GDT 75

A. Scope

For a complete list of GDTs, see the Table of Contents.

Use this test method to determine the durability of aggregate. The durability index is a value indicating the relative resistance of an aggregate to produce detrimental clay-like fines when subjected to the prescribed mechanical methods of degradation.

Referenced Documents

AASHTO Standards

M 92 Wire-cloth Sieves for Testing Purposes

M 231 Weighing Devices Used in the Testing of Materials

T 27 Method of Test for Sieve Analysis of Fine and Coarse Aggregates

T 248 Method of Test for Reducing Field Samples of Aggregate to Testing Size

GDT 26 Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method

B. Apparatus

The apparatus consists of the following:

1. Mechanical Washing Vessel ("Pot") - Use a flat bottom, straight-sided, cylindrical vessel. (A discarded air meter bucket with dimensions as shown in GDT 26 alternate is satisfactory. Mill the top and lip of the bucket to prevent leaks and to make the container adaptable to the shaker.)
2. Lid - Use an 8 in (200 mm) sieve pan with nesting skirt fitted with an "O" ring.
3. Agitator - Use a modified Tyler Portable sieve shaker set to operate at 285 ± 10 complete cycles per minute.
4. Graduated Cylinder - Use a 33.8 oz (1000 ml) graduated cylinder for measuring water.
5. Measuring Can - Use a 3 oz (85 ± 5 ml) can.
6. Funnel - Use a wide mouth for transferring material into cylinder.
7. Timing Clock or Watch.
8. Sieves - Use sieves that conform to the requirements of AASHTO M 92.
9. Scale - Use a scale with a minimum capacity of 1.5 lb (700 g) and accurate to 0.0002 lb (0.1 g).
10. Mechanical Sand Equivalent Shaker - Use a mechanical shaker having a horizontal throw of 8 in ± 0.04 in (200 mm ± 1.02 mm) and operating at 175 ± 2 cycles per minute, modified with the addition of a 30 minute timer. The shaker should be securely fastened to a firm and level mount.
11. Plastic Bag
12. Spoon - Use a large spoon with the sides bent in an approximate "V" shape.
13. Graduated Plastic Cylinder - Use a cylinder made of transparent acrylic plastic with an inside diameter of 1-1/4 in (32 mm) and a height of 17 in (432 mm). It must have gradations up to 15 in by 1/10 in (380 mm by 2.5 mm), starting at the inside bottom, and a rubber stopper to fit in the mouth of the cylinder.
14. Irrigator Tube - Use 1/4 in (6 mm) outside diameter, stainless-steel tubing. Close one end to form a wedge-shaped point. A hole (drill size No. 60 (250 µm)) is drilled on each side of the wedge, approximately 1/8 in (3 mm) from the tip. The angle of the holes should be between 30 and 50 degrees from vertical.
15. Siphon Assembly - Use a 1 gal (3.8 L) bottle; a 1/4 in (6 mm) diameter, 16 in (406 mm) long, bent copper tube; 48 in of 3/16 in (1.2 m of 5 mm) inside diameter rubber tubing (pure gum or equal) with pin clamp; a blow tube; 2 in of 1/4 in (50 mm of 6 mm) diameter copper tube; 2 in of 3/16 in (50 mm of 5 mm) inside diameter rubber tube; and a No. 6 (3.5 mm) rubber two-hole stopper.

    Fit the siphon assembly to a 1 gal (3.8 L) bottle of working calcium chloride solution. Place it on a shelf 36 in ± 1 in (0.91 m ± 25 mm) above the work surface. In place of the bottle, you may use a larger-capacity glass or plastic vat, provided you keep the liquid level of the working solution between 36 in and 46 in (0.91 m and 1.17 m) above the work surface (WS-E-01).

16. Weighted Foot Assembly - Use a 1/4 in (6 mm) diameter brass rod 17-1/2 in (445 mm) long, threaded on both ends; a brass foot 1.187 in hex by 0.54 in (244 mm hex by 14 mm); a weight 2 in by 2.078 in (50.8 mm by 52.8 mm) of cold-rolled steel; a sand reading indicator 1.13 in (28.7 mm) diameter by 0.59 in (15 mm) made of Nylon 101, Type 66 Annealed. The top edge of the sand reading indicator shall be exactly 10.1 in (256.54 mm) from the bottom of the brass foot. The total weight of the assembly shall be 2.2 lbs ± 0.01 lb (1000g ± 5 g).
17. Stock Calcium Chloride Solution (WS-E-03) - Make the stock solution by dissolving 1 lb (454 g) of calcium chloride in 1/2 gal (1.89 L) of distilled water. Cool and filter through ready-pleated, rapid filtering filter paper. Add 2050 g (1640 ml) of USP glycerin and 47 g (45 ml) of formaldehyde to the filtered solution. Mix well and dilute to 1 gal (3.8 L).
18. Working Calcium Chloride Solution - Dilute 3 oz (85 ± 5 ml) of the stock solution to 1 gal (3.8 L) with distilled water.
19. Water - Use demineralized or tap water of good quality, but check it by comparing results of the Durability Index Tests on identical samples using water in question and distilled water.

C. Sample Size and Preparation

1. Precautions

   Use the following precautions while performing the tests:

   a. Perform the test in a location free of vibrations. Vibrations may cause the suspended material to settle at a faster rate or prevent settling.

   b. Do not expose the plastic cylinders to direct sunlight any more than necessary.

   c. You may occasionally need to remove a fungus growth (a slimy substance in the solution) from the working calcium chloride solution container and from the inside of the flexible tubing and irrigator tube.

      1) To remove the growth, prepare a cleaning solution by diluting sodium hypochlorite (like Clorox or its equivalent) with an equal quantity of water.

      2) Fill the solution container with the prepared solvent and allow about 1.2 qt (1 L) of the solvent to flow through the siphon assembly and irrigator tube.

      3) Close the pin clamp on the end of the tubing to hold the solvent in the tube.

      4) Refill the container and allow to stand overnight.

      5) After the soaking, remove the solvent through the siphon assembly and irrigator tube.

      6) Remove the siphon assembly from the solution container and rinse both with clear water. You may connect a hose between the tip of the irrigator tube and a water faucet and backwash fresh water through the tube and the siphon assembly.

   d. Occasionally the holes in the tip of the irrigator tube may be clogged with a particle of sand. If you cannot remove the sand with water or another non-destructive method, use a pin or other sharp object to force it out.

Note: Use extreme care to not enlarge the opening.

   e. Perform this test with strict temperature control. The temperature of the water and working calcium chloride solution shall remain 72 ° ± 5 °F (22 ° ± 3 °C).

   f. Frequently check the play between the cam and eccentric on the modified Tyler portable shaker.

      1) Grasp one of the hanger rods and attempt to move the sieve base. If you notice any play, replace the cam and/or bearing.

   g. Lubricate the sieve shaker at least every 3 months.

2. Sample Preparations

   a. Dry the preliminary test sample to constant weight at 230 ° ± 9 °F (110 ° ± 5 °C).

   b. Cool to room temperature.

   c. Sift the sample over a No. 10 (2.00 mm) sieve.

   d. Break up any lumps of clay or bonded fine material and remove the coatings of fines from the plus No. 10 (2.00 mm) material without appreciably reducing the natural individual particle sizes.

   e. Discard the plus No. 10 (2.00 mm) material.

f. Reduce the sample in accordance with AASHTO T 248 to obtain a representative portion from the material passing the No. 10 (2.00 mm) sieve so that it weighs 1.1 lbs ± 0.05 lbs (500 ± 25 g).

D. Procedures

1. Place this preliminary test sample in the mechanical washing vessel.
2. Add 33.8 oz (1000 ml) of demineralized water or tap water of acceptable quality and clamp the vessel lid in place.
3. Secure the vessel in the sieve shaker so you can begin agitation 10 minutes ± 30 seconds after you added wash water to the material.
4. Agitate the vessel for 2 minutes ± 5 seconds.
5. After the 2-minute agitation period, remove the vessel from the shaker.
6. Unclamp the lid and carefully pour 1/3 of the contents into a No. 200 (75 µm) sieve.
7. Wash the sample until the water passing the sieve is clear.
8. Repeat with the other 2/3 of the sample.
9. Rinse any remaining fines from the vessel onto the sieve.
10. Flush the material from the sieve to a drying pan and let the material settle.
11. Pour off the excess water, being careful not to lose any of the sample.
12. Dry the material to constant weight at 230 °, ± 9 °F (110 °, ± 5 °C) and allow to cool.
13. When cool, put the material in a plastic bag and twist the end of the bag closed so it traps air in the bag.
14. Thoroughly mix the sample by holding the bag at both ends and vigorously shaking it back and forth in a elliptical motion.
15. Lay the plastic bag on its side so you can scoop into the material with the large spoon that has been bent into a “V” shape.
16. Fill the 3 oz (85 ml) measuring can. While filling, tap the bottom edge of the cans on the work table or other hard surface to consolidate the material and to allow more material to be placed in the can.
17. Fill the can to the brim or to give a slightly rounded surface above the brim, but do not overflow. Use extreme care to obtain a truly representative sample.
18. Siphon 4 in ± 0.1 in (100 mm ± 2.5 mm) of working calcium chloride solution into the plastic cylinder.
19. Pour the prepared test sample through the funnel into the plastic cylinder.
20. Tap the bottom of the cylinder sharply with the heel of your hand several times to release air bubbles and to thoroughly wet the sample.
21. Allow the sample to soak undisturbed for 10 ±1 minutes.
22. After soaking, stopper the cylinder.
23. Loosen the material from the bottom by partially inverting the cylinder and shaking it.
24. Place the stoppered cylinder in the mechanical sand equivalent shaker.
25. Let the machine continuously shake the cylinder and contents for 10 minutes ± 15 seconds.
26. After shaking, set the cylinder upright on the work table and remove the stopper.
27. Insert the irrigator tube into the cylinder and rinse the material from the cylinder walls as you lower the irrigator tube.
28. Force the irrigator tube through the material to the bottom of the cylinder. Gently stab and twist the material while the working solution flows from the irrigator tip. This flushes the fine material into suspension above the coarser sand particles.
29. Continue to stab and twist the material until the cylinder is filled to the 15 in (381 mm) mark.
30. Slowly raise the irrigator without shutting off the flow so that the liquid level is maintained at about 15 in (381mm) while withdrawing the irrigator.
31. Regulate the flow just before removing the irrigator and adjust the final level to 15 in (381 mm).
32. Allow the cylinder and contents to stand undisturbed for 20 minutes ± 15 seconds for sedimentation. Start tracking time immediately after withdrawing the irrigator tube.

33. After the 20-minute sedimentation period, read and record the level of the top of the clay suspension. This is the "clay reading."
    a. If you cannot clearly see a line of demarcation at the end of the 20-minute period, let the sample stand undisturbed until you can obtain a clay reading. Continue to track the time.
    b. Immediately read and record the level of the top of the clay suspension and the total sedimentation time.
    c. If the total sedimentation time exceeds 30 minutes, rerun the test using three individual samples of the same material.
    d. Read and record only the clay column height of that sample requiring the shortest sedimentation period.
34. After taking the clay reading, place the weighted foot assembly over the cylinder with the guide in position on the mouth of the cylinder.
35. While lowering the weighted foot, keep one of the centering screws in contact with the cylinder wall near the gradations so you can see it at all times.
36. Gently lower the weighted foot until it rests on the sand.
37. Read and record the level of the centering screw. This reading is the "sand reading."
38. If either clay or sand reading falls between the 0.1in (2.5 mm) graduations, record the level of the higher graduation as the reading. For example, record a clay level at 7.95 as 8.0 in (201.93 as 202 mm) and a sand level at 3.22 in as 3.3 in (81.788 mm as 83.8 mm).
39. If the results of the two tests are within four points of each other, report the average.
    a. Variances of more than four points between results indicate too much error in operator procedure or sample selection. In such cases, run a third test and average the two closest results (within four points of each other) using the method shown in the calculations below.

E. Calculations

1. Calculate the durability index of the fine aggregate to the nearest 0.1 using the following formula:

$$D_f = \frac{\text{Sand Reading}}{\text{Clay Reading}}(100)$$

2. If the calculated durability index is not a whole number, report it as the next higher number. For example, if the durability index were calculated from the example in Procedures, step 38, the calculated durability index would be:

$$D_f = \frac{3.3}{8.0}(100) = 41.2$$

   Since this calculated durability index is not a whole number, report it as the next higher number, or "42".

3. If the average of the two tests is not a whole number, round it to the next higher number as in the example below:

$$\frac{41+42}{2} = 41.5 = 42$$

F. Report

Report the average durability index on the appropriate form, as in this example:

$D_f = 42$