~~Designation:D806–00 (Reapproved 2006)~~ Designation: D806 – 11

Standard Test Method for Cement Content of Hardened Soil-Cement Mixtures [1]

This standard is issued under the fixed designation D806; 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 This test method covers the determination by chemical analysis of cement content of hardened soil-cement mixtures.

~~1.2All~~1.2 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

~~1.3The values stated in SI units are to be regarded as the standard.~~

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.* For specific hazard precautions, see Section 6.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C125 Terminology Relating to Concrete and Concrete Aggregates
C219 Terminology Relating to Hydraulic Cement
D653 Terminology Relating to Soil, Rock, and Contained Fluids
D2901 Test Method for Cement Content of Freshly Mixed Soil-Cement
D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing
D5982 Test Method for Determining Cement Content of Fresh Soil-Cement (Heat of Neutralization Method)
D6026 Practice for Using Significant Digits in Geotechnical Data
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
E145 Specification for Gravity-Convection and Forced-Ventilation Ovens
E832 Specification for Laboratory Filter Papers

3. Terminology

3.1 *Definitions*:

3.1.1 Refer to Terminology D653 for definitions of terms relating to soil.

3.1.2 Refer to Terminologies C125 and C219 for definitions of terms relating to cement.

4. Significance and Use

4.1 This test method determines cement content in mixtures of cement with soil or aggregate by chemical analysis. It was developed primarily for testing samples for which a significant degree of cement hydration or hardening has taken place. Test Methods D2901 or D5982 may be used for determining cement content of freshly mixed soil-cement mixtures.

4.2 This test method is based on determination by chemical analysis of the calcium oxide (CaO) content of the sample. The method may not be applicable to soil-cement materials containing soils or aggregates which yield significant amounts of dissolved calcium oxide (CaO) under the conditions of the test.

NOTE 1—The agency performing this test method can be evaluated in accordance with Practice D3740. Not withstanding statements on precision and bias contained in this test method: the precision of this test method is dependent on the competence of the personnel performing it and the suitability of

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization ~~with~~With Admixtures.

Current edition approved ~~May~~Nov. 1, ~~2006.~~2011. Published ~~June 2006.~~January 2012. Originally approved in 1944. Last previous edition approved in ~~2000~~2006 as ~~D806–00.~~D806–00(2006). DOI: ~~10.1520/D0806-00R06.~~10.1520/D0806-11.

[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.**

the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing. Users of this test method are cautioned that compliance with Practice D3740 does not, in itself, ensure reliable testing. Reliable testing depends on many factors; Practice D3740 provides a means of evaluating some of these factors.

5. Apparatus

5.1 *Analytical Balance*—An analytical balance conforming to the requirements of Class GP2 in Specification D4753 and with Class S weights.

5.2 *Filter Paper*—Filter paper including Whatman No. 1, 11 and 15 cm in diameter; Whatman No. 41, 15 cm in diameter; and Whatman No. 2, 11 or 15 cm in diameter.

5.3 *Fifty-Millilitre-Pipet*.

5.4 *Drying Oven*—Thermostatically controlled, preferably of the forced-air type, meeting the requirements of Specification E145 and capable of maintaining a uniform temperature of 110 ± 5°C throughout the drying chamber.

5.5 *Miscellaneous Apparatus*—Supplementary equipment, such as electric ovens, hot plates, a small riffle, a No. 40- (425 µm-) sieve with bottom pan and cover, a cast iron mortar and pestle, and a ball mill if possible.

6. Reagents

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[3] Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

6.2 *Potassium Permanganate, Standard Solution* (0.1 *N*)~~—Prepare and standardize a 0.1~~ *—Prepare a 0.1 N $KMnO_4$ ~~solution.~~ solution and standardize against primary standard grade oxalic acid, sodium oxalate or iron (II) ammonium sulfate hexahydrate.*

NOTE 2—The use of a standard 0.1 *N* $KMnO_4$ solution is not necessary when the samples are titrated in accordance with 8.9 and the results are calculated in accordance with 9.2~~.~~. However, the actual reagent concentration must be determined by titration against primary standard grade oxalic acid, sodium oxalate or iron (II) ammonium sulfate hexahydrate.

6.3 *Ammonium Nitrate Solution*—Dissolve 20 g of NH_4NO_3 in 1L of distilled water.

6.4 *Hydrochloric Acid (1 + 3)*—Add 200 mL of HCl (sp gr 1.19) to 600 mL of distilled water.

6.5 *Hydrochloric Acid (1 + 1)*—Add 25 mL of HCl (sp gr 1.19) to 25 mL of distilled water.

6.6 *Nitric Acid*—See Note 3.

6.7 *Ammonium Oxalate Solution (5 %)* —50 g of ammonium oxalate. (**Warning** —In addition to other precautions, this is done by adding the acid, slowly while stirring, to the water to avoid a sudden temperature rise that could cause boiling and spattering of the acid solution.)

6.8 *Ammonium Hydroxide, NH_4OH* (sp gr 0.90).

6.9 *Sulfuric Acid (1 + 1)*—Add 500 mL H_2SO_4 (sp gr 1.84) to 500 mL of distilled water.

7. Samples

7.1 Samples of the following shall be selected for the test:

7.1.1 *Raw Soil*, representative of the soil phase of the soil-cement mixture.

7.1.2 *Cement*, representative of the cement phase of the soil-cement mixture, and

7.1.3 *Soil-cement Mixture* to be analyzed.

7.2 The gross laboratory sample of each component shall be approximately 200 g. This may be obtained by reducing the sample in bulk and, if necessary, in particle size through the use of drying, riffling and grinding processes.

8. Procedure

~~8.1Dry~~8.1 Dry 25 g of each of the samples in an oven to constant mass at 110 ± 5°C (230 ± 9°F) to remove free water. Reduce the samples to pass a No. 40- (425 µm-) sieve.

8.2 Using an analytical balance, prepare the following amounts for each of the samples: raw soil, 5 g; soil-cement mixture, 5 g; and cement, 1 g. Place each of the weighed samples in a 250-mL beaker. Add 50 mL of HCl (1 + 1) (Note 3) to each sample, cover, and boil *gently* for 5 min on the hot plate.

NOTE 3—In the case of the cement sample, it is usually preferable first to add ~~40~~25 mL of water and then stir to obtain a thorough mixture. Then add ~~10~~25 mL of HCl (sp gr 1.19) and boil *gently* just long enough to obtain decomposition of the cement. Vigorous or extended boiling of soil or cement samples is seldom necessary, and often results in much slower filtration.

8.3 Add 25 mL of hot water to the beakers, stir, allow to settle momentarily, and then decant the contents through a Whatman No. 1 filter paper (Note 4), preferably 15 cm in diameter. The filtrate should be received in a 250-mL volumetric flask. When the

[3] "Reagent Chemicals, American Chemical Society Specifications," American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."