1. Multifrequency PVC Analysis

Instrument: Tritec 2000 Dynamic Mechanical Analyser

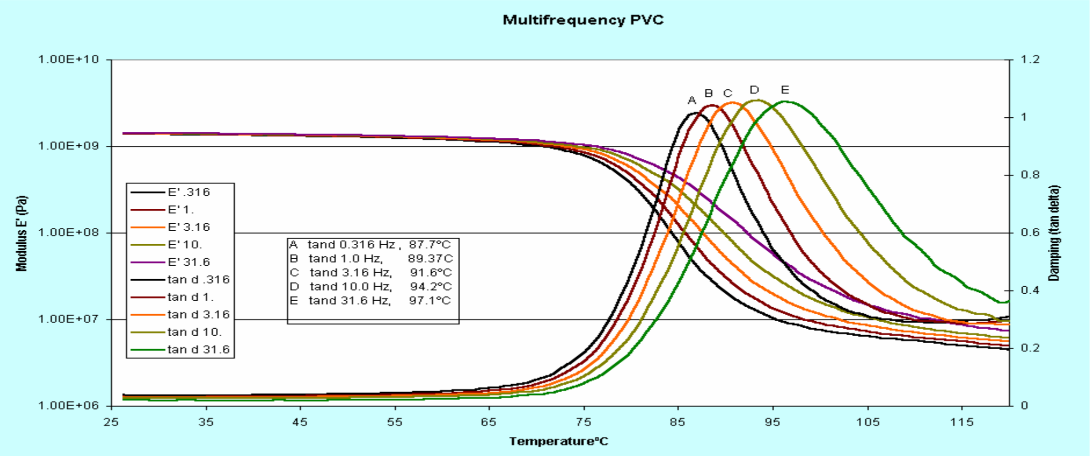
Sample: 1.5mm Polyvinylchloride sheet

Geometry: Single cantilever bending 10mm x 5mm x 1.5mm

%RMS strain: 0.075

Frequencies (Hz): 0.316, 1.0, 3.162, 10.0, 31.6

Thermal profile: 2°C/minute to 120°C



Comments:

Multifrequency analysis using a dynamic mechanical analyser allows the user to distinguish between frequency dependent processes and those that are not.

Molecular relaxations e.g. α relaxations (or glass transitions) and β relaxations are always frequency dependent, as illustrated by the α relaxation (or glass transition) of PVC shown here. Examples of processes that are not frequency dependent are melting, thermal degradation, curing and crystallisation.

This allows an unknown material to be examined and characterised with some ease. The technique has parallels with modulated scanning differential calorimetry but interpretation is somewhat simpler and the sensitivity can be as much as a 1000 times greater for a glass transition compared to the same relaxation observed by differential scanning calorimetry. For polymeric materials, dynamic mechanical analysis would be the sensible choice if relaxation processes are the key area of interest. For crystallinity and melt studies, differential scanning calorimetry would be a more appropriate technique. The complimentary nature of these two techniques rapidly becomes apparent.

The data here shows the change in modulus (Log E') as the sample progresses through the glass transition. Modulus is computed from the measured stiffness of the sample (kE'). It is apparent that geometry and compliance issues play a key role in determining accurate modulus information from the stiffness measurement and due care is therefore required if these are of interest. The characterisation of the polymer is described using tan δ vs temperature. Tan δ is the ratio of the storage and loss moduli and is therefore not affected by geometry/compliance issues. This makes tan δ vs temperature a simple method for characterising the material accurately. The area below the glass transition peak is a reflection of the damping behaviour of the material under examination. This can be very useful for certain areas of research. For example, vibration and impact damping studies, and when combined with multifrequency data collection, in the preparation of 'master curves' used as an extrapolation technique to study damping behaviour at frequencies beyond the direct measurement range of the instrument.