calmetrix

I-CAL FLEX

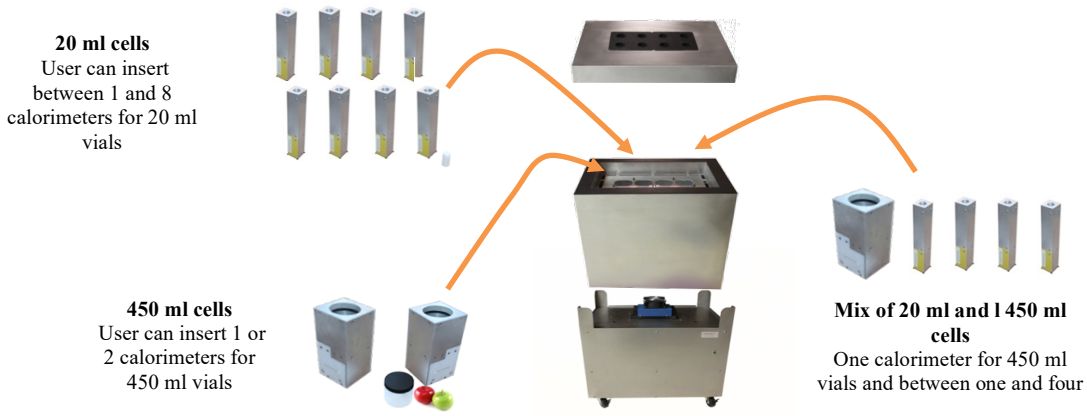
I-CAL FLEX FOR THE MATERIAL SCIENCES
SPECIFICATIONS SHEET

About Isothermal Calorimetry in Material Science.

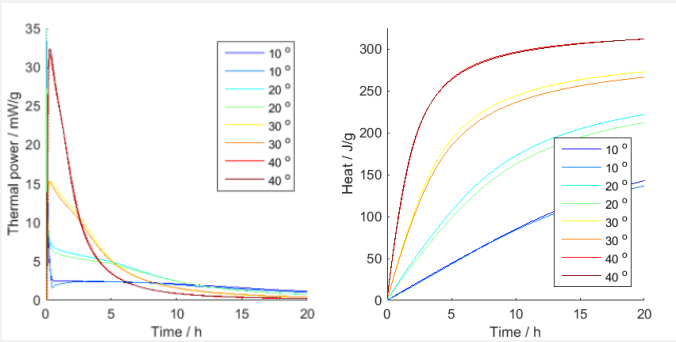
Material Science studies the composition, properties and applications of materials used in every aspect of human activity. Isothermal calorimetry measures the heat released by any chemical or physical reaction in an active sample while the surrounding temperature is maintained constant.
Isothermal calorimeters are different and complementary to other commonly used types of calorimeters, such as differential scanning calorimeters, where the temperature is gradually increased during a test to study phase changes on a very small sample.

Built-in flexibility.

I-Cal Flex not only features the highest performance in its class, it is also flexible in every way. Its design allows for up to eight individual calorimeter cells of 20 ml capacity for smaller or homogeneous samples such as metals, or polymer resins, but also for two large sample cells of 450 ml capacity that will generate better results for larger and inhomogeneous samples such as wood, ceramic materials, cement materials, or more complex or layered materials. The 20 ml and 450 ml cells are seamlessly interchangeable in minutes. An advanced air-circulating thermostat offers excellent temperature stability of +/- 0.001 °C and a temperature range of 2°C to 90°C, I-Cal Flex is ready for long-term studies at all temperatures, including shelf life in real refrigerated conditions, corrosion studies, degradation, etc.

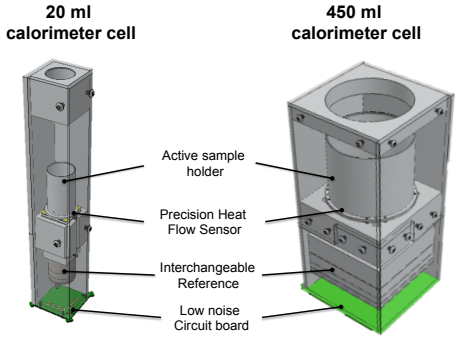


Example: Curing of a polyurethane sealant



This example illustrates the measurement of a polymerization reaction in an isothermal calorimeter, in this case the curing of a polyurethane sealant. The graphs show the thermal power (left) and total heat of reaction (right) of the reaction at different ambient temperatures, from 10°C to 40°C. The thermal power is a measurement of the kinetics of the reaction, directly proportional to the rate at which monomers convert into the polymer. The heat is proportional to the total progression of the reaction. Such kinetics and progressions can be followed in real time and minute by minute. Test results are easily interpreted to assess the influence of temperature on the efficiency of polymerization.

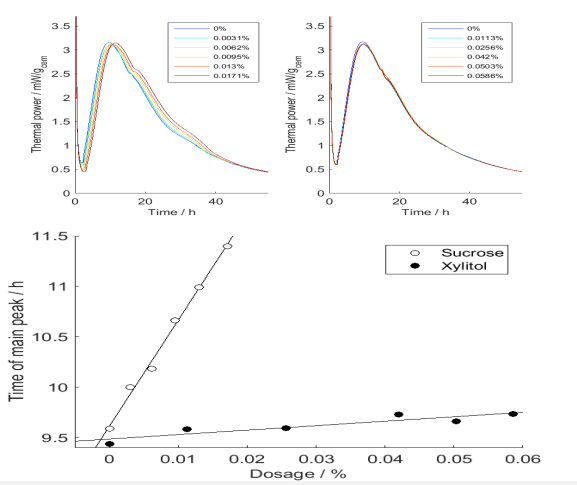
The I-Cal Flex has the highest performance of all microcalorimeters in its class. With individual calorimeter cells that are completely isolated from each other, cross-talk is non-existent. A high precision thermostat, with tightly controlled air flow and optimized design of calorimeters gives the I-Cal Flex a baseline that is ten times more stable than that of its closest competitor, which warrants precision especially for long-term measurements (multiple weeks or months).



Specifications	
Operating Voltage	110 - 240 VAC - 50/60Hz
Sample size	Up to 20 ml / up to 450 ml
Operating Temperature Range	2 °C to 90 °C
Temperature Stability	+/- 0.001 °C
Detection Limit	2 µW
Precision*	+/- 2 µW
Number of test channels	1- 8 (user defined)
Baseline* (24 hours)	
Drift	< 5 µW
Random noise	< +/- 1 µW
Dimensions	L20"xW16"xH44" (50 cm x 40 cm x 108 cm)
Weight	75 lbs (34 kg)

* as measured in 20 ml calorimeter at 23 °C. I-Cal Flex is an instrument suited for high precision testing in an advanced research laboratory setting. Optimal performance and conformance with specifications is achieved when placed in a climate-controlled room according to standard research laboratory conditions.

Example: effect of two retarders on cement hydration



This example shows how to quantify the effect of xylitol and sucrose on the delay of the alite reaction in a Portland-limestone cement paste.

The effect of retardation can be seen in the shift of the main peak of reaction as both the sucrose (left graph) and xylitol (right graph) were added in increasing dosages. The dosage increment was 0.0031% for the sucrose and 0.0113% for the xylitol.

By plotting the retardation (time of main peak) as a function of dosage, it can be seen that the response to dosage increments for both components is linear, although the sucrose has a stronger retarding effect than the xylitol, by a factor of 25.

Applications.

Isothermal calorimetry is suitable for a number of applications in Material Science. Sample preparation and interpretation of results usually takes only minutes, and the continuous measurement of reaction kinetics gives a wealth of information that cannot be derived from most traditional physical testing.

Plastics

Polymerization
Hardening / drying of resins
Oxidation of polymers
Adhesive curing
Efficiency of stabilizers

Metals

Corrosion rate in metals / alloys
Influence of storage conditions
Battery testing

Other Materials / Applications

Cement hydration
Package – product compatibility
Alkaline hydrolysis
Wood rot
Amorphous vs. Crystalline phases