Designation: D 6473 – 99

Standard Test Method For Specific Gravity And Absorption of Rock For Erosion Control[1]

This standard is issued under the fixed designation D 6473; 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 determination of specific gravity and absorption of rock for erosion control, commonly referred to as riprap or armor stone. The specific gravity may be expressed as bulk specific gravity or apparent specific gravity. Bulk specific gravity and absorption are based on a 24-h soaking time for the rock specimens tested.

1.2 The use of reclaimed concrete and other materials is beyond the scope of this test method.

1.3 The values stated in SI units are to be regarded as 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 127 Test Method for Specific Gravity and Absorption of Coarse Aggregate[2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[3]

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[3]

D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Testing Soil, Rock, and Related Construction Materials[3]

D 4992 Practice for Evaluation of Rock to Be Used for Erosion Control[3]

3. Terminology

3.1 *Definitions*—Definitions for terms in this test method shall be in accordance with Terminology D 653 except as noted in 3.2.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *absorption*—the increase in the mass of rock due to water in the pores of the material, but not including water adhering to the outside surface of the particles. Absorption is expressed as a percentage of the dry mass. The rock is considered "dry" if it has been maintained in an environment for sufficient time to remove all visible water.

3.2.2 *apparent specific gravity*—the ratio of (1) the mass in air of a given volume of the impermeable portion of a permeable material (that is, the solid matter including its impermeable pores or voids) at a stated temperature to (2) the mass of an equal volume of distilled water at the same stated temperature. The value is dimensionless.

3.2.3 *bulk specific gravity*—the ratio of (1) the mass in air of a given volume of a permeable solid (including both permeable and impermeable voids within the material) at a stated temperature, to (2) the mass in air of an equal volume of distilled water at the same stated temperature. The value is dimensionless.

3.2.4 *bulk specific gravity (saturated surface-dry) (SSD)*—the ratio of (1) the mass of a given volume of permeable solid, (including the mass of water within the saturated permeable voids) filled to the extent achieved by submerging in water for approximately 24 h at the stated temperature to (2) the mass of an equal volume of water at the same stated temperature. The value is dimensionless.

3.2.5 *specific gravity*—the ratio of (1) the mass in air of a given volume of solid at a stated temperature to (2) the mass of an equal volume of distilled water at the same stated temperature. The value is dimensionless.

4. Summary of Test Method

4.1 An air-dried specimen (block, chunk, or slab) of rock is submerged in water for 24 h after which it is weighed while still submerged. It is then removed from the water, dried to a surface dry condition, and weighed again. Finally it is dried in an oven for a specified length of time and weighed again. The initial mass and increase in mass are used to determine the specimen's specific gravity and percentage of water absorbed.

NOTE 1—Immersion durations other than the 24-h period have been used. Specimens in those tests have been immersed in increments over a four-day period. Test results indicate a higher percentage of water absorption than the 24 h test. Negligible differences in bulk specific gravity were measured after one-day soaking and four-day incremental soakings.

[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.17 on Rock and Erosion Control.

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

[3] *Annual Book of ASTM Standards,* Vol 04.08.

5. Significance and Use

5.1 Rock riprap and armor stone are composed of pieces of natural rock that are placed on construction projects to minimize the effects of erosion. The ability of rock to withstand deterioration from weathering affects both the effectiveness of the project and its cost. The specific gravity and absorption of rock provide useful information that can be used in evaluating possible deterioration of rock.

5.2 Bulk specific gravity and bulk specific gravity SSD may reflect the quality of rock and is important in that it may provide one indicator to the resistance of a rock to movement by water.

5.3 The absorption of water into rock may affect its durability under freezing conditions and salt crystallization conditions. In addition, the absorption test has been used as an index test in determining whether additional tests are needed to evaluate the durability of a rock.

5.4 Test specimens equal in size to the proposed design size would provide the best correlations between laboratory tests and actual field performance, however this is usually neither practical nor economically feasible.

5.5 The results of these tests are not to be used as the sole basis for determination of rock durability, but should be used in conjunction with the results of other tests.

5.6 These test methods have been used to evaluate different types of rocks. There have been rare occasions when test results have provided data that have not agreed with the durability of rock under actual field conditions. For example, some rocks with low absorption values have fragmented in actual usage and some with high absorption values have proven to be durable.

NOTE 2—The quality of the result produced by this test method is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies which meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this test method are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depends on many factors; Practice D 3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Specimen Container*—A container capable of holding a submerged rock specimen being tested.

6.2 *Balance*—A balance or scale conforming to the requirements of Specification D 4753 and readable (with no estimation) to the nearest 5 g or to 0.1 % or better of the mass of the test specimen.

6.3 *Oven*, capable of drying the specimen to a temperature of 110 ± 5°C (230 ± 9°F).

7. Sampling

7.1 Practice D 4992 provides guidance on sampling a source of rock. A source that is macroscopically uniform in color, texture, mineralogy, or some other visual property shall be represented by a sample consisting of a minimum of five specimens of rock. A macroscopically nonuniform source shall be represented by a sample consisting of a minimum of eight specimens of rock for testing. Rock types that comprise less than 5 % of the total source, as determined from their macroscopic properties may be ignored, unless their presence will greatly affect the test results and subsequent proposed use of the rock. Sample the rock types in their approximate proportion to the types that occur at the source.

7.2 Specimens shall be clean and without soil particles or other materials that will adhere to them and affect test results. Specimens shall have all loose parts and adhering material removed by brushing with a stiff brush (including the use of water, as necessary) and shall be allowed to air dry.

7.3 Each specimen shall be a minimum of 1 kg (2.2 lb) in mass. The maximum mass shall be limited only by the capacity of the scale and size of the water-filled tank.

NOTE 3—Tests to determine the absorption and specific gravity have been performed on aggregate-sized particles in accordance with Test Method C 127. Larger-sized particles may include more variability in rock properties than small particles and can give a better indication of the bulk properties than small ones.

8. Procedure

8.1 Conduct the testing procedure at ambient laboratory temperatures.

8.2 Completely submerge the air-dried specimens in water at 20 to 30°C (68 to 86°F) for a period of 24 ± 4 h. Determine the mass of each specimen while they are immersed in water at the end of this time period. Record these, and all subsequent masses, to the nearest 5 g or 0.1 %, whichever is more precise.

8.3 Remove each specimen from the water and roll it in a large absorbent cloth until all visible films of water are removed. A moving stream of air (but not a heated air stream, such as from a drier) may be used to assist the drying, but care should be taken to avoid evaporation of water from the pores. Determine and record the mass of each specimen.

8.4 Dry each specimen for 24 h or to a mass that is constant within ±0.1 % at a temperature of 110 ± 5°C (230 ± 9°F), then cool them in air at room temperature for 1 to 3 h, and record their mass.

NOTE 4—The use of tap water instead of distilled water is permitted. The tap water shall not contain a high amount of dissolved minerals and shall stand for several hours to dissipate any dissolved air. Laboratory test results run on specimens tested in distilled water were sufficiently close to those tested in tap water so as not to significantly affect the result.

9. Calculation

9.1 Calculate the bulk specific gravity, bulk specific gravity (SSD), apparent specific gravity, and absorption for each specimen at ambient laboratory temperature as follows:

$$\text{bulk specific gravity} = A/(B–C) \quad (1)$$

$$\text{bulk specific gravity (SSD)} = B/(B–C) \quad (2)$$

$$\text{apparent specific gravity} = A/(A–C) \quad (3)$$

$$\text{absorption, \%} = [(B–A)/A] \times 100 \quad (4)$$

where:

A = mass of oven-dry test specimen in air, g,
B = mass of saturated-surface dry test specimen in air, g, and
C = buoyant mass of submerged test specimen in water, g.

9.1.1 Calculate the results for each specific gravity test to the nearest 0.01. Calculate the averages of all specific gravity tests by summing the results of all test specimens and dividing

by the number of specimens tested and report to the nearest 0.01.

9.1.2 Calculate the results for each absorption test to the nearest 0.1 %. Calculate the averages for all absorption tests by summing the results of all specimens and dividing by the number of specimens and report to the nearest 0.1 %.

10. Report

10.1 Report the following information:

10.1.1 Prepare a separate report on rock from each source. Report the source of the samples, its location, the dates sampled and tested, and the geological formation if known,

10.1.2 Description and type of materials,

10.1.3 Name of the individuals performing the test,

10.1.4 Indicate the type of specific gravity, whether bulk, bulk (SSD), or apparent. The specific gravity results for each specimen tested and the average of each type of test to the nearest 0.01, and

10.1.5 Absorption result for each specimen tested and the average of all the specimens tested to the nearest 0.1 %.

11. Precision and Bias

11.1 *Precision*—Subcommittee D18.17 is presently conducting a series of tests that it hopes will permit determining precision of test results. Subcommittee D18.17 welcomes proposals from the users of this test method that might be used to make a limited statement on precision.

11.2 *Bias*—There is no accepted reference value for this test method; therefore bias cannot be determined.

12. Keywords

12.1 absorption; riprap; rock material properties; specific gravity