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Concrete Aggregate Moisture Content

1. WHAT is Concrete Aggregate Moisture Content?

The moisture content of concrete aggregates is an important factor that should be monitored by concrete producers on a regular basis and used as a control provision in the production of quality concrete.

The total moisture content of a concrete aggregate is the sum of the water held within the pours of the aggregate particles, also known as the absorbed moisture, and the free water on the outside of the concrete aggregate, also known as the free surface moisture.

2. WHY Monitor Concrete Aggregate Moisture?

The properties of fresh and hardened concrete are influenced by the quantity of mix water in the batch. The strength, durability and ultimate service life of concrete is strongly influenced by strict adherence to CSA Standard exposure class water to cementitious materials ratios (w/cm). CSA A23.1 Clause 5.2.2.6 states that “Mixing water shall consist of all water in the batch, including water occurring as surface moisture on the aggregate,... And a note to that clause further emphasizes the fact that aggregate moisture contents should be checked frequently and that adjustments of batch quantities of mix water and aggregate are necessary to achieve good quality control.

3. How Frequently Should Concrete Aggregate Moistures Be Monitored?

The frequency of concrete aggregate moisture determinations will be influenced by a number of factors including, concrete production rates, the rates of consumption of defined lots of aggregate (stockpiles) represented by the moisture content determinations of the sample tested, the provisions in place to mitigate the influences of the environment in which the aggregates are store such as evaporation and precipitation. Obtaining a representative sample for the determination of moisture content of a lot of aggregate for the concrete production shall be in accordance with CSA A23.2-1A. Note the accuracy of subsequent moisture correction related adjustments to batch aggregate and water quantities will be influenced by the manner in which the aggregate lot represented is reclaimed for production.

CSA A23.2-11A Test method for surface moisture in fine and coarse aggregate.

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Methods and Standard Practices for concrete.
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REFERENCES
AASHTO (American Association of State Highway and Transportation Officials) T 255 Standard Method of Test for Total Evaporable Moisture Content of Aggregate by Drying.
NCPA (National Precast Concrete Association Aggregate Moisture Content Testing By Kayla Hanson, P.E., NPCA's director of technical services. January 17, 2019. https://precast.org/blog/aggregate-moisture-content-testing/
TIP 6:Aggregate Moisture and Making Adjustments to Concrete Mixtures Technology in Practice NRMCA, Silver Spring, MD.
CSA Group: CSA A23.1/CSA A23.2, Concrete materials and methods of concrete construction/Test

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4. How Should Concrete Aggregate Moistures be determined?

As mentioned above, a representative sample of a defined lot of a given aggregate for concrete production, should be obtained in accordance with CSA A23.2-1A. The sample should then be reduced to a test sample size indicated in accordance with CSA A23.2-11A.

Summary of Test

Apparatus:

A balance or scale shall be used having a capacity of 1 kg or more, sensitive to 0.1 g or less, and accurate to 0.1% of the test load at any point within the range of use for this test. Within any 100 g range of test load, a difference between readings shall be accurate to 0.1 g.
Source of Heat Options: oven, ideally*, capable of maintaining a temperature of 110 ± 5°C, electric or gas hot plate, electric heat lamps, or microwave oven. For quicker determinations, use a hot plate or microwave. However, the higher temperatures may cause certain minerals to fracture or pop but this may be negligible as long as all fractured particles are recovered for weighing.. Some experimentation will be necessary to ensure the best settings for the material, to avoid this situation. When a hot plate is used, the sample is stirred repeatedly while observing the state of the aggregate. The microwave should not be used where there is metal or metal oxides present in the aggregate.

*Note: While the oven method of drying may be best for determining the absorption rate of aggregates, total moisture content determination of in-production aggregate may not be achievable within the time window required by this method.

Procedure

1. Tare the scale with the sample container and a pad on it to protect the scale from heat damage from the sample container during subsequent weighings.
2. Weigh the sample and record the weight (W)
3. Dry the sample until there is less than 0.1% change in weight over subsequent weighings.
4. Record the final weight of the dried sample (D)

Calculations

The calculation for moisture content (P) is as follows:

$$P = 100 \times \frac{(W - D)}{D}$$

where: P = moisture content of sample, %
W = original wet weight of sample, g
D = dry weight of sample, g

Example:

W = 546.2 gms. D = 541.2 g

$$P = 100 \times \frac{(546.2 - 541.2)}{541.2} = 100 \times \frac{5.0}{541.2} = 0.92\%, \text{ record as } 0.9\%$$

The total moisture content is calculated to the nearest first decimal place (0.0).

Knowing in advance, the absorption of each aggregate, the moisture corrected weight proportions of each aggregate can be calculated from a Saturated Surface Dry (SSD) mix design.

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