Test Procedure for

SAND EQUIVALENT TEST

TxDOT Designation: Tex-203-F

Effective Dates: August 1999–August 2009.

1. SCOPE

1.1 This method determines the relative proportion of detrimental fine dust or clay-like particles in soils or fine aggregates.

1.2 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. APPARATUS

2.1 Transparent plastic graduated cylinder, 31.8 mm (1.25 in.) inside diameter, 432 mm (17 in.) height (approximately), graduated up to 381 mm (15 in.) in intervals of 2.5 mm (0.1 in.), starting at the base.

2.2 Rubber stopper, to fit the mouth of the graduated cylinder.

2.3 Agitator tube, brass, stainless steel, or copper; 6.4 mm (0.25 in.) outside diameter; 508 mm (20 in.) long (approximately); one end closed to form a wedge-shaped tip; two holes (drill size 60) drilled laterally through the flat side of the wedge.

2.4 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 g.

2.4.1 The foot has a conical upper surface and three small screws to center it loosely in the cylinder.

2.4.2 A cap to fit the top of cylinder is bored to fit loosely around the rod and serves to center the weighted foot assembly in the cylinder.

2.4.3 The weight of this cap is not part of the total weight of the assembly, as discussed above.

2.5 Weighted foot assembly, similar to the one described above, but with a sand reading indicated on the rod 254 mm (10 in.) above the base of the foot, may also be used.
2.6 Glass bottle, 3.8 L (1 gal.), equipped with a siphon assembly consisting of a two-hole rubber stopper and pieces of glass or copper tubing, sits 914 ± 25 mm (3 ft. ± 1 in.) above the work surface.

2.7 Tubing, 1.22 m (4 ft.) long, plastic or rubber, with pinch clamp to connect the open end of the agitator tube with the siphon assembly.

2.8 Standard U.S. sieve, 4.75 mm (No. 4), meeting the requirements of Tex-907-K.

2.9 Measuring can, 85 ml (3 fl. oz.).

2.10 Wide mouth funnel.

2.11 Watch or clock, reading in minutes and seconds.

2.12 Glass cylinder, 100 cc, graduated in increments of 2 cc or less.

2.13 Drying oven, maintained at 110 ± 5°C (230 ± 9°F).

2.14 Motor-driven mechanical sand equivalent shaker.

2.15 Straight edge or spatula.

2.16 Splitter or quartering device.

3. MATERIALS

3.1 Stock solution, prepared as follows:

3.1.1 Dissolve 577 g of ACS grade calcium chloride dihydrate in 1.9 L (0.5 gal.) of distilled or demineralized water.

3.1.2 Cool the solution.

3.1.3 Add 1640 ml (55 fl. oz.) of U.S.P. glycerin and 53 ml (1.76 fl. oz.) of 50% 1,5-Pentanediol (Glutaraldehyde) in water to the solution and mix well (see Section 7.5).

3.2 Working calcium chloride solution, prepared as follows:

3.2.1 Dilute 88 cc of the stock calcium chloride solution to 3.8 L (1 gal.) of distilled or demineralized water. Use a good quality tap water if the purity does not affect the test results.

3.2.2 Maintain working solution temperature of 22 ± 3°C (72 ± 5°F) during test. If this is not possible, samples should be frequently tested under proper temperature control conditions.
4. PROCEDURES

4.1 Preparing Sample:

4.1.1 Select a representative sample of material.

4.1.2 Tests on damp samples will generally give lower sand equivalent values than tests on oven-dried samples.

4.1.3 Considerable time can be saved by not drying samples. This is permissible, but if the test values are near or below the specified minimum, the sample must be retested in the oven-dry condition.

4.1.4 In field control testing of bituminous aggregates, it is permissible to omit 'dry to a constant weight' when using samples from the hot bins cooled to room temperature for the test sample.

4.1.5 Dry limestone asphalt aggregates to a constant weight at a minimum temperature of 37.8°C (100°F) (See Section 7.2). Do not use a microwave for drying limestone rock asphalt aggregates.

4.1.6 Using the 4.75 mm (No. 4) sieve, separate the sample into two portions, breaking up lumps that consist of particles obviously finer than the 4.75 mm (No. 4) sieve.

4.1.7 Secure the sand equivalent test sample from the portion passing the 4.75 mm (No. 4) sieve by carefully reducing the amount of material to laboratory test size.

4.1.8 Split or quarter the material to obtain a minimum 500 g (18 oz.) sample.

4.1.9 To insure representative samples when working with a material that is predominantly coarse (4.75 mm [No. 4] to 2.00 mm [No. 10]), separate the sample into 4.75 mm (No. 4) to 2.00 mm (No. 10), and minus 2.00 mm (No. 10) sizes, then recombine in proper proportions to produce a uniform sample. Any sample may be separated into various size fractions and be proportionally recombined to produce test samples when difficulty occurs in test repeatability.

4.1.10 Secure the test sample by passing the measuring can through a thoroughly mixed sample of the prepared material in a pan.

4.1.11 Strike off the excess material using a straight edge or spatula.

4.1.12 Do not compact the sample prior to striking it off.

4.1.13 If running the test in pairs, the two values should agree with the tolerances provided under Section 7.

4.2 Performing the Sand Equivalent Test:

4.2.1 Siphon 101.6 ± 2.5 mm (4 ± 0.1 in.) of the solution into the plastic cylinder. Check the agitator tube to be certain that the solution flows freely.
4.2.2 Transfer the sample from the measuring can into the plastic cylinder using the small funnel.

4.2.3 Stopper the cylinder.

4.2.4 Tap the bottom of the cylinder on the heel of the hand several times to remove air bubbles and promote thorough wetting of the sample.

4.2.5 Remove stopper.

4.2.6 Wash particles clinging to wall of cylinder into the mixture, using a minimum amount of solution.

4.2.7 Allow the cylinder with contents to stand undisturbed, free of any vibration, for 10 ± 1 minutes.

4.2.8 Replace stopper in the end of cylinder.

4.2.9 Partially invert cylinder and shake to dislodge material from the bottom.

4.2.10 Place stoppered cylinder in the mechanical sand equivalent shaker, set timer.

4.2.11 Allow machine to shake the cylinder and contents for 45 ± 1 seconds.

4.2.12 Following the mixing operation, place the cylinder on the worktable.

4.2.13 Remove stopper.

4.2.14 Wash down the cylinder wall with the agitator tube.

4.2.15 Then force the agitator through the material to the bottom of the cylinder by gently twisting and shoving while the solution flows from the tip of the tube.

4.2.16 Continue smoothly jabbing the agitator tube up and down with a gentle twisting motion while slowly rotating the cylinder in a vertical position to flush the fine clay-like material into suspension above the coarse sand particles.

4.2.17 Continue the operation until the cylinder is filled to the 381 mm (15 in.) mark.

4.2.18 Then slowly remove the agitator tube without shutting off the flow so the level of the liquid is maintained at 381 mm (15 in.).

4.2.19 Regulate the flow of the solution and adjust the level of solution to 381 mm (15 in.) when the agitator tube is entirely withdrawn.

4.2.20 Allow the cylinder and contents to stand undisturbed for 20 minutes ± 15 seconds. Start the timing immediately after the removal of the agitator tube.

4.2.21 After the 20-minute sedimentation period, read the level of the top of the clay suspension and record as the clay reading.
4.2.21.1 In some cases, a clearly readable line of demarcation occurs, but the liquid immediately above the line is still clouded at the end of 20 minutes.

4.2.21.2 The demarcation line appears to be in the sediment column itself.

4.2.22 When this occurs, read and record the level of this line after the required 20-minute period.

4.2.23 If there is no clear line of demarcation or clay meniscus at the end of the 20-minute sedimentation period, allow the material to stand undisturbed until a clay reading can be obtained.

4.2.24 Then read and record the level of the clay meniscus and the total sedimentation time.

4.2.25 If the total sedimentation time exceeds 30 minutes, rerun the test using three more samples of the same material.

4.2.26 Record for calculations the value obtained from the shortest sedimentation time.

4.2.27 Gently lower the weighted foot assembly in the cylinder until it comes to rest on top of the sand.

4.2.28 Keep one of the centering screws in contact with the cylinder wall near the graduation marks, so that it can be seen.

4.2.29 When the weighted foot has come to rest, read the middle of the centering screw and, record as the sand reading.

4.2.30 Should either reading in Sections 4.2.21 or 4.2.29 fall between two divisions on the graduated cylinder, raise the reading to the higher reading. (Example: 8.68 = 8.7 in., 6.21 = 6.3 in.)

4.2.31 When using the weighted foot assembly with the sand reading indicator, gently lower the assembly into the cylinder until it comes to rest on the sand.

4.2.32 Very gently tilt the assembly until the indicator touches the graduation marks on the cylinder.

4.2.33 Tilt assembly back to vertical before taking reading.

4.2.34 Read the level indicated by the top edge of the indicator and subtract 254 mm (10 in.).

4.2.35 Record this reading as the sand reading.
5. **CALCULATIONS**

5.1 Calculate the sand equivalent value to the nearest 0.1 using the following formula:

\[ \text{Sand Equivalent Value} = 100 \times \left( \frac{\text{Sand Reading}}{\text{Clay Reading}} \right) \]

6. **REPORTING TEST RESULTS**

6.1 Report sand equivalent test result as a whole number.

EXAMPLE:

\[ SE = 100 \times \left( \frac{3.2}{6.9} \right) = 46.4 \]

6.2 Report the value as 47. If the calculated SE value exceeds 100, report the value as 100.

7. **NOTES**

7.1 Repeated results should check within ±4.

7.2 Accomplish drying to a "constant weight" by drying for a specific period of time that has proven experimentally adequate in the past, or by drying to the point that, by experienced observation, indicates that the material is sufficiently dry for testing.

7.3 Should floating lightweight aggregate preclude accurate test results, samples should be taken from the cold bins to minimize the effect of these materials on the sand equivalent value.

7.4 If the hot bin samples contain mineral filler or lime additive, samples should be taken from the cold bins to minimize the effect of these materials on the sand equivalent value.

7.5 1, 5-pentanediol is also known as glutaraldehyde, glutaric dialdehyde, and trade name UCARCIDE. It may be obtained as "Glutaraldehyde Solution 50%" from the following sources:

<table>
<thead>
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<th>Name</th>
<th>Address</th>
</tr>
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<tbody>
<tr>
<td>Aldrich Chemical Co.</td>
<td>P.O. Box 2060; Milwaukee, WI 53201</td>
</tr>
<tr>
<td>Fisher Scientific</td>
<td>♦ P.O. Box 869022; Plano, TX 75086</td>
</tr>
<tr>
<td></td>
<td>♦ P.O. Box 1307; Houston, TX 77251</td>
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