Designation: C1603 – 23

Standard Test Method for Measurement of Solids in Water[1]

This standard is issued under the fixed designation C1603; 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 measurement of the solids content in water for use as mixing water in ready-mixed concrete and the measurement of its density. Solids content is expressed in terms of parts per million (ppm) or in terms of percent by mass of the water sample.

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 The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 *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.*

1.5 *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:*[2]

C125 Terminology Relating to Concrete and Concrete Aggregates

C185 Test Method for Air Content of Hydraulic Cement Mortar

C188 Test Method for Density of Hydraulic Cement

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

C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

3. Terminology

3.1 *Definitions:*

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

4. Significance and Use

4.1 This test method is used to determine the solids content of mixing water used to produce concrete when one or more of the water sources is wash water from concrete production operations or water that contains solids when batched as mixing water in concrete.

4.2 The test method provides a means to determine the relationship between the density and solids content of water for compliance with solids content limits of mixing water such as in Specification C1602/C1602M.

4.3 During production of concrete, the water property measured is its density, which can then be used to estimate the solids content from procedures described in this test method.

4.4 To develop a correlation between the density and solids content of water, water samples should be tested that cover the range of solids concentrations anticipated during production.

5. Apparatus

5.1 Density Measure: A cylindrical container (Note 1) with a volume of at least 200 mL with a glass or hard plastic plate that is placed over it. The glass or plastic plate shall be at least 6 mm thick and 40 mm larger than the outer diameter of the measure. The top of the density measure shall be flat such that it does not leak when the plate is placed over it.

NOTE 1—A commonly available smaller size mason jar with top ground smooth or the density measure used in Test Method C185 are acceptable.

5.2 The volume of the density measure shall be determined to nearest 0.1 mL using the verification procedure described in Test Method C185.

5.3 A microwave oven with at least 900 W of power capacity.

5.4 A microwave-safe glass dish large enough to contain the water sample and fiberglass cloth (See Note 2).

[1] This test method is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.40 on Ready-Mixed Concrete.

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[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.

***A Summary of Changes section appears at the end of this standard**

NOTE 2—A450 × 450 × 25 mm dish is acceptable. Fiberglass cloth commonly used with fiberglass resin for boat or auto body repair is found in most hardware stores.

5.5 A balance or scale with a minimum capacity of 2000 g accurate to 0.1 g

5.6 A rubber syringe

6. Measurement of Density

6.1 Obtain the mass of the empty density measure and plate to the nearest 0.1g.

6.2 If the water contains solids in suspension, ensure that the water is sampled while the water source is being agitated. Take a representative sample of water and fill the density measure to overflowing. Slide the cover plate over the measure ensuring that there are no air bubbles. Wipe the outside of the plate and measure dry and obtain the mass of the filled density measure covered with the plate.

6.3 Calculate the density of the water sample to 0.001 g/mL

$$D_W = \frac{M_W}{V} \quad (1)$$

Where:

D_W = Density of the water, g/mL,
M_W = Net mass of water in the density measure, g, and
V = Volume of the density measure, mL.

7. Measurement of Solids Content

7.1 Obtain the mass of the empty dish and a piece of fiber glass cloth about 500 mm square to the nearest 0.1 g.

7.2 For the water sample used in the density measurement, keep the glass plate over the density measure and shake the water suspension. If the density of water is not determined, obtain at least 200 mL of a representative sample of water in a container and determine the mass of the water sample to the nearest 0.1 g. Pour the water sample into the glass dish. Using the rubber syringe, wash solids adhered in the measure into the dish using a minimum amount of water. Cover the water with the fiberglass cloth to prevent loss of solids during drying.

7.3 Place the dish in a microwave oven and heat it for approximately 20 min or until the water has evaporated. Determine the mass of the dish and place it back in the microwave oven for 2 min increments until the mass determined in two subsequent determinations do not differ by more than 0.5 g. At any step in the drying process, discontinue additional drying if the net mass of water and solids in the dish is less than 0.5 g.

7.4 Determine the mass of the dish and cloth with the dried solids.

7.5 Calculate the percent solids in terms of percent by mass to the nearest 0.1 % and in ppm to the nearest 1000 ppm. If the measured value is less than 500 ppm, record the value as zero or the actual calculated value.

$$S_W,\% = \frac{M_s}{M_W} \times 100 \quad (2)$$

$$S_{ppm} = S_W \times 10\,000 \quad (3)$$

Where:

M_s = Mass of dry solids,
M_W = Mass of water with solids,
S_W = Solids content in water, in percent, and
S_{ppm} = Solids content in water, in ppm.

7.6 Repeat these measurements for water with different solids content. Test water at 4 or more different levels of solids content.

8. Relationship Between Density and Solids Content

8.1 Establish a relationship using linear regression analysis (See Note 3) between the measured density and solids content of water sample measurements for a range of solid concentrations that cover the anticipated range in the production facility.

NOTE 3—The linear regression analysis can be performed using spreadsheet software.

8.1.1 Express the relationship between the density of the water and the solids content as follows, such that the measured density on a particular production day can be used to determine the solids content of the water.

$$S_{ppm} = A + B \times D_W \quad (4)$$

Where: A and B are regression constants

NOTE 4—Eq 4 provides an approximate linear relationship between solids content and measured density. The relationship between solids content and density is non-linear (see Eq 5) and Eq 4 should not be used to estimate the solids content of water outside the range of values used to establish the relationship in Eq 4.

NOTE 5—During concrete production, a producer might choose to monitor the density of a water source using a hydrometer. It is recommended that the density of the water using a hydrometer be determined on the water at the time of this density measurement to obtain a relationship, if needed, or to calibrate the hydrometer. The water sample should be placed in a transparent volumetric measuring flask. The hydrometer measurement should be taken within 10 s after filling the water in the flask. This is to ensure that significant settlement of solids has not occurred before the measurement is taken as that will affect the measured density.

8.2 When the relationship between density and solids content is not determined by testing, calculate the solids content of the water in ppm from the measured density using the following:

$$S_{ppm} = \left(\frac{D_W - 1}{D_S - 1}\right) \times \frac{D_S}{D_W} \times 1\,000\,000 \quad (5)$$

where:

D_S = Density of solids in the water, g/mL

8.2.1 To measure the density of solids, use at least 50 g of the dried solids and measure the density in accordance with Test Method C188.

8.2.2 When the density of solids in the water is unknown, an assumed value of 2.6 g/mL is adequate (See Note 6). Determine the solids content of the water in ppm from the measured density using the simplified form of Eq 5 as follows:

$$S_{ppm} = 1\,625\,000 \times \left(1 - \frac{1}{D_W}\right) \quad (6)$$

NOTE 6—There are several conditions that will change the density of solids extracted from water from ready mixed concrete production within a relatively small range. For the purpose of establishing the relationship between the density of water and the solids content, using an assumed