calmetrix

# I-CAL ULTRA

## CALMETRIX I-CAL ULTRA FOR ADVANCED TESTING OF CEMENT

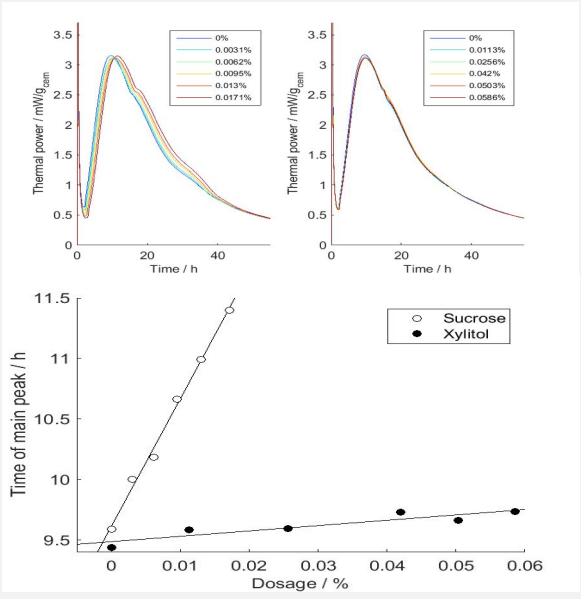
**Background: Isothermal Calorimetry in cement testing.**

Isothermal calorimetry measures the heat generated by a cementitious binder in a tightly controlled temperature environment. The thermal power is used as a continuous measurement of the rate of reaction, which itself is a determining factor for engineering properties such as workability, set and early strength development. Calorimetry is widely used to perform research and development of new materials and processes in the cement industry.

**I-Cal Ultra for advanced precision testing of cement and pozzolanic materials.**

The I-Cal Ultra is an advanced Isothermal Calorimeter for up to 8 sample channels of differential measurement with variable references. It is designed to be ideally suited for measurements that require a high level of precision or very long term testing. The I-Cal Ultra can carry up to eight individual plug-and-play calorimeters. Users can choose the number of calorimeter cells they want to install, between one and eight channels. Each calorimeter can be taken out or plugged back into the thermostated chamber individually at the user's discretion. The I-Cal Ultra is the only isothermal calorimeter where each sample cell is completely isolated from the others, thereby completely eliminating any cross talk and resulting in unparalleled precision and stability. The high precision thermostat spans a temperature range from 4 °C to 90 °C, with a stability of +/- 0.01 °C over an indefinite time period, thereby extending the potential of very long term testing over periods of several weeks or months. The I-Cal Ultra's baseline drift and noise levels are the best in its category among any cement calorimeters. Optional accessories are available for internal mixing and injection of water and admixtures. Naturally, the I-Cal Ultra is fully compliant with ASTM C1679 and ASTM C1702.

**Example: comparative effect of two retarders**
*(Applicable Instruments: I-Cal Ultra)*



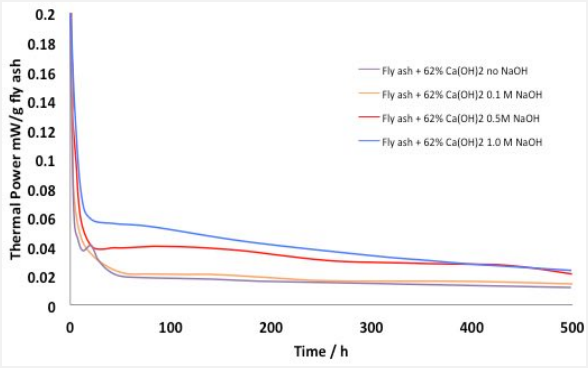

This example shows how to quantify the effect of xylitol and sucrose on the delay of the alite reaction in a Portland-limestone cement paste. In this experiment, each sample contained 2 g of Portland limestone cement, showing the excellent signal-to-noise ratio obtained in the I-Cal Ultra with small samples. The measurements were carried out simultaneously in six of the eight calorimeters, and no cross-talk was observed, as the calorimeters are physically separated by a wide air gap.

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 increasingly larger dosages. The dosage increment was 0.0031% for the sucrose and 0.0113% for the xylitol. The near perfect resolution of the Thermal Power curves with these small dosage increments highlights the excellent precision of the instrument.

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.

Data generated by the I-Cal Ultra is retrieved and analyzed with Calmetrix's state-of-the art CalCommander 2.0 software. Featuring a new design for use with touchscreen computers and an emphasis on user friendliness CalCommander 2.0 offers cement scientists a series of tools for easy determination of setting times, compressive strength, activation energy, sulfate optimization and heat of hydration testing in exact conformance with ASTM C1702. Users can also easily create customized reports and export data into their own analytical software tools.

**Example: long-term reactivity testing**
*(Applicable Instruments: I-Cal Ultra)*




Supplementary materials such as fly ash typically react slowly with calcium hydroxide generated by the hydration of clinker. One can measure the reactivity of supplements directly by using a simulated Portland Cement environment consisting of a mixture of calcium and alkali hydroxide, as would be found in a Portland Cement after several days of hydration.
The graph on the left shows a comparative reactivity test for a low calcium fly ash sourced form a power plant in India. The results show that for this fly ash, the effect of an increase in sodium hydroxide concentration is quite substantial, which is possibly attributable to a relatively high content of amorphous material.
I-Cal Ultra is a powerful tool for long term studies of materials like seen here, that exhibit a low heat of reaction.

**Applications and uses.**

I-Cal Ultra is an advanced precision calorimeter that is particularly suitable for all applications that require a very high degree of precision or long term testing. The I-Cal Ultra's main uses are found in R&D and Investigative work on the properties of clinker phases, cement, pozzolanic materials, and other hydraulic binders or specialty materials, such as:

- testing of individual clinker, or synthetic clinker
- evaluation of pozzolanic reactivity over extended periods of time
- resolution of sulfate imbalance issues
- determination of the exact heat of hydration of cement (e.g. ASTM C1702)
- complex sensitivity testing on variations in admixture or other material content
- precise assessment of activation energy in geopolymers or other alkali activated systems

Typical users of I-Cal Ultra are laboratories for advanced research of cement and other hydraulic materials among Cement Producers, Universities, and Specialty Chemicals companies.

**Specifications.**

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| **Operating Voltage** | 110 - 240 VAC - 50/60Hz | **Precision** | +/- 2 µW |
| **Number of test channels** | 1- 8 (user defined) | **Baseline (24 hours)** | |
| **Sample vial size** | 20 ml | **Drift** | < 5 µW |
| **Operating Temperature Range** | 4 °C to 90 °C | **Deviation** | < +/- 1 µW |
| **Temperature Stability** | +/- 0.01 °C | **Error** | < +/- 10 µW |
| **Temperature Accuracy** | +/- 0.4 °C | **Dimensions** | L20"xW16"xH44"<br>(50 cm x 40 cm x 108 cm) |
| **Detection Limit** | 2 µW | **Weight** | 75 lbs (34 kg) |

Note: I-Cal Ultra 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.