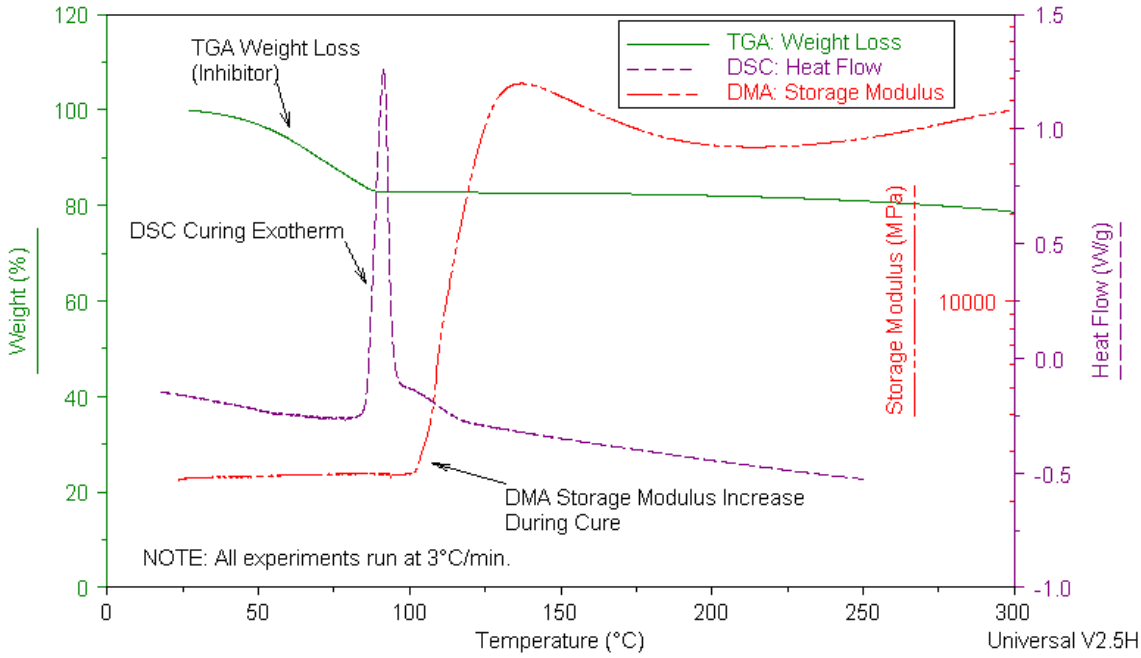
THERMAL SOLUTIONS

Characterization of a Polyester Resin/Catalyst System by TGA, DSC, and DMA



Thermal Analysis encompasses a family of techniques that, when used together to characterize material properties, will yield important information regarding how materials will perform under a wide range of operating temperatures. DSC measures the temperatures and heat flows associated with transitions in materials as a function of temperature or time in a controlled atmosphere. This technique provides quantitative and qualitative information about physical and chemical changes that involve endothermic or exothermic processes, or changes in heat capacity. Thermogravimetric Analysis (TGA) measures the amount and rate of change in sample weight as a function of temperature or time. DMA measures the modulus (stiffness) and damping (energy dissipation) properties of materials as the materials are deformed under a periodic stress.

The above plot demonstrates how DSC, TGA, and DMA were used to characterize the curing behavior of a polyester resin/t-butyl perbenzoate catalyst system. For the system to cure, the inhibitor must be removed from the sample. As the sample is heated, TGA detects the weight loss associated with the loss of inhibitor between room temperature and 75°C. Immediately after the loss of inhibitor, DSC detects the exotherm associated with the cross-linking/cure reaction. When a material cross-links there is a significant change in the mechanical properties of the sample. DMA easily detects the rapid increase in modulus at the later stages of cure. Because DMA measures the physical and mechanical changes in a material, this technique is inherently more sensitive to the final stages of cure compared to DSC. This example shows how data from multiple thermal analysis techniques can be correlated to better understand the thermal properties of a sample.