SULZER

Materials and Failure Analysis

Methods of Thermal Analysis

Sulzer Innotec

Thermal analysis (TA) is the collective term for methods of characterisation in which a substance is subjected to a controlled temperature-time treatment in order to determine some temperature dependent chemical or physical property.

Thermal Analysis

Thermal analysis is an effective way to determine various characteristic thermo-physical material properties such as the glass transition temperature, melting point, dissociation temperature, heat capacity (Cp), coefficient of thermal expansion (CTE/α) elastic moduli and temperature dependent weight changes. TA is particularly suitable for the characterisation of polymeric materials.

TGA analysis: Perkin Elmer

Test methods

- . Differential Scanning Calorimetry (DSC):

  By monitoring the heat flow between a sample and a reference substance as a function of temperature or time, whilst they are subjected to a controlled temperature regime, materials properties such as T_g, T_m, T_{ox}, ΔH, α, c_p may be determined.

- Thermogravimetry (TGA):

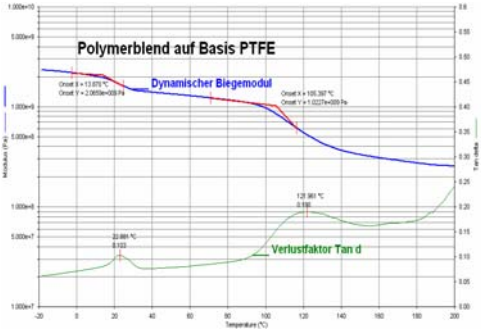
  The thermal decomposition behaviour of a material is monitored by recording weight change in a sample as a function of temperature.

- Dynamic-mechanical Analysis (DMA):

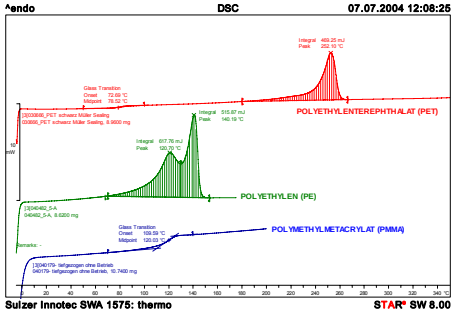
  DMA is used to determine the mechanical properties of a material as a function of temperature, time and the frequency of an applied oscillating load. To do this, the visco-elstic material is loaded with a defined frequency of vibrations and the phase shift of the material response is recorded and analysed.

- Thermomechanical Analysis (TMA):

  This method is used to determine the dimensional change in a solid or paste-like material as a function of temperature. In addition to length changes, the thermomechanical properties, of visco-elastic materials in particular, can be characterised. Such materials exhibit pronounced changes in expansion behaviour when undergoing phase changes, transformations or relaxation



E-modulus v. Temp. of a polymer blend determined by DMA



DSC curves of PET, PE and PMMA

Examples of application

- Identification of types of polymer, and compositions of compounds and blends including their softener and filler content
- Creep, relaxation and visco-elastic properties
- Aging and decomposition behaviour
- Feedstock management, quality control, contamination, moisture
- Optimisation of processing, shrinkage, distortion, residual stress

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