) to allow it to pass through the screen. Any material retained by the screen shall be gently emptied into the measure. Further portions shall be treated in a similar manner until the measuring cylinder and collar are full.
- 7.7 Level off the material at the top of the collar and remove the collar. Using a light sawing action (to avoid compaction) work straight-edge (5.5) through the middle of the product down one diameter of the measuring cylinder, to the top of the cylinder. Move the straight-edge, with a light sawing action, carefully to the edge of the cylinder, to the top of the cylinder. Care shall be taken not to drag fibrous or lumpy material from below the top of the measure. Repeat this operation in the opposite direction to remove the remaining surplus material. Any hollows created shall be re-filled using some fine discarded material.
- 7.8 Weigh the measuring cylinder and its contents, and note its mass m_4 .

8 Calculation and expression of results – Bulk density

Calculate the arithmetic mean of all the results obtained using the following equation:

$$D_B = \frac{(m_4 - m_3)}{V_1}$$

where

m_3 is the mass in grams of the measuring cylinder (5.1);

m_4 is the mass in grams of the measuring cylinder (5.1) and its contents

V_1 is the volume in litres of the measuring cylinder (5.1) determined to the nearest 10 ml.

The average of the determinations shall be used to calculate the volume of the material.

9 Test report

The test report shall contain the following information:

- a) a complete identification of the sample;
- b) a reference to this European Standard;
- c) the results expressed in accordance with clause 8;
- d) any unusual features noticed during determination;
- e) any operation not included in this method or that is regarded as optional;
- f) the calibration of the volume of the measuring cylinder;
- g) the calibration of the weighing instrument using masses of class M1 or above accuracy level as given in EN 45501;
- h) the identity of the person carrying out the volume determination;
- i) the date and time of sampling, and the postal address of the place of sampling;
- j) the date and time of measurement, and the postal address of the place of measurement;

10 Performance characteristics

Performance data in terms of repeatability and reproducibility

Annex A
(informative)

Validation of methods

Annex B
(informative)

The modular horizontal system

Annex C
(informative)

Information on WP xx and the project Horizontal

Bibliography