Step Isothermal TGA: Enhanced Component Separation in Thermal Analysis

Overview

In thermogravimetric analysis (TGA), one of the primary objectives is to separate and characterize individual components within a sample based on their thermal decomposition behavior. However, when multiple thermal events occur in close temperature proximity, overlapping mass-loss signals can reduce resolution and limit interpretability.

Factors such as sample mass, purge gas, and heating rate affect this resolution, with **heating rate** being the most impactful. To address these limitations, **AMI has integrated a Step Isothermal function** into the **InfinityPro** software platform for its TGA systems.

What Is Step Isothermal?

Step Isothermal TGA introduces dynamic control over heating conditions by allowing the system to:

- Heat the sample at a defined linear rate
- Monitor **real-time derivative weight loss** (%/min)
- Automatically switch to an **isothermal hold** once a predefined **Iso Start Threshold** is exceeded
- Resume the temperature ramp once the **Ramp Resume Threshold** is reached

This smart switching improves separation of closely spaced decomposition steps that may otherwise appear merged during traditional linear ramping.

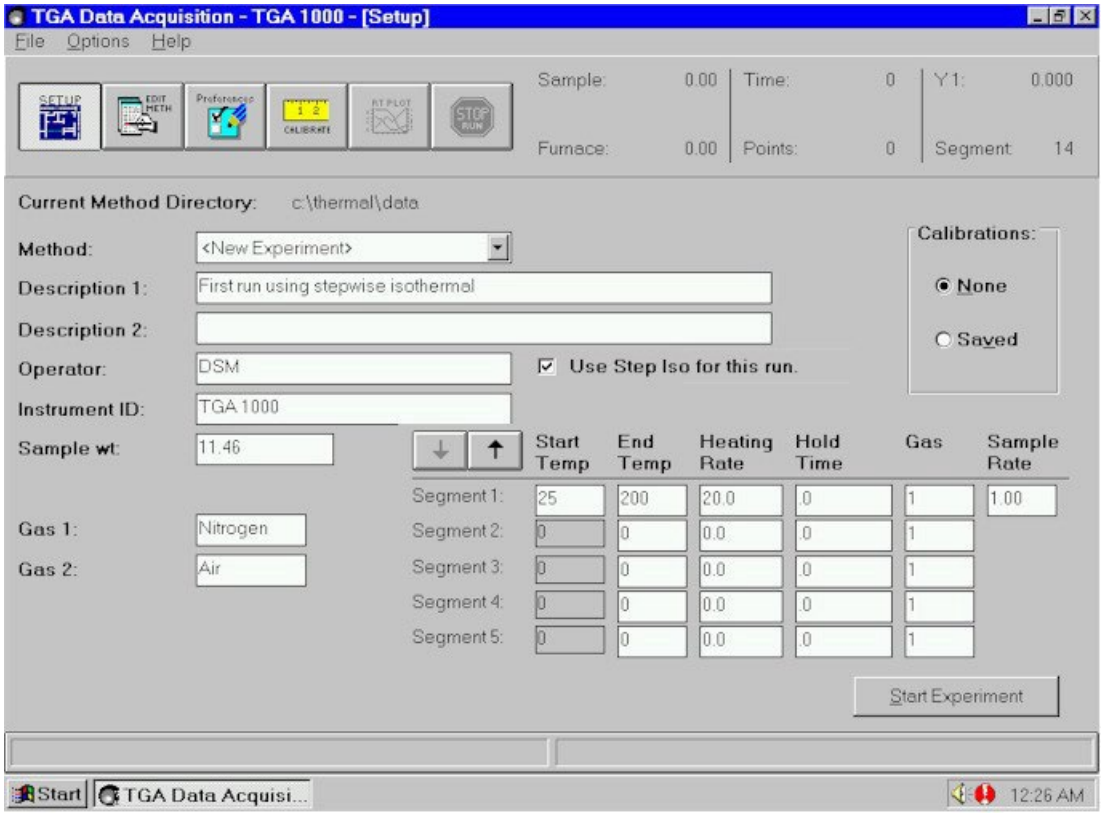

Figure1: TGA software setup window with Step Isothermal option enabled

How It Works

- The **Iso Start Threshold** defines the rate of weight loss at which the system will enter an isothermal hold. This is typically set at ~1/10th to 1/15th of the expected peak weight loss rate.
- The **Ramp Resume Threshold** determines when the system will exit the isothermal condition and resume ramping. It is typically ~1/15th or less of the Iso Start Threshold.

This cycle continues throughout the experiment, enabling adaptive thermal profiling based on the material's real-time behavior.

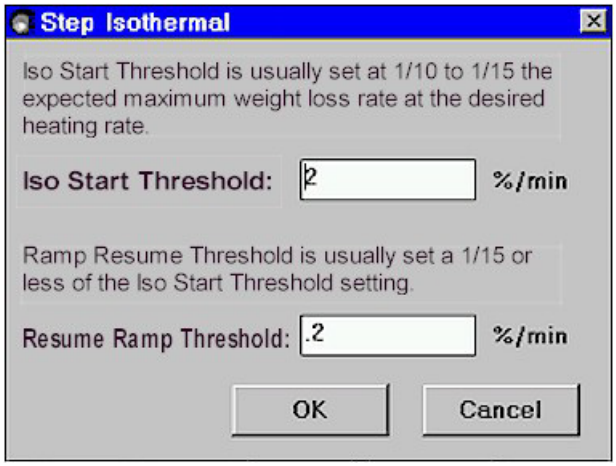

Figure 2: Step Isothermal method setup dialog showing threshold parameters.

Case Study Example

A conventional TGA run on **Barium Chloride** at 20 °C/min reveals two overlapping mass-loss events—one at approximately 80 °C and another around 110 °C. These transitions appear as a single broadened event in standard TGA.

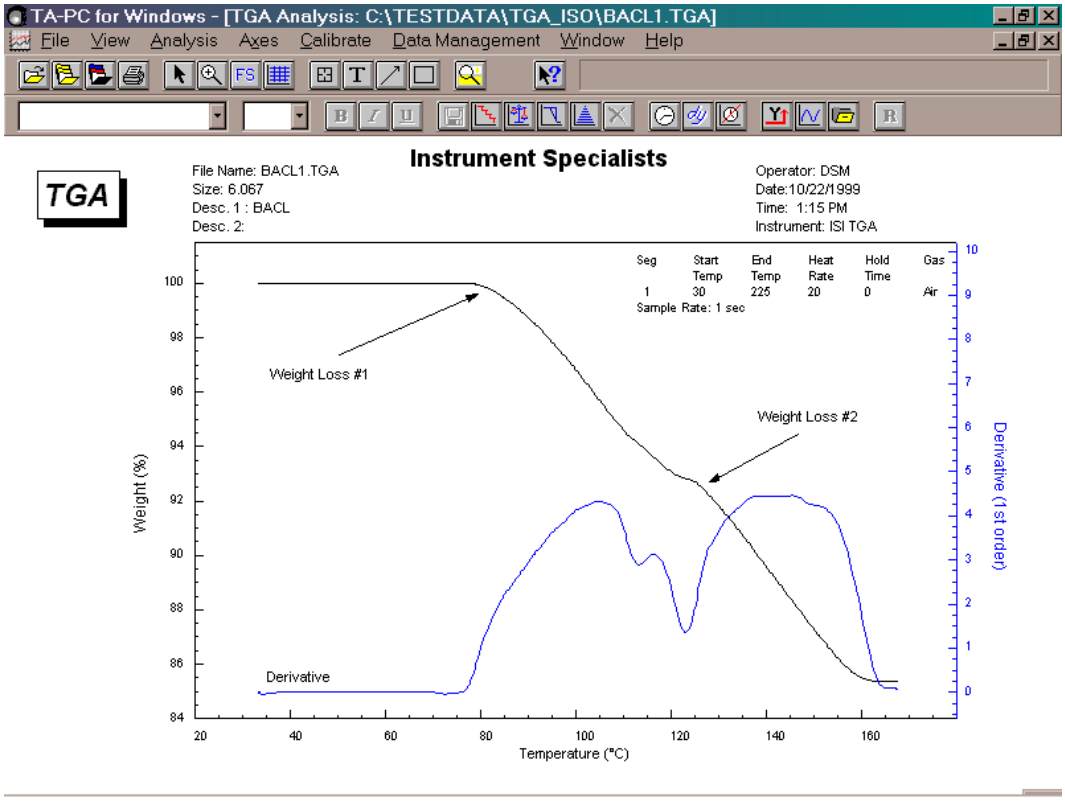

Figure 3: Conventional TGA curve for Barium Chloride showing overlapping events.

Using **Step Isothermal**, the same material yields two **distinct weight-loss steps**, allowing accurate resolution of each component's thermal behavior. The system automatically pauses heating during high-rate decomposition, improving event separation.

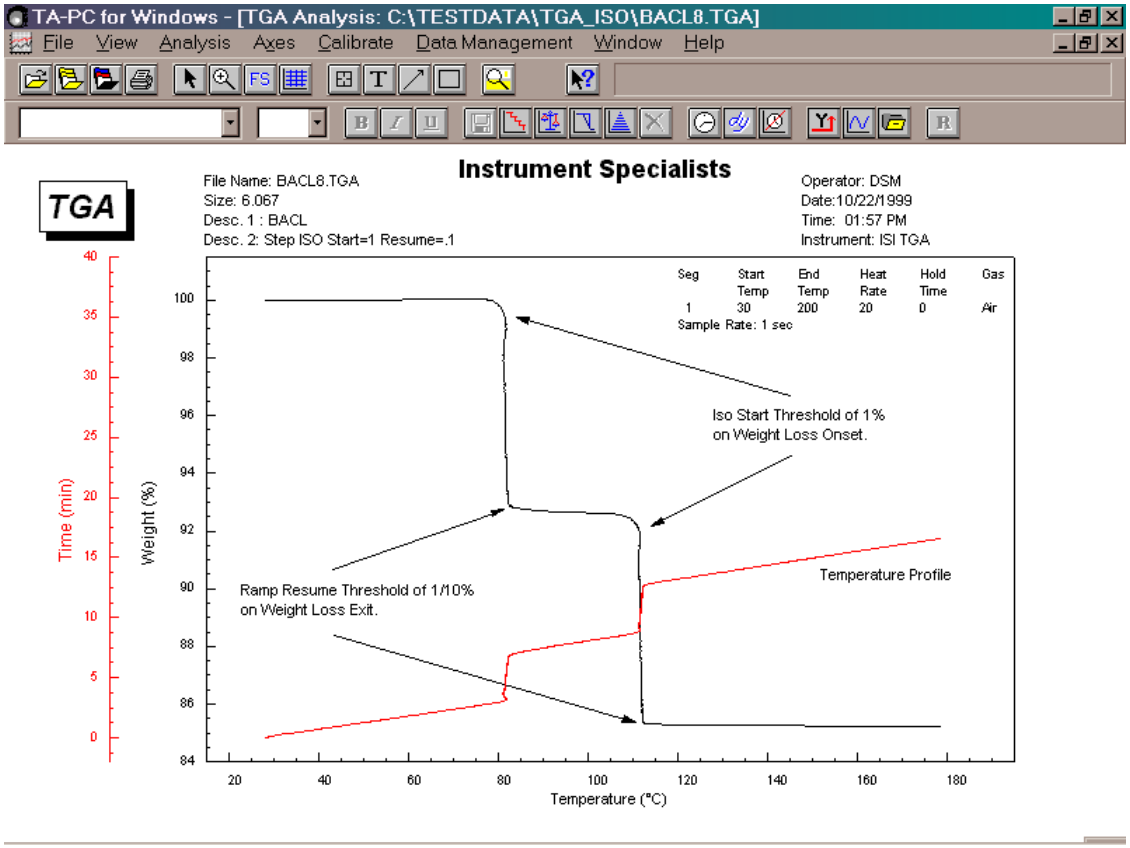

Figure 4: Improved separation using Step Isothermal mode on the same material.

Key Benefits

- Enhanced separation of overlapping decomposition or reaction events.
- Automated transition control based on actual weight loss.
- No need for complex scripting or multiple trial runs.
- Especially useful for polymers, composites, hydrates, and materials with closely spaced transitions.

Conclusion

Step Isothermal TGA, standard on all AMI TGA instruments, enables high-resolution thermal analysis for complex materials by combining real-time mass-loss monitoring with intelligent temperature control. This feature adds analytical power and flexibility while remaining fully accessible through AMI's intuitive **InfinityPro** interface.