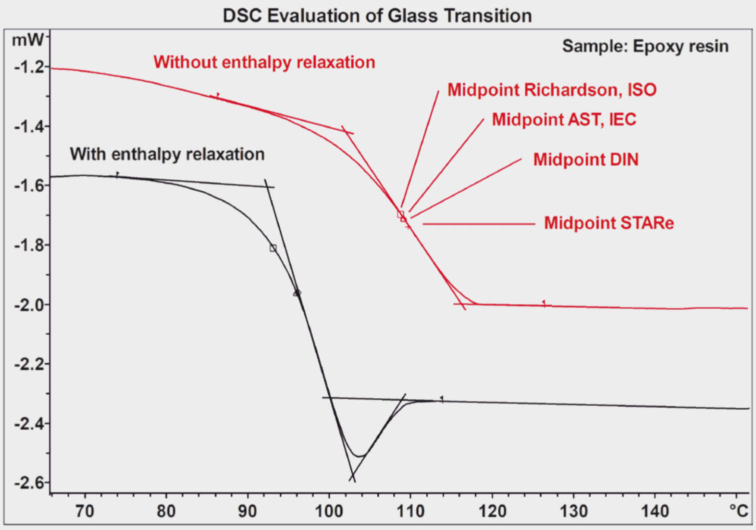
Thermal Analysis Option

DSC Evaluation
for Easy Routine Analysis

The DSC evaluation software option provides DSC users with additional evaluation capabilities. Included are the functions for the determination of glass transitions, the crystallinity, the content according to DIN, ASTM and IEC standard methods, and contains the conversion determination capabilities required for kinetics applications.



Glass transition determination according to different standards:
The glass transition of two epoxy resins after curing at 140 °C, evaluated according to different methods.

The glass transition (T_g) can be calculation both with and without the relaxation peak according to several different standard (DIN 51007, ASTM/ICE, Richardson). You are able to choose the calculation method that suits your needs best.

Features and benefits

- **Basic DSC evaluations** – quick results on specific effect
- **Glass transition (T_g)** – evaluate the T_g of materials with multiple standards

METTLER TOLEDO

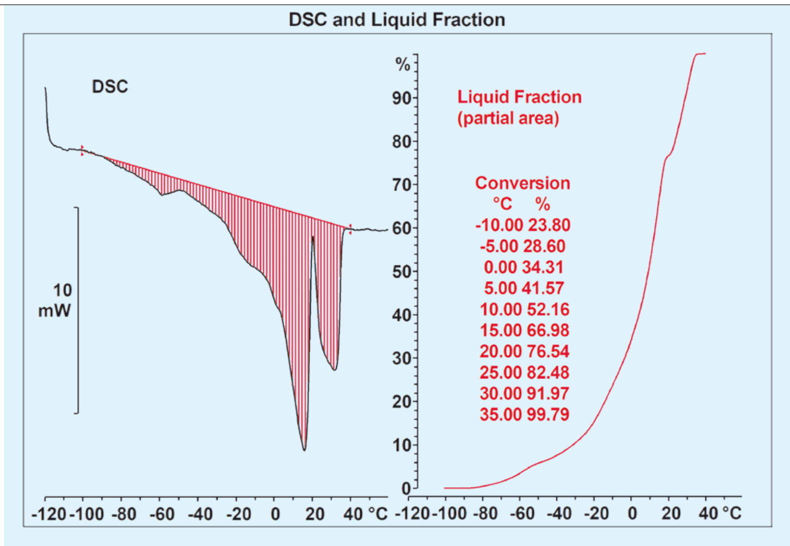
DSC Evaluation
Expand your Possibilities

In differential scanning calorimetry (DSC), enthalpy changes of samples are measured as function of temperature or time. This software option provides a number of DSC-specific evaluation tools for both quality control and research and development purposes. The easy-to-use evaluations allow for important characteristic values to be obtained immediately without the need for time-consuming manual calculations.

The software option includes the following evaluation possibilities specific for the DSC:

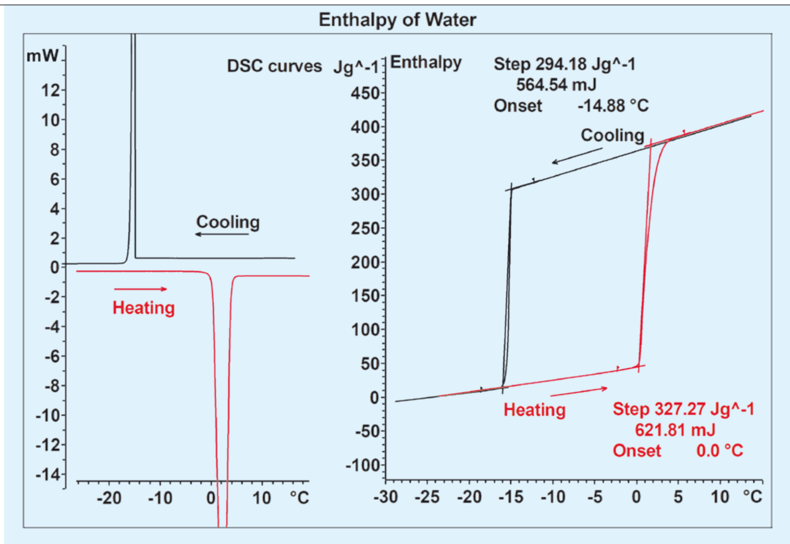
Function	Description
Content calculation	The content routine allows the proportion of a component in a substance to be determined. It is assumed that the effect used for the evaluation occurs in isolation and that the enthalpy change for the pure component is known (ΔH_{Lit}).
Crystallinity	The crystallinity is a characteristic value that is used to characterize polymers. The ratio of the measured heat of fusion to the literature value for the 100% crystalline substance is calculated.
Conversion	The calculation of the conversion curve is the basis for the evaluation of the kinetics of isothermal and dynamic reactions (curing, decomposition). The determination of the liquid fraction of fats or oils is also based on this evaluation. Cases in which a sample has already partially reacted ($\alpha_{start} > 0\%$) or in which a reaction does not go to completion ($\alpha_{end} < 100\%$) can also be taken into account.
Enthalpy	The enthalpy program allows the enthalpy temperature function of a substance to be calculated.
Glass transition	At the glass transition, the DSC curve shows a step due to the change of c_p of the sample. In addition, an endothermic relaxation peak can occur with physically aged samples.

Application Examples



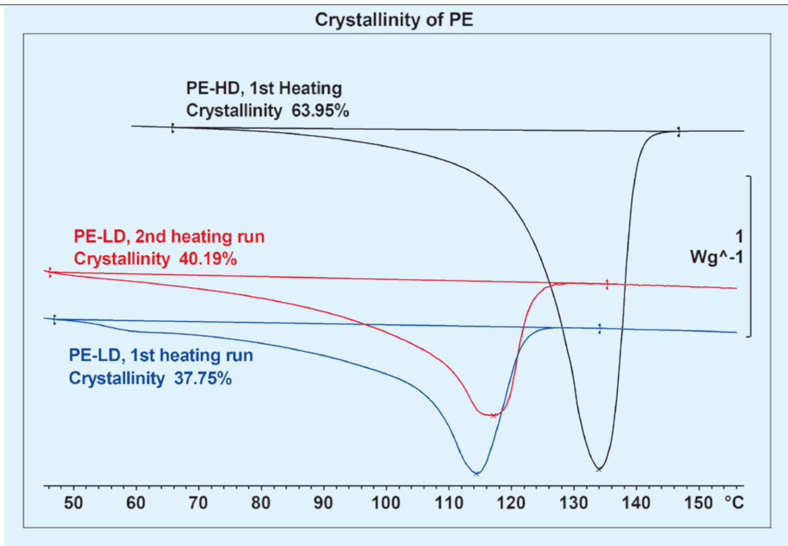
Liquid fraction of butter

The conversion curve is the best means of characterizing substances that melt over a wide temperature range. In connection with fats, the terms liquid fraction or molten fraction are also used. This indicates the percentage of the substance that has already melted at any given temperature. Using the DSC melting curve of butter as an example, the liquid fraction is calculated from the conversion curve and the results shown in tabular form. At 15 °C for example, approximately 67% of the butter has already melted.



Enthalpy temperature function

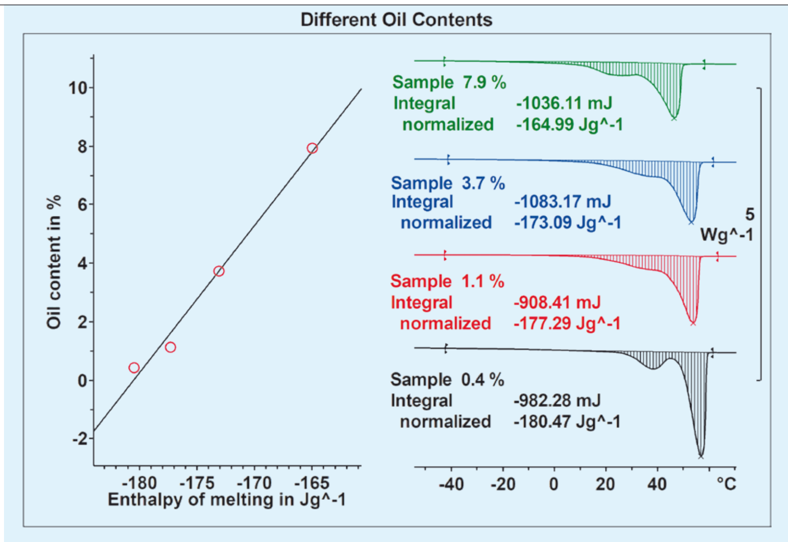
The calculation of the enthalpy curve is shown using the crystallization and melting of water as an example. The DSC heating and cooling runs are shown in the left part of the diagram. As a result of super cooling, the crystallization of the water occurs at –14.6 °C, while the melting occurs at the expected 0 °C. In the right portion of the diagram, the enthalpy curve is shown as a function of the reference temperature. The enthalpy steps correspond to the heat of fusion and the heat of crystallization of the water. Whereas, the value of 327.27 J/g for the heat of fusion at 0 °C corresponds quite well with the literature value, the value of 294.18 J/g for the heat of crystallization at –14.9 °C is distinctly lower.



Crystallinity of PE

The example shows the DSC curves of different samples of polyethylene. The crystallinity is calculated as the ratio of the measured heat of fusion of the sample to that of 100% crystalline PE (290 J/g). The crystallinity of the polyethylene PE-HD and PE-LD samples used in this example are clearly different. A second measurement of PE-LD was performed after the effects of thermal history were removed. The crystallinity of each sample was calculated using the built in function, and the results are as followed:

PE-HD 1st heating: 63.95%
PE-LD 1st heating: 37.75%
PE-LD 2nd heating: 40.19%



Wax content in oil

Petroleum oil often contains small amounts of paraffin wax. This example shows four different oils samples with varying amount of wax content. Using the melting point of paraffin waxes, which generally falls between 45–65 °C, the content can be calculated. The wax content in Oil 1, Oil 2, Oil 3, and Oil 4 was found to be 0.10%, 0.27%, 0.42%, and 0.009%, respectively. Based on the composition of the paraffin waxes, their enthalpy of fusion varies in the range of 200–240 J/g.

METTLER TOLEDO Group
Analytical Division
Local contact: www.mt.com/contacts

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