Standard Method of Test for

Portland Cement Content of Hardened Hydraulic-Cement Concrete

AASHTO Designation: T 178-15 (2019)

Technical Subcommittee: 3c, Hardened Concrete

Release: Group 1 (April)

ASTM Designation: C1084-10

AASHTO

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1. SCOPE

1.1. This test method covers the determination of portland cement content of a sample of hardened hydraulic-cement concrete.

1.2. The values in SI units are to be regarded as the standard. The values given 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.* Disposal of some or all of the chemicals used in this method may require adherence to EPA or other regulatory guidelines.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards*:

- M 231, Weighing Devices Used in the Testing of Materials
- R 76, Reducing Samples of Aggregate to Testing Size
- T 24M/T 24, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- T 105, Chemical Analysis of Hydraulic Cement

2.2. *ASTM Standards*:

- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- C823/C823M, Standard Practice for Examination and Sampling of Hardened Concrete in Constructions
- C856, Standard Practice for Petrographic Examination of Hardened Concrete
- D1193, Standard Specification for Reagent Water
- E11, Standard Specification for Wire-Cloth Sieves for Testing Purposes
- E832, Standard Specification for Laboratory Filter Papers

3. SIGNIFICANCE AND USE

3.1. This test method consists of two independent procedures: an oxide-analysis procedure that consists of two subprocedures and an extraction procedure. Each procedure requires a substantial degree of chemical skill and relatively elaborate chemical instrumentation. Except for the influence of known interference, determined cement contents are normally equal to, or slightly greater than, actual values except for the maleic acid procedure, where results can also be significantly low when the paste is carbonated (Note 1).

Note 1—With certain limitations, the procedure is also applicable for eliminating the combined content of portland cement and pozzolan or slag in concretes made with blended hydraulic cement and blends of portland cement with pozzolans and slags. The results of this test method when applied to concretes made with blended cements or pozzolans depend on the composition of the pozzolan, the age of the concrete, the extent of the reaction of the pozzolan, and the fact that this test method may determine only the portland cement component of a blended cement. The test method should be applied to the determination of the blended cement content or the pozzolanic content only by use of calibration concrete samples or other information. Earlier versions of this test method can provide useful information as detailed by Hime[1] and Minnick.[2]

4. INTERFERENCES

4.1. Many constituents of concrete may interfere with the analysis of the concrete for portland cement content. The following limited lists of materials have been provided as a guide. The rocks, minerals, or mineral admixtures listed will interfere with the cement content determination to the extent of their solubility during the dissolution procedure used. The solubility of rocks, minerals, or mineral admixtures may depend on the fineness of the test sample, the water/cement ratio of the concrete, the extent of hydration, and the age of the concrete (extended exposure of the high pH of the concrete may affect the solubility of some minerals).

4.2. *Substances Affecting Calcium Oxide Subprocedure*:

4.2.1. The following are soluble in even the cold dilute hydrochloric acid of this procedure and will contribute a high bias to the cement content calculated from the soluble calcium oxide: limestone, marble, dolomitic limestone, calcareous sandstone, calcareous chert, and caliche-encrusted and calcite- or dolomite-coated rocks.

4.2.2. The following may be soluble depending on the age and pH of the concrete; whether the mineral present is glassy or crystalline, or weathered or strained; and the fineness of the minerals present, and, if soluble, will bias the cement content calculated from the soluble calcium oxide high depending on the calcium content of the minerals: weathered or altered plagioclase feldspar, caliche-encrusted rocks, altered volcanic rocks (with calcareous inclusions), and many other calcium containing rocks.

4.2.3. Every percent of soluble calcium oxide that is contributed by soluble aggregate or mineral admixtures will bias the cement content high by approximately 1.6 percent.

4.2.4. Silica fume may lower the acid solubility of the sample and hence bias the result low.

4.3. *Substances Affecting the Soluble Silica Subprocedure*:

4.3.1. The following may be soluble depending on the age and pH of the concrete; whether the aggregate is glassy or crystalline, or weathered or strained; and the fineness of the minerals: chert, opal, chalcedony, glassy volcanic rock, strained quartz (highly strained), quartzite, cataclastic rocks (mylonite, phyllonite), gneiss, schist, metagraywacke, and many other soluble silicon-containing rocks and minerals.