Designation: C1152/C1152M – 04$^{\varepsilon 1}$

StandardTest Method for Acid-Soluble Chloride in Mortar and Concrete[1]

This standard is issued under the fixed designation C1152/C1152M; 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.

ε^1 NOTE—A typo in the equation in paragraph 9.1 was corrected editorially February 2006.

1. Scope

1.1 This test method[2] provides procedures for the sampling and analysis of hydraulic-cement mortar or concrete for chloride that is acid soluble under the conditions of test. In most cases, acid-soluble chloride is equivalent to total chloride.

1.2 The text of this standard references notes and footnotes that provide explanatory information. These notes and footnotes shall not be considered as requirements of this standard.

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.*

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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

C114 Test Methods for Chemical Analysis of Hydraulic Cement

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

C702 Practice for Reducing Samples of Aggregate to Testing Size

C823 Practice for Examination and Sampling of Hardened Concrete in Constructions

C1084 Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete

D1193 Specification for Reagent Water

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Significance and Use

3.1 The amount of acid-soluble chloride in most hydraulic-cement systems is equal to the total amount of chloride in the system. However, some organic substances that may be introduced into mortar or concrete contain chloride that is initially acid-insoluble that can eventually ionize and thus become acid-soluble or water-soluble after a period of exposure in the very alkaline cement system.

3.2 Sulfides are known to interfere with the determination of chloride content. Blast-furnace slag aggregates and cements contain sulfide sulfur in concentrations that can cause such interference and produce erroneously high test results. Treatment with hydrogen peroxide, as discussed in Test Methods C114, is used to eliminate such interference.

3.3 There are aggregates that contain chloride that is not available for corrosion. Such chloride will be detected by the use of this method.[4]

4. Apparatus

4.1 *Sampling Equipment*

4.1.1 The apparatus required for obtaining samples by coring or sawing is described in Test Method C42/C42M.

4.1.2 Use the following apparatus for sampling by drilling (pulverization):

4.1.2.1 *Rotary Impact Drill* and drill or pulverizing bits of sufficient diameter to provide a representative sample of sufficient size for testing.

4.1.2.2 *Spoon* or other suitable means to remove pulverized sample material from drill hole without contamination.

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregatesand is the direct responsibility of Subcommittee C09.69 on Miscellaneous Tests.

Current edition approved June 1, 2004. Published July 2004. Originally approved in 1990. Last previous edition approved in 2003 as C1152 – 03. DOI: 10.1520/C1152_C1152M-04E01.

[2] This test method is based on a report by Clear, K. C., and Harrigan, E. T., "Sampling and Testing for Chloride Ion in Concrete," Report No. FHWA-RD77-85, Federal Highway Administration, Washington, DC, Aug. 1977 (Available as PB 275-428/AS National Technical Information Services).

[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.

[4] For more information, see "The Determination of the Chloride Content of Concrete," by Brian B. Hope, John A. Page and John S. Poland, *Cement and Concrete Research*, Volume 15, Number 5, Pergamon Press, New York, September 1985, pp. 863-870.

4.1.2.3 *Sample Containers* capable of maintaining samples in an uncontaminated state.

4.2 *Sample Processing Apparatus*—The apparatus required for processing samples shall be chosen for its suitability for the purposes of the investigation, and frequently includes a concrete saw and one or more pulverizers.

4.2.1 Samples more than 25 mm (1 in.) in maximum dimension shall be reduced in size by use of a jaw crusher or broken into smaller pieces by hammering carefully to avoid loss of smaller pieces.

4.2.2 Crush particles less than 25 mm (1 in.) in maximum dimension using a rotating puck grinding apparatus, or by using a disk pulverizer, or mortar and pestle operated to restrict to negligible levels the loss of fine particles.

4.2.3 *Sieve,* 850-µm [No. 20], which shall comply with Specification E11.

4.3 *Chloride Determination*

4.3.1 *Balance*, shall be capable of reproducing results within 0.0002 g with an accuracy of ± 0.0002 g. Direct-reading balances shall have a sensitivity not exceeding 0.0001 g. Conventional two-pan balances shall have a maximum sensibility reciprocal of 0.0003 g. Any rapid weighing device that may be provided, such as a chain, damped motion, or heavy riders, shall not increase the basic inaccuracy by more than 0.0001 g at any reading and with any load within the rated capacity of the balance.

4.3.2 *Stirrer*, magnetic variable speed, with a TFE-fluorocarbon coated magnetic stirring bar.

4.3.3 *Chloride, Silver/Sulfide Ion Selective Electrode*, or a silver billet electrode coated with silver chloride (see Note 1) with an appropriate reference electrode.

4.3.4 *Potentiometer*, with millivolt scale readable to 1 mV or better. A digital readout is preferred but not required.

NOTE 1—See Note 67 of Test Methods C114 for a discussion of suitable electrodes and coating methods.

4.4 *Glazed Paper*—Paper to which fine particles do not adhere, for use as described in 7.1.

5. Reagents

5.1 *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[5]. 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.

5.1.1 *Sodium Chloride* (NaCl).

5.1.2 *Silver Nitrate* ($AgNO_3$).

5.1.3 *Potassium Chloride* (KCl), (required for silver billet electrode only).

5.1.4 *Reagent Water* conforming to the requirements of Specification D1193 for Type III reagent water.

5.1.5 *Sodium Chloride, Standard Solution* (0.05 N NaCl)—Dry sodium chloride at 105 to 110 °C to a constant mass. Weigh 2.9222 g of dried reagent. Dissolve in water and dilute to exactly 1 L in a volumetric flask and mix thoroughly. This solution is the standard and requires no further standardization.

5.1.6 *Silver Nitrate, Standard Solution* (0.05 N ($AgNO_3$))—Dissolve 8.4938 g of silver nitrate in water. Dilute to 1 L in a volumetric flask and mix thoroughly. Standardize against 5.00 mL of standard 0.05 N sodium chloride solution diluted to 150 mL with water following the titration test method given in 8.1 beginning with the second sentence. The exact normality shall be calculated from the average of three determinations as follows:

$$N = 0.25/V, \text{ where:}$$

N = normality of $AgNO_3$ solution,
0.25 = milliequivalents NaCl (5.0 × 0.05 N), and
V = volume of $AgNO_3$ solution, mL.

Commercially available standard solutions may be used provided the normality is checked according to the standardization procedure.

5.1.7 *Methyl Orange Indicator*—Prepare a solution containing 2 g of methyl orange per litre of 95 % ethyl alcohol.

5.1.8 *Nitric Acid* (1+1).

5.1.9 *Hydrogen Peroxide* (30 %).

6. Sampling

6.1 Select the sample per Practice C823 or as required for the purpose of the investigation.

6.1.1 Because of the small nominal maximum size of the aggregate in a mortar, pieces of mortar having a mass of 10 g or more will be representative of a rather large volume of mortar.

6.1.2 Take concrete cores in accordance with Test Method C42/C42M unless otherwise specified.

NOTE 2—Concrete cores taken in accordance with Test Method C42/C42M may be cut longitudinally to provide a 12-mm [½-in.] thick section generally representative of the core, or cut laterally into 12-mm [½-in.] thick disks representative of the concrete core at various depths. Concrete farthest from a surface into which chloride has penetrated often provides chloride data close to that of the originally placed fresh concrete. The cooling water from core cutting may dissolve some of the chloride.

6.1.3 Powdered concrete obtained by use of a rotary impact drill is frequently used in determining chloride concentration with depth in bridge decks, pavements, etc. Such samples may be unrepresentative, especially when the nominal maximum coarse aggregate size is 25 mm [1 in.] or more. Thus, several such samples should be combined, or the data used with care. Procedures for this method of sampling are as follows:

6.1.3.1 Using the rotary impact drill, drill perpendicular to the concrete surface or parallel to the axis of a cored specimen to a specified depth or a depth sufficient to obtain a representative sample of the concrete mixture of at least 20 g of powdered material. To prevent sample contamination, avoid contact of sample with hands and other sources of perspiration.

[5] *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 *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.