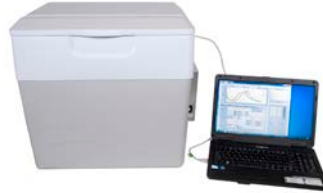


# calmetrix

## I-CAL 4000



### CALMETRIX I-CAL 4000 EQUIPMENT & SOFTWARE

#### 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.

The curing temperature is also known to greatly affect the reaction rate and thus the engineering properties of cementitious materials. Isothermal calorimeters, as opposed to semi-adiabatic calorimeters, allow for testing at controlled temperature, thus enabling excellent repeatability and accurate studies of temperature effects on the rate of reaction.

#### I-Cal 4000 Isothermal Calorimeter for Cement / Concrete Professionals.

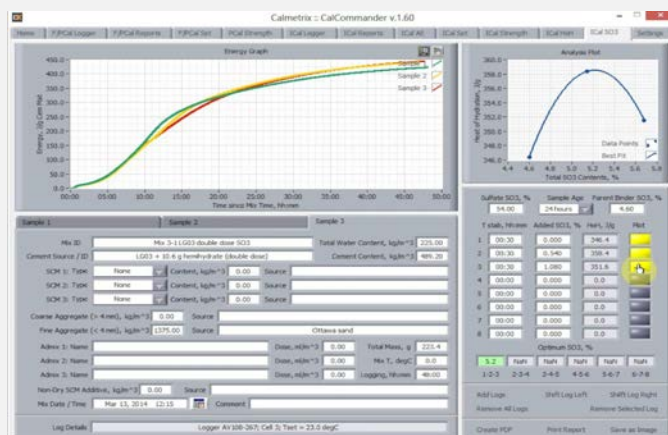
The I-Cal 4000 is a 4-channel Isothermal Calorimeter that can be used to test cement paste, mortar or **even real concrete**. Testing on real concrete is particularly important to detect unwanted interactions between complex admixture molecules and aggregates. A thermal hydration curve is plotted as 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 4000 complies with ASTM C1679. It features Calmetrix's proprietary system of variable reference cells to adjust the thermal reference mass for each sample, thereby allowing for increased flexibility and better precision, while its configuration of individual cells reduces cross-talk.



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.

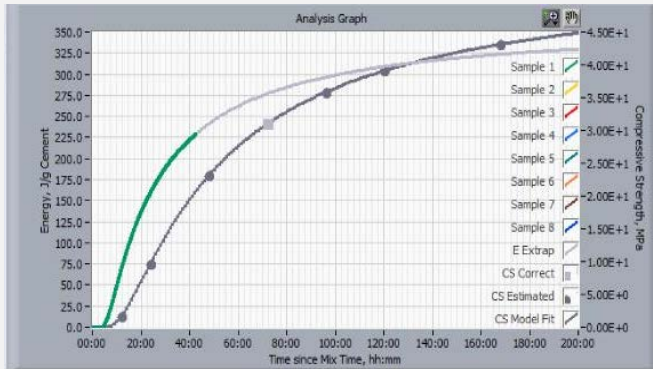
#### Example: sulfate optimization using the I-Cal SO3 software (Applicable Instruments: I-Cal 4000 / 8000 & I-Cal 4000 / 8000 HPC)



Sulfate balance is important in cement manufacturing to avoid performance issues. Optimizing sulfate content in cement is often very labor intensive, as it requires compressive strength testing. With I-Cal SO3, and using the close correlation between compressive strength and heat of hydration, this task becomes easy. In the curves to the left, three (or more) calorimetry curves are loaded following the procedure outlined in ASTM C563, the standard for sulfate optimization. The software automatically calculates the optimum sulfate level and displays it graphically on a parabolic curve fitted to the data points. The whole operation takes less than ten minutes for sample preparation, and 5 minutes for data analysis.

**Example: compressive strength prediction using the I-Cal Strength software**

(Applicable Instruments: any I-Cal instrument)



Laboratory work frequently involves a lot of physical testing of compressive strength at multiple ages. With I-Cal, you can save time and money by extrapolating calorimetry curves and predict or estimate compressive strength at any curing age. This example shows the relationship between heat of hydration and strength development for a given mix. The “green” curve is the actual energy released by hydration, and the gray part is the extrapolation. Dots along the second curve are compressive strength estimates at different curing ages chosen by the user.

**Applications and uses.**

I-Cal 4000 is very cost effective, making it affordable even for smaller laboratories to own a powerful research tool. Like any isothermal calorimeter, the main uses are found in R&D and Investigative work on concrete properties, and daily QC needs in Cement and Concrete production.

I-Cal 4000 is often used to perform the following tasks:

- prediction and estimation of compressive strength or setting times
- determination of activation energy for maturity, strength and thermal crack prediction
- studies of hydration patterns and correlation to shrinkage or other parameters
- 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 small variations in admixture or other material content

Users of I-Cal 4000 can be found among Universities, Cement Producers, Concrete Producers, Fly Ash Distributors, Admixture Producers and Testing Laboratories.

**Specifications.**

Specifications			
Operating Voltage	110 - 240 VAC - 50/60Hz	Sample size	up to 125m/~340g (12oz.)
Number of Test Channels	4	Baseline over 24 hours	
Operating Temperature Range	5 to 50°C (41 to 140°F)	Drift	< +/-0.2 mW
Ambient Temperature Range	5 to 40°C (41 to 104°F) within +/-1°C	Random noise	< +/-0.1 mW
Software Compatibility	CalCommander on Windows XP or later	Dimensions	L21"xW16"xH20" (52.5cmx40cmx50cm)
Max.recommended test duration	72 hours	Weight	87 lbs (39.5 kg)



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

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