TA Instruments

Thermal Analysis & Rheology

Thermal Analysis Application Brief

Differentiation Between Grades of ABS by Hi-Res™ TGA*

Number TA-127

Summary

In today's competitive environment, polymers used as raw materials in extrusion processes may be sourced from several suppliers. Usually, this variation in source leads to differences in the raw polymer, and hence differences in the processability and potentially in the quality of the final product. TGA provides a rapid method for differentiating between different grades of the same polymer, so that the processing changes required to achieve consistent final product quality can be made.

Introduction

Thermogravimetric analysis (TGA) is a technique which measures weight change in a material with increasing temperature. The information obtained can be used to evaluate thermal stability of materials and to provide material compositional analysis. The recent development of a TGA enhancement which improves resolution further increases the utility of TGA for compositional analysis. This enhancement, high resolution TGA (Hi-Res™ TGA), provides the ability to generate TGA derivative profiles which can be used as "fingerprints" to distinguish between slightly different formulations of the same basic polymer.

Hi-Res™ TGA is based on adjusting the heating rate during weight loss in order to improve separation between closely occurring decomposition events. Although there are several Hi-Res approaches which can be used to optimize results for a specific material, the "dynamic rate" approach is most often used because it provides the best compromise between improved resolution and analysis time. In dynamic rate Hi-Res™ TGA, the heating rate of the sample is dynamically and continuously varied in response to changes in the sample's rate of decomposition. This approach allows very high heating rates to be used in regions where no weight changes are occurring while avoiding transition temperature overshoot. Only two experimental parameters need to be selected to run a dynamic rate Hi-Res™ TGA experiment - the initial heating rate (usually 20 - 50°C/minute) and the resolution index. [Another variable (sensitivity) is available for further "fine tuning" if required].

Experimental

In this study, four different acrylonitrile - butadiene - styrene (ABS) polymers from four different suppliers (samples A-D) were analyzed over the temperature range ambient to 600°C using both conventional TGA at 20°C/minute heating rate, and Hi-Res™ TGA at 50°C/minute and a resolution index of 5. All scans were run in flowing nitrogen atmosphere at 100 ml/minute. Approximately 3.3mg of sample (ground to increase surface area) was used. The TGA used was a TA Instruments Hi-Res™ TGA 2950 coupled to a Thermal Analyst 2100.

Results

Figure 1 shows the TGA profile for one of the ABS samples. The TGA weight loss curve (solid line) is often used to provide compositional analysis. In this case, the sample decomposed in a single weight loss. This is supported by the derivative curve (dashed line) which shows only a single peak.

The derivative weight loss curve is generally more sensitive to subtle differences in weight loss than the parent curve, and hence it is most commonly used to compare similar materials. Figure 2 compares the derivative curves for samples C & D by conventional (constant heating rate) TGA. Differentiation is minimal. Figure 3, on the other hand, shows the derivative curves for the same samples using Hi-Res™ TGA. Visual differentiation is now easier.

Figure 4 shows the Hi-Res™ TGA derivative curves for all four ABS samples. This comparative data indicates that differentiation is possible among this whole series of samples. To further verify that the curves shown in Figure 4 are distinctive, an unknown ABS sample from one of the original four suppliers was evaluated and compared to the "reference" curves shown in Figure 4. Based on the comparison (Figure 5), the unknown is correctly identified as being from supplier B.

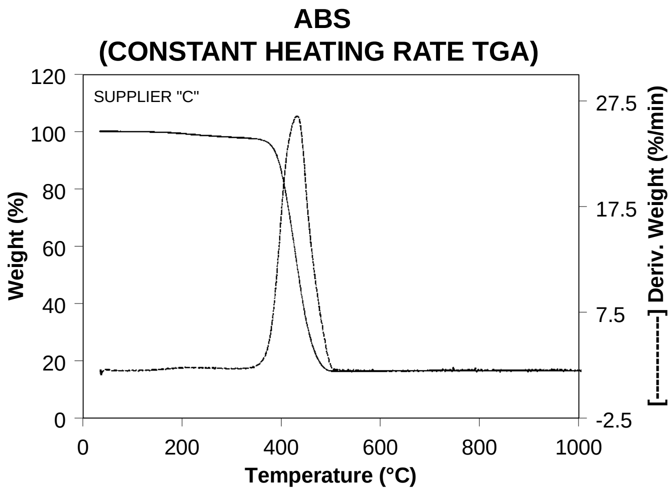

Figure 1

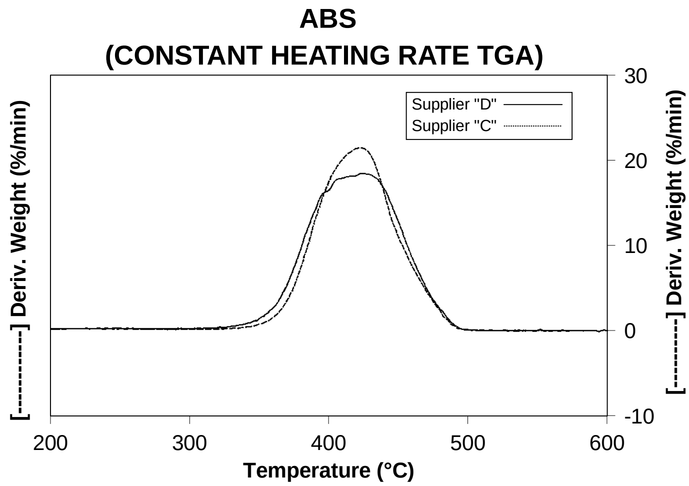

Figure 2

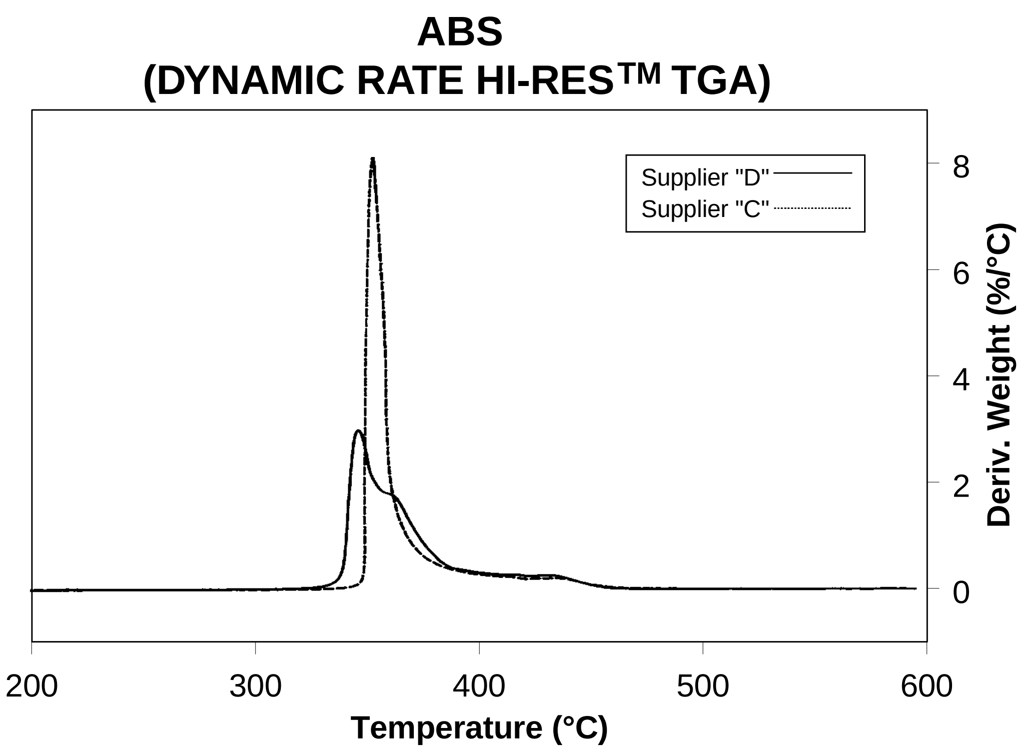

Figure 3

ABS
(DYNAMIC RATE HI-RES™ TGA

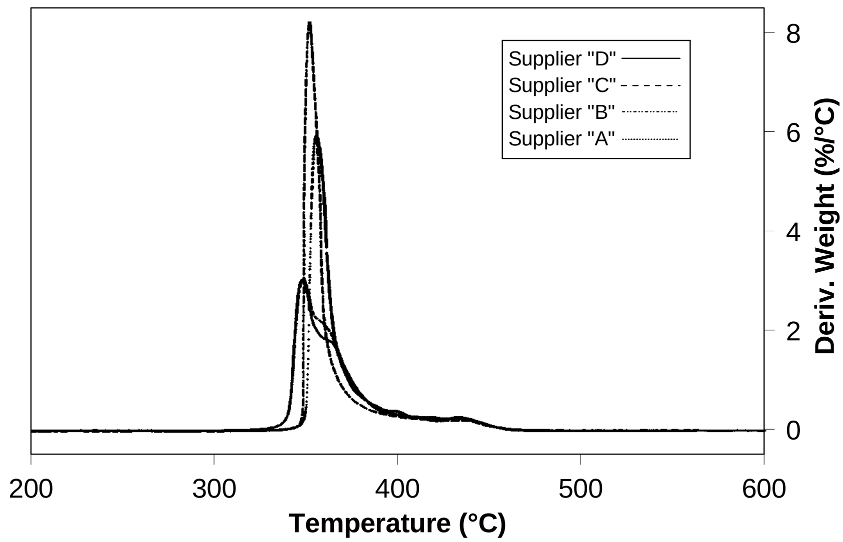

Figure 4

ABS
(DYNAMIC RATE HI-RES™ TGA

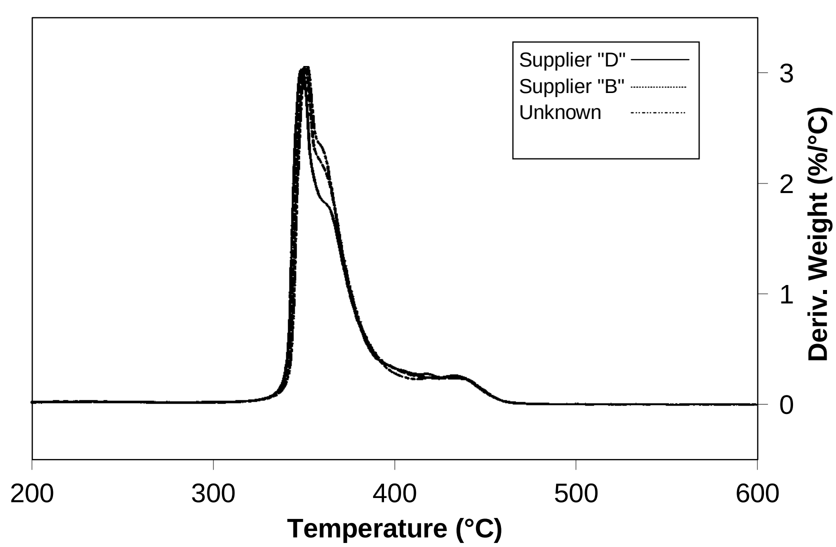

Figure 5

*<u>**Acknowledgment**</u>

This brief was developed by I. Groves, T. Lever, and N. Hawkins of TA Instruments, Ltd. (U.K.)

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