SPECIFIC GRAVITY AND ABSORPTION OF FINE AGGREGATES

AASHTO T 84

GLOSSARY

Absorption: The increase in mass due to water in the pores of the material.

Bulk Specific Gravity (also known as Bulk Dry Specific Gravity): The ratio of the weight in air of a unit volume of aggregate at a stated temperature to the weight in air of an equal volume of gas-free distilled water at the stated temperature.

Bulk SSD Specific Gravity: The ratio of the weight in air of a unit volume of aggregate, including the weight of water within the voids filled to the extent achieved by submerging in water for approximately 15 hours, to the weight in air of an equal volume of gas-free distilled water at the stated temperature.

Apparent Specific Gravity: The ratio of the weight in air of a unit volume of the impermeable portion of aggregate (does not include the permeable pores in aggregate) to the weight in air of an equal volume of gas-free distilled water at the stated temperature.

SSD - Saturated, Surface Dry. The condition in which the aggregate has been soaked in water and has absorbed water into its pore spaces. The excess, free surface moisture has been removed so that the particles are still saturated, but the surface of the particle is essentially dry.

SCOPE

Specific Gravity is the ratio of the weight of a given volume of aggregate to the weight of an equal volume of water. Water, at a temperature of 73.4°F (23°C) has a specific gravity of 1. Specific Gravity is important for several reasons. Some deleterious particles are lighter than the "good" aggregates. Tracking specific gravity can sometimes indicate a change of material or possible contamination. Differences in specific gravity may be used to separate the deleterious particles from the good using a heavy media liquid.

Specific gravity is critical information for the Hot Mix Asphalt Design Engineer. This value is used in calculating air voids, voids in mineral aggregate (VMA), and voids filled by asphalt (VFA). All are critical to a well performing and durable asphalt mix. Water absorption may also be an indicator of asphalt absorption. A highly absorptive aggregate may result in a low durability asphalt mix.

In Portland Cement Concrete the specific gravity of the aggregate is used in calculating the percentage of voids and the solid volume of aggregates in computations of yield. The absorption is important in determining the net water-cement ratio in the concrete mix. Knowing the specific gravity of aggregates is also critical to the construction of water filtration systems, slope stabilization projects, railway bedding and many other applications.

This test method determines the specific gravity of fine aggregates that have been soaked for a period of 15-19 hrs. The determinations that may be made from this procedure are identical to those made in AASHTO T 85 (Specific Gravity and Absorption of Coarse Aggregate).

SUMMARY OF TEST

Apparatus

Balance, conforming to the requirements of M 231, Class G2

Pycnometer, a flask or other suitable container into which the fine aggregates may be readily introduced (Figure 1). Volume content for the container needs to be reproduced within ± 100 mm^3. The volume of the container filled to the mark shall be at least 50 percent greater than the space required to accommodate the test sample.

Mold, metal in the form of a frustum of cone with acceptable dimensions of 40 ± 3 mm inside diameter at top, 90 ± 3 mm inside diameter at the bottom, and 75 ± 3 mm in height. The metal thickness is a minimum of 0.8 mm.

Tamper, metal having a mass of 340 ± 15g and having a flat circular tamping face of 25 ± 3 mm in diameter.

Figure 1
Fine Aggregate Specific Gravity Apparatus

Procedure

1. Thoroughly mix the sample and reduce the sample to the required size in accordance with AASHTO T 248 (Reducing Field samples of Aggregates to Test Size). The sample size for this procedure is approximately 1000g of material passing the No. 4 (4.75 mm) sieve.

2. Dry test samples to constant weight in an oven set at 230 ± 9°F (110 ± 5°C). Cool the sample at room temperature for 1 to 3 hours. After the cooling period, immerse the sand in water at room temperature for a period of 15 to 19 hours.

Instead of completely immersing the sand in water, AASHTO considers sand to be "soaked" if the sand is maintained at a moisture content of at least 6% for the prescribed period. This is the recommended procedure to eliminate the need to decant excess water from the sand prior to testing. The decantation process is time consuming and difficult, since great care must be taken to avoid decanting some of the sample along with the water. Additionally, the sand will be much closer to the SSD condition when soaked at 6% moisture, which expedites the dry procedure.

3. Decant water from sample, avoiding loss of fines. Spread the sample on a flat, non-absorbent surface. Stir the sample occasionally to assist in homogeneous drying. A current of warm air may be used to assist drying procedures (Figure 2); however, fine particles may be lost with this procedure if not careful.

Figure 2
A current of air being used
to achieve SSD condition.

4. Determine the SSD condition of the sand using the Cone Test.

Note: Throughout the process of drying in Step 3, test the sand for SSD condition using the cone method. Place the cone with the large diameter down on a glass plate. Fill cone to overflowing with drying sand. Lightly tamp the fine aggregate into the mold with 25 light drops of the tamper (Figure 3). Each drop should start about 1/5 in. above the top surface of the fine aggregate. Remove loose sand from base and carefully lift the mold vertically. If surface moisture is still present, the fine aggregate will retain the molded shape. When the sand achieves an SSD condition, the sand will slump (Figure 4).

Figure 3
Tamping sand using the cone
method to determine SSD

If on the first trial the sand slumps, moisture must be re-added and the drying process repeated. Record the weight of the sand as SSD mass when the sand slumps to the nearest 0.1 g.

Figure 4
Sand at SSD condition will slump
once the cone is removed

5. Calibrate a specific gravity flask pycnometer by filling with water at 73.4 ± 3°F (23 ± 1.7°C) to the calibration line. Record this weight as the weight of the pycnometer filled with water to the nearest 0.1g.

6. Place the SSD sand into the pycnometer (Figure 5) and fill with water (set at 73.4 ± 3°F (23 ± 1.7°C)) to 90% of pycnometer capacity.

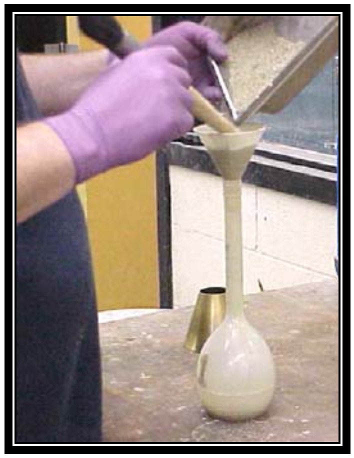

Figure 5
Pouring sand into pycnometer
once SSD is achieved

Manually roll, invert, and agitate the pycnometer to eliminate air bubbles (Figure 6). This procedure should be repeated several times to ensure that any entrapped air is eliminated. Agitation of the pycnometer does not have to be constant.

Figure 6
Agitating the pycnometer

7. Bring the pycnometer to the pycnometer calibrated capacity with additional water (Figure 7).

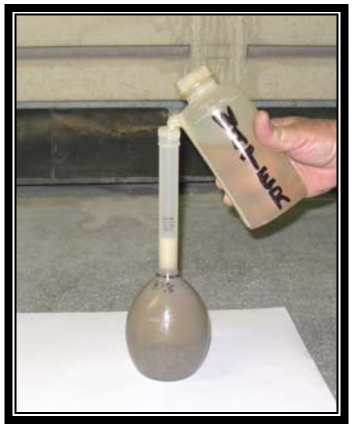

Figure 7
Adding Water to Calibrated Capacity

If bubbles prevent the proper filling of the pycnometer, adding a few drops of isopropyl alcohol is recommended to disperse the foam. Place the pycnometer in a water bath at the regulated temperature and allow the sample to equalize.

8. Determine the total weight of pycnometer, specimen, and water. Record the weight to the nearest 0.1g as Weight of Pycnometer with sample and water.

Calculations

Determine calculations based on appropriate formula for desired result as follows:

A. Bulk Specific Gravity (Gsb): The ratio of the weight in air of a unit volume of aggregate at a stated temperature to the weight in air of an equal volume of gas-free distilled water at a stated temperature.

Gsb = A / (B-C)

Where: A = Oven dry wt. B = SSD wt. C = Wt. in water

B. Bulk SSD Specific Gravity (Gsb SSD): The ratio of the weight in air of a unit volume of aggregate, INCLUDING the weight of water within the voids filled to the extent achieved by submerging in water for approximately 15 hours, to the weight in air of an equal volume of gas-free distilled water at a stated temperature.

Gsb SSD = B / (B-C)

C. Apparent Specific Gravity (Gsa): The ratio of the weight in air of a unit volume of the IMPERMEABLE portion of aggregate (does not include the permeable pores in aggregate) to the weight in air of an equal volume of gas-free distilled water at a stated temperature.

Gsa = A / (A-C)

D. Absorption (% Abs): The increase in weight of aggregate due to water in the pores of the material, but not including water adhering to the outside surface of the particles.

% Abs = [(B-A) / A] x 100

<u>Example</u>

Trial	Wet Weight	Dry Weight	Wet - Dry	% Absorbed
1	118.11	117.42	0.69	0.59
2	158.10	157.13	0.97	0.62
3	172.81	171.12	1.09	0.64

Trial	S	A	B	C	B + S - C	B + A - C
1	500.05	497.1	670.7	983.8	186.9	184.0
2	499.77	496.7	679.6	992.4	187.0	183.9
3	499.61	496.5	671.6	984.1	187.1	184.0

Trial	Bulk SSD S/B+S-C	Bulk A/B+S-C	APPARENT A/B+A-C
1	2.675	2.660	2.702
2	2.673	2.656	2.701
3	2.670	2.654	2.698
Average	2.673	2.657	2.700

A = Weight of Oven Dry Specimen in Air
B = Weight of Pycnometer filled with water
C = Weight of Pycnometer with specimen and water to calibration mark
S = SSD Weight