CRD-C 169-97

Standard Test Method for Resistance of Rock to Wetting and Drying

1. Scope

1.1 This test method covers a procedure for determining the resistance of rock to wetting and drying. Information developed by use of this method may be applicable in the evaluation of rock for use as slope protection, as concrete aggregate, or for other purposes.

2. Referenced Documents

2.1 *ASTM Standards*

C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate (CRD-C 137)

C 295 Guide for Petrographic Examination of Aggregates for Concrete (CRD-C 127)

D 4992 Practice for Evaluation of Rock to be Used for Erosion Control (CRD-C 157)

E 11 Specification for Wire-Cloth Sieves for Testing Purposes (CRD-C 102)

2.2 *Corps of Engineers Standards*

CDC-C 144 Method of Testing Stone for Resistance to Freezing and Thawing

3. Significance and Use

3.1 This test method provides a procedure for obtaining information on the resistance to wetting and drying of rock for use as slope protection material or as concrete aggregate. The information obtained may be used with other information relating rock quality and resistance to weathering to performance of the rock to those purposes.

3.2 This test method is a revision of that proposed by Lutton et al (1981)* cited in Section 11.2.1 of Practice D 4992 (CRD-C 168).

4. Apparatus

4.1 *Saw* - A rock-cutting saw, preferably having a diamond blade, of suitable diameter for sawing specimens in a single pass.

4.2 *Pans* - One or more pans, each large enough to hold one sample slab, with sides at least 75 mm high, made of stainless steel or other suitable noncorroding material.

4.3 *Specimen supports* - Specimen supports to hold specimens above the bottom of the pan shall consist of lengths of noncorroding material approximately 6 mm in diameter.

4.4 *Drying Oven* - A drying oven, as described in Method C 88 (CRD-C 137), of sufficient capacity for containing the samples in the pans.

4.5 *Balance or scale* - Balance or scale having a capacity adequate for determining the mass the test material to an accuracy of at least 0.1 percent of the mass of the material whose mass is being determined.

4.6 *Photographic Equipment* - Equipment suitable for preparing photographs of the test samples before, during, and after test.

5. Immersion Fluid

5.1 To facilitate entry of the water into the pore space in the rock, the immersion fluid used shall be tap water to which 0.5 percent ethyl alcohol has been added by mass. This is the fluid prescribed for use in CRD-C 144. Its effectiveness is discussed in Mather and Mather (1962).**

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* Lutton, Richard J.; Billy J. Houston; and James B. Warriner. 1981. "Evaluation of Quality and Performance of Stone as Riprap or Armor." USAE Waterways Experiment Station, Technical Report GL-81-8, 106 pp, Vicksburg, MS.

** Mather, Katharine and Bryant Mather. 1962. "Evaluation of Stone for Protection Work," USAE Waterways Experiment Station, Misc. Paper No. 6-480, 18 pp, Vicksburg, MS.

6. Test Specimens

6.1 Specimens for use in this test shag he sawed slabs 25 ± 6-mm thick. Specimens shall be prepared to represent each of the principal varieties and conditions of rock present in the sample. Selection of material to use in preparation of specimens shag preferably be accomplished using the procedures described in ASTM C 295 (CRD-C 127). Preferably three slabs should be tested to represent each principal variety and condition of rock present.

6.2 Slabs should be sawed so as to include at their edges as much of the surface of the material received for testing as possible. Slabs from rock having visible bedding planes or other planar structures should usually be prepared by sawing normal to such structures. Preferably three specimens should be prepared to represent each principal variety or condition of rock. Slabs should be as large as the material available for their preparation will allow, up to the capacity of the pans used for the test.

6.3 Slabs of different materials, the performance of which is to be compared, should preferably be of similar sizes.

6.4 Slabs prepared with sawing equipment and cutting oils shall be carefully cleaned of oil by use of suitable solvents. After having been sawed and cleaned, the slabs should be inspected by the same procedures that were employed in selecting material from which the slabs were sawed to confirm that the slabs adequately represent the types and conditions of material that were intended to be represented. In the event that a sawed slab is found to be nonrepresentative, additional material should be selected and a replacement slab prepared that is representative.

7. Procedure

7.1 After having been cleaned of cutting oil, each test specimen shall be examined and preferably photographed.

7.2 One test specimen shall be placed in a pan and covered by water so that the depth of the solution over the upper surface of the specimen is 25 ± 6 mm. The total volume of a test specimen placed in any one pan shall be such that the volume of rock does not exceed the volume of the solution.

7.3 The pans containing the specimens shall be stored at 23 ± 2 °C for at least 16 ± 1/2 h. They shall then be removed from water and placed in the oven for 8 ± 1/2 hr at 90 ± 5 °C. Afterwards, they shall be removed and inspected to observe the effects of the exposure. Any observed changes shall be recorded. The slab specimens shall be photographed if these changes are regarded as significant.

7.4 Additional cycles of wetting and drying, followed by inspection and photographing as appropriate, shall be continued until a total of 30 cycles have been obtained. The test solution shall be maintained at the specified depth or volume by adding additional solution as needed After every 5 cycles, the solution shall be changed by carefully decanting through a 75-µm (No. 200) sieve so as not to displace any fragments; all material and fragment retained on the sieve shall be returned to the container. New solution shall then be added. When the 16-h or the 8-h portion of the cycle is interrupted, as for holidays and weekends, the specimens shall remain in a dry condition until the sequence is resumed.

7.5 The exposure of a slab specimen may be terminated prior to completion of the 30 cycles if the mass of the largest remaining fragment of the slab amounts to less than half of the mass of the original slab specimen.

7.6 After the 30 cycles of wetting and drying have been completed, the solution shall be carefully poured off as described above. Then, the contents of the container, both the slab specimen fragments remaining in the container and the fragments caught on the 75-µm sieve, shall be dried in the oven until the loss in mass between successive weighing at intervals of not less than 4 h does not exceed 0.1 percent of the later mass. The final dry mass shall be recorded. The dry mass of the container and specimen, less the mass of the container, will be taken as the initial dry mass of the specimen. The contents of the container shall be photographed. Each fragment weighing more than 25 percent of the final dry mass of the specimen shall be determined, and the sum of the masses of such fragments shall be recorded.

8. Calculation and Report

8.1 The report shall include the following:

8.1.1 Source of material.

8.1.2 Tabulation of data on each test specimen as follows:

8.1.2.1 Designation of type and condition of rock represented.

8.1.2.2 Initial dry mass.

8.1.2.3 Changes observed at each inspection.

8.1.2.4 Number and mass of all fragments remaining at conclusion of test that weigh more than 25 percent of the final dry mass of specimen.

8.1.3 Photographs as appropriate.

Appendix

A1. Interpretation

A1.1 The results of this test should generally be employed as a basis for comparing the relative resistance of different types of material, from one or more sources, being considered for me same use. The results of this test as performed on a single material will not ordinarily provide a basis for concluding that the material is "satisfactory" or "unsatisfactory" for a proposed use unless the specimens are essentially completely either unaffected or disintegrated by the action of the test. The interpretation of the results will also depend on the nature of the material tested, the degree to which the specimens represent the material, and the intended use.

A1.2 Rock of uniform structure and texture intended for use as a source of either protection stone or crushed stone for concrete aggregate will generally be affected by surface scaling, crumbling, flaking, or disaggregation. The total amount of material separated from the largest remaining fragment, i.e. the mass loss, will normally be a suitable basis for quantitative comparison of such materials.

A1.3 Rock with observable bedding planes, joints, seams, stringers, or other planar structures will generally be affected, if at all, by separation into discrete portions along such planes. Such separation may be of little importance when the rock is being considered as crushed stone aggregate to be confined in concrete. Such separation may be of much greater importance in rock proposed for use as protection stone. In the latter instance, however, it will be necessary to estimate the separation distance of the planes such as those at which test specimens have separated in the material from which the specimens were made. If these planes are so closely spaced that the stone, after separating thereon, is in sizes too small to serve the intended purpose, the rock may be unsuitable for such use. If these planes are more widely spaced, or only infrequently closely spaced, the rock may be suitable for such use, even though planes of potential separation are present.