Designation: C 87 – 03

Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar[1]

This standard is issued under the fixed designation C 87; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope *

1.1 This test method covers the determination of the effect on mortar strength of the organic impurities in fine aggregate, whose presence is indicated using Test Method C 40. Comparison is made between compressive strengths of mortar made with washed and unwashed fine aggregate.

1.2 The SI values shown are to be regarded as the standard. The inch-pound values shown in parentheses are provided for information purposes only.

1.3 *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.*(**Warning—**Fresh hydraulic cementitous mixtures are caustic and may cause chemical burns to exposed skin and tissue upon prolonged exposure.)[2]

2. Referenced Documents

2.1 *ASTM Standards:*

C 33 Specification for Concrete Aggregates[3]

C 40 Test Method for Organic Impurities in Fine Aggregates for Concrete[3]

C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)[4]

C 128 Test Method for Density, Relative Density, (Specific Gravity), and Absorption of Fine Aggregate[3]

C 150 Specification for Portland Cement[4]

C 230 Specification for Flow Table for Use in Tests of Hydraulic Cement[4]

C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency[4]

C 511 Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes[4]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[3]

C 702 Practice for Reducing Samples of Aggregate to Testing Size[3]

D 75 Practice for Sampling Aggregates[5]

D 3665 Practice for Random Sampling of Construction Materials[5]

3. Significance and Use

3.1 This test method is of significance in making a final determination of the acceptability of fine aggregates with respect to the requirements of Specification C 33 concerning organic impurities.

3.2 This test method is applicable to those samples which, when tested in accordance with Test Method C 40, have produced a supernatant liquid with a color darker than that of the reference standard color plate No. 3 or color solution.

4. Basis for Comparison

4.1 The fine aggregate shall be compared in mortar, as described in this test method, with a sample of the same aggregate that has been washed in a 3 % solution of sodium hydroxide followed by thorough rinsing in water. The washing shall be repeated until the supernatant liquid obtained in Test Method C 40 has a color lighter than the reference standard. The washing shall be performed in such a way as to minimize the loss of fines, so that the washed aggregate has a fineness modulus within 0.10 of that of the unwashed aggregate. The prepared aggregate shall be checked with a suitable indicator such as phenolphthalein, pH paper or by using a pH meter to assure that sodium hydroxide has been removed prior to preparation of the mortar.

4.2 Unless otherwise specified or permitted, strength comparisons shall be made at 7 days in accordance with the following conditions:

4.2.1 Mix three batches of mortar with the prepared aggregate washed in sodium hydroxide and three batches with the

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concretes and Concrete Aggregates and is the direct responsibility of Subcommittee C09.20 on Normal Weight Aggregates.

Current edition approved Jan. 10, 2003. Published March 2003. Originally approved in 1931. Last previous edition approved in 1995 as C 87-83 (1995)ε1.

[2] See section on Safety Precautions, *Manual of Aggregate and Concrete Testing, Annual Book of ASTM Standards,* Vol 04.02.

[3] *Annual Book of ASTM Standards,* Vol 04.02.

[4] *Annual Book of ASTM Standards,* Vol 04.01.

[5] *Annual Book of ASTM Standards,* Vol 04.03.

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

unwashed aggregate on the same day. Mix the batches for the two conditions alternately.

4.2.2 Mold three 50-mm (2-in.) cubes from each batch.

4.2.3 Test the three cubes from each batch at the age specified.

5. Apparatus

5.1 *Flow Table, Flow Mold, and Caliper*, as described in Specification C 230.

5.2 *Tamper, Trowel, Cube Molds, and Testing Machine*, as described in Test Method C 109/C 109M.

5.3 *Mixer, Bowl, and Paddle*, as described in Practice C 305.

5.4 *Curing Apparatus*, as described in Specification C 511.

6. Reagents and Materials

6.1 Portland cement shall be Type I or Type II, meeting the requirements of Specification C 150.

6.2 *Sodium Hydroxide Solution* (3 %)—Dissolve 3 parts by mass of sodium hydroxide (NaOH) in 97 parts water.

7. Sampling

7.1 Fine aggregate for this test shall be obtained from the same sample used for Test Method C 40. Any reduction of samples to obtain test specimens shall be in accordance with Practice C 702.

7.2 Secure an additional field sample if needed from the aggregate supply in accordance with Practice D 75 and Practice D 3665.

8. Temperature and Relative Humidity

8.1 8.1 The temperature of the mixing water, moist cabinet, moist room and storage tank water shall be maintained at 23.0 ± 2.0°C (73.5 ± 3.5°F).

8.2 The relative humidity of the moist cabinet or moist room shall be maintained at not less than 95 %.

9. Preparation of Mortar

9.1 Prepare the mortar in a mechanical mixer (see **Warning** in 9.1.2) in accordance with the procedure for mixing mortars described in Practice C 305, as modified below.

9.1.1 The mortar shall be proportioned to produce a consistency of 100 ±5 as determined by the flow test.

9.1.2 In the event that the fine aggregate being used includes particles so large that the adjustment bracket (as described in Practice C 305) cannot provide adequate clearance, the oversized particles shall be removed by sieving on the 4.75-mm (No. 4) or 2.36-mm (No. 8) sieve. If this procedure is employed, the report shall so state and shall indicate the quantity of material so removed. (**Warning—**The clearances between the paddle and the bowl specified in Practice C 305 are suitable when using the standard mortar made with Ottawa Sand. To permit the mixer to operate freely and to avoid serious damage to the paddle and bowl when coarser aggregates are used, it may be necessary to set the clearance adjustment bracket to provide greater clearances than specified. A clearance of approximately 4.0 mm is required in Practice C 305; a clearance of approximately 5.0 mm has been found to be satisfactory for this method when used with fine aggregate from which the material retained on the 4.75-mm (No. 4) sieve has been removed.)

9.2 Use water and cement in quantities that will yield a water-cement ratio of 0.6 by mass (see Note 1).

NOTE 1—It has been found that 600 g of cement and 360 mL of water will usually be adequate for a 6-cube batch.

9.3 Using fine aggregate that has been brought to a saturated surface dry condition as described in Test Method C 128, prepare a quantity of aggregate that is slightly more than needed to produce a batch of the desired consistency (see Note 2).

NOTE 2—If the absorption has been determined in accordance with Test Method C 128, the aggregate may be prepared for test by adding to a known mass of dry aggregate the amount of water it will absorb, mixing thoroughly, and permitting the aggregate to stand in a covered pan for 30 min before use.

9.4 After placing all the mixing water in the bowl, add the cement to the water. Start the mixer and mix at the slow speed (140 ±5 r/min) for 30 s.

9.5 While still mixing at slow speed over a 30-s period, add a measured quantity of aggregate estimated to provide the proper consistency.

NOTE 3—The quantity of aggregate used may be determined by subtracting from a known quantity of prepared aggregate the mass of the portion remaining after mixing.

9.6 Stop the mixer, change to medium speed (285 ±10 r/min), and mix for 30 s.

9.7 Stop the mixer and let the mortar stand for 1.5 min. During the first 15 s of this interval, quickly scrape down into the batch any mortar that may have collected on the side of the bowl, then for the remainder of this interval, cover the bowl with the lid.

9.8 Finish by mixing for 1 min at medium speed. If the flow appears to be too high additional sand may be added after the first 30 s of this mixing period. If so, stop the mixer briefly, add the sand, and then complete the additional 30 s of mixing.

9.9 In any case requiring a remixing interval, any mortar adhering to the side of the bowl shall be quickly scraped down into the batch with the scraper prior to remixing.

9.10 Make a determination of the flow.

10. Procedure

10.1 *Flow Test*:

10.1.1 Carefully wipe the flow table clean. Dry the surface and place the flow mold at the center. Immediately after completing the mixing operation, place a layer of mortar approximately 25 mm (1 in.) in thickness in the mold and tamp 20 times with the tamper. The tamping pressure shall be just sufficient to ensure uniform filling of the mold. Fill the mold with mortar and tamp as specified for the first layer. Cut off the mortar to a plane surface, flush with the top of the mold, by drawing the straight edge of the trowel (held nearly perpendicular to the mold) with a sawing motion across the top of the mold. Wipe the table top clean and dry, being especially careful to remove any water from around the edge of the flow mold. Lift the mold away from the mortar 1 min after completing the

mixing operation. Immediately drop the table through a height of 12.7 mm (0.5 in.) ten times in 6 s. The flow is the resulting increase in average diameter of the mortar specimen, measured on at least four diameters at approximately equal angles, expressed as a percentage of the original diameter.

10.1.2 Should the flow be too great, return the mortar to the mixing vessel, add additional sand, mix for 30 s at medium speed, and make another determination of the flow. If more than two trials must be made to obtain a flow of 100 ±5, consider the mortar as a trial mortar, and prepare a new batch.

10.1.3 If the mortar is too dry, discard the batch.

10.1.4 Determine the quantity of sand used by subtracting the weight of the portion remaining after mixing from the mass of the initial sample.

10.2 *Molding Test Specimens*—Immediately following completion of a flow test that indicates acceptable consistency, return the mortar from the flow table to the mixing bowl, scrape down the bowl, and then remix the entire batch for 15 s at medium speed. Upon completion of mixing, shake the excess mortar from the paddle into the bowl. Place the mortar in cube molds in two layers in accordance with the procedures described in Test Method C 109/C 109M.

10.3 Store the test specimens initially in a moist cabinet or moist room for 24 ± 0.5 h. Additional curing shall be by immersion in saturated lime water.

10.4 Determine compressive strength of the cubes in accordance with Test Method C 109/C 109M.

11. Calculation and Report

11.1 Calculate the compressive strength of each specimen by dividing the maximum load it carried during the test by the cross-sectional area. Average the strengths of the three specimens from each batch. Calculate three strength ratios by dividing the average strength for a batch containing unwashed sand by the average strength for the corresponding (in respective order of mixing) batch containing washed sand.

11.2 Report the average of the three ratios, expressed as a percentage, as the relative strength for the sand under test.

12. Precision and Bias

12.1 The following precision statement is applicable when a test result is the average ratio, as defined by this test method, of three pairs of mortar batch strength tests with all the batches mixed on the same day and tested at the same age.

12.2 The single laboratory coefficient of variation has been determined to be 5.4 % (Note 4). Therefore, results of two properly conducted tests in the same laboratory should not differ from each other by more than 15.3 % (Note 4) of their average. The maximum range (difference between highest and lowest) of the three individual ratios used in calculating the average should not exceed 17 % (Note 5).

NOTE 4—These numbers represent respectively the (1s %) and (d2s %) limits as described in Practice C 670.

NOTE 5—Calculated as described in Practice C 670.

13. Keywords

13.1 aggregate; organic impurities; mortar strength

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this standard since the last issue (C 87-83 (1995)$^{\epsilon 1}$) that may impact the use of this standard.

(1) Revised Section 1.
(2) Updated Section 2.
(3) Revised 3.2.
(4) Revised Section 4.
(5) Added new 5.4.
(6) Revised 6.2.
(7) Revised 7.1.
(8) Revised Section 8.
(9) Revised Section 9.
(10) Revised Section 10.
(11) Revised Note 5.