Designation: D6473/D6473M – 24

Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control[1]

This standard is issued under the fixed designation D6473/D6473M; 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. The specific gravity may be expressed as bulk specific gravity or apparent specific gravity. Bulk specific gravity and absorption are based on a 24 ± 4-h soaking time for the rock specimens tested. This test is appropriate for breakwater stone, armor stone, riprap, and gabion sized rock materials, or similar.

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

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.3.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In the system, the pound (lbf) represents a unit of force (weight), while the units for mass is slugs. The slug unit is not given, unless dynamic (F = ma) calculations are involved.

1.3.2 It is common practice in the engineering/construction profession to concurrently use pounds to represent both a unit of mass (lbm) and of force (lbf). This practice implicitly combines two separate systems of units; the absolute and the gravitational systems. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit of mass. However, the use of balances and scales recording pounds of mass (lbm) shall not be regarded as nonconformance with this standard.

1.4 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this standard.

1.4.1 For purposes of comparing measured or calculated value(s) with specified limits, the measured or calculated value(s) shall be rounded to the nearest decimal or significant digits in the specified limits.

1.4.2 The procedures used to specify how data are collected/recorded or calculated, in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analytical methods for engineering design.

1.5 *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.*

1.6 *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]

C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate (Withdrawn 2024)[3]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

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

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

D4753 Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing
D4992 Practice for Evaluation of Rock to be Used for Erosion Control
D5121 Practice for Preparation of Rock Slabs for Durability Testing
D5312/D5312M Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions
D5313/D5313M Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions
D6026 Practice for Using Significant Digits and Data Records in Geotechnical Data

3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this standard, refer to Terminology D653.

3.1.1 *gabion fill stone, n—in rock*, stone generally less than 22 kg [50 lb] and placed in baskets of wire or other suitable material that is tied together to form an integral structure designed to resist erosion along stream banks and around bridge piers as well as stabilize shorelines, stream banks or slopes as well as retaining walls, noise barriers, temporary flood walls, silt filtration from runoff, for small or temporary/permanent dams, or channel lining. D5121, D5312/D5312M, D5312/D5312M

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *absorption, n—in rock*, 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; expressed as a percentage of the dry mass.

4. Summary of Test Method

4.1 An air-dried specimen (block, chunk, or slab) of rock is submerged in water for 24 ± 4 h after which its buoyant mass is determined while still submerged. It is then removed from the water, dried to a surface dry condition, and its mass in air is determined. Finally, it is dried in an oven to a constant mass. The oven-dry mass and saturated surface dry masses in air and when submerged in water 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.

5. Significance and Use

5.1 Rock for erosion control is composed of pieces of natural rock that are placed on construction projects, shorelines, streambeds, bridge abutments, pilings, and other structures 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 the durability of the rock as well as its resistance to movement by water.

5.2 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.

5.3 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.

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

5.5 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 standard 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 D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depends on many factors; Practice D3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Balance*—A balance or scale conforming to the requirements of Guide D4753 and readable (with no estimation) and accurate to the nearest 5 g [0.01 lbm] or to 0.1 % or better of the mass of the test specimen. The balance shall be equipped with suitable apparatus for suspending the sample container in water from the center of the platform or pan of the balance.

6.2 *Specimen Container*—A wire basket capable of holding the submerged rock specimen being tested. The container shall be constructed so as to prevent trapping air when the container is submerged.

6.3 *Water Tank*—A watertight tank capable of holding the fully immersed rock and specimen container while suspended below the balance.

6.4 An example of the assembled test apparatus is shown in Fig. 1.

6.5 *Drying Oven*—Vented, thermostatically-controlled, preferably of the forced-draft type and capable of maintaining a uniform temperature of 110 ± 5°C [230 ± 9°F] throughout the drying chamber. These requirements typically require the use of a forced-draft oven.

6.6 *Thermometric Device*—A thermometric device capable of measuring the temperature of the water in the Water Tank within which the test is being performed readable to 0.1°C or better and having an accuracy of at least ±0.5°C.

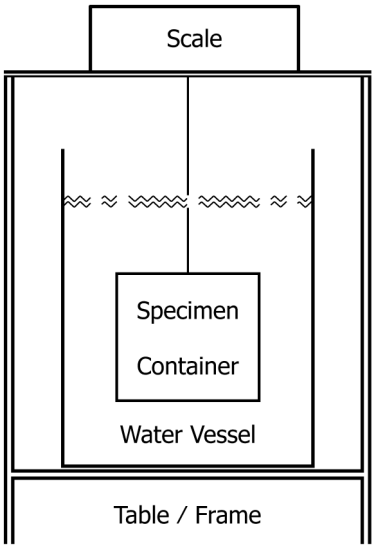

FIG. 1 Example Apparatus

7. Sampling

7.1 Practice D4992 provides guidance on sampling a source of rock. A source that is judged to be macroscopically uniform shall be represented by a sample consisting of a minimum of five specimens of the source rock. A source judged to be macroscopically non-uniform shall be represented by a sample consisting of a minimum of eight specimens of the source rock. 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.

8. Specimens

8.1 Specimens shall be clean and without soil particles or other adherent materials. Specimens shall have all loose fragments and adherent material removed by brushing with a stiff brush (including the use of water, as necessary) and shall be allowed to air dry.

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

8.3 Specimens may be pieces of rock directly sampled in the field, slab specimens prepared for other test methods (for example, for freeze-thaw durability testing per D5312/D5312M), cut off pieces of larger pieces of rock from which other slab specimens have been prepared, or drill core from exploratory borings.

NOTE 3—Tests to determine the absorption and specific gravity have been performed on aggregate-sized particles in accordance with Test Method C127. 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.

9. Procedure

9.1 Conduct the testing procedure at ambient laboratory temperatures.

9.2 Completely submerge the air-dried specimens in water at 20 to 30°C [68 to 86°F] for a period of 24 ± 4 h. During this time, the water and submerged specimen will come into temperature equilibrium with the ambient laboratory conditions.

9.3 Fill the water tank for weighing submerged specimens with water and allow the water to come into temperature equilibrium with the ambient laboratory conditions, typically 24 ± 4 h. Record the temperature of the water to the nearest 0.1°C.

9.4 Place the soaked test specimens, one at a time, in the suspended specimen container ensuring it is completely immersed in water. The specimen container shall be immersed to the same level (depth) as when determining the tare value to reduce error caused by the mass of the equipment above and below the water level. Take care to remove all entrapped air before determining its mass in water by shaking the immersed container. Determine and record the mass of each specimen as the buoyant mass, C. Record this, and all subsequent masses, to the nearest 5 g [0.01 lbm] or 0.1 %, whichever is more precise.

NOTE 4—Care should be taken to ensure that any material detached from its parent specimen during the immersion process shall remain with its parent specimen throughout the balance of testing. The detached material shall be treated and its mass determined, as with the parent specimen.

9.5 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. Take care to avoid evaporation of water from the pores during the surface drying operation. Determine and record the mass of each specimen as the saturated-surface dry mass, B.

9.6 Dry each specimen for a minimum of 24 h or to a constant mass 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. Constant mass will be considered to have been achieved when weight loss is less than 0.1 % of specimen weight in four hours of drying. Determine and record the mass of each specimen as the oven-dry mass, A.

NOTE 5—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.

10. Calculations

10.1 Calculate the specific gravity, apparent dry bulk specific gravity, and apparent saturated (surface dry) specific gravity for each specimen at test temperature as follows:

$$G_t = A/(A - C) \quad (1)$$

$$G_{a,d,t} = A/(B - C) \quad (2)$$

$$G_{a,s,t} = B/(B - C) \quad (3)$$

where:

G_t = specific gravity at test temperature, unitless, nearest 0.01,

$G_{a,d,t}$ = apparent dry bulk specific gravity at test temperature, unitless, nearest 0.01,