Designation: D4531 – 15

Standard Test Methods for Bulk and Dry Density of Peat and Peat Products[1]

This standard is issued under the fixed designation D4531; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 These test methods cover the determination of the bulk and dry density of both peat in its natural state and peat products (Note 1). These test methods consist of defining a volume of peat and determining the mass of that specific volume. The difference in the respective methods is in the procedures employed to determine the peat volume.

NOTE 1—Test Method D2978 is used for specifying the volume represented by a quantity of loose processed peat or the volume of a peat bale.

1.2 *Method A*—The core method covers the determination of the bulk density of a core of peat taken with a piston sampler or other suitable core sampler (Sections 6 and 7).

1.3 *Method B*—The paraffin wax method, covers the determination of the bulk density of clods or irregular pieces of wet peat and compressed peat products (Sections 8 and 9).

1.4 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5 The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a evaluating some of those factors.

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

1.6.1 The procedures used to specify how data are collected/recorded or calculated, in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analysis methods for engineering design.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D2978 Test Methods for Volume of Processed Peat Materials

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D6026 Practice for Using Significant Digits in Geotechnical Data

3. Terminology

3.1 For definitions of common technical terms used in this standard, refer to Terminology D653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bulk density,* ρ—as used for peat products is the total mass (solids plus water) per unit of total volume of a peat at a given moisture condition.

3.2.2 *dry density,* ρ_d—mass of dry organic and mineral matter per unit of total volume of a peat at a given moisture condition.

NOTE 2—In many peat science applications and publications, the term defined here as "dry density" in accordance with common geotechnical engineering usage is referred to as "bulk density". Care is necessary to

[1] These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.22 on Soil as a Medium for Plant Growth.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

distinguish which definition is being used when such a term is encountered.

4. Significance and Use

4.1 These test methods provide uniform procedures for determining the bulk density of in situ peat and processed peat products. The bulk density is of use in the calculation of in situ stresses for engineering analysis and in quantifying the amount of material present when considering peat as a resource. In the latter case, it is necessary to consider the moisture condition for which the bulk density was determined; a more useful parameter to consider may well be the dry density, ρ_d.

NOTE 3—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a evaluating some of those factors.

5. Apparatus

5.1 *Drying Oven*—A thermostatically controlled drying oven maintained at a temperature of 105 ± 5°C.

5.2 *Balances*—Balances sensitive to 0.01 g for specimen less than 100 g, sensitive to 0.1 g for specimen between 100 g and 1000 g, or sensitive to 1 g for specimen over 1000 g.

5.3 *Moisture Content Containers*—Suitable containers for laboratory moisture content determinations.

5.4 *Plastic Sample Bags or Sampling Jars.*

5.5 *Sampler*—Piston sampler or other suitable coring device which will give a cylindrical sample.

NOTE 4—Samples taken with the Macaulay type peat sampler are semicylindrical in shape. They may also be used in this method of determination.

5.6 *Sharp Knife*—An electric knife or barber's razor will be best for laboratory work.

5.7 *Paraffin Wax,* maintained at a temperature between 60 and 70°C, for use in Method B only.

5.8 *Graduated Cylinder,* for use in Method B only.

METHOD A—CORE METHOD

6. Procedure

6.1 Take a representative core of peat with a sampler.

6.2 With a sharp knife, cut specimens at least 50 mm in length from the various layers included in the core. Measure and record the specimen length to the nearest millimetre.

6.3 For specimen extruded in the field, place the specimen into a plastic sampling bag or sampling jar and seal to prevent moisture loss.

6.4 Transfer the whole specimen and any free water to a moisture content container in the laboratory and obtain and record the moist mass of peat, M, to the sensitivity of the balance used.

6.5 Dry the specimen in a drying oven at 105 ± 5°C until a constant mass is reached. Record the mass of dry peat, M_s.

7. Calculation

7.1 The bulk density, ρ, is calculated as follows:

$$\rho = (M/AL)\ \text{g/cm}^3 \quad (1)$$

where:

M = mass of the wet peat specimen, g,
L = length of specimen, cm, and
A = cross-sectional area of specimen, as determined from the diameter and form of the sampling device, cm^2.

7.2 The moisture content, w_d, by dry mass of the specimen is calculated as follows:

$$w_d = M - M_s/M_s \quad (2)$$

where:

M_s = mass of the oven dried peat specimen, g.

7.2.1 The moisture content, w_t, may also be expressed in terms of total mass, and is then calculated as follows:

$$w_t = M - M_s/M \quad (3)$$

7.2.2 It is of the utmost importance that the approach taken in calculating moisture contents be specified when reporting results or when the term is first used in a report.

7.3 The dry density, ρ_d, is calculated as follows:

$$\rho_d = (M_s/AL)\ \text{g/cm}^3 \quad (4)$$

METHOD B—PARAFFIN WAX METHOD

8. Procedure

8.1 Take a representative specimen of the peat and trim it into as smooth a shape as possible. Weigh and record the moist mass of the peat sample, M.

8.2 Dip the sample momentarily into melted paraffin maintained at a temperature between 60 and 70°C. Allow the excess paraffin to drain and the coating to dry. Repeat the dipping and drying until a continuous coating is formed.

8.3 Obtain and record the mass of the paraffin coated peat specimen, M_{pc}.

8.4 Submerge the coated specimen in water in a graduated cylinder and determine the volume of the paraffin coated specimen, V_{pc} by observing the volume of water displaced.

8.5 Remove the paraffin coating from the peat specimen using a sharp knife.

8.6 Place the remainder of the specimen in a moisture content container and record the moist mass of the peat, M' to the accuracy specified for the balance used.

8.7 Dry the specimen in a drying oven at 105 ± 5°C until a constant mass is reached. Record the mass of dry peat, M_s.

9. Calculation

9.1 To determine the bulk density of the peat, ρ, a correction for the volume of the paraffin coating must be made as follows:

$$\text{Mass of paraffin coating} = M_p = (M_{pc} - M) \cdot \quad (5)$$

$$\text{Volume of paraffin coating} = V_p = (M_p/\rho_p)$$

where:

M_{pc} = mass of paraffin coated specimen, g
ρ_p = density of paraffin, g/cm^3, and
M = mass of peat specimen, g.

$$\text{Volume of peat sample} = V = (V_{pc} - V_p) \quad (6)$$

$$\text{Bulk density, } \rho = (M/V)$$

where:

V_{pc} = volume of paraffin coated specimen, cm^3.

9.2 The moisture content, w_d, in this test method must be obtained in terms of dry mass to allow the dry density, ρ_d, to be calculated.

$$w_d = M' - M_s/M_s \quad (7)$$

where:

M' = moist mass of peat removed from paraffin, g, and
M_s = mass of dry peat, g.

9.3 The dry density, ρ_d, of the peat is calculated as follows:

$$\rho_d = (\rho/1 + w_d) \quad (8)$$

where:

w_d = moisture content in terms of oven dry mass.

10. Report

10.1 For each test record the following as a minimum:

10.1.1 Identify the sample and the personnel collecting the sample. Report the bulk density, ρ, to the nearest 0.01 g/cm^3 and also state the method used to determine.

10.1.2 Report the dry density, ρ_d to the nearest 0.01 g/cm^3 and also state the method used to determine.

10.1.3 Report the moisture content, w, to the nearest 0.1 %. It is of the utmost importance that it be stated whether the moisture content is in terms of the dry mass or the total mass of the peat.

11. Precision and Bias

11.1 *Precision*—The subcommittee is seeking pertinent data from users of the test method to determine the precision of this test method.

11.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for the procedure, bias has not been determined.

12. Keywords

12.1 bulk density; core sampling; dry density; paraffin-wax displacement method; peat; peat products

SUMMARY OF CHANGES

In accordance with Committee D18 policy, this section identifies the location of changes to this standard since the last edition (1986 (Reapproved 2008)) that may impact the use of this standard.

(1) Added references and standard statements to D653, D6026, and D3740.
(2) Changed title to include dry density.
(3) Revised Section 4.
(4) Replaced sample with specimen.