Method of Test for Sand Equivalent of Fine Aggregate

1. Scope:

This test is for determining the relative proportion of detrimental fine dust or clay-like particles in fine aggregates (Passing the #4 sieve).

2. Apparatus:

2.1 Balance having a sufficient capacity to weigh any sample which may be tested utilizing this procedure, accurate and readable to the nearest 0.1 gram.

2.2 Transparent plastic graduated cylinder having; a 1.25 in. inside diameter, approximately 17 in. in height and graduated up to 15 in. in intervals of 0.1 in. starting at the base. The base dimensions must be ½ x 4 x 4 in. Do not expose the plastic cylinders to direct sunlight any more than is necessary.

2.3 A rubber stopper that fits into the open end of the graduated cylinder.

2.4 Stock solution and set up must meet the requirements of AASHTO T-176. 3 oz. of stock solution added to 1 gallon of distilled water. The solution needs to be maintained as close to 72 ± 5°F as possible to obtain representative results. Working solution more than 30 days old shall be discarded. If organic growth is present in the working solution, discard the solution, and then clean the container, tubing, irrigation tube and system with a 50:50 mixture of Clorox and water. Rinse the complete system with distilled water. Mix and use new solution.

2.5 An irrigator tube made of brass, stainless steel or copper with a 0.25 in. outside diameter, approximately 20 in. long, with one end closed to form a wedge-shaped tip with 2 small #60 holes through the flat side of the wedge.

2.6 A weighted foot assembly consisting of a metal rod connected to a foot with a flat, smooth surface at the lower end with the upper end weighted to give the total assembly a weight of 1000 ± 5 grams.

2.7 A 1 gallon glass or plastic bottle equipped with a siphon assembly consisting of a 2 hole rubber stopper and pieces of copper tubing. The bottle sits 3 feet ± 1 inch above the work surface. A larger glass or plastic vat may be used provided that the liquid level of the working solution is maintained between 36 in. to 46 in. above the working surface.

2.8 A measuring can with a capacity of 3 ounces approximately 2.25 inches in diameter at the mouth.

2.9 A timer reading in minutes and seconds.

2.10 A manually operated shaker capable of producing an oscillating motion at a rate of 100 complete cycles in 45 ± 5 seconds with a hand-assisted half stroke length of 5.0 ± 0.2 in. or a mechanical shaker having a throw of 8.00 ± 0.04 in. and operating at 175 ± 2 cycles per minute. The shaker set up should be level and secure for either type system.

2.11 A splitting cloth made of plastic or canvas material approximately 2 ft. by 2 ft.

2.12 Drying oven capable of maintaining a temperature of approximately 230° ± 9°F.

2.13 Funnel with a wide mouth about 4 in. in diameter.

2.14 Spatula or straightedge that is used to strike off the measuring can after obtaining the sample.

3. Procedure:

3.1 Obtain a split sample of - #4 material from SD 202 of approximately 750 to 1000 grams. Mix the sample in a pan using a spatula and add enough water so the material, when squeezed in the hand, forms a cast without free water present. The cast of material should break up slightly when rolled gently in the palm of the hand. If the material crumbles, add more water and mix the sample and recheck to see if a cast can be made which does not crumble. If the material forms a cast which does not break up, the material has free water and it must be allowed to dry before the sample is ready to be taken. After the required moisture content is obtained the sample shall sit a minimum of 15 minutes covered with a lid or damp cloth.

3.2 Place the sample on the splitting cloth and alternately lift each corner and pull toward the center to thoroughly mix the material. After thoroughly mixing the material, make a pile in the center of the cloth.

3.3 To take a sample, hold the 3 oz. sample can on its side on one side of the sample pile with the other hand palm facing the pile on the other side. Fill the container by pushing it through the pile while pushing the material into the container with the other hand. Press firmly so that the maximum amount of material will be placed in the tin. Strike off the top of the tin with a level spatula or straightedge.

3.4 Place the tin in an oven at 230° ± 9°F and dry to a constant weight. Material may also be removed from the tin and placed in a pan to dry. Remove the sample from the oven and cool to room temperature.

3.5 Repeat steps 3.2 to 3.4 to get a 2nd sample to test.

3.6 Siphon 4 ± 0.1 in. of working calcium chloride solution into a plastic cylinder. Pour the sample into the cylinder using a funnel to assure material is not

spilled. Tap the bottom of the cylinder with the heel of your hand several times to release air bubbles and make sure the sample is wetted thoroughly.

3.7 Put the cylinder on the counter and allow to stand undisturbed for 10 ± 1 minute.

3.8 Put the stopper in the cylinder and loosen the material in the cylinder by tipping (Partially inverting) the cylinder and shaking it at the same time.

3.9 A. Manual Shaker Method.

Make sure the stopper is securely in the cylinder. Place the cylinder in the manual shaker. Set the counter to zero. Apply enough force to the steel strap to make the cylinder move to the range markers on the shaking apparatus. The tip of the pointer should reverse direction within the marker limits. Continue the shaking action until 100 strokes (within 45 ± 5 seconds) are reached.

B. Mechanical Shaker Method.

Secure the cylinder in the mechanical shaker and operate for a complete cycle (usually 45 seconds.)

3.10 Take the cylinder out of the apparatus and set upright on the working table. Remove the stopper, take irrigator tube and rinse material from the side of the cylinder while moving the tube down into the material to the bottom of the cylinder. Irrigate the material at the bottom, by stabbing and twisting to make sure that all the fine material is being agitated from the bottom and moves towards the top of the solution. When the solution in the cylinder is close to the 15 in. mark, slowly pull the irrigator out of the material and towards the top of the cylinder. Regulate the flow of solution so the 15 in. mark is reached when the irrigator is completely removed from the cylinder. 23

3.11 Set the cylinder on a flat surface that does not have any other vibrating equipment on it and let the material solution settle for 20 min. ± 15 sec. Time clock should be set right after the irrigator is completely withdrawn.

NOTE: Field laboratories shall be adequately anchored to the ground, leveled, and rigidly supported to eliminate floor and workbench vibrations. Vibrations may cause the suspended material to settle at a rate greater than normal.

3.12 When 20 min. is up, take the “Clay reading” which is at the top of the clay suspension. If there is no definite line, let the solution set till a clay line appears. If there is no definite line after 30 minutes, the test must be rerun with three separate samples of the same material. Read and record the sample with the shortest sedimentation period only.

NOTE: If clay or sand readings fall between 0.1 in. graduations, record the level of the higher graduation as the reading. A clay reading of 6.95 would be recorded as 7.0 and a sand reading of 2.63 would be recorded as 2.7.

3.13 After the clay reading is taken, the "Sand reading" will be taken by using a weighted foot as described. Slowly set the foot into the cylinder allowing it to rest on the sand, taking caution as to not jar the cylinder during this process. Take a reading at the top edge of the weighted foot indicator, and then subtract 10 in. Record the reading of the sand level.

4. Report:

4.1 Calculate the sand equivalent reading as follows:

$$\text{Sand equivalent (SE)} = \frac{\text{Sand reading X 100}}{\text{Clay reading}}$$

If the calculated sand equivalent is not a whole number, report the result to the next higher whole number.

$$\frac{4.2}{7.9 \text{ X } 100} = 53.16 = 54$$

4.2 Average the test results of the two samples as follows: if the average of the two test results in not a whole number, raise the test result to the next higher whole number.

$$54 + 53 = 53.5 = 54$$

4.3 Test results will be reported on form DOT-69.

5. References:

AASHTO T 176
SD 202
DOT-69