Understanding Nylon Degradation and Crystallinity with DSC

Introduction

Nylon is a widely used engineering thermoplastic in industries ranging from automotive to consumer goods. However, nylon components can sometimes fail in service—becoming brittle, discolored, or dimensionally unstable. One of the most efficient tools for uncovering the root cause of such failures is **Differential Scanning Calorimetry (DSC)**.

Whether you're comparing raw material pellets to molded parts or screening materials for consistency, the **AMI DSC 600** offers the sensitivity, reproducibility, and thermal range necessary to evaluate critical transitions like melting, crystallization, and glass transition temperature.

Can DSC Detect Degradation Between Pellets and Molded Parts?

Yes. While degradation may not always be obvious visually or mechanically, DSC can identify subtle thermal changes that result from:

- **Over-processing** during molding
- **Thermal oxidation** due to poor purge conditions
- **Pigment-induced crystallization shifts**

In these cases, comparing the **heat of melting (ΔH)** and the **onset temperatures** between raw pellets and molded parts can reveal whether the polymer structure has changed—suggesting degradation, increased crystallinity, or contamination.

What Should You Look For in Nylon DSC Data?

- **Heat of Melting (ΔH):**
  Indicates the degree of crystallinity. Excess crystallinity often correlates with brittleness and cracking in molded parts. If a pigment or filler acts as a nucleating agent, ΔH will increase.
- **Onset of Melting:**
  A shift to lower melting onset temperatures may suggest thermal degradation or molecular weight reduction.
- **Small Peaks After Melting:**
  Occasionally, a minor endothermic peak appears just above the main melt. With nylon, this is often an **experimental artifact**—caused by sample movement inside the pan. The AMI DSC 600's stable temperature control and pan sealing options help minimize these artifacts.
- **Cooling Curve:**
  Differences in crystallization behavior during cooling can be just as important as melting behavior

during heating. The DSC 600's fast, accurate cooling rate control enables clear observation of **crystallization onset and kinetics**—critical for understanding processing impact.

Why Use the AMI DSC 600 for Nylon?

The **AMI DSC 600** is ideal for polymer QC and failure analysis:

- **High Sensitivity:**
  Detects subtle differences in melting and crystallization events even in partially degraded or pigmented samples.
- **Excellent Reproducibility:**
  Reduces uncertainty in comparing similar materials—essential for determining batch consistency or subtle degradation.
- **User-Friendly Software:**
  Streamlined interface for rapid data comparison, overlay plotting, and automated heat/cool cycles.
- **Programmable Cooling:**
  Enables precise control of crystallization conditions for process simulation.
- **Purge Flexibility:**
  Allows use of inert gases (e.g., nitrogen or argon) to avoid oxidation—especially important for nylons.

Practical Tips for Nylon Analysis

- **Run Under Nitrogen:**
  Oxidation in air or oxygen can cause exothermic reactions unrelated to normal melting—use inert purge to get accurate data.
- **Compare Crystallinity:**
  Increased crystallinity may indicate improper cooling or pigment-induced changes. ΔH is your key metric.
- **Check for Yellowing:**
  When possible, run unpigmented nylon. Yellowing in DSC samples often indicates oxidative degradation.

Conclusion

Whether you're investigating a failure or verifying material consistency, **DSC analysis with the AMI DSC 600** provides clear, actionable data on nylon degradation and crystallinity. From production monitoring to troubleshooting molded parts, our DSC platform is your lab's essential tool for polymer performance assurance.