Designation: C1827 – 20

Standard Test Method for Determination of the Air-Entraining Admixture Demand of a Cementitious Mixture[1]

This standard is issued under the fixed designation C1827; 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 is for the determination of the air-entraining admixture (AEA) demand of a mixture of cementitious materials, AEA, and water.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* **Warning—***Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.*[2]

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C114 Test Methods for Chemical Analysis of Hydraulic Cement

C125 Terminology Relating to Concrete and Concrete Aggregates

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology C125.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *absolute volume of AEA, n*—the air-entraining admixture demand expressed as volume of un-diluted air-entraining admixture to produce a stable foam.

3.2.2 *air-entraining admixture demand, n*—the quantity of air-entraining admixture required to produce a stable foam for a specific mixture of cementitious materials, air-entraining admixture, and water.

3.2.3 *foam index, n*—the air-entraining admixture demand expressed as the number of drops of a dilute solution of air-entraining admixture required to produce a stable foam.

3.2.3.1 *Discussion*—For a given combination of materials, the number of drops required to produce a stable foam will depend on the concentration of the AEA solution that is used.

3.2.4 *slurry concentration, n*—the concentration in percent volume of air-entraining admixture in the liquid portion of the slurry of combined cement, test material, and AEA solution.

3.2.5 *solution concentration, n*—the concentration in percent volume of air-entraining admixture in an aqueous solution that is prepared and added to the test sample dropwise.

3.2.6 *stable foam, n*—a continuous foam layer that covers the entire surface at the air/liquid interface of a mixture of cementitious materials, air-entraining admixture, and water and maintains that coverage for a specified duration.

4. Summary of Test Method

4.1 The cementitious material or combination of materials to be tested is combined with water and a dilute solution of AEA that is added one drop at a time (dropwise), and the mixture is agitated for a fixed period of time to produce a foam. The stability of the foam is observed. If the foam is not stable, additional AEA solution is added dropwise and the agitation and observation is repeated. The combined cycle of AEA addition, agitation, and observation is repeated until a stable foam is observed. The number of drops required to achieve a stable foam is recorded as the foam index.

5. Significance and Use

5.1 For a specific mixture of cementitious material and AEA solution, the foam index or the absolute volume of AEA

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.48 on Performance of Cementitious Materials and Admixture Combinations.

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[2] Section on Safety, Manual of Cement Testing, *Annual Book of ASTM Standards*, Vol. 04.01.

[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.

determined by this test method provides a measure of effectiveness in producing a stable air-void system for that specific mixture. Values of foam index can be compared only if the AEA solutions used in each test have the same concentration of AEA, the same type of AEA is used, and the same cementitious materials are used. Values of absolute volume of AEA can be compared only if the AEA solutions used in each test are prepared using the same AEA type.

5.2 The foam index or the absolute volume of AEA of a cementitious mixture can be expressed as an absolute value, or as a ratio with the foam index or the absolute volume of AEA, respectively, obtained using a slurry of only portland cement and water.

5.3 When successive foam index or absolute volume of AEA test results are compared, changes can be detected in the effectiveness of the AEA with a specific mixture of cementitious material in producing concrete with a suitable entrained air-void system.

5.4 The foam index and the absolute volume of AEA are not a quantitative measure of AEA dosage for a concrete mixture.

6. Apparatus

6.1 *Analytical Balance,* accurate to ± 0.01 g.

6.2 *Graduated Cylinders,* 10 mL and 25 mL.

6.3 *Volumetric Flask,* 1 L.

6.4 *Magnetic Stirrer.*

6.5 *Storage Bottle,* 1 L minimum.

6.6 *Pipette or Eye Dropper,* capable of delivering a drop volume (Vd) of 0.02 – 0.10 mL per drop.

NOTE 1—Pipettors that deliver a prescribed volume of solution are commercially available.

6.7 *Beakers,* 200 mL.

6.8 *250 mL Cylindrical Wide-Mouth Plastic Container,* with a water-tight screw top lid.

NOTE 2—An equivalent volume glass container may be used. The wide-mouth designation is recommended for ease of placing materials in the container.

6.9 *Stop Watch or Other Timing Device,* readable to ± 0.5 seconds.

6.10 *Mechanical Agitator with Timer Control (optional),* capable of holding a 250 mL wide-mouth plastic container.

6.10.1 The mechanical agitator shall be capable of vertical-displacement agitation similar to shaking by hand as described in 9.3.6.1. The mechanical agitator timer control shall be capable of producing 10 second and 30 second agitation cycles.

NOTE 3—Use of a mechanical agitator reduces test result variability that results from different agitation energy.

7. Materials

7.1 *Cement*—Grab sample of the portland cement that is to be evaluated.

7.2 *Supplementary Cementitious Material (SCM)*—Sample of a single SCM or SCM combination that is to be evaluated.

NOTE 4—The type of sample obtained is determined by the purposes of the test.

7.2.1 If more than one SCM is used in the cementitious materials mixture being evaluated, the specifier of the test shall determine if each separate SCM or the combined SCM is to be tested.

7.3 AEA to be evaluated.

7.4 Reagent water as defined in Test Methods C114.

7.5 All materials shall be conditioned at 23.0 ± 3.0 °C.

8. Standardization

8.1 *Standardization of Pipette or Eye Dropper:*

8.1.1 Pipette or eye dropper standardization is required only if the absolute volume of AEA is determined.

8.1.2 Standardize the pipette or eye dropper at an ambient temperature of 23.0 ± 3.0°C.

8.1.3 Standardize the pipette or eye dropper for use as follows:

8.1.3.1 Place a folded piece of paper towel on the balance to absorb drops of water from the device to be standardized. Tare the balance.

8.1.3.2 Deposit 20 drops of distilled water from the pipette or eye dropper to be standardized on to the folded piece of paper towel.

8.1.3.3 Record the total mass of the deposited water (W_W), in units of grams. Assume the density of water is 1.0 g/ml. Therefore, W_W is numerically equivalent to the total volume of water dispensed (V_W), in units of mL.

8.1.3.4 Calculate V_d.

$$V_d\,(\text{mL}) = V_W / 20 \qquad (1)$$

8.1.3.5 Record the single-drop volume (V_d), in units of mL, for later use.

8.1.4 Pipette and eye dropper standardization shall be performed at least once per year for each individual pipette or eye dropper, and each time after the pipette or eye dropper has been disassembled for cleaning or maintenance.

8.1.5 If using an eye dropper, each technician shall perform a standardization at least once per year for each eye dropper as the drop formed will be affected by the technique used by the technician.

NOTE 5—The drop size can vary with the eye dropper and test precision is improved with the use of a pipette.

8.2 *Preparation of AEA Solutions:*

8.2.1 The AEA to be evaluated is used as an aqueous solution. To ensure accuracy in mixing AEA solutions, at least 1 L of solution shall be prepared.

NOTE 6—The optimal AEA solution concentration used will depend on the cementitious materials and AEA being tested. Recommended solution concentrations are 2.5%, 5.0%, 7.5%, 10%, and 15% AEA by volume. However, any known solution concentration may be used. Preparing a range of solution concentrations is only required if a wide range of SCMs is routinely tested. For more guidance on selecting solution strength see Appendix X1.

8.2.2 To prepare a specific AEA solution concentration, measure the required amount of AEA using a graduated cylinder and place in a 1 L volumetric flask.