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Test Method to Determine the Moisture Content of Lightweight Fine Aggregate

New York State Department of Transportation,
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SCOPE:

This method describes the procedures for determining the total, absorbed, and surface (free) moisture of Lightweight Fine Aggregate to be used for Internal Curing of concrete. [*This includes concrete that contains both portland cement and supplementary cementitious materials [SCM].*]

EQUIPMENT:

1. Sampling container: Non-absorbent, sealable, bag or tub with a capacity sufficient for holding approximately 2000 grams of fine aggregate.
2. Scoop, shovel, or large spoon.
3. Sheet of non-absorbent cloth, canvas or polyethylene (approximate size, 24" (600 mm) x 24" (600 mm)).
4. Drying apparatus: A ventilated oven capable of maintaining temperature of $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$) for 24 hours. In cases where the aggregate is not altered by overheating, other sources of heat, such as electric or gas hotplates, electric heat lamps, or a ventilated electric microwave oven may be used.
5. Disposable paper towels: Commercial grade, typically manufactured from post consumer recycled paper [*commonly referred to as 'brown paper towels'.*]
6. Heat resistant pans: With sufficient capacity to hold a minimum of 500 grams of fine aggregate in an oven or on a hot plate at the specified temperature. If a microwave oven is used for drying, the container shall be non-metallic.

SAMPLING:

- For determination of surface moisture content at the Portland cement batching facility (for adjustments to target batch weights) prior to batching:

After the required soaking [*wetting or pre-wetting*] and draining of the stockpiles has been completed, obtain a representative sample from the stockpile or plant storage bin in accordance with sampling procedures described in Materials Method (MM) 9.1, Plant Inspection of Portland Cement Concrete [*or concrete that also contains SCM*]. Obtain a minimum sample size of 1500 grams. Immediately upon obtaining the composite sample, place it in a non-absorbent container to prevent loss of moisture prior to testing.

- For determination of moisture and absorption (for information and reference) in the laboratory:

Obtain a representative sample from the stockpile in accordance with sampling procedures described in MM 9.1. Obtain a minimum sample size of 1500 grams. Place the sample in a clean, watertight laboratory pan. Completely immerse the sample in clean water, at ambient laboratory temperature, for a minimum of 72 hours. After immersion, carefully drain the excess water from the pan, taking care not to lose suspended particles during the process.

TESTING:

Reduce the sample, by quartering, into four sub-samples of approximately 350 grams each.

Immediately determine the initial weight of one sub-sample by weighing to the nearest 0.1 grams. This sub-sample will be known as "Sample #1." Record the initial weight of Sample #1 as W_T . Place Sample #1 in the drying apparatus. Dry Sample #1 to a constant weight, so that the loss in weight between subsequent measurements does not change by more than 0.1 % of the original weight.

After drying, allow Sample #1 to cool sufficiently, so as to not damage the weighing equipment. Measure the weight of Sample #1 to the nearest 0.1 grams and record the weight as W_{OD} . The mathematical difference between the initial weight (W_T) and the oven dried weight (W_{OD}) represents the "total" (absorbed and surface) moisture.

Calculate the "% Total Moisture" content of Sample #1 (expressed as a percent of the oven dried weight) as follows:

$$\text{Total Moisture: } (M_T) = 100 \times (W_T - W_{OD}) / W_{OD}$$

Place another sub-sample, which will be known as "Sample #2," on a 2 - 3 foot long sheet of clean, dry paper towel. Spread the sample uniformly across the paper towel while patting the sample with another paper towel. Continue patting and spreading the sample, replacing the sheets of paper towel whenever the paper becomes too damp or dirty to absorb moisture. This process should be conducted as quickly and carefully as possible. Repeat the patting and spreading of the sample until no further moisture appears on the clean paper towels. Immediately weigh Sample #2 to the nearest 0.1 gram. Since the surface moisture has been removed, this weight represents only the moisture that has absorbed into the sample. Record this weight as W_{TD} .

Place Sample #2 in the drying apparatus. Dry Sample #2 to a constant weight so that the loss in weight between subsequent measurements does not change by more than 0.1% of the original weight. Measure the weight of Sample #2 to the nearest 0.1 grams and record the weight as W_{2OD} .

Calculate the "% Absorbed Moisture" content of Sample #2 as follows:

$$\% \text{ Absorbed Moisture: } (M_A) = 100 \times (W_{TD} - W_{2OD}) / W_{2OD}$$

Calculate the "% Surface Moisture" content as follows:

$$\% \text{ Surface Moisture: } (M_S) = \text{Total Moisture } (M_T) - \text{Absorbed Moisture } (M_A)$$

Example: $M_S = M_T - M_A$

$$M_S = 20.3\% - 16.4\% = 3.9\% \text{ Surface Moisture.}$$

Report the Surface Moisture to the nearest 0.1 %.

This value will be used to adjust the pre-programmed target weight of the lightweight fine aggregate and water in the batching facility's automated batching system. Consult MM 9.1 for more information on automated batching systems.

Note: the test method references New York State Test Method MM 9.1 Plant Inspection of Portland Cement Concrete. This test method can be found at:

<https://www.dot.ny.gov/divisions/engineering/technical-services/materials-bureau-repository/mm9-1.pdf>