Designation: C1073 – 12

Standard Test Method for Hydraulic Activity of Slag Cement by Reaction with Alkali[1]

This standard is issued under the fixed designation C1073; 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 rapid determination of hydraulic activity of slag cement. This test method measures the accelerated strength development of the slag cement by using sodium hydroxide solution as mixing water and curing at elevated temperature.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in 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.* A specific warning statement is given in Section 6.

1.4 The text of this standard references notes and footnotes which provide explanatory information. These notes and footnotes (excluding those in tables) shall not be considered as requirements of this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

C125 Terminology Relating to Concrete and Concrete Aggregates

C219 Terminology Relating to Hydraulic Cement

C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

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

C778 Specification for Sand

C989 Specification for Slag Cement for Use in Concrete and Mortars

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are given in Terminology C125 and C219.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *slag, n*—granulated blast-furnace slag as defined in Terminology C125 and ground to cement fineness.

4. Significance and Use

4.1 This test method can be used as a quality-control test for slag production from a single source after adequate correlation with tests stipulated in Specification C989.

4.2 This test method may be used as an evaluation technique for slag cement, when an appropriate correlation with various finenesses of slag cements from a specific source ground in a specific laboratory mill has been previously developed.

4.3 The hydraulic activity as measured by this test method on slag cement samples can provide guidance to a manufacturer as to fineness level required to maintain a certain level of hydraulic activity.

4.4 While this test method is intended primarily as a quality control test, some studies have shown that the test method is capable of evaluating the hydraulic activity of slag cements from different sources.

5. Apparatus

5.1 *Three-Gang Molds for 2-in. or 50-mm Cubes and Compression Test Machine,* as specified in Test Method C109/C109M (Note 1).

NOTE 1—Silicone grease is recommended for protection of mold surfaces from the caustic solution in this test.

5.2 *Mixer,* as specified in Method C305.

5.3 *Curing Chamber,* capable of maintaining a temperature of air or water bath of 55 ± 2°C.

5.4 *Containers,* capable of holding one three-cube mold in an essentially vapor-tight condition. If polyethylene or other plastic bags are used, they shall have a closure of the zip type. If rigid containers are used, they shall have tight sealing covers (Note 2). The acceptability of containers shall be determined

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregatesand is the direct responsibility of Subcommittee C09.27 on Ground Slag.

Current edition approved July 15, 2012. Published October 2012. Originally approved in 1985. Last previous edition approved in 2011 as C1073–97a(2011). DOI: 10.1520/C1073-12.

[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.

by measuring the water loss after curing in air or the gain after curing in water bath. Water loss shall be less than 15 mL in air curing or gain less than 5 mL in water-bath curing.

NOTE 2—Plastic boxes designed for household storage of celery with a bottom grid have given good service.

6. Materials

6.1 *Graded Standard Sand*—The sand used for making test specimens shall be natural silica sand conforming to the requirements for graded standard sand in Specification C778.

6.2 *Reagent Sodium Hydroxide Solution* (20 %):

6.2.1 Prepare fresh daily using boiled distilled water and reagent grade sodium hydroxide (NaOH).

6.2.2 Dissolve 200 g of sodium hydroxide in 1 L of distilled water and cool to room temperature. **Warning—**All work with this highly caustic solution should be completed with the use of gloves, apron, and face mask.

NOTE 3—One litre will provide enough solution for eight three-cube batches. More or less solution in these proportions should be made depending on the number of batches to be mixed during the day.

7. Procedure

7.1 *Batch*—The quantities of materials to be mixed at one time in the batch of mortar for making three or six specimens shall be as follows:

	Number of Specimens	
	3	6
Slag Cement, g	250	500
Sand, g	687.5	1375
NaOH solution, mL	112.5	225

7.2 *Preparation of Specimens*—Prepare specimens in accordance with Test Method C109/C109M, except that the mixing water shall be replaced by the volume of NaOH solution equal to the volume of water which would give a water/slag cement ratio of 0.45 by mass.

7.3 *Curing*—Immediately upon completion of molding place each three-cube mold in a container. Add approximately 50 mL of water into the container at the mold base in order to assure 100 % relative humidity during the curing cycle. In the case where plastic bags are employed, special care should be exercised to avoid tearing the plastic during handling. Place the container and molds in the curing chamber maintained at 55 ± 2°C. If water curing is used, rigid containers shall be required and the water temperature shall be controlled to the prescribed temperature and a minimum 5 mL of water shall cover the containers. At the end of 23 ± ¼ h remove the molds from the curing chamber and examine each container for leaks. If more than 15 mL of water has escaped or more than 5 mL of water has entered, discard the specimens and retest. Remove the specimens from the mold and store in room air until tested.

7.4 *Determination of Compressive Strength*—Test the specimens for compressive strength at 24 ± ½ h in accordance with Test Method C109/C109M.

8. Calculation

8.1 Calculate the compressive strength of the specimens in accordance with Test Method C109/C109M.

9. Faulty Specimens and Retests

9.1 Faulty specimens and the need for retest shall be determined in accordance with Test Method C109/C109M.

10. Report

10.1 The average strength in MPa rounded to the nearest 0.1 MPa at 24 h shall be reported as the hydraulic activity of the sample. For example, Hydraulic Activity with NaOH: 7.3 MPa.

11. Precision and Bias

11.1 *Precision*—The following precision statements were developed using data generated from an interlaboratory test program. Nine laboratories participated in the program and tested three slags with varied hydraulic activity. Duplicate tests were performed on different days. Revisions to the precision statements shall be made as more comprehensive data become available.

11.1.1 The precision statements are applicable when a test result is the average of compressive strengths of three cubes molded from a single batch of mortar and tested at the same age.

11.1.2 The multilaboratory coefficient of variation has been found to be 8.1 % (Note 4). Therefore, results of properly conducted tests of single batches by two different laboratories should not differ by more than 22.9 % of their average (Note 4).

11.1.3 The single-laboratory coefficient of variation has been found to be 4.6 % (Note 4). Therefore, results of two properly conducted tests of single batches of mortar made with the same materials either on the same day or within the same week should not differ from each other by more than 13.0 % of their average (Note 4).

NOTE 4—These numbers represent respectively the (Is) and (d2s) limits as described in Practice C670.

11.2 *Bias*—The procedure in this test method has no bias since the hydraulic activity is defined only in terms of the test method.

12. Keywords

12.1 ground slag; hydraulic activity; slag cement