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WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

STANDARD METHOD OF TEST FOR DETERMINING THE PERCENTAGE
OF COAL AND LIGHTWEIGHT PARTICLES IN AGGREGATE

- 1.0 PURPOSE
- 1.1 To provide a standard method of testing for coal and lightweight particles in aggregates by means of a sink-float separation in a heavy liquid with a designated specific gravity.
- 2.0 SCOPE
- 2.1 This procedure is applicable to fine and coarse aggregates.
- 3.0 APPLICABLE DOCUMENTS
- 3.1 ASTM C 123 OR AASHTO T 113
- 3.2 ASTM E 11
- 3.3 ASTM E 100
- 3.4 ASTM C 702 OR AASHTO T 248
- 3.5 MP 700.00.06
- 3.6 ASTM C 127 OR AASHTO T 85
- 3.7 ASTM C 128 OR AASHTO T 84
- 4.0 APPARATUS
- 4.1 A 4.75 mm and 300 μ m U.S. Standard 203 mm diameter sieve conforming to ASTM E 11 Specifications.

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- 4.2 Balance or scale having a capacity of 500 grams and a sensitivity of at least 0.1 gram for weighing fine aggregates; and a capacity of 10,000 grams with a sensitivity of 1 gram for weighing coarse aggregates.
- 4.3 Oven capable of being maintained at $110^{\circ} \pm 5^{\circ}\text{C}$.
- 4.4 Containers: Large Nalgene vat (or comparable material) for storage of heavy liquid and compatible mesh bucket for immersion of coarse aggregate into heavy liquid.
- Buckets for soaking and pans for surface drying the aggregates.
- 600 ml pyrex beakers for fine aggregates.
- 4.5 Skimmers: Made of No. 50 sieve cloth conforming to ASTM E 11. Fitting one with a handle for scooping floating particles from heavy liquid. The other must be capable of fitting over 600 ml pyrex beakers.
- 4.6 Stirring Rods: A glass rod for use with fine aggregates and a large metal rod for coarse aggregates.
- 4.7 Heavy Liquid: Consisting of a mixture of acetylene tetrabromide (1,1,2,2 - Tetrabromoethane) and kerosene in such proportions so that a designated specific gravity of 2.00 ± 0.01 can be maintained at all times during the test.
- 4.8 Hydrometer: Conforming to the requirements of ASTM E 100 and capable of measuring the liquid specific gravity to within ± 0.01 .
- 4.9 Safety Equipment: Industrial type rubber gloves, face shield or goggles, and respirator capable of filtering organic vapors.

NOTE: Caution - (1,1,2,2 - Tetrabromoethane) is highly toxic both by absorption through the skin or by inhalation. Due to its nature, the solution should be under an exhaust hood or kept in a well ventilated area when in use. Adequate protection should be taken to avoid contact with the skin and clothes or inhalation of fumes.

- 4.10 Isopropyl Alcohol (70 percent)
- 5.0 SAMPLE PREPARATION
- 5.1 Samples shall be representative of the sources from which they are obtained and shall be reduced to an appropriate size by use of a sample splitter or by quartering in accordance with ASTM C 702 or AASHTO T 248.
- 5.2 Fine aggregate samples shall be dried in an oven to a constant temperature of $110^{\circ} \pm 5^{\circ}\text{C}$).
- 5.2.1 The oven dry sample shall be sieved over a 300 μm until less than one percent of the retained material passes through the sieve in one minute of continuous sieving. Discard the minus 300 μm sieve material.
- 5.2.2 Bring the plus 300 mm test portion to a saturated-surface-dry condition as specified in ASTM C 128 or AASHTO T 84. (See Note 1 and Note 2).
- Note 1 - If material undergoes degradation in water, the material does not have to be brought to an SSD condition.
- Note 2 - Pit derived silica sand has been shown to commonly contain soft and easily degradable aggregations of sub-bituminous coal. Because of this possible degrading constituent, pit sand will not be subjected to SSD condition under this procedure.
- 5.3 Coarse aggregates shall be sieved over a 4.75 mm sieve. The plus 4.75 mm material shall be thoroughly washed and oven dried to a constant temperature of $110^{\circ} \pm 5^{\circ}\text{C}$).
- 5.3.1 In the following minimum test portions, the oven dried sample shall be weighed to the nearest one gram and that weight recorded.

<u>Nominal Maximum Size of Aggregate (Sieve Openings)</u>	<u>Minimum Weight of Test Sample (Grams)</u>
6.3 mm	3,000 grams
19.0 mm	5,000 grams
75.0 mm	10,000 grams

6.0 PROCEDURE

6.1 Under a ventilation hood or in adequately ventilated area, check the heavy liquid (1,1,2,2 - Tetrabromoethane) for correct specific gravity (2.00 ± 0.01).

6.2 Fine aggregate - weigh a test portion to a minimum of 200 grams to the nearest 0.1 gram and record weight. This test portion shall be placed in a 600 ml beaker and a volume of heavy liquid poured into the beaker until the liquid level is at least 25 mm above the sample level.

6.2.1 Agitate the test portion by means of a glass stirring rod allowing the lightweight particles to float to the surface.

6.2.2 Pour the liquid and floating lightweight particles into a second beaker, passing through a 300 mm skimmer, making sure that only the floating particles are poured off with the liquid.

6.2.3 Repeat procedure in 6.2.2 until test portion is free from floating particles, then drain test portion and discard.

6.2.4 Wash to decanted particles retained on the 300 mm skimmer with isopropyl alcohol (70 percent) until all the Tetrabromoethane is removed.

6.2.5 Dry decanted particles to a constant weight and weigh to the nearest 0.1 gram.

6.3 The coarse aggregate test portion shall be brought to a saturated-surface-dry condition as specified in ASTM C 127 or AASHTO T 85.

NOTE: If material undergoes degradation in water, the material does not have to be brought to an SSD condition.

6.3.1 Place material into mesh bucket and place into vat of Tetrabromoethane solution.

NOTE: If test portion is sufficiently large, two or more runs may be necessary to complete testing.

- 6.3.2 Agitate test portion by means of a large metal stirring rod allowing the lightweight particles to float to the surface.
- 6.3.3 Remove floating pieces from heavy liquid by scooping with a 300 mm skimmer.
- 6.3.4 Repeat process until test portion is free of floating particles, then drain test portion and discard.
- 6.3.5 Wash lightweight particles with isopropyl alcohol (70 percent) until all the Tetrabromoethane is removed.
- 6.3.6 Dry lightweight particles to a constant weight and weigh to the nearest 1.0 gram.

6.4 Slag: Due to the manufacturing process, there is entrapped air in the aggregate. The procedure for slag is the same for any other coarse aggregate, however, a greater number of pieces will come to the surface than with other types of aggregates. The floating particles must be friable before they are considered as deleterious.

7.0 CALCULATION

7.1 Calculate the percentage of lightweight particles as follows:

Fine Aggregates

$$L = \frac{W1}{W2} \times 100$$

Coarse Aggregates


$$L = \frac{W1}{W3} \times 100$$

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Where:

L = Percentage of lightweight particles
W1 = Dry weight of lightweight particles
W2 = Dry weight of fine aggregate test portion
W3 = Dry weight of coarse aggregate test portion

7.2 Report results to nearest 0.1 percent.



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