

APPLICATION SHEET

Specific Heat Capacity – DSC 214 Polyma

Accurate Specific Heat Results by Means of the DSC 214 Polyma

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Introduction

The specific heat capacity of a material (c_p) is the quantity of heat necessary to raise the temperature of the unit mass of a material by 1 K at a constant pressure [1]. For the determination of the heat capacity of a material by DSC according to ASTM 1269 and ISO 11357-4, three measurements are required: a blank run with two empty crucibles, a calibration measurement and the sample measurement. Accurate specific heat capacity results are only achieved if all three runs are carried out under exactly the same conditions. This is only possible if the curves delivered by the DSC device are well reproducible.

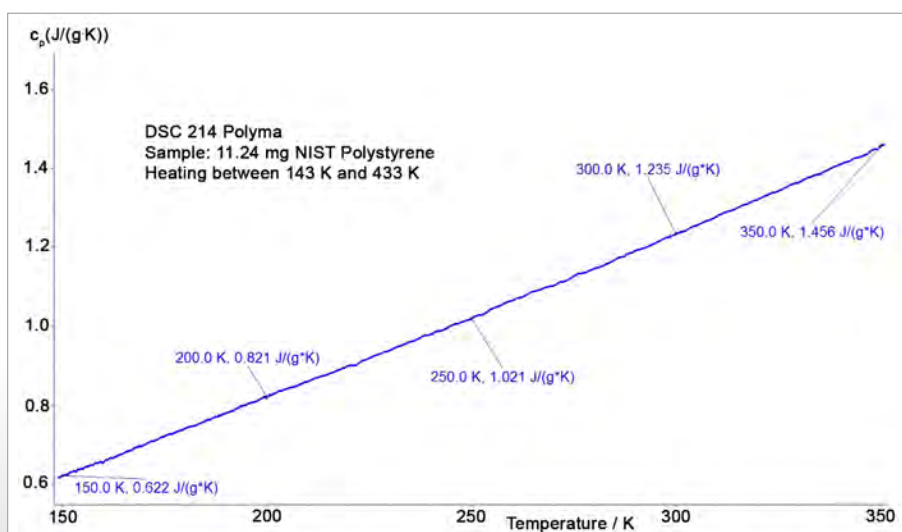
Test Conditions

The three measurements (baseline, calibration and sample runs) were carried out with the DSC 214 Polyma between

-130°C and 160°C, i.e., between 143 K and 433 K at 10 K/min. Different *Concavus* pans were used for the three measurements. A sapphire disk of 12.47 mg was employed as calibration material; the sample investigated was a granulate of 11.24 mg NIST polystyrene.

Test Results

The heat capacity results of the sample are depicted in figure 1. The temperature is displayed in Kelvin for better comparison of the heat capacity values with the literature data published by NIST. This comparison is presented in table 1.



1 Specific heat capacity curve obtained by means of the DSC 214 Polyma

Tab. 1 Comparison of the theoretical and experimental c_p data of polystyrene

Temperature (K)	NIST SRM 705a [2] (Polystyrene) ($J \cdot g^{-1} \cdot K^{-1}$)	Specific heat measured with the DSC 214 <i>Polyma</i> ($J \cdot g^{-1} \cdot K^{-1}$)	Difference between literature and measured values (%)
150	0.624	0.622	-0.32
160	0.659	0.655	-0.61
170	0.695	0.702	1.01
180	0.736	0.743	0.95
190	0.770	0.782	1.56
200	0.808	0.821	1.61
210	0.848	0.861	1.53
220	0.888	0.900	1.35
230	0.929	0.941	1.29
240	0.972	0.981	0.93
250	1.014	1.021	0.69
260	1.057	1.066	0.85
270	1.100	1.103	0.27
280	1.144	1.146	0.17
290	1.188	1.191	0.25
300	1.232	1.235	0.24
310	1.276	1.278	0.16
320	1.321	1.323	0.15
330	1.365	1.265	0.00
340	1.410	1.410	0.00
350	1.456	1.456	0.00

The specific heat values determined by means of the DSC 214 *Polyma* are in very good agreement with the literature data (maximum error: 1.61%). This excellent result could only be achieved thanks to the good reproducibility of the DSC measurements, even if different *Concavus* pans were used for the baseline, sapphire and sample measurements.

Sources

[1] Norm ISO 11357-4:2005(E) Plastics – Differential scanning calorimetry (DSC) – Part 4: Determination of specific heat capacity

[2] W.P. Reed, NIST Certificate, SRM 705a, Polystyrene, Gaithersburg, MD 20899 (1990)