TA Instruments

Thermal Analysis & Rheology

# THERMAL SOLUTIONS

## STORAGE EFFECTS ON Tg FOR EPOXY MOLDING COMPOUND*

### PROBLEM

A manufacturer of epoxy molding compound received complaints from one of its customers that the batches (drums) of material supplied were pre-cured to different levels. This conclusion was based on the fact that the glass transition temperature was lower for some batches than others. Since all batches (Tg) were prepared using the same process, the differences seen could not be explained by the manufacturer.

### SOLUTION

By carefully monitoring the procedure the customer followed when using the epoxy, the manufacturer noticed that drums of the material were not closed tightly in cases where only a partial batch was initially used. Evaluation of the epoxy after varying exposure to air by TMA (Figure 1) subsequently showed that the glass transition shifted to lower temperature with longer exposure. This shift, which was as much as 8°C after 93 hours of exposure, was traced to moisture in the air. The effects of moisture were not reversible since post exposure baking did not restore a higher Tg.

TMA was ideal for evaluating these materials because of its high sensitivity to the Tg based on the associated change in expansion coefficient. Although several thermal analysis techniques can be used to detect the Tg, the relative sensitivity of each technique depends on the amount of change in the measured parameter at the Tg. Table 1 summarizes these factors.

Figure 1. EPOXY MOLDING COMPOUND (NO AIR EXPOSURE)

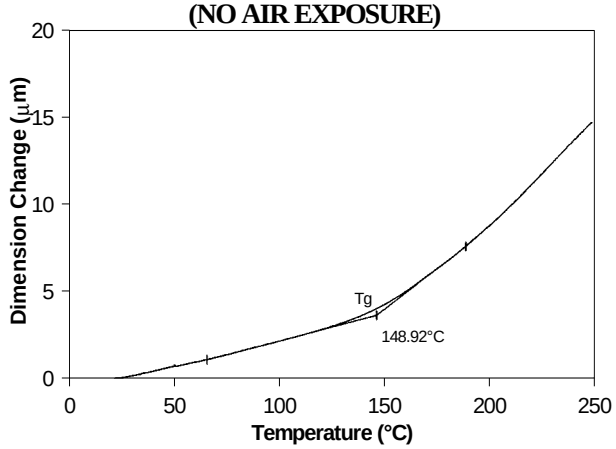


**TABLE 1**

COMPARISON OF THERMAL TECHNIQUES FOR Tg MEASUREMENT

| TECHNIQUE | MEASURED PARAMETER | RELATIVE SENSITIVITY (10 is most sensitive) |
|---|---|---|
| DSC | Heat Capacity | 1 |
| TMA | Coefficient of expansion | 5 |
| DMA | Modulus, damping | 10 |
| DEA | Permittivity, loss factor | 10 |

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