1215.0 PLASTIC FINES IN GRADED AGGREGATE BY USE OF THE SAND EQUIVALENT TEST

AASHTO Designation T 176 (Mn/Dot Modified)

1215.1 SCOPE

This is a rapid test intended to show the proportions of claylike materials contained in the -4.75mm (#4) portion of graded aggregates.

1215.2 APPARATUS

A. Graduated Cylinder – A graduated plastic cylinder, rubber stopper, irrigator tube, weighted foot assembly and siphon assembly all conforming to the respective specifications and dimensions in AASHTO T 176 (Figure 1, Assembly #1 & #2).

B. Measure – A tinned measure having a capacity of 85 ± 5 ml (3 oz.) And an approximate diameter of 57mm (2.25”).

C. Funnel – A wide-mouth approximately 100mm (4”) wide at the mouth.

D. Timer – A clock or watch reading in minutes and seconds.

E. Shaker – A mechanical shaker as shown in AASHTO T 176 (Figure #3) having a throw of 203.2 ± 1.0mm (8.00 ± 0.04”) and operating at 175 ± 2 cycles per minute (2.92 ± 0.03 Hz).

E. Calcium Chloride Solutions – See Sections 1215.3 and 1215.4.

F. Straightedge or Spatula – Which is capable of striking off the excess material from the tin measure.

F. Oven – Capable of maintaining a temperature of 110 ± 5 °C (230 ± 9 °F).

1215.3 STOCK CALCIUM CHLORIDE SOLUTION

A. Required Chemicals

1. Technical grade anhydrous calcium chloride – 454 g (1 lb.)

2. USP glycerin 2050 g (1640 ml)

3. Formaldehyde 47 g (45 ml) (40 percent by volume solution)

B. Procedure for Preparing Stock Calcium Chloride Solution

1. Dissolve the calcium chloride in 1.9 liters (½ gal) of distilled or demineralized water. Cool the solution, then filter the solution through a Whatman No. 12 or equivalent filter paper. Add the glycerine and formaldehyde to the filtered solution and mix well. Then dilute the solution to 1 gal (3.9 liters) with distilled or demineralized water.

NOTE 1: The above solution is available in a premixed liquid concentrate to be diluted as per manufacturer's recommendations.

1215.4 Working Calcium Chloride Solution

A. Procedure for Preparing Working Calcium Chloride Solution

1. Dilute one measuring tin full (85 ± 5 ml [3 oz.]) of the stock calcium chloride solution into 1 gal (3.8 liters) of distilled or demineralized water.

NOTE 2: The temperature of the working solution shall be maintained at 22 ± 3 °C. (72 ± 5 °F.) during the performance of the test.

NOTE 3: Working solutions more than 30 days old shall be discarded.

1215.5 Siphon Assembly Setup

A. Attach the siphon assembly to a minimum 4 liters (1 gal.) bottle of working calcium chloride solution placed on a shelf 915 ± 25mm (36 ± 1") above the work surface. A larger than specified bottle or vat may be used as long as the liquid level of the working calcium chloride solution is maintained between 915 to 1170mm (36 to 46") above the work surface.

1215.6 SAMPLE PREPARATION (AASHTO T176, Section 4.3.1, Alternate Method #1 – Air Dry)

A. Split or quarter in accordance with Manual Section 1002 enough -4.75mm (#4) material to fill the 85 ± 5 ml (3 oz.) tin measure so it is slightly rounded above the brim. While filling the measure tap the bottom edge of the tin on the worktable or other hard surface to cause the maximum amount to be placed in the tin. With the spatula or straightedge strike off the tin measure level full.

NOTE 4: For bituminous materials the above sample should be oven dried at 110 ± 5 °C. (230 ± 9 °F.) and then cooled to room temperature before testing.

NOTE 5: Use extreme care to obtain a truly representative portion of the original sample. Experiments show that as the amount of material being reduced by splitting or quartering is decreased the accuracy of providing representative portions is reduced. It is imperative that the sample be split or quartered carefully. When it appears necessary dampen the material to avoid segregation or loss of the fines.

1215.7 TEST PROCEDURE

A. Start the siphon and fill the graduated cylinder to a level of 101.6 ± 2.5mm (4.0 ± 0.1") with working calcium chloride solution.

B. Pour the prepared test sample from the measured tin into the graduated cylinder using the funnel to avoid spillage.

C. Tap the bottom of the cylinder sharply on the heel of the hand several times to release air bubbles and to promote thorough wetting of the sample.

D. Allow the wetted sample to stand undisturbed for 10 ± 1 minutes.

E. At the end of the 10 minute soaking period place the rubber stopper on the cylinder then loosen the material from the bottom by partially inverting the cylinder and simultaneously shaking it.

F. After loosening the material from the bottom of the cylinder place the cylinder into the mechanical shaker.

G. Set the timer to 45 ± 1 seconds and shake the contents.

H. Following the shaking operation set the cylinder upright on the work surface and remove the stopper.

I. Insert the irrigator tube inside the cylinder and rinse the material from the cylinder walls as the irrigator is lowered.

J. Now force the irrigator through the material to the bottom of the cylinder by applying a gentle stabbing and twisting action while the working solution flows from the irrigator tip. This flushes the finer material into suspension above the coarser sand particles.

K. Continue to apply the stabbing and twisting action while flushing the fines upward until the cylinder is filled to the 381mm (15") mark.

L. Raise the irrigator slowly without shutting off the flow so that the liquid level required above is maintained while the irrigator is being withdrawn.

M. Before the irrigator is entirely withdrawn adjust the final level so that the bottom of the meniscus of working solution is at the 381mm (15") mark.

N Start the timer immediately after the irrigator is withdrawn and allow the cylinder and contents to stand for 20 minutes ± 15 seconds.

NOTE 6: Perform the test in an area free of vibrations. Vibrations may cause the suspended material to settle at a rate greater than normal.

O. At the end of the 20-minute sedimentation period, read and record the top of the clay suspension. This is referred to as the "Clay Reading". If no clear line has formed after the 20 minute sedimentation period allow the sample to stand undisturbed until the clay reading can be determined. Then immediately read and record the level of the top of the clay suspension and the total sedimentation time.

NOTE 7: If the total sedimentation time exceeds 30 minutes, rerun the test using three individual samples of the same material. Read and record ONLY the clay column height of that sample requiring the shortest sedimentation period.

P. Place the weighted foot assembly with the sand indicator on the rod over the cylinder and gently lower the assembly toward the sand until the weighted foot comes to rest on the sand. Do not allow the indicator to hit the mouth of the cylinder as the assembly is being lowered.

Q. Then tip the assembly toward the graduations on the cylinder until the indicator touches the inside of the cylinder. Subtract 254mm (10") from the level indicated from the extreme top edge of the indicator and record this value as the "Sand Reading".

R. If the sand or clay reading falls between the 2.5mm (0.1") graduations, always round up and record the level of the highest graduation as the reading.

1215.8 CALCULATIONS

A. Calculate the "Sand Equivalent" to the nearest 0.1 using the following formula:

$$\frac{\text{SAND READING}}{\text{CLAY READING}} = \text{SAND EQUIVALENT}$$

EXAMPLE: $(2.9 \div 7)$ **X** 100 **=** 41.43

NOTE 8: If the calculated sand equivalent is not a whole number report it as the next highest whole number. In the example report, 42.

NOTE 9: If the sand equivalent is an average of a series of tests average each individual test and the calculated average value should be rounded to the next highest whole number.

EXAMPLE: 41.43 = 42, 42.4 = 43 & 39.8 = 40 or $(42 + 43 + 40) \div 3 =$ 41.67 or 42