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Standard Test Method for Surface Moisture in Fine Aggregate[1]

This standard is issued under the fixed designation C 70; 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 field determination of the amount of surface moisture in fine aggregate by displacement in water.

1.2 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 128 Test Method for Specific Gravity and Absorption of Fine Aggregate[2]

C 566 Test Method for Total Moisture Content of Aggregate by Drying[2]

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

3. Significance and Use

3.1 This test method is not widely used. However, it is a convenient procedure for field or plant determination of moisture content of fine aggregate if specific gravity values are known and if drying facilities are not available. It can be used to adjust aggregate weights for moisture content and to determine surface moisture contribution to mixing water in portland cement concrete.

3.2 The accuracy of the test method depends upon accurate information on the bulk specific gravity of the material in a saturated surface-dry condition.

4. Apparatus

4.1 *Balance*, having a capacity of 2 kg or more and sensitive to 0.5 g or less.

4.2 *Flask*—A suitable container or flask, preferably of glass or noncorrosive metal. The container may be a pycnometer, a volumetric flask, a graduated volumetric flask, or other suitable measuring device. The volume of the container shall be from two to three times the loose volume of the sample. The container shall be so designed that it can be filled to the mark, or the volume of its contents read, within 0.5 mL or less.

5. Sample

5.1 Select a representative sample of the fine aggregate to be tested for surface moisture content. It shall weigh not less than 200 g. Larger samples will yield more accurate results.

6. Procedure

6.1 The surface water content may be determined either by weight or volume. In each case the test shall be made at a temperature range of 65 to 85°F (18 to 29°C).

6.2 *Determination by Weight*—Determine the weight of the container, in grams, filled to the mark with only water. Before placing the sample into the container, adjust the level of the water so that it will be sufficient to cover the sample without going over the original mark. Introduce the weighed sample of fine aggregate into the container and remove the entrained air. Fill the container to the original mark, and determine the weight in grams. Calculate the amount of water displaced by the sample, as follows:

$$W_d = W_c + W_s - W \tag{1}$$

where:

W_d = weight of water displaced by the sample, g,
W_c = weight of container filled to the mark with water, g,
W_s = weight of sample, g, and
W = weight of container and sample, filled to the mark with water, g.

6.3 *Determination by Volume*—Measure a volume of water, in millilitres, sufficient to cover the sample and place in the container. Introduce the weighed sample of fine aggregate into the container and remove the entrained air. Determine the combined volume of the sample and the water by direct reading when a graduated flask is used. When a pycnometer or volumetric flask of known volume is used, fill the container to the known volume mark with an additional measured volume of water. The flask or pycnometer volume is then equal to the combined volume of sample and water. Calculate the amount of water displaced by the sample, as follows:

$$V_s = V_2 - V_1 \tag{2}$$

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

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

where:
V_s = volume of water displaced by the sample, mL,
V_2 = combined volume of sample and water, mL, and
V_1 = total volume of water in the flask or pycnometer required to cover the sample and bring the level up to the known volume mark, mL.

7. Calculation

7.1 Calculate the percentage of surface moisture in terms of the saturated surface-dry fine aggregate (see Appendix X1), as follows:

$$P = [(W_d - V_d)/(W_s - W_d)] \times 100 \quad (3)$$

where:
P = surface moisture in terms of saturated surface-dry fine aggregate, %,
V_d = weight of the sample (W_s in 6.2) divided by the bulk specific gravity of the fine aggregate in a saturated surface-dried condition, determined as prescribed in Test Method C 128, and
W_d = weight of water displaced, g, and
W_s = weight of sample, g

7.2 Calculate the percentage of surface moisture in terms of dry aggregate if the absorption of the aggregate is known as follows:

$$P_d = P[1 + (P_a/100)] \quad (4)$$

where:
P_d = surface moisture in terms of dry fine aggregate, %, and
P_a = absorption of the fine aggregate, %, determined in accordance with Test Method C 128.

Total moisture content, on a dry aggregate basis, is the sum of the surface moisture, P_d, and the absorption, P_a.

8. Report

8.1 Report surface moisture test results as determined by this method to the nearest 0.1 %.

9. Precision and Bias

9.1 This procedure is estimated to be less precise than properly conducted moisture content tests by drying (Test Method C 566). Accurate specific gravity information is essential to the bias of this method. Test Method C 566 can be used to verify the level of bias.

9.2 *Precision*—These estimates of precision are based on results from the AASHTO Materials Reference Laboratory (AMRL) Proficiency Sample Program, of testing conducted on Fine Aggregate Proficiency Sample Numbers 99 and 100. The precision limits are based on test results submitted by 144 laboratories that tested two fine aggregate test samples of approximately 500 g mass with average surface moisture contents of 2.323 % and 2.075 % respectively.

9.2.1 *Single-Operator Precision*—The single-operator standard deviation of a single test result has been found to be 0.50 %.[3] Therefore, results of two properly conducted tests by the same operator should not differ by more than 1.39 %.

9.2.2 *Multilaboratory Precision*—The multilaboratory standard deviation of a single test result has been found to be 0.82 %.[3] Therefore, results of two properly conducted tests in different laboratories on the same material should not differ by more than 2.31 %.[3]

9.3 *Bias*—Since there is no accepted reference material suitable for determining the bias of this test procedure, no statement on bias (other than that in 9.1) is made.

10. Keywords

10.1 fine aggregate; fine aggregate moisture; surface moisture

[3] These numbers represent, respectively, the (1s) and d2s) limits as described in Practice C 670.

APPENDIX

(Nonmandatory Information)

X1. DEVELOPMENT OF EQUATIONS

X1.1 These equations are readily derived from basic relationships. For convenience express P in terms of the ratio r, that is, the ratio of the weight of surface moisture to the weight of the saturated, surface-dry sample. It follows that:

$$r = \frac{W_s - [W_s/(1 + r)]}{W_s/(1 + r)} \quad (X1.1)$$

X1.1.1 If G is bulk specific gravity of the saturated, surface-dry fine aggregate, then

$$W_d = \frac{W_s}{G(1 + r)} + W_s - \frac{W_s}{1 + r} \quad (X1.2)$$

where the first term gives the water displaced by the saturated surface-dry fine aggregate and the second that displaced by the surface moisture.

X1.1.2 From Eq X1.2:

$$\frac{W_s}{1 + r} = \frac{W_d - W_s}{\frac{1}{G} - 1} \quad (X1.3)$$

By definition,

$$W_s = V_d G \quad (X1.4)$$

X1.1.3 Substituting for $W_s/(1 + r)$ and W_s in Eq X1.1 and simplifying,

$$r = (W_d - V_d)/(W_s - W_d) \quad (X1.5)$$