

FIELD CALORIMETRY

What is Calorimetry?

Calorimetry measures the heat generated from the early hydration reactions of cementitious materials. The heat outflow tracks the hydration reactions of cement, which gives visibility into the behavior of concrete or mortar in a way that a simple set time or compressive strength test could not. The timing and shape of the temperature curve obtained through calorimetry is an indicator of relative performance of cementitious mixes.

Practical uses of calorimetry for contractors.

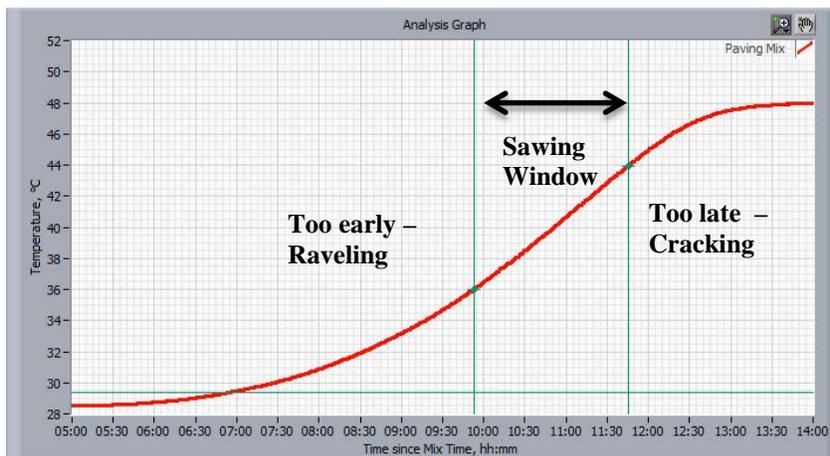
Calorimeters are effective tools for research, mix design, determination of potential material incompatibility and to infer physical properties such as compressive strength, setting times (ASTM C403) and saw cut times. For contractors, a simple semi-adiabatic calorimeter can be used in lieu of physical testing to determine setting times, saw cut times, form stripping or curing time.

Example: determination of saw cutting times.



The time of sawing is critical to prevent raveling or cracking. The newly poured concrete for the paving application must develop enough strength to allow saw equipment to get on the slab. Sawing must be completed before the concrete has developed too much strength, leading to the development of random cracks. A calorimetry test measures the heat release in concrete, thereby determining the degree of hydration,

which is correlated to strength gain for each individual mix. As the calorimetry curve reaches the minimum degree of hydration, the software indicates the start of the sawing cut window. And as the degree of hydration progresses, it shows the end of the Sawing Window, as shown in the graph below.



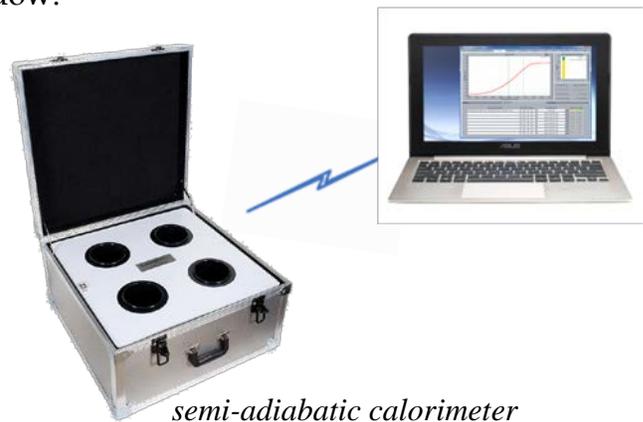
Example of a typical calorimetry curve for a paving mix, as measured in a semi-adiabatic portable field calorimeter

Protocol

At the time the concrete is poured for paving, a sample should be taken in a standard 4"x8" test cylinder and then placed in a semi-adiabatic field calorimeter. The first time a given mix is tested in the calorimeter, the user records the calorimetry curve and use the actual saw cut times to define the position on the calorimetry curve that indicates the beginning of the sawing window. For all subsequent batches of the same mix design the software will use this point on the live calorimetry curve to indicate the beginning of the saw cutting window. The field calorimeter communicates wirelessly to a laptop computer where the saw cutting application is installed. Operators can observe the calorimetry curve from the comfort of their truck or field office and wait for the indicator of the beginning of the Sawing Window.

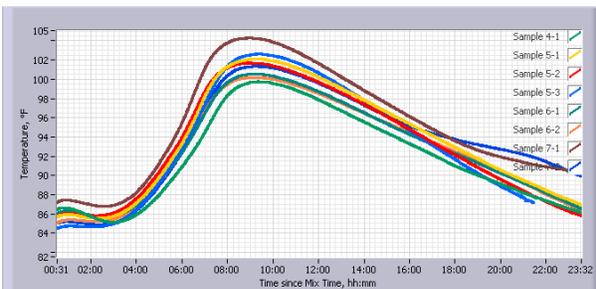
Equipment.

The semi-adiabatic calorimeter is the size of a suitcase (24"x24"x14"), making it easy to take it along for an on-site set-up at or near the job site. Besides the determination of saw cut times, semi-adiabatic calorimeter can also be used for mix designs, the determination of setting times and quality control.

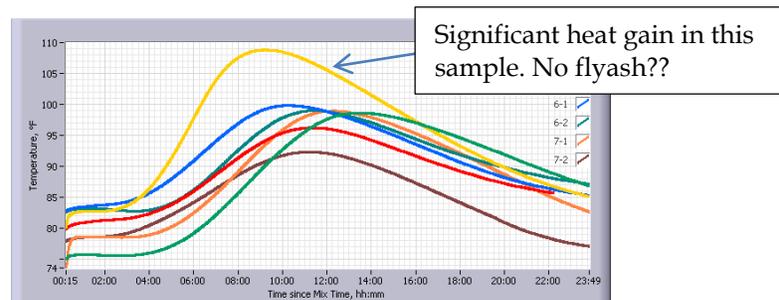


Example: Quality Control

The figures below show calorimetry curves of production concrete samples. In example 2, the concrete samples were very consistent, in terms of the quantity and source of cementitious contents and admixture dosages since the calorimetry curves have the same shape and peak heat of hydration. Example 3, is a case where the cement and admixture quantities have changed between samples and in one case, there was significantly high heat of hydration which could be due to no fly ash in this sample.



Example 2: Consistent Calorimetry Curves



Example 3: Inconsistent Calorimetry Curves

Vendor

Calmetrix Inc, Arlington, MA 02476

Phone: (888) 202-2060

www.calmetrix.com

Price: \$4895 (4 cylinder unit)

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