CRD-C 112-69

METHOD OF TEST FOR SURFACE MOISTURE IN AGGREGATE BY WATER DISPLACEMENT

1. Scope

1.1 This method of test covers procedures for determining the percentage of surface moisture in aggregate samples by water displacement. It is assumed that the bulk specific gravity (saturated surface-dry basis) of the material is known.

1.2 Surface moisture is the free water retained on surfaces of aggregate particles and considered to be part of the mixing water in concrete, as distinguished from absorbed moisture. Surface moisture, as determined by these procedures, is expressed as a percentage by weight of the saturated surface-dry aggregate.

1.3 Method of Test for Moisture Content of Aggregate by Drying (CRD-C 113) provides a basis for calculating surface moisture content from total moisture content and absorption.

2. Apparatus

2.1 Balance.- A balance with the smallest graduation not more than 0.1 percent of the total weight of the samples to be tested, and accurate within 0.5 percent of the total sample weight.

2.2 Volumetric Containers.- Volumetric containers shall be rigid enough to hold their shape while in use during testing, and constructed of nonabsorbent and noncorrosive material. Total volume shall be from two to three times the loose aggregate volume of the test sample, and the volume shall be determined to the nearest 0.1 percent. If the volume is to be measured by filling to a cover plate, then the top surface shall be plane within 0.001 in. (0.0254 mm), as checked using a machined plate and a feeler gage.

2.3 Cover Plates.- Cover plates shall be made of nonabsorbent material, shall cover the volumetric container, and shall be plane within 0.001 in. (0.0254 mm) on the surface which will be in contact with the container. The cover plate may contain a small vent hole in the center to allow air to escape.

2.4 Immersion Containers.- An immersion container shall be made of noncorrosive and nonabsorbent material. The depth shall be sufficient so that, when it contains an aggregate test sample and is immersed in water, the aggregate will remain in the container. The container shall be provided with a bail or hanger which shall extend down into the water during weighings and thereby cut to a minimum the wetted surface above the water level created during immersions.

3. Sample

3.1 The test sample shall consist of a representative fraction of the aggregate weighing not less than the amount designated in Table 1 of Method CRD-C 113. The bulk specific gravity, saturated surface-dry (G) of material similar to that of which the sample is composed shall have been determined by Method CRD-C 107 or 108.

4. Procedures

4.1 Three general procedures (A, B, C) have been found satisfactory for determining the percentage of surface moisture in aggregates (P), as follows:

4.1.1 Procedure A.- This procedure, applicable to the determination of free moisture of fine and coarse aggregate, requires a balance and immersion container similar to that known as the Dunagan apparatus, which will permit samples to be weighed in air and in water. The weighing device shall conform to the requirements of Section 2.1. The immersion container shall conform to the requirements of Section 2.4. Samples of the test aggregate conforming to the requirements of Par. 3 shall be taken and tested as follows: Weigh the wet aggregate test sample in air (W_{sa})

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and then in water ($W_{s\,w}$). Specific gravity of the aggregate in a saturated surface-dry condition (G) shall have been previously determined. Percentage of surface moisture (P) shall then be determined as follows:

$$P = \frac{100\,(GW_{sa} - GW_{sw} - W_{sa})}{GW_{sw}}$$

In case P is a negative quantity, then the amount of moisture in the aggregate is not sufficient to saturate it, and it therefore does not contain surface moisture.

4.1.2 Procedure B.- This procedure, applicable to fine and coarse aggregate, requires a direct reading scale[1] for the surface moisture determination. The scale and the surface moisture reading dial shall comply with the requirements of Section 2.1. An example of instructions with a particular scale[1] is as follows: Set the target indicator of the dial segment marked "Weight of Sample" on the previously determined specific gravity of the aggregate. Place the weighing pan on the special lever arm and add aggregate until the main scale pointer reaches the set target indicator. Pour the aggregate into the volumetric container, add water until the aggregate is inundated, and remove all trapped air by stirring and lightly tapping the sides of the container with

a nonmetallic device. Take care during the stirring and tapping to prevent loss of aggregate. Completely fill the container with water and securely seat the lid, allowing surplus water to run over the side of the container or out the vent hole in the lid. Dry off the container, and then place it on the special lever arm. Read the indicated percentage of surface moisture on the dial segment marked "Percentage of Moisture."

4.1.3 Procedure C.- This procedure for the determination of surface moisture of fine aggregate requires the use of a 1000 ± 1 ml volumetric container, a cover plate, and a balance. Pour approximately 400 ml water into the container and add 2 drops of caprylic alcohol. Weigh to the nearest 0.1 g a quantity of fine aggregate equal to 500 times its saturated surface-dry specific gravity and pour this into the water in the container. Finish filling the container with water and slide the cover over the top in such a manner that no air bubbles are trapped beneath it. Wipe the outside of the container and weigh to the nearest 0.1 g. Obtain net weight of fine aggregate and water by subtracting the container weight from the weight of the container filled with the fine aggregate and water. From the net weight of the filled container and the bulk specific gravity of the fine aggregate, the percentage of surface moisture may be read directly from the graph in Fig. 1 or obtained by interpolation from the values in Table 1.

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[1]As manufactured by the Toledo Scale Company, commonly called an SC[2] scale.

PROCEDURE

1 – DETERMINE BULK SPECIFIC GRAVITY (SAT. SURF. DRY)

2 – ADD ± 400 ML. WATER AND 2 DROPS OF CAPRYLIC ALCOHOL TO CONTAINER.

3 – WEIGH OUT SAMPLE (SEE TABLE I) AND ADD TO CONTAINER.

4 – FILL CONTAINER WITH WATER AND STRIKE OFF WITH GLASS PLATE.

5 – WEIGH FILLED CONTAINER.

6 – FIND NET WEIGHT AND REFER TO LOWER SCALE.

7 – POINT OF INTERSECTION OF THAT ABSCISSA WITH CURVE FOR THE DETERMINED SPECIFIC GRAVITY, PROJECTED ON SCALE TO LEFT GIVES PERCENTAGE OF FREE MOISTURE.

TABLE I

BULK SPECIFIC GRAVITY (SAT. SURF. DRY)	WEIGHT OF SAMPLE GRAMS
2.50	1250
2.52	1260
2.54	1270
2.56	1280
2.58	1290
2.60	1300
2.62	1310
2.64	1320
2.66	1330
2.68	1340
2.70	1350
2.72	1360
2.74	1370
2.76	1380
2.78	1390
2.80	1400
2.82	1410
2.84	1420
2.86	1430
2.88	1440
2.90	1450

SURFACE MOISTURE IN PER CENT

12.0 11.0 10.0 9.0 8.0 7.0 6.0 5.0 4.0 3.0 2.0 1.0 0

BULK SPECIFIC GRAVITY →

2.50 2.52 2.54 2.56 2.58 2.60 2.62 2.64 2.66 2.68 2.70 2.72 2.74 2.76 2.78 2.80 2.82 2.84 2.86 2.88 2.90

1650 1700 1750 1800 1850 1900 1950
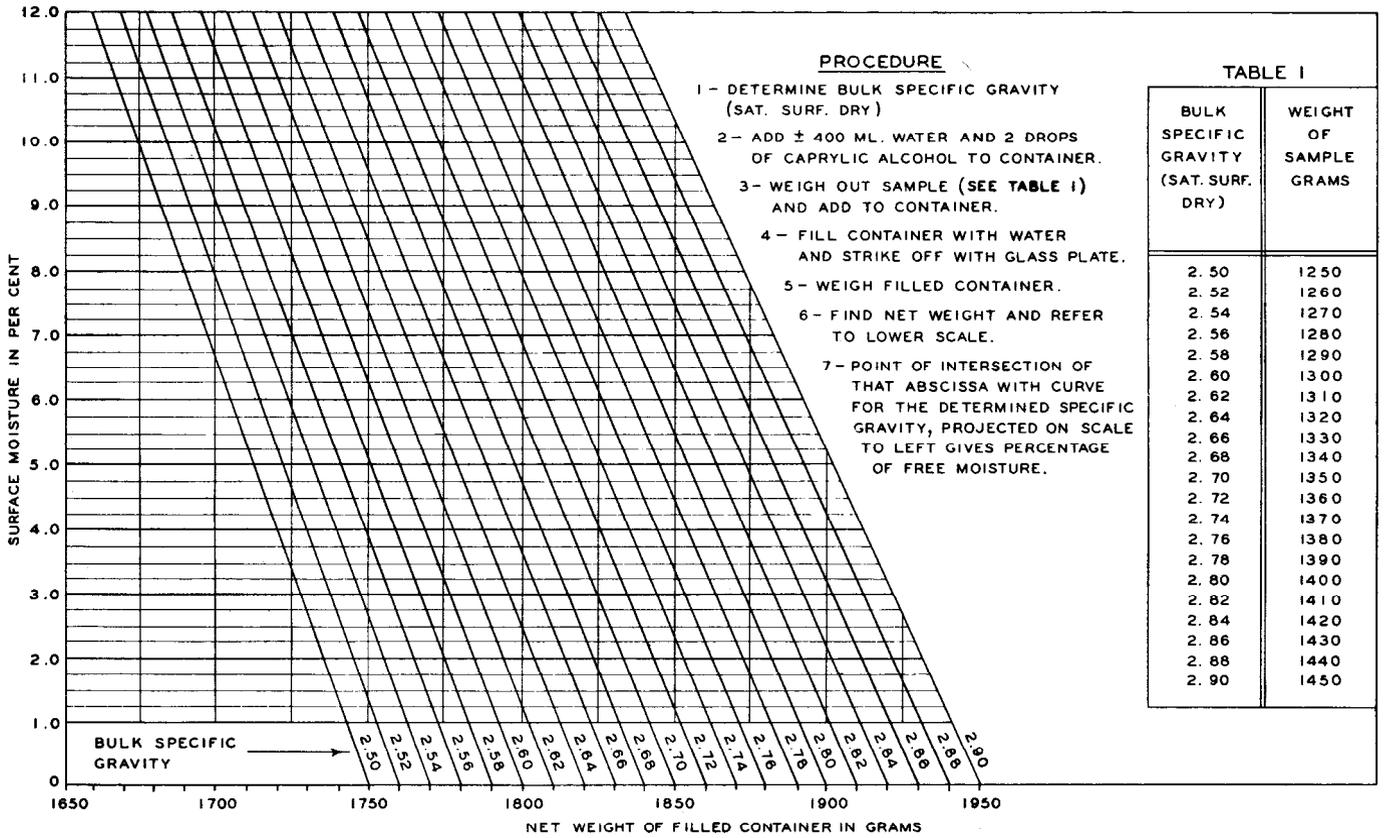
NET WEIGHT OF FILLED CONTAINER IN GRAMS

Fig. 1. Determination of percentage of surface moisture in fine aggregate

TABLE 1

Percentage of Surface Moisture in Fine Aggregate	Bulk specific gravity (saturated surface-dry)									
	2.59	2.60	2.61	2.62	2.63	2.64	2.65	2.66	2.67	2.68
	Combined weight in grams of fine aggregate and water									
0.0	1795.0	1800.0	1805.0	1810.0	1815.0	1820.0	1825.0	1830.0	1835.0	1840.0
0.5	1791.0	1796.0	1801.0	1806.0	1811.0	1816.0	1821.0	1826.0	1831.0	1836.0
1.0	1787.0	1792.0	1797.0	1802.0	1807.0	1812.0	1817.0	1822.0	1826.5	1831.5
1.5	1783.0	1788.0	1793.0	1798.0	1803.0	1808.0	1813.0	1818.0	1822.5	1827.5
2.0	1779.0	1784.5	1789.0	1794.0	1799.0	1804.0	1809.0	1813.5	1818.5	1823.5
2.5	1775.5	1780.5	1785.5	1790.0	1795.0	1800.0	1805.0	1809.5	1814.5	1819.5
3.0	1772.0	1776.5	1781.5	1786.5	1791.5	1796.0	1801.0	1806.0	1810.5	1815.5
3.5	1768.0	1773.0	1778.0	1782.5	1787.5	1792.5	1797.0	1802.0	1807.0	1811.5
4.0	1764.5	1769.0	1774.0	1779.0	1783.5	1788.5	1793.5	1798.0	1803.0	1807.5
4.5	1761.0	1765.5	1770.5	1775.0	1780.0	1784.5	1789.5	1794.5	1799.0	1804.0
5.0	1757.0	1762.0	1766.5	1771.5	1776.0	1781.0	1785.5	1790.5	1795.0	1800.0
5.5	1753.5	1758.5	1763.0	1768.0	1772.5	1777.0	1782.0	1786.5	1791.5	1796.0
6.0	1750.0	1754.5	1759.5	1764.0	1769.0	1773.5	1778.5	1783.0	1787.5	1792.5
6.5	1746.5	1751.0	1756.0	1760.5	1765.5	1770.0	1774.5	1779.5	1784.0	1788.5
7.0	1743.0	1747.5	1752.5	1757.0	1761.5	1766.5	1771.0	1775.5	1780.5	1785.0
7.5	1739.5	1744.0	1749.0	1753.5	1758.0	1763.0	1767.5	1772.0	1777.0	1781.5
8.0	1736.0	1740.5	1745.5	1750.0	1754.5	1759.5	1764.0	1768.5	1773.0	1778.0
8.5	1732.5	1737.5	1742.0	1746.5	1751.0	1756.0	1760.5	1765.0	1769.5	1774.0
9.0	1729.5	1734.0	1738.5	1743.0	1747.5	1752.5	1757.0	1761.5	1766.0	1770.5
9.5	1726.0	1730.5	1735.0	1739.5	1744.5	1749.0	1753.5	1758.0	1762.5	1767.0
10.0	1722.5	1727.5	1732.0	1736.5	1741.0	1745.5	1750.0	1754.5	1759.0	1763.5