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I-CAL 8000 HPC

CALMETRIX I-CAL 8000 HPC FOR CEMENT AND CONCRETE SCIENCE

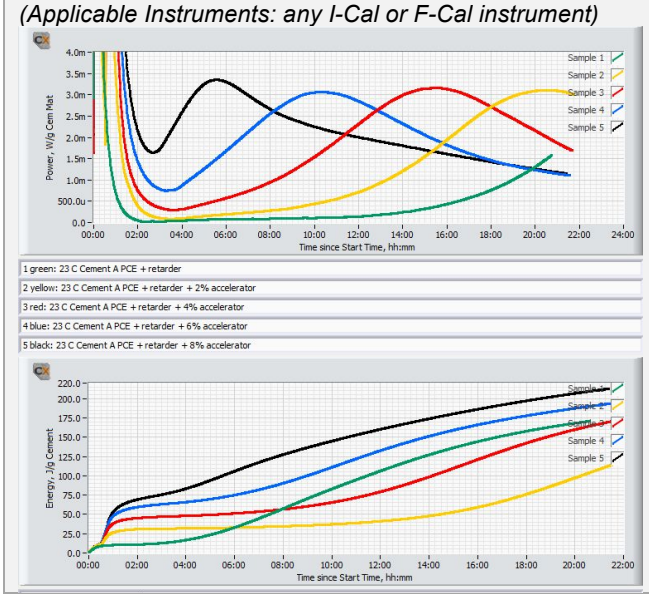
Background: Isothermal Calorimetry in cement and concrete testing.

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 performance.

I-Cal 8000 HPC High Precision Calorimeter for Cement / Concrete Professionals.

The I-Cal 8000 HPC is an 8-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 8000 HPC complies with ASTM C1679 and ASTM C1702, and is recommended for heat of hydration measurements of up to seven days.

Example of use: efficiency of shotcrete accelerator
(Applicable Instruments: any I-Cal or F-Cal instrument)



Shotcrete accelerators work through accelerated formation of calcium aluminate sulfate hydrates. The reactivity of the aluminate and sulfate phases in the binder used is of particular importance, both of which are visible in isothermal calorimetry, making it an excellent tool for optimizing admixtures for shotcrete as well as for the selection of binders for shotcrete.

This example shows the hydration performance of a cementitious binder in presence of a dispersant, a retarder (green curve) and four increasing dosages of a shotcrete accelerator (yellow to black). The initial exotherm measured immediately after dosing of the accelerator (first two hours on top graph) correlates primarily to set, while the main cement hydration peak occurring after the accelerator exotherm correlates to strength development.

The relative impact of the accelerator on strength development is most easily visualized by plotting the integrated power – Heat of hydration (bottom graph).

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 includes software tools for reporting, the determination of activation energy, set time estimation, compressive strength prediction, heat of hydration testing and sulfate optimization.

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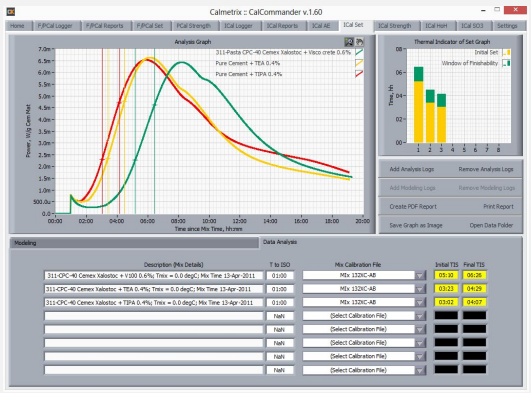
Example of use: estimating setting times
(Applicable Instruments: any I-Cal, F-Cal or P-Cal instrument)



Isothermal calorimetry can be used to estimate setting times, as heat rates shown in the Power curve correlate with physical test data obtained applying a standard such as, for example, ASTM C403.
In the example to the left, the green curve is mix of a Portland cement with a high range water reducer, the yellow curve is the same cement with 0.4% TEA and a the red curve is the same cement with 0.4% TIPA.
Calmetrix's proprietary I-Cal Set software models the initial and final set for each mix, clearly showing the effect of each admixture on the cement.
The use of calorimetry can greatly reduce the time, effort and cost required for physical testing of setting times by penetration methods. Furthermore, the tight temperature control in an isothermal calorimeter provides an easy way to guarantee reproducible results.

Applications and uses.

I-Cal 8000 HPC is a high precision calorimeter with a large sample size, which makes it suitable for all applications in cement and concrete applications. Like Calmetrix's other isothermal calorimeters, the I-Cal 8000 HPC'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 8000 HPC is typically used to perform the following tasks:

- prediction and estimation of compressive strength or setting times
- sensitivity tests on temperature variations
- testing and resolution of sulfate imbalance issues
- determination of heat of hydration of cement (e.g. ASTM C1702) or cementitious materials
- 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 8000 HPC can be found in laboratories of 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	8	Baseline over 72 hours *	
Operating Temperature Range	5 to 70°C (41 to 158°F)	Drift,	< 0.1 µW/g/h
Ambient Temperature Range	5 to 40°C (41 to 104°F)	Random noise	< +/-4 µW/g
Software Compatibility	CalCommander on Windows XP or later	Dimensions	L21.5"xW16.5"xH22" (55 cm x 42 cm x 56 cm)
Max.recommended test duration	7 days	Weight	104 lbs (47 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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