Concrete Property Test

Workability 1-2: Aggregate Moisture Content

National Concrete Pavement Technology Center
www.cptechcenter.org

Purpose – Why Do This Test?

Mixture proportions must be adjusted for the moisture found in the aggregate stockpiles. Batching concrete based on inaccurate aggregate moisture contents can impact workability, strength development, air entrainment, permeability, and shrinkage of the concrete mixture. Adjusting mixture proportions based on the actual aggregate moisture content is critical to producing uniform concrete.

Principle – What is the Theory?

Mixture proportions are based on the total water content for a given mixture design. Water is introduced into a concrete mixture from two sources: the water added during batching and any free water on the aggregate particles. Aggregates can be found in four moisture conditions:

- Oven dry—aggregate particles are completely dry and able to absorb water from the mixture.
- Air dry—aggregates are partially dry and able to absorb water from the mixture.
- Saturated surface dry (SSD)—aggregates have absorbed all of the water that they potentially can and are dry on the surface. Water is neither absorbed from nor contributed to the mixture.
- Damp or wet—aggregates fully absorbed the water and have excess moisture on the surface (free water).

Aggregates are most commonly found in the air dry or damp/wet states. Air dry aggregates will absorb paste (water + cementitious material + air) from the mixture. Damp or wet aggregates will add water to a mixture increasing the w/cm. Both conditions will adversely affect concrete properties.

Test Procedure – How is the Test Run?

ASTM C 566, the Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying, determines the moisture content of an aggregate sample by drying the aggregate and determining the mass of water present in the aggregate sample.

Test Apparatus (figure 1)

- Scale for measuring the mass of wet and dried aggregate samples.
- Oven, microwave oven, or hot plate for heating the aggregate samples.
- Heat-resistant sample container.

Test Method – Refer to ASTM C 566 for Comprehensive Guidance

1. Sample a sufficient mass of aggregate in accordance with ASTM D 75 from the stockpile in a location that is representative of the aggregate that will be batched subsequent to this moisture content test. Protect the sample from moisture loss until the original mass is determined.
2. Weigh the sample and determine its mass.
3. Dry the sample thoroughly until further heating yields an additional loss of mass less than 0.1%.

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Figure 1. Sieve analysis test equipment

4. Calculate the moisture content by subtracting the dry mass from the original mass and dividing by the dry mass.

   Moisture content (%) = ([original mass – dry mass] ÷ dry mass) • 100

   Note: Failure to completely dry the sample and/or any loss of aggregate particles during the test will yield incorrect results.

Output – How Do I Interpret the Results?

Test results should be provided to the batch plant as soon as possible so that mixture proportions can be adjusted to match the actual moisture condition of the aggregates being batched (table 1).

Repeat aggregate moisture testing whenever unit weight and/or microwave water content testing indicate an out-of-control condition in the total water content of a mixture (figure 2).

Construction Issues – What Should I Look For?

Failing to adjust mixture proportions for the correct aggregate moisture content may be identified through unit weight testing and microwave water content testing (figure 2). Concrete batched with the incorrect volume of water will primarily affect workability, strength development, permeability, and shrinkage properties. Aggregate stockpiles that have variable moisture contents will result in non-uniform concrete, adversely affecting the workability. Strive for consistent moisture content throughout the aggregate stockpile. If possible, allow recently delivered aggregates 24 to 36 hours to drain before incorporating into the project.

Table 1. Aggregate Moisture Content Test Results

Aggregate moisture content	
Project	I-35 Payne Co.
Aggregate	1 ½ in. limestone coarse aggregate
Aggregate absorption from previous testing	0.71%
Minimum sample mass required (kg)	6.0
Date & time sampled	2-Jun-08 1:30 PM
Location(s) sampled	East ¼ of stockpile, 50 ft. north of working face
Approximate date and time aggregate represented by this sample will be batched	3-Jun-08 7:00 AM
Original mass (W)(g)	6228.0
Dried mass (D)(g)	5994.0
Moisture content	3.9%

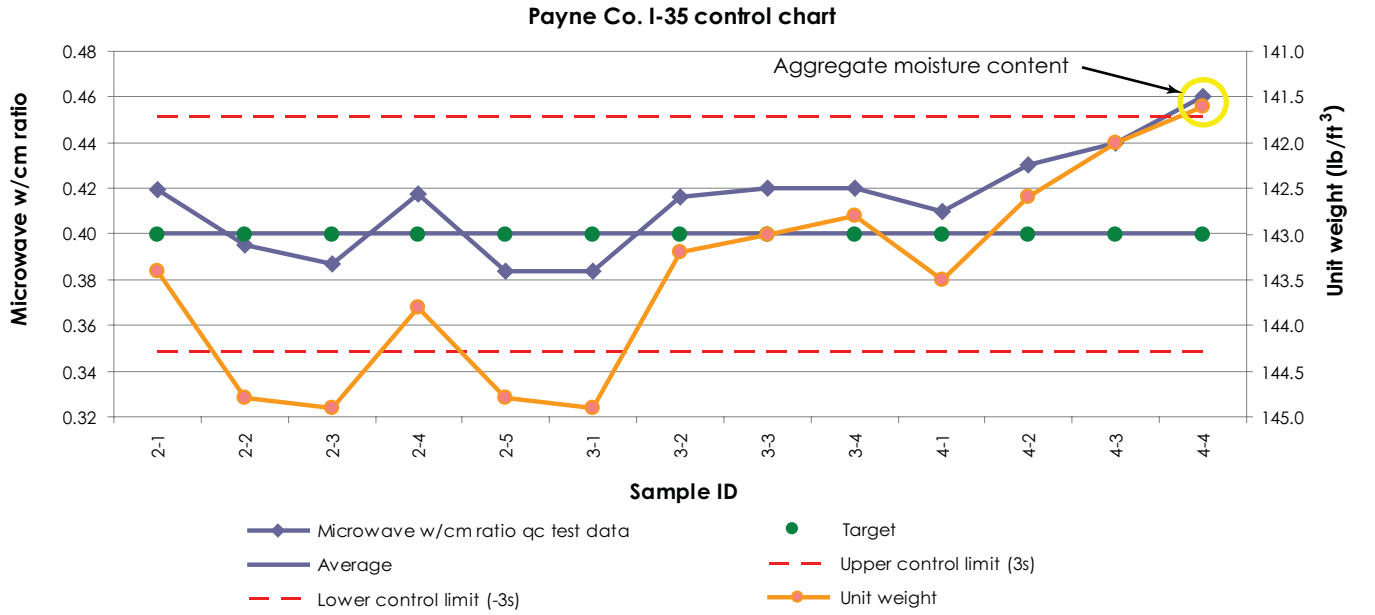

Figure 2. Microwave w/cm and unit weight test results indicate potential aggregate moisture error

APRIL 2008

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This test summary is one of a set of summaries originally published in chapter 7 of the *Testing Guide for Implementing Concrete Paving Quality Control Procedures* (Fick, G., Iowa State University, Ames, Iowa, 2008). The testing guide is a product of a 17-state, Federal Highway Administration pooled-fund project, Material and Construction Optimization for Prevention of Premature Pavement Distress in PCC Pavements, TPF-5(066). The project was managed by the National Concrete Pavement Technology Center at Iowa State University.