

The 3-layer calorimeter

A precise yet simple method to measure the latent heat storage capacity of phase change materials (PCM).

General description

Existing measurement devices to determine the heat storage capacity are costly and built for very small sample sizes. More constraining is that i.e. DSCs when confronted with the specific characteristics of most PCMs (e.g. low thermal conductivity, high thermal capacity over limited temperature range, in some cases in-homogeneity) require a very careful calibration, skilled operation and are error-prone regarding the accuracy of the results. To overcome these challenges the specialist company w&a has developed the **3-layer calorimeter** – a real-world, exact and yet economical measurement device for these materials.

The 3-layer calorimeter is a recognized measuring system of the PCM RAL Quality Assurance Association and was verified by a ring test measurement by the Fraunhofer Institute Freiburg and the ZAE Bayern.

The measurement method

The required temperature curves are programmed into a standard climatic test cabinet inside which the **3-layer calorimeter** with the sample is measured. A cooling / heating rate of 0.3 K/min is applied to the test samples which weigh 100ml each.

The large quantity of 100ml reduces the impact of potential weighing tolerances deviations and allows a correct measurement for example of salt hydrate PCMs because the sample contains sufficient quantities of all required components, nucleating agents and crystals to be representative for the PCM as a whole.

The outer shell of the calorimeter is designed to guarantee that a single temperature is applied evenly to all sides of the device and thus a representative hull-temperature can be measured. The next layer attenuates and limits the heat flow into the interior whilst avoiding unwanted convection effects in the sample. The sample itself is again enclosed in another layer that evens out the temperature distribution on the sample surface. Thus the temperature measured in the center of the sample is representative for the whole sample.

The geometry of the sample compartment has been designed such that the different heat transfer coefficients have minimal effect on the temperature curves. The geometry of the 3-layer calorimeter is 300 x 250 x 110 mm (length x width x height)

The same samples can be subjected to other tests after capacity measurement, i.e. for example cycle stability validation.

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The measurement principle

The determination of the capacity is carried out according to the fundamental principles of thermodynamics. The calorimeter is calibrated using a substance with a known enthalpy distribution (e.g. water and C 16-99) and with the thus obtained calibration, factors the enthalpy can be directly deduced from the outer device and sample temperature curves.

Necessary equipment



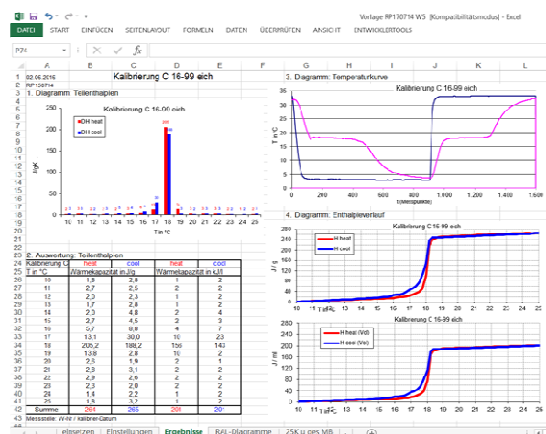
3-layer calorimeter



3-layer calorimeter with data logger system



Climatic exposure test cabinet
(not included in the delivery)



evaluation program

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Example output results – analysis and reporting software

Example based on a PCM C 16-99 (18°C phase change temperature)

