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I-CAL 2000 HPC

CALMETRIX I-CAL 2000 HPC FOR CEMENT AND CONCRETE SCIENCE

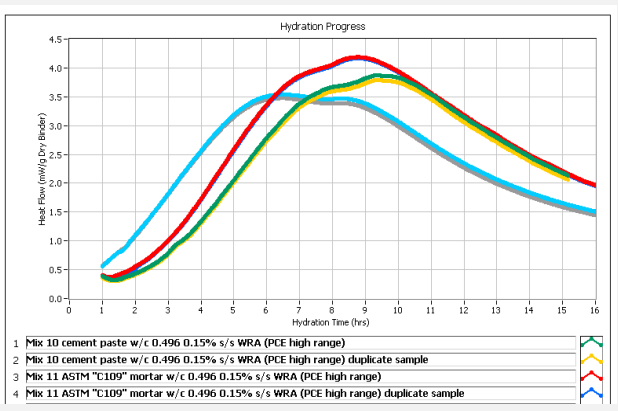
Background: Isothermal Calorimetry in cement and concrete testing.

Isothermal calorimetry measures the heat generated by a cementitious binder as an indicator for the rate of reaction. Since the rate of reaction is very important for engineering properties such as workability, set and early strength development, calorimetry is widely used to develop new binders and mixes, for quality control and to study the effect of different chemical admixtures and binder compositions on the rate of reaction.

I-Cal 2000 HPC High Precision Calorimeter for Cement / Concrete Professionals.

The I-Cal 2000 HPC is a 2-channel Isothermal Calorimeter that can be used to test cement paste, mortar or **even real concrete**. Testing on real concrete is particularly important to detect unwanted interactions between complex admixture molecules and binders. A thermal hydration curve is plotted as the ambient temperature around the sample is kept constant. The temperature is easily set via software interface with a feedback loop to ensure optimal control, while precision sensors measure the heat flow generated by the cementitious binders reacting in concrete during the first days. I-Cal 2000 HPC also features Calmetrix's system of variable reference cells to adjust the thermal reference mass for each sample, thereby allowing for increased flexibility and better precision.

Example of use: effect of mixing energy
(Applicable Instruments: any I-Cal instrument)



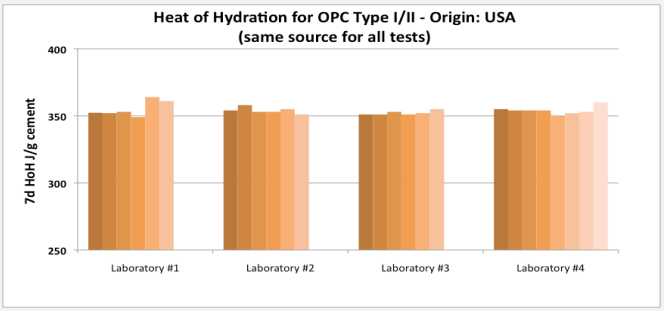
The mixing action in concrete is very different from cement paste, and can lead to very different behaviors in the presence of certain chemical admixtures, such as polycarboxylate based additives. This example shows the differences in the rate of hydration in paste (green & yellow curves) mortar (red curve) and concrete (blue curve) in the presence of a single dose of a high range water reducer. As seen here, paste based samples are usually more retarded than concrete or mortar samples. See "Evaluating the Effect of Mixing Method on Cement Hydration in the Presence of a Polycarboxylate High-Range Water Reducing Admixture by Isothermal Conduction Calorimetry" by S.A. Farrington, ICCC Montreal 2007 for more on this important issue. The implications for researchers are important, as the effect of mixing energy will significantly alter the formulation, dosage and compatibility studies of chemical admixtures in concrete or mortar mixes.

Data generated by I-Cal is retrieved and analyzed with Calmetrix's state-of-the art CalCommander software, which combines ease of use and a suite of analytical tools. CalCommander makes heat of hydration studies easy as a "one-click" experience. Total energy by unit of mass is automatically calculated and a report is generated in the standard required format.

I-Cal 2000 HPC is also fully compliant with both ASTM C1679 and ASTM C1702 "Standard Test Method for Measurement of Heat of Hydration of Hydraulic Cementitious Materials Using Isothermal Conduction Calorimetry". Heat of hydration tests can be conducted on standard cement for short term studies or up to 28 days of continuous measurement.

I-Cal 2000 HPC's two active cells are completely separated, thereby reducing cross talk to less than 0.1%. This makes I-Cal 2000 HPC the best performing isothermal calorimeter in its class.

Example of use: Heat of Hydration testing
(Applicable Instruments: I-Cal 2000 / 4000 / 8000 HPC)



I-Cal 2000 HPC is designed to yield robust results, both in terms of repeatability and in the response to varying outside conditions. The graph on the left shows results of heat of hydration tests performed multiple times in different laboratories (non air-conditioned rooms), using the same cement. The graphical representation shows the consistency of the results obtained with I-Cal 2000 HPC, despite the absence of a controlled room temperature. The Standard deviation was 3.37 J/g (< 1%) for an average heat of hydration value of 353.9 J/g.

Applications and uses.

I-Cal 2000 HPC is a high precision calorimeter with a large sample size, which makes suitable for all applications in cement and concrete applications. Like Calmetrix's other isothermal calorimeters, the I-Cal 2000's main uses are found in R&D and Investigative work on concrete properties, and daily QC needs in Cement and Concrete production.

I-Cal 2000 HPC is typically used to perform the following tasks:

- determination of heat of hydration of cement (e.g. ASTM C1702) or cementitious materials
- prediction and estimation of compressive strength or setting times
- sensitivity tests on temperature variations
- testing and resolution of sulfate imbalance issues
- mix design optimization, selecting type and dosage of admixture, SCM
- troubleshooting complex mixes, detect potential material – admixture incompatibility
- sensitivity tests on variations in admixture or other material content
- determination of activation energy for maturity, strength and thermal crack prediction

Users of I-Cal 2000 HPC can be found among Cement Producers, Universities, Concrete Producers, Fly Ash Distributors, Admixture Producers and Testing Laboratories.

Specifications.

Specifications			
Operating Voltage	110 - 240 VAC - 50/60Hz	Sample size	up to 125ml/~340g mortar (12oz.)
Number of Test Channels	2	Baseline over 72 hours *	
Operating Temperature Range	5 to 70°C (41 to 158°F)	Drift,	< 0.01 µW/g/h
Temperature stability	< +/- 0.02 °C in laboratory conditions	Random noise	< +/-0.5 µW/g
Software Compatibility	CalCommander on Windows XP or later	Dimensions	L17"xW13"xH19" (43 cm x 33 cm x 48 cm)
Max.recommended test duration	28 days	Weight	58 lbs (26 kg)

* Baseline is measured at 23 °C for 3 days on a 50 g sample. A straight line is fitted to the power (J/g/s) versus time (h) data using a linear regression procedure. The long term drift is the slope and the baseline noise level is the standard deviation around this regression line.

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Innovation and QC for Cement and Concrete ... Made Easy

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