Designation: C1757 – 13

Standard Test Method for Determination of One-Point, Bulk Water Sorption of Dried Concrete[1]

This standard is issued under the fixed designation C1757; 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 of water ingress into the bulk (mass) of a hardened, dried concrete specimen after being submerged for 30 minutes.

1.2 The text of this test method references notes that provide explanatory information. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this 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 test method 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]

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C125 Terminology Relating to Concrete and Concrete Aggregates

C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes

C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements

C1585 Test Method for Measurement of Rate of Absorption of Water by Hydraulic-Cement Concretes

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology C125 for definitions of terms used in this test method.

3.2 *Definitions:*

3.2.1 *sorption, n*—the change in mass divided by the product of the surface area of the test specimen and the density of water, expressed in millimetres.

4. Summary of Test Method

4.1 A cylindrical concrete specimen is dried at 50°C to constant mass, and then placed in a sealed container for one day. After immersion in water for 30 minutes, the specimen's gain in mass is measured and the depth to which water is absorbed in millimetres is calculated.

5. Significance and Use

5.1 The durability of concrete largely depends on the ease with which fluids, both liquids and gases can enter into and move through, the concrete.[3] Adsorption and absorption of a liquid into empty or partially empty pores occur by capillary attraction.[4] The continuity of the pores and their size, as well as the volume of the voids, are factors that affect the sorptivity.[4]

5.2 This test method is intended to compare the relative performance of concrete mixtures exposed to wetting and drying. It is not intended to compare the performance of concrete mixtures that will be submerged continuously.

5.3 This test method tests a concrete that is essentially dry, as contrasted to the condition of the concrete in Test Method C1585, in which much of the capillary water is retained.

5.4 This test method determines the water absorbed into dried concrete in the first 30 minutes as an indicator of the

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.66 on Concrete's Resistance to Fluid Penetration.

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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.

[3] Properties of Concrete, A. M. Neville, Fourth Edition, Pearson Education Limited, Essex. England, p 483.

[4] Construction Materials: Their Nature and Behavior, Edited by J. M. Illston and P. L. J. Domone, Third Edition 2001, Spoon Press, 29 W 35th St., New York, New York 1000, pp192-194.

susceptibility of the concrete to water intrusion. This test method subjects all of the surfaces of the specimen to water thereby giving a value for bulk sorption of the specimen which gives an indication of the potential durability of the concrete mixture.

5.5 This test is applicable to hydraulic cement concrete mixtures with or without supplementary cementitious materials or admixtures.

5.6 This test method permits for the use of both cores and cast specimens. The results for cast specimens are not equivalent to those obtained from cores. Results can differ because, compared with cores, cast specimens have smoother surface texture, no damage from coring, and a greater amount of paste exposed at the surface.

5.7 This test is a measurement of the bulk sorption of concrete and has not been evaluated as a technique to assess the effectiveness of surface treatments applied to the concrete.

6. Apparatus

6.1 *Balance,* complying with Specification C1005 of sufficient capacity and readable to at least 0.01 % of the mass of the specimen.

NOTE 1—A balance having at least a 1000 gram capacity, readable to 0.1 g is sufficient for a 100 mm diameter, 50 mm thick specimen of normal weight concrete.

6.2 *Core Drill,* shall comply with Test Method C42/C42M.

6.3 *Saw,* shall comply with Test Method C42/C42M.

6.4 *Forced-Air Oven,* capable of maintaining a temperature of 50 + 2°C and such that the specimens can be placed in the oven at least 25 mm from any heating surface and from another specimen.

6.5 *Airtight Vessel or Desiccator,* of sufficient size to contain the specimens.

6.6 *Immersion Container,* for submersion of the specimens, containing tap water and the specimen support rack,

6.7 *Specimen Support Rack,* which keeps the specimen from contacting the bottom of the container and provides minimal contact area with the specimen.

NOTE 2—A light wire cake rack or hail screen with a spacing of approximately 15 mm is acceptable for the purpose.

6.8 *Absorbent Cloth,* suitable for absorbing free moisture from the specimen surface.

7. Test Specimens and Sampling

7.1 Specimen selection and preparation depends on the purpose of the test. For evaluation of materials or their proportions, permitted specimens include: *(a)* 100 mm diameter cores taken from test slabs or from large diameter cylinders or *(b)* 100 mm diameter cast cylinders. For evaluation of structures or the field concrete, specimens include: *(a)* 100 mm diameter cores taken from the structure or field-cast specimens or *(b)* 100 mm diameter cylinders cast at the field site. The preferred test specimen length is 50 mm. In no instance shall a test specimen be shorter than 30 mm or longer than 150 mm.

7.2 Specimens cast in the laboratory shall be made and cured in accordance with Practice C192/C192M. Specimens cast in the field shall be made and cured in accordance with the field-curing procedure in Practice C31/C31M. The test age shall be stated by the specifier of the testing. If no test age is specified, begin the oven drying at 28 days.

NOTE 3—As with other properties of hydraulic concrete mixtures, specimens tested at 28 days are likely to give results indicative of a mature concrete. Mixtures with supplementary cementitious materials may require longer times to show the effect of these materials. Test results for sorption of all concretes at early ages can be expected to be higher than the sorption results at later ages. The improvement at later ages is dependent on the hydration of the cementitious materials. Results from later ages (28 days and beyond) should be used for any comparisons between concretes.

7.3 Coring and cutting the specimen to length shall be in accordance with Test Method C42/C42M. Field cores shall be handled and initially conditioned in accordance with Section 7.3 of Test Method C42/C42M. If additional moist curing of field cores is specified, provide additional curing in a moist room or storage tank in accordance with Specification C511.

7.4 Drill cores according to Test Method C42/C42M. The ends of the specimen shall be square to the longitudinal axis within 5 mm across the 100 mm face. Saw as necessary.

7.5 Measure the dimensions of the specimen to the nearest millimetre in accordance with Test Method C42/C42M.

7.6 The average of two or more cores or cast cylinders shall constitute the test result.

8. Procedure

8.1 Begin testing by placing the specimen in the forced-air oven so that it is at least 25 mm from any heating surface and from another specimen. Dry the specimen at 50 ± 2ºC for an initial period of 48 ± 2 h. After the initial period, determine the mass of the oven-warm specimen. Return the specimen to the oven and determine subsequent oven-warm masses every 24 ± 2 h. Drying is complete when the specimen loses less than 0.2 % of its previous mass during a 24 ± 2 h period of drying. For weekend and holiday interruptions in this cycle, store the specimen in the airtight vessel as specified in 8.2 and then begin with another 24-hour drying cycle.

NOTE 4—Good quality 28 day-old concrete can be expected to lose less than 0.2 % of its mass in 24 ± 2 h of drying within three or four days.

8.2 Upon completion of the drying, store the specimen in the airtight vessel for 24 ± 1 h. Maintain the ambient temperature around the vessel at 23 ± 3ºC. After 24 h in the vessel, determine the mass of the specimen and record it as the oven-dried mass. Within ten minutes, place the specimen on the support rack in the immersion container with a flat face horizontal and so that it does not contact the container walls or another specimen. Maintain the water temperature at 23 ± 3°C and the water level in the container such that there is 25 ± 10 mm of water over the top of the specimen.

8.3 Immerse the specimen for 30 ± 0.5 min. Remove the specimen; shake it to remove the bulk of the surface water. Dry it using a damp absorbent cloth as rapidly as possible until all visible films of water are removed and the surface appears

damp. Immediately determine the mass of the specimen and record it as the mass after immersion.

NOTE 5—The cloth is considered damp when it has been wetted and wrung out by hand twisting.

9. Calculation

9.1 Calculate the sorption of the specimen as the change in mass divided by the product of the surface area of the test specimen and the density of water. For the purpose of this test, the temperature dependence of the density of water is neglected and a value of 0.001 g/mm^3 is used. The units of sorption are mm.

$$\text{Sorption} = \frac{W - D}{A * d} \quad (1)$$

Where:

W = mass of specimen after immersion in grams,
D = mass of oven-dried specimen in grams, and
A = the surface area of the specimen in square millimetres

$$A = 3.14 * sd * (sd/2 + sh) \quad (2)$$

Where:

sd = specimen diameter in mm,
sh = specimen height in mm, and

d = density of water (0.001) in grams per cubic millimetre

10. Report

10.1 Report the following information:
10.1.1 Specimen identification number,
10.1.2 The source of the concrete,
10.1.3 Relevant background information on the specimen such as mixture proportions, date when the concrete was cast, type of finishing, curing type and history, and the date when the concrete was sampled, if available,
10.1.4 The age of the concrete when testing was begun,
10.1.5 Length and diameter of the specimen, in millimetres;
10.1.6 The type of specimen, either core or cast cylinder,
10.1.7 The type of the top and bottom faces of the specimen, either formed, finished, or cut,
10.1.8 If the specimen was from a structure, its location in the structure,
10.1.9 The number of specimens in the set and the sorption for the set of specimens to the nearest 0.001 mm.

11. Precision and Bias

11.1 *Single-Operator Precision*—The single-operator coefficient of variation of a single test result for cast cylinders, (where a test result is the average of two separate measurements) using two materials with average sorption values ranging from 0.186 mm to 0.409 mm, has been found to be 4.8 %. For these parameters, the single-operator coefficient of variation of individual determinations has been found to be 6.2 %.

NOTE 6—The reproducibility of this test method will be determined and should be available within 5 years of the initial approval of this test method.

11.2 *Bias*—No information can be presented on the bias of the procedure in Test Method C1757 for measuring the corrected sorption because no material having an accepted reference value is available.

12. Keywords

12.1 absorption; capillary; pores; sorption; water