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Chemical Analyses - Determination of laboratory compacted bulk density

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Contents

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Foreword

1 Scope

1.1 This standard specifies a methods to estimate the laboratory compacted bulk density of a laboratory sample of soil, sludge, soil improvers and growing media in its “as received state” and enable a calculated weight of sample to be taken which will accurately represent the required (small) volume of sub-sample prescribed in the analytical methods.

1.2 This method enables computation and expression of analytical results on a weight in volume basis when results are obtained from analysis of a known weight of sub-sample.

1.3 When used for wet and sticky material, such as sludges, the use of the supported sieve is omitted.

2 Normative reference

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 Definition

To be inserted, if applicable

4 Principle

A one-litre test cylinder – fitted with an extension collar, fixed screen/flow breaker and funnel shall be filled with the material. The fixed screen/flow breaker shall be omitted for materials that contain more than 10 % by weight greater than 20 mm in any dimension. Except for very compressible or springy materials static compaction is applied and the final contents of the cylinder are weighed.

5 Apparatus

5.1 Test cylinder

A rigid test cylinder (see figure 1), having a capacity of 1000 ml ± 30 ml, made from pipe of 100 mm ± 1 mm diameter, and 127 mm ± 1 mm in height. Other dimensions are as in Figure 1.

The capacity should be checked by weighing, to the nearest 1 g, the empty cylinder and a clear rigid striking plate, which is larger than the surface of the cylinder. Fill the cylinder with tap water; apply the striking plate wiping all the exterior surfaces until dry and reweigh. The difference between the two weighings should equal 1000 g ± 30 g. Repeat the test, the difference between the two tests should not exceed ± 5 g.

5.2 Removable collar

50 mm high and of the same internal diameter as the cylinder.

5.3 Analytical balance

with a scale interval of 1 g and a capacity of weighing 5000 g

5.4 Straight edge

5.5 Scoop
250 ml to 500 ml capacity.

6 Procedure

6.1 Manually, but carefully homogenize and gently open up any agglomerations or accretions, which have resulted from handling or transportation of the sample. (8.1) Care shall be taken to avoid reducing the inherent size of particles, which would render the material finer than it was at the time of manufacture.

6.2 Take about 5 L of the homogenized sample (4.1) and, using the scoop (3.8) pass the material through the screen (3.5) with gentle agitation, if required. If more than 10 % volume is retained on the screen then the procedure is inappropriate to the material under test. If less than 10 % is retained, this material shall be broken down as described in (8.3) above.

6.3 Weigh the empty test cylinder (3.1) to the nearest 1 g using the balance (3.6). Place the collar (3.2) and the funnel (3.4) in position. Place the screen (3.5) in position 5 mm above the funnel.

6.4 Gently spread out approximately 5 L of the screened homogenized material (4.2) once again and, using the scoop (3.8), take equal amounts of the material throughout the mass, filling the apparatus by sprinkling the material on top of the screen/flow breaker (3.5). Material from each aliquot not immediately passing through the screen may be gently agitated with fingertips to assist the process. Material of each aliquot retained on the screen (but not exceeding 10 % of the total volume) shall be reduced in size (by halving for a minimum number of times), by hand or with the aid of any simple tool so that it just passes the screen before the next aliquot is applied.

6.5 Once the apparatus is overfilled, remove the screen and strike off the excess material level with the top of the collar using the straight edge (3.7). Place the plunger (3.3) gently on the material, leave for 180 s ± 10 s then carefully remove the plunger and collar, taking care not to vibrate the cylinder, then use the straight edge (3.7) to strike off the material level with the top of the cylinder avoiding further compaction or disturbance. Weigh the material and cylinder to the nearest 1 g using the balance. Record the result (m_x).

If the material is very compressible and the top surface is found to be below the top of the cylinder when the plunger is removed after static compaction of 180 s ± 10 s, then compaction is inappropriate for the test material. In these circumstances repeat the procedure without application of the plunger to provide a measure of the un-compacted bulk density. The deviation shall be recorded.

With very coarse, fibrous, woody or otherwise heterogeneous materials, striking off may be difficult and large pieces might have to be removed by hand, cut with a pair of scissors or broken off level with the top of the cylinder. Any depressions on the surface of the cylinder resulting from this should be filled from the remainder of the sample.

6.6 Repeat 3 times, using fresh material each time, to obtain a mean value.

7 Calculation

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

$$m_L = \frac{\sum m_x}{n}$$

where

m_L is the arithmetic mean mass in grams of sample and cylinder;
m_x is the mass in grams of the cylinder ad sample;

• m_x is the sum of the mass in grams of *n* replicates where *n* is the number of replicates.

The laboratory bulk density is given by the following equation:

$$L_D = \frac{m_L - m_0}{V}$$

L_D is the laboratory bulk density in grams per litre:
m_0 is the mass in grams of the empty test cylinder;
m_L is the arithmetic mean mass in grams of sample and cylinder;
V is the volume in litres of the test cylinder.

8 Use and storage of material

8.1 Because of the physical characteristics of material subjected to this procedure will have been altered, the material used in this test should not be used subsequently for the determination of any physical properties such as moisture content, particle size analysis or water retention. However, it may be used for other analysis, where a dried sample is appropriate.

8.2 If not for immediate use the sample should be re-placed into a moisture-proof bag or container and the container re-sealed and stored below 5°C but not frozen.

9 Precision

The repeatability and reproducibility of the compacted laboratory bulk density content measurement in three separately prepared samples should be in accordance with …….

A summary of the results of an in interlaboratory trial to determine the precision of the method in accordance with ISO 5725 is given in Annex A.

NOTE The values derived from the interlaboratory trial may not be applicable to concentrations and matrices other than those given.

10 Test report

The test report shall contain the following information:

a) a reference to this European Standard;
b) all information necessary for complete identification of the sample;
c) the results of the determination to the nearest 5 g per L;
d) details of any operation not specified in the European Standard or regarded as optional, as well as any factor which may have affected the results.

ANNEX A
(Informative)

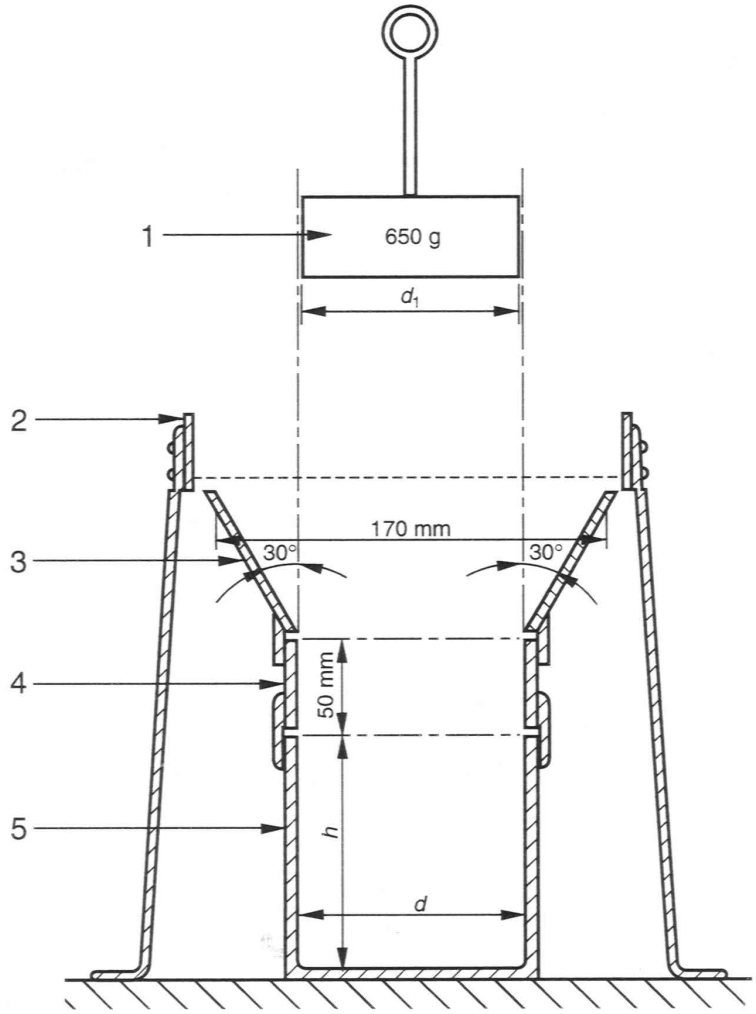
Results of an interlaboratory trial to determine laboratory compacted density

An interlaboratory trial was organized in 1995 under the auspices of the European Committee for Standardization; to test the procedure specified in the European Standard EN 13040:1999 for laboratory compacted bulk density. The method s equivalent to the method described in the present standard.

In the trial the number of laboratories given in Table A.1 determined the laboratory compacted bulk density in three types of samples.

Sample	**Unfertilized peat perlite**	**Composted coarse bark**	**Composted straw and domestic sewage**
Number of laboratories retained after eliminating outliers	14	14	14
Number of outliers (laboratories)	0	0	0
Mean value (g/litre)	204,01	382,06	608,7
Repeatability standard deviation, S_r (g/litre)	1,82	4,31	4,30
Repeatability relative standard deviation (%)	2,50	3,16	1,98
Repeatability limit, r = 2,8 S_r (g/litre)	5,11	12,08	12,03
Reproducibility standard deviation, S_R (g/litre)	9,92	26,98	19,26
Reproducibility relative standard deviation (%)	13,62	19,77	8,86
Reproducibility limit, R = 2,8 S_R (g/litre)	27,78	75,53	53,94

Figure 1



Key

1 plunger
2 supported sieve
3 funnel
4 collar
5 test cylinder
d diameter 100 mm ± 1 mm
h height 127 mm ± 1 mm
d1 diameter 95 mm ± 1 mm

Figure 1. – Bulk density test cylinder, collar, sieve and plunger