5.16.55 PLASTIC FINES IN COMBINED AGGREGATES BY USE OF THE SAND EQUIVALENT TEST (Kansas Test Method KT-55)

a. SCOPE

This test is intended to serve as a rapid test to show the relative proportions of fine dust or claylike material in minus No. 4 (4.75 mm) combined aggregates. KT-55 reflects testing procedures found in AASHTO T 176.

b. REFERENCED DOCUMENTS

b.1. AASHTO T 176; Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

c. APPARATUS

c.1. A graduated plastic cylinder, rubber stopper, irrigator tube, weighted foot assembly, and siphon assembly, all conforming to their respective specifications and dimensions described in AASHTO T 176 2.1. Fit the siphon assembly to a 1 gal (4 L) bottle of working calcium chloride solution (see section **c.7.**) placed on a shelf 36 ± 1 in (915 ± 25 mm) above the work surface.

c.2. An 3 oz (85 ± 5 mL) tinned box approximately 2.25 in (57 mm) in diameter, with Gill style cover.

c.3. A wide mouth funnel approximately 4 in (100 mm) in diameter.

c.4. A clock or watch reading in minutes and seconds.

c.5. A mechanical shaker as described in AASHTO T 176 **2.5**.

c.6. Stock calcium chloride solution: Prepare the stock calcium chloride with the following three ingredients:

1 - 1 lb (454 g) technical grade anhydrous calcium chloride by mass;
2a- 0.072 oz (2.050 g) USP glycerine
3a- 1.658 oz (47 g) formaldehyde
or by volume;
2b- 0.055 fl oz (1.640 mL) USP glycerine
3b- 1.52 fl oz (45 mL) formaldehyde [40% by volume]

c.6.a. Dissolve the calcium chloride in 1/2 gal (1.9 L) of distilled or demineralized water. Cool the solution, then filter it through Whatman No. 12 or equivalent filter paper. Add the glycerine and formaldehyde to the filtered solution, mix well, and dilute to 1 gal (3.8 L) with distilled or demineralized water.

c.7. Working calcium chloride solution: Prepare the working calcium chloride by diluting one measuring tin full of the stock calcium chloride solution to 1 gal (3.8 L) with water. Use distilled or demineralized water for the normal preparation of the working solution.

c.8. A straightedge or spatula, suitable for striking off the excess material from the tin measure.

c.9. A thermostatically controlled drying oven capable of maintaining a temperature of 230 ± 9°F (110 ± 5°C).

d. CONTROL

d.1. Maintain the temperature of the working solution at 72 ± 5°F (22 ± 3°C) during the performance of this test. If field conditions prevent temperatures from staying within this temperature range, submit frequent referee samples to the district laboratory for comparison. Temperature correction factors can also be established for each combined aggregate being tested.

e. SAMPLE PREPARATION

e.1. Perform the sand equivalent test on combined aggregate materials passing the No. 4 (4.75 mm) sieve. Pulverize all aggregates of fine-grained soil materials to pass the No. 4 (4.75 mm) sieve, and clean all fines from the particles retained on the No. 4 (4.75 mm) sieve and include with the material passing the No. 4 (4.75 mm) sieve.

e.2. Split or quarter enough of the original sample to yield slightly more than four-3 oz (85 mL) tin measures of material passing the No. 4 (4.75 mm) sieve. Use extreme care to obtain a truly representative portion of the original sample.

e.3. Prepare the desired number of test samples using the following method:

e.3.a. (Air Dry Method)[1]

e.3.a.1. Split or quarter enough material from the portion passing the No. 4 (4.75 mm) sieve to fill the 3 oz. (85 mL) tin measure so it is slightly rounded above the brim. While filling the measure, tap the bottom edge of the tin on the work table or other hard surface to cause consolidation of the material and allow the maximum amount to be placed in the tin. Strike off the tin measure level full with a spatula or straightedge.

f. PROCEDURE

f.1. Siphon 4 ± 0.1 in (101.6 ± 2.5 mm) of working calcium chloride solution into the plastic cylinder. Pour the prepared test sample from the measuring tin into the plastic cylinder using the funnel to avoid spillage. 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.

f.2. Allow the wetted sample to stand undisturbed for 10 ± 1 minutes. At the end of the 10-minute soaking period, stopper the cylinder, then loosen the material from the bottom by partially inverting the cylinder and shaking it simultaneously.

[1] AASHTO T 176 also includes a pre-wet method. The Air Dry method is the only method permitted for preparing the aggregate under KT-55.

f.3. After loosening the material from the bottom of the cylinder, place the stoppered cylinder in the mechanical[2] sand equivalent shaker and secure. Make sure the timer is set for 45 seconds then turn the shaker on.

f.4. Following the shaking operation, set the cylinder upright on the work surface and remove the stopper.

f.5. Insert the irrigator tube in the cylinder and rinse material from the cylinder walls as the irrigator is lowered. 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 fine material into suspension above the coarser sand particles. Continue to apply the stabbing and twisting action while flushing the fines upward until the cylinder is filled to the 15 in (381 mm) mark. Then raise the irrigator slowly without shutting off the flow so that the liquid level is maintained at 15 in (381 mm) while the irrigator is being withdrawn. Regulate the flow just before the irrigator is entirely withdrawn and adjust the final level to 15 in (381 mm).

f.6. Allow the cylinder and contents to stand undisturbed for 20 minutes $\pm$ 15 seconds. Start the timing immediately after withdrawing the irrigator tube.

f.7. At the end of the 20-minute sedimentation period, read and record the top level of the clay suspension. This is referred to as the "clay reading". If no clear line of demarcation has formed at the end of the specified 20-minute sedimentation period, allow the sample to stand undisturbed until a clay reading can be obtained, then immediately read and record the top level of the clay suspension and total sedimentation time. If the total sedimentation time exceeds 30 minutes, rerun the test using three individual samples of the same material. Read and record the clay column height of that sample requiring the shortest sedimentation period only.

f.8. Obtain the "sand reading" after the clay reading has been taken. The sand reading is determined by placing the weighted foot assembly over the cylinder and gently lowering the assembly toward the sand. Do not allow the indicator to hit the mouth of the cylinder as the assembly is being lowered. As the weighted foot comes to rest on the sand, tip the assembly toward the graduations on the cylinder until the indicator touches the inside of the cylinder. Subtract 10 in (254 mm) from the level indicated by the extreme top edge of the indicator and record this value as the sand reading.

f.9. If clay or sand readings fall between 0.1 in (2.5 mm) graduations, record the level of the higher graduation as the reading. For example, a clay reading of 7.95 in (199 mm) would be recorded as 8.0 in (200 mm), and a sand reading of 3.32 in (83 mm) would be recorded as 3.4 in (85 mm).

g. CALCULATIONS

g.1. Calculate the sand equivalent (SE) to the nearest 0.1 using the following formula:

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

[2] AASHTO T 176 **5.4.2** and **5.4.3** provide alternative means of shaking the sample; the Manual and Hand Method. These alternatives are not options under **KT-55**. In removing the Manual and Hand Method, AASHTO T 176, **8. OPERATOR QUALIFICATIONS,** is not necessary and not included within KT-55.

g.2. If the calculated sand equivalent is not a whole number, report it as the next higher whole number, as in the following example:

$$\text{SE(Metric)} = \frac{100(85)}{200} = 42.5, \text{ or}$$

$$\text{SE(English)} = \frac{100(3.4)}{8} = 42.5, \text{ which is reported as 43.}$$

g.3. If it is desired to average a series of sand equivalent values, average the whole number values determined as described above. If the average of these values is not a whole number, raise it to the next higher whole number.

h. PRECAUTIONS

h.1. Perform the test in a location free of vibrations; vibrations may cause the suspended material to settle at a rate greater than normal.

h.2. Do not expose the plastic cylinders to direct sunlight any more than is necessary.

h.3. Removal of Organic Growth: To remove organic growth from the working calcium chloride solution container and from the inside of the flexible tubing and irrigator tube, prepare a cleaning solvent by diluting sodium hypochlorite with an equal quantity of water. Fill the solution container with the prepared cleaning solvent. Allow about a liter of the cleaning solvent to flow through the siphon assembly and irrigator tube, then place the pinch clamp on the end of the tubing to hold the solvent in the tube. Refill the container and allow to stand overnight. After soaking, allow the cleaning solvent to flow out through the siphon assembly and irrigator tube. Remove the siphon assembly from the solution container and rinse both with clear water. The irrigator tube and siphon assembly can be rinsed easily by attaching a hose between the tip of the irrigator tube and water faucet and backwashing fresh water through the tube.

h.4. Occasionally the holes in the tip of the irrigator tube may become clogged by a particle of sand. If the obstruction cannot be freed by any other method, use a pin or other sharp object to force it out, using extreme care not to enlarge the size of the opening.