calmetrix

Biocal 2000/4000

CALMETRIX BIOCAL ISOTHERMAL CALORIMETER FOR FOOD SCIENCE

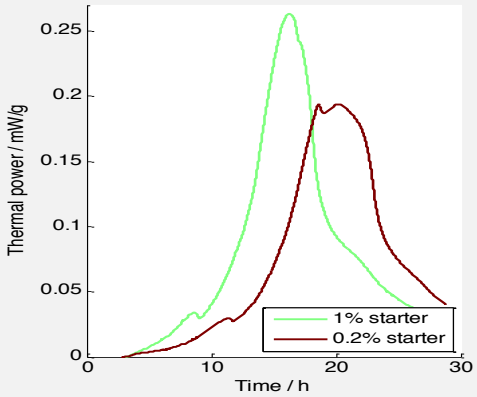
Background: Isothermal Calorimetry

Calorimetry is a useful tool for any chemical, biological or physical reaction that releases or absorbs heat. In a calorimeter, thermal power is measured continuously, thereby providing information about the kinetics of a reaction, i.e. how, and how quickly, a given process evolves over time. This provides researchers an understanding that most traditional physical testing cannot provide.
Isothermal conduction calorimeters are devices where the temperature is kept constant around the sample for the duration of the experiment. One significant advantage of this type of instrument is the larger sample size, which opens the possibility to study the properties and processes related to a wide variety of samples, such as for example, whole pieces of fruits and vegetables, meat, fish, dairy and cheeses, chocolate, as well as fruit juices, seeds in germination, etc.

Biocal 2000 & Biocal 4000: isothermal calorimetry with multiple applications in Food Science

Biocal is available in two models: the 2-cell Biocal 2000 and the 4-cell Biocal 4000. With a large sample capacity of up to 125 ml on each channel, variable reference cells and a computer controlled temperature range between 5°C and 65°C, Biocal calorimeters are ideal for multiple applications such as fermentation studies, bacterial or fungal activity, metabolic response of fruits and vegetables, food spoilage and shelf life, etc. Biocal is versatile enough to test or develop new conservation processes or to control quality of production and storage for a variety of food sources, including dairy, fruits and vegetables, meat and fish, nuts, grains and dry foods.

Example of use: Milk fermentation



This test shows two samples of milk mixed with starter cultures at different concentrations. The brown curve has the lower concentration of starter cultures at 0.2%, and the green curve corresponds to a concentration of 1%.
Both samples show the typical behavior during milk fermentation: first an exponential phase that ends with a sudden drop in activity, then the second main phase.
The sample with less cultures lags about 3 hours behind the other sample as the microorganisms with lower initial concentration take a longer time to multiply to reach a certain number of bacteria. Given that the ratio between the initial concentrations was 5 and it took 3 hours for the lower concentration to reach the level of the higher one, one can infer the time constant of the exponential growth as (found from solving the equations for exponential growth):

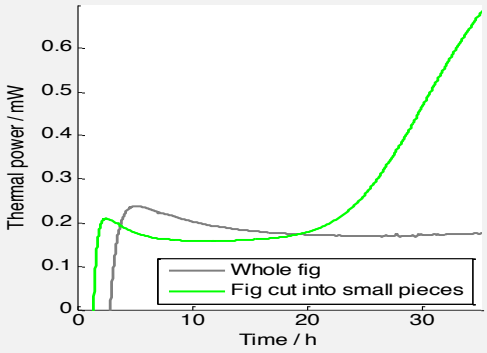
$$k = \frac{\ln(5)}{3} \approx 0.54 \ \text{h}^{-1}$$

This corresponds to a doubling time of about 1.3 h.

The ambient temperature around the samples is computer-controlled by Calmetrix's Biocal software, with precision sensors measuring the heat flow generated by the chemical or biological reaction occurring in the active sample.

The Biocal software is a flexible interface that can be used for virtually any Life Sciences application, where Power and Energy are measured and can be normalized by parameters that are entirely user-defined, e.g. by weight or volume of sample, weight of active components, surface area, … or a combination of such parameters, expressed in a mathematical equation defined by the user.

Example of use: Respiration and spoilage



This test compares the thermal activity of a whole fig (gray curve) with that of a fig cut in 10 mm pieces (green curve). Both samples show similar respiration at about 0.2 mW for about 15 hours. After this, the heat production from the cut fruit starts to accelerate noticeably. In the present case we have surface growth of molds (and possibly also other organisms, e.g., bacteria), and the rate of such a process is not only influenced by how fast the organism can multiply/divide/grow, but also by such factors as nutrient availability and crowding on the surface, all of which can be assessed in an isothermal calorimeter with the ultimate goal of optimizing storage conditions and unit operations in the food industry.

Applications and uses

Of the many applications of Biocal in Food Science, the most common can be summarized in three categories:

- Spoilage and shelf life (e.g. compare the efficiency of different conserving methods and determine the optimum dosage of a preservative, detect degradation in food that is not visible through other observations, understand when degradation starts and at what rate);
- Metabolic response (study ageing of sliced fruits and vegetables, understand the response to blanching or parboiling);
- Fermentation studies (measure doubling time, detect adverse reactions between additives, understand fermentation kinetics and how external factors affect them).

Additional applications are seed germination, or crystallization, such as for chocolate.

Typical users of Biocal calorimeters are food technologists at universities, food processing companies, testing laboratories, manufacturers and marketers of preservatives and food scientists in the domains of research and quality control in general.

Specifications

Specifications				
			Biocal 4000	*Biocal 2000*
Operating Voltage	110 - 240 VAC - 50/60Hz	**Number of test channels**	4	2
Sample size	up to 125 ml	**Baseline (24 hours)**		
Operating Temperature Range	5 to 70 °C	**Drift**	< 60 µW	< 20 µW
Temperature Stability	+/- 0.02 °C	**Random noise**	< +/- 100 µW	< +/- 25 µW
Detection Limit	5 µW	**Dimensions**	L21.5"xW16.5"xH22" (55 cm x 42 cm x 56 cm)	L17"xW13"xH19" (43 cm x 33 cm x 48 cm)
Precision	+/-100 µW	**Weight**	104 lbs (47 kg)	58 lbs (26 kg)

Calmetrix Inc.
P.O. Box 70
Arlington, MA 02476-0001 USA
T: +1 (617) 203-2090
e: info@calmetrix.com
w: www.calmetrix.com