Designation: C87 – 05

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

This standard is issued under the fixed designation C87; 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 C40. 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:*[3]

C33 Specification for Concrete Aggregates
C40 Test Method for Organic Impurities in Fine Aggregates for Concrete
C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
C128 Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
C150 Specification for Portland Cement
C230/C230M Specification for Flow Table for Use in Tests of Hydraulic Cement
C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
C702 Practice for Reducing Samples of Aggregate to Testing Size
D75 Practice for Sampling Aggregates
D3665 Practice for Random Sampling of Construction Materials

3. Summary of Test Method

3.1 A portion of the fine aggregate that produced a color darker than the standard in Test Method C40 is used to prepare mortar cube specimens. A separate portion of the same fine aggregate is washed in sodium hydroxide solution to remove the organic impurities that caused the failing result when tested in accordance with Test Method C40, and that washed fine aggregate is used to prepare another set of mortar cube specimens.

3.2 After curing for a stated period, the compressive strengths of the two sets of cube specimens are determined and compared.

4. Significance and Use

4.1 This test method is of significance in making a final determination of the acceptability of fine aggregates with respect to the requirements of Specification C33 concerning organic impurities.

4.2 This test method is applicable to those samples which, when tested in accordance with Test Method C40, have produced a supernatant liquid with a color darker than standard color plate No. 3 or color solution.

4.3 Many specifications provide for the acceptance of fine aggregate producing a darker color in the Test Method C40 test, when testing by this test method indicates the strength of the mortar cubes prepared with the unwashed fine aggregate is

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

Current edition approved July 1, 2005. Published July 2005. Originally approved in 1931. Last previous edition approved in 2004 as C87 – 04. DOI: 10.1520/C0087-05.

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

[3] 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.**

comparable to the strength of mortar cubes made with the washed fine aggregate.

5. Apparatus

5.1 *Flow Table, Flow Mold, and Caliper*, as described in Specification C230/C230M.

5.2 *Tamper, Trowel, Cube Molds, and Testing Machine*, as described in Test Method C109/C109M.

5.3 *Mixer, Bowl, and Paddle*, as described in Practice C305.

5.4 *Curing Apparatus*, as described in Specification C511.

5.5 *pH Paper*, 0–14.

5.6 *pH Meter*, capable of reading to 0.1 pH units or better.

6. Reagents and Materials

6.1 Portland cement shall be Type I or Type II, meeting the requirements of Specification C150.

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

6.3 *Phenolphthalein*—Dissolve 1 g of reagent grade phenolphthalein in 1 L of 95 % reagent grade ethyl alcohol.

7. Sampling and Sample Preparation

7.1 If sufficient material remains from the sample used for testing in accordance with Test Method C40, use this material for the tests described in this test method. If there is insufficient material remaining, obtain another field sample from the same source in accordance with Practice D75 and Practice D3665.

NOTE 1—At least 20 kg of fine aggregate should be available for the testing described herein.

7.2 If the fine aggregate contains particles coarser than the 4.75-mm (No.4) sieve, remove the coarser particles by sieving on the 4.75-mm (No.4) sieve, so that when the particles are mixed in the designated mixer, there will be no damage to the mixer or crushing of the fine aggregate particles. Determine the percentage of the sample removed. (**Warning**—The clearances between the paddle and the bowl specified in Practice C305 are suitable when using the mortar made with graded standard 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 C305; 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.)

7.3 Split the fine aggregate to be used for these tests into two approximately equal portions, using the procedure described in Practice C702. Set one portion aside to be used in the unwashed condition. The second portion is to be washed before use.

7.4 *Preparing Washed Fine Aggregate*:

7.4.1 Perform the washing and rinsing of the fine aggregate with care to minimize the loss of fines, so that the aggregate after washing and rinsing has a fineness modulus within 0.10 of that of the unwashed aggregate.

7.4.2 *Establishing a Standard for Thoroughness of Rinsing*—Place a small amount of the water to be used for washing and rinsing in a clean, clear container, and determine the pH of the water by use of pH paper, pH meter, or add a drop of phenolphthalein to the wash water and retain for later comparison.

7.4.3 *Washing the Aggregate*—Place sufficient quantity of fine aggregate for three batches in a suitable container, flood with the sodium hydroxide solution, and agitate thoroughly with a spoon or trowel. At the end of the washing and after allowing to stand for fines to settle, siphon off as much of the sodium hydroxide solution as possible, without removing any of the aggregate fines.

7.4.4 *Rinsing the Aggregate* —Add a large quantity of water to the washed aggregate, agitate, allow to stand for fines to settle, and then siphon off the rinse water. Repeat this operation several times, until the water used for rinsing has a pH equal to or lower than the pH of the water prior to contact with the fine aggregate. If phenolphthalein was used as an indicator, the color of the wash water is to be equal or lighter in color than the solution prepared in 7.4.2.

7.4.5 *Verifying Removal of Organic Impurities*—Repeat the Test Method C40 procedure to determine if the washing has removed sufficient organic impurities to produce a satisfactory result (color lighter than the standard). If the fine aggregate continues to produce an unsatisfactory result (color darker than the standard), repeat the washing and rinsing procedure (described in 7.4.3 and 7.4.4) as many times as necessary until a satisfactory result is obtained by Test Method C40.

8. Procedure

8.1 *Number of Test Batches*—Prepare three batches of mortar using the washed aggregate and three batches of mortar using the unwashed aggregate, on the same day. Mix the batches, alternating between the washed and unwashed aggregate.

8.2 *Fine Aggregate*—For both the washed and the unwashed fine aggregates, bring the portions of fine aggregate to the saturated surface dry condition as described in Test Method C128. Prepare a quantity of aggregate of known mass (*the aggregate specimen*) that is slightly more than needed to produce a single batch of the desired consistency.

8.2.1 *Optionally*, if the absorption has been determined in accordance with Test Method C128, prepare the aggregate 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.

8.3 *Preparation of Mortar*—Prepare the mortar in a mechanical mixer in accordance with the procedure for mixing mortars described in Practice C305, as modified below.

8.3.1 Use water and cement in quantities that will yield a water-cement ratio of 0.6 by mass (See Note 2). The mixing water shall be at a temperature of 23.0 ± 2.0 °C (73.5 ± 3.5 °F). The mortar shall be proportioned to produce a consistency of 100 ± 5 % as determined by the Section on Flow Test (see 8.4.1).

NOTE 2—It has been found that 600 g of cement and 360 mL of water will usually be adequate for a 6-cube batch. The flow is adjusted by the quantity of fine aggregate added to the mixture.