



Beaumont: Material Characterization Lab Update

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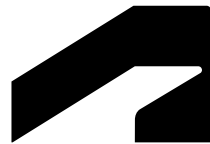
- With Beaumont Since 2014
 - Research and Development
 - Production Molding
 - Moldflow Material Characterization



Presentation Overview

- 1 2024 Characterization Trends
- 2 AMPL Lab Transition to BAP
- 3 Standard Changes in .udb Files
- 4 Thermal Conductivity and Orientation
- 5 Case Study

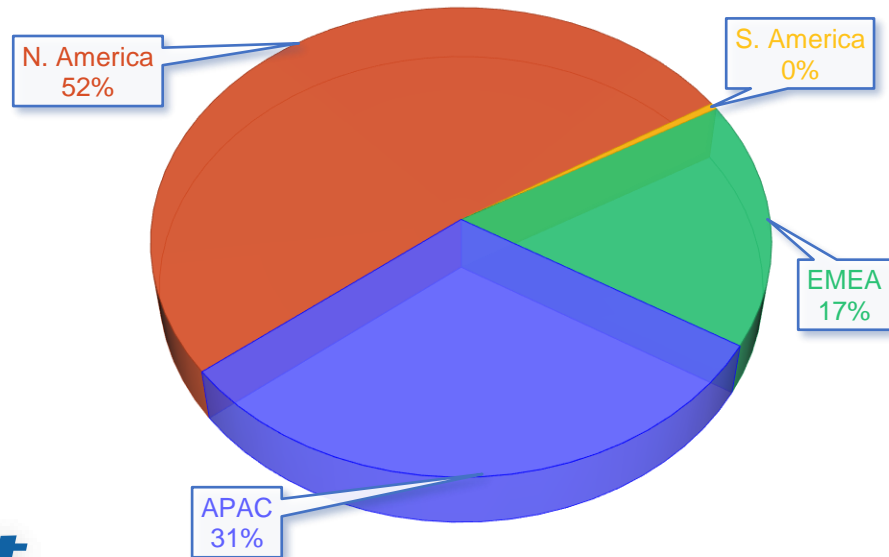




2024 Characterization Trends

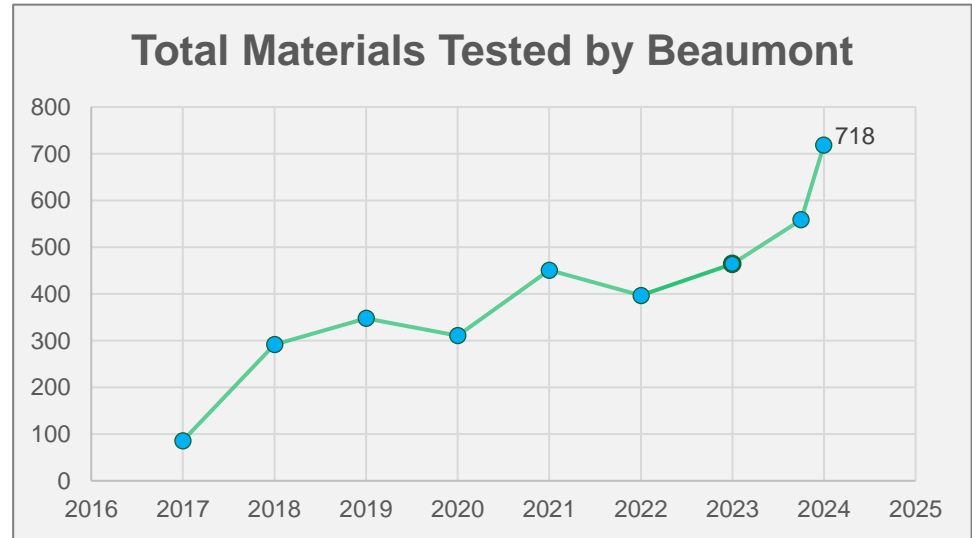
Geographical Breakdown

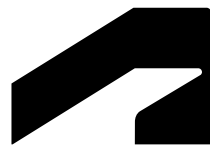
MATERIALS CHARACTERIZED BY REGION; 2024



Characterization Totals and Market Trends

- Characterized 3000+ Materials
 - Majority of these included or expected to be included in the Public Database





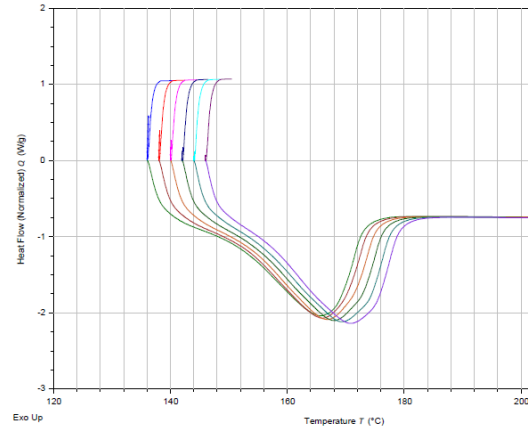
AMPL Lab Transition to BAP

Equipment Transition

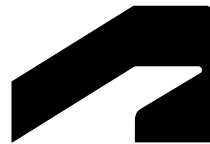


Equipment/Package Updates

- Now Supported
 - MPL-420 Crystallization
- Upcoming
 - MPL-410 Viscoelasticity for Birefringence
 - Duplicate equipment
 - Electrical infrastructure complete
 - Equipment operational
 - Equipment calibrated and validated
 - Increased capacity – reduced lead times



Shrinkage Properties		Filler / Fiber	Microcellular Properties	Optical Properties
Description		Recommended Processing	Rheological Properties	
Crystallization Morphology			Stress - Strain (Tension)	
Quiescent nuclei number coefficients				
aN	<input type="text" value="0.547738"/>	<input type="text" value="1/m^3-K [0.1e+07]"/>		
bN	<input type="text" value="-15.1999"/>	<input type="text" value="1/m^3 [-200.1e+07]"/>		
Equilibrium melting temperature (T _{eq})		<input type="text" value="473.39"/>	<input type="text" value="K [0.1e+07]"/>	
Growth rate (Hoffmann-Lauritzen) coefficients				
G0	<input type="text" value="0.0455637"/>	<input type="text" value="m/s [0.1e+12]"/>		
Kg	<input type="text" value="111401"/>	<input type="text" value="K^2 [0.1e+12]"/>		
Glass transition temperature (T _g)		<input type="text" value="263.1"/>	<input type="text" value="K [0.1e+07]"/>	
Relaxation time at reference temperature (T _{rx})		<input type="text" value="0.04"/>	<input type="text" value="s [0.1e+12]"/>	
Free energy coefficients				
C0	<input type="text" value="5.08"/>	<input type="text" value="1/J^2*s [0.1]"/>		
C1	<input type="text" value="3.90382"/>	<input type="text" value="[0.1]"/>		
Index (q _{indx}) for free energy		<input type="text" value="0.371009"/>	<input type="text" value="[0.1e+07]"/>	
Non-linear spring parameter (bFENE) for FENE ^P		<input type="text" value="5"/>	<input type="text" value="[0.1e+07]"/>	
Parameter for Shah (g _L)		<input type="text" value="1"/>	<input type="text" value="[0.1e+07]"/>	
Parameter for shrinkage anisotropy (GL2)		<input type="text" value="0.15"/>	<input type="text" value="[-1.1e+07]"/>	
Viscosity modifying coefficients				
Beta	<input type="text" value="21"/>	<input type="text" value="[0.1e+07]"/>		
Beta1	<input type="text" value="1"/>	<input type="text" value="[0.1e+07]"/>		
A	<input type="text" value="0.44"/>	<input type="text" value="[0.1e+07]"/>		
Crystallization effect on specific heat (C _p eff)		<input type="text" value="0.01"/>	<input type="text" value="[0.1]"/>	
Fiber effect on crystallization (cN)		<input type="text" value="0.000343"/>	<input type="text" value="[0.1e+07]"/>	
Ultimate crystallinity (X _{Inf})		<input type="text" value="0.6"/>	<input type="text" value="[0.1]"/>	



Standard Changes in .udb Files

STAMP

- Will become default 3D shrinkage model when data is available
- No additional data required if shrinkage testing was completed

Thermoplastics material

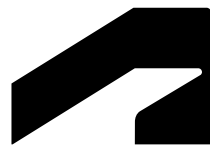
Crystallization Morphology		Stress - Strain (Tension)		Stress - Strain (Compression)		Powder Properties	
Description	Recommended Processing	Rheological Properties		Thermal Properties	pv T Properties	Mechanical Properties	
Shrinkage Properties		Filler / Fiber	Microcellular Properties	Optical Properties	Environmental Impact	Material data completeness	
Select a shrinkage model (Midplane and Dual Domain)							
Corrected residual in-mold stress (CRIMS)		Examine CRIMS model		Default Flow/Fiber set		Edit model coefficients...	
Select a shrinkage model (3D)							
Shrinkage test adjusted mechanical properties (STAMP)							
Observed nominal shrinkage							
Parallel		1.546		% [-100:100]			

Environmental Impact Tab

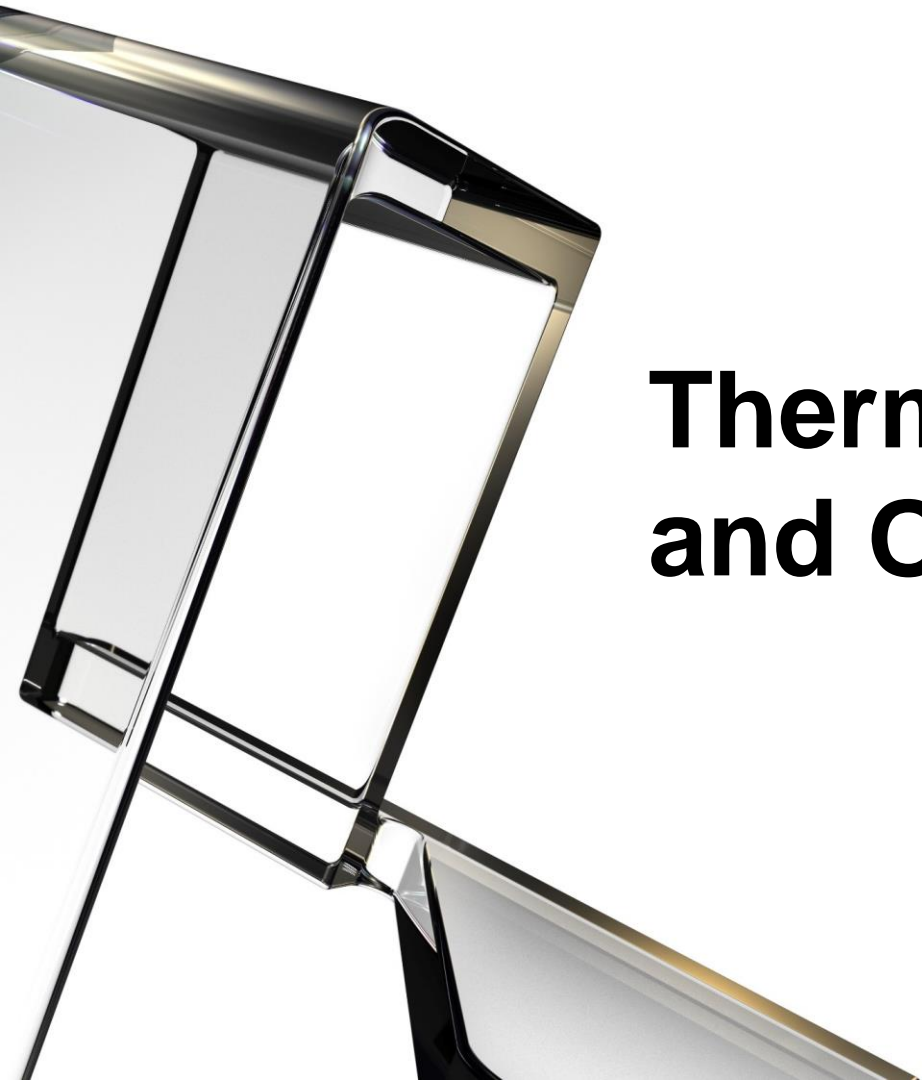
Autodesk Moldflow Sustainability Descriptors (Optional):

The completion of this section is optional for customers ordering Autodesk Moldflow Material Characterization. If chosen to report this information, the data will be available with 2025 release of Autodesk Moldflow products.

Sustainability Field	Available Values	Assigned Value
Minimum Potential Biomass Sourced Feedstock	0-100%	
Maximum Potential Biomass Sourced Feedstock	0-100%	
Biodegradable?	Yes / No	
Minimum Recycled Content	0-100%	
Maximum Recycled Content	0-100%	
Recycling Method	Unknown / Mechanical / Chemical / Other	
Recycled Source	PCR / PIR / Other	
Comments on Environmental Impact		



Thermal Conductivity and Orientation



Filler Properties

- Why filler properties are important
- Removed mineral option as it is very generic and often hides the aspect ratio we should be capturing

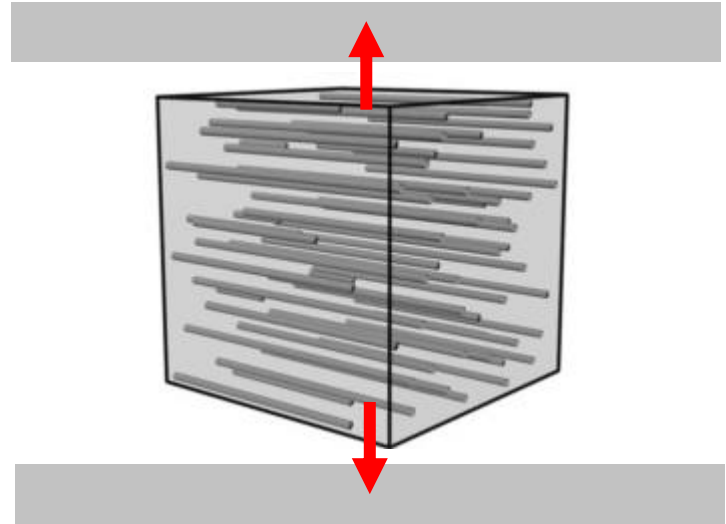
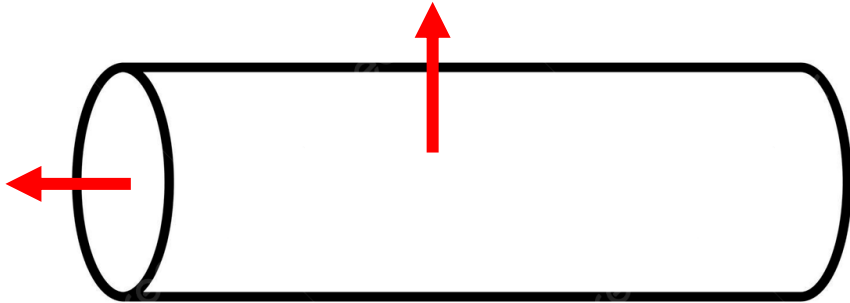


Thermoplastics material

Crystallization Morphology		Stress - Strain (Tension)		Stress - Strain (Compression)		Powder Properties							
Description	Recommended Processing	Rheological Properties		Thermal Properties		pvT Properties	Mechanical Properties						
Shrinkage Properties	Filler / Fiber	Microcellular Properties		Optical Properties	Environmental Impact		Material data completeness						
Fiber orientation calculation (Midplane and Dual Domain) by													
Moldflow model with auto-calculated Ci and Dz values													
Fiber orientation calculation (3D) by													
Moldflow Rotational Diffusion model													
View settings...													
Filler data													
<table border="1"><thead><tr><th></th><th>Description</th><th>Weight %</th></tr></thead><tbody><tr><td>1</td><td>Mineral</td><td>41</td></tr></tbody></table>									Description	Weight %	1	Mineral	41
	Description	Weight %											
1	Mineral	41											
Details <<													
Density (rho)		<input type="text"/> g/cm ³											
Specific heat (Cp)		<input type="text"/> J/kg·C											
Thermal conductivity (k)		<input type="text"/> W/m·C											
Mechanical properties data													
Elastic modulus, 1st principal direction (E1)		<input type="text"/> MPa											
Elastic modulus, 2nd principal direction (E2)		<input type="text"/> MPa											
Poissons ratio (v12)		<input type="text"/>											
Poissons ratio (v23)		<input type="text"/>											
Shear modulus (G12)		<input type="text"/> MPa											
Coefficient of thermal expansion (CTE) data													
Alpha1		<input type="text"/> 1/C											
Alpha2		<input type="text"/> 1/C											
Tensile strength data													
Parallel to major axis of fiber/filler		<input type="text"/> MPa											
Perpendicular to major axis of fiber/filler		<input type="text"/> MPa											
Aspect ratio (L/D)		<input type="text"/> 1											
Filler length information													
Initial Length		<input type="text"/> mm											
Measurement method		Not specified											
Year measured		<input type="text"/>											

Isotropic vs. Anisotropic Fillers

- Carbon Fiber
 - Thermal Conductivity can be 10x lower through plane vs. axially along the fiber



Transient Plane Source Method

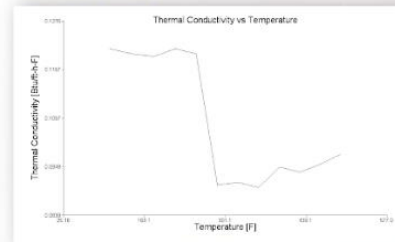
K | THERMAL CONDUCTIVITY TEST

Hot Disk Thermal Constants Analyzer:
A measure of a material's ability to conduct heat.

How a test works

During a measurement, a current passes through the sensor spiral and creates an increase in temperature, which is recorded over time. Heat generated, dissipates into the sample at a rate dependent on the thermal transport characteristics of the material.

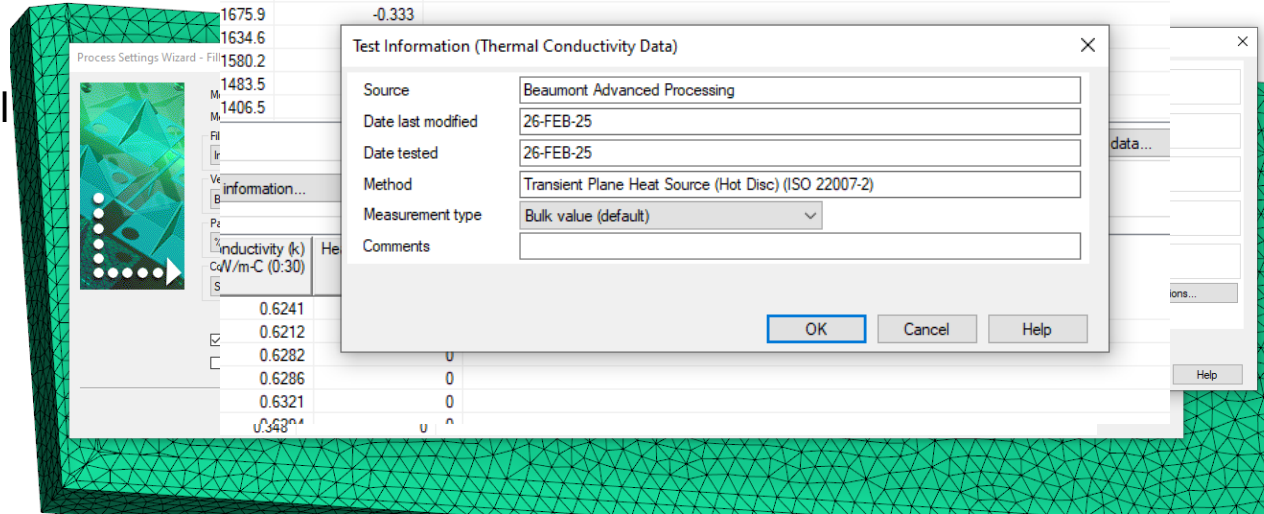
The results

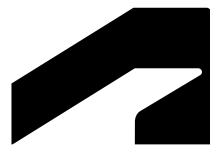


Anisotropic Thermal Conductivity

- 2024 Release offered the ability to incorporate anisotropic thermal conductivity when considering fiber orientation in 3D analysis
- Prior versions would have listed 'anisotropic-through-thickness' thermal conductivity
- Now Bulk is recorded in the file to allow for decomposition of thermal conductivity

Axial: 1.5048 W/mk
Bulk: 6.3524 W/mk
Radial: 27.1101 W/mk



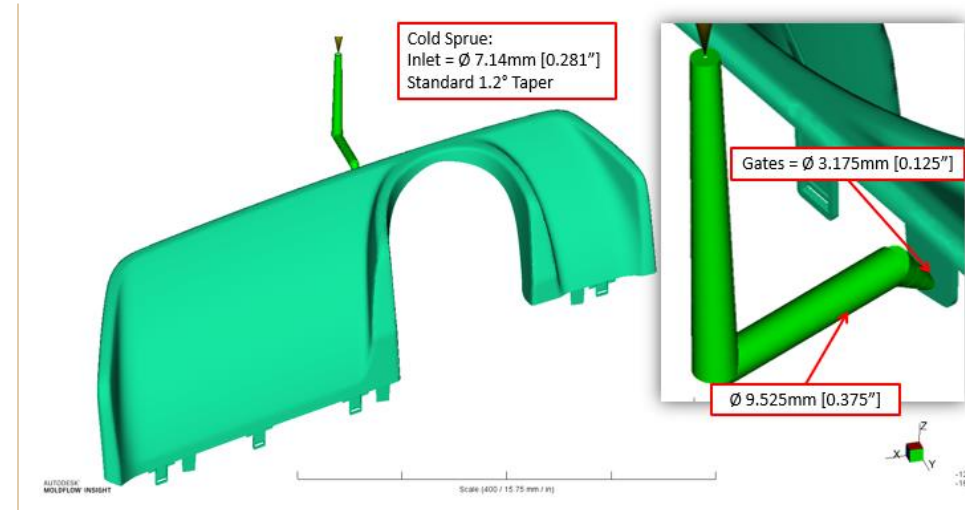


Case Study: Slow Crystallization: Fitting Strategies for Copolyesters

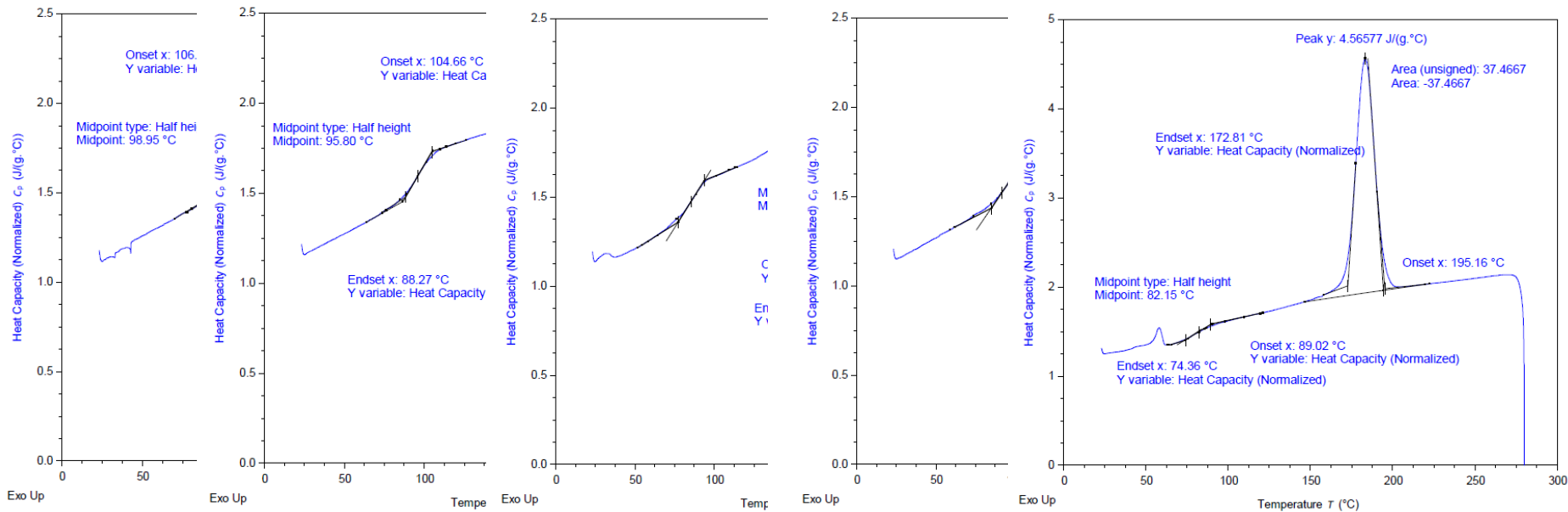
Slow Crystallization: Fitting Strategies for Copolyesters

Copolyesters

Typically Amorphous when
molded

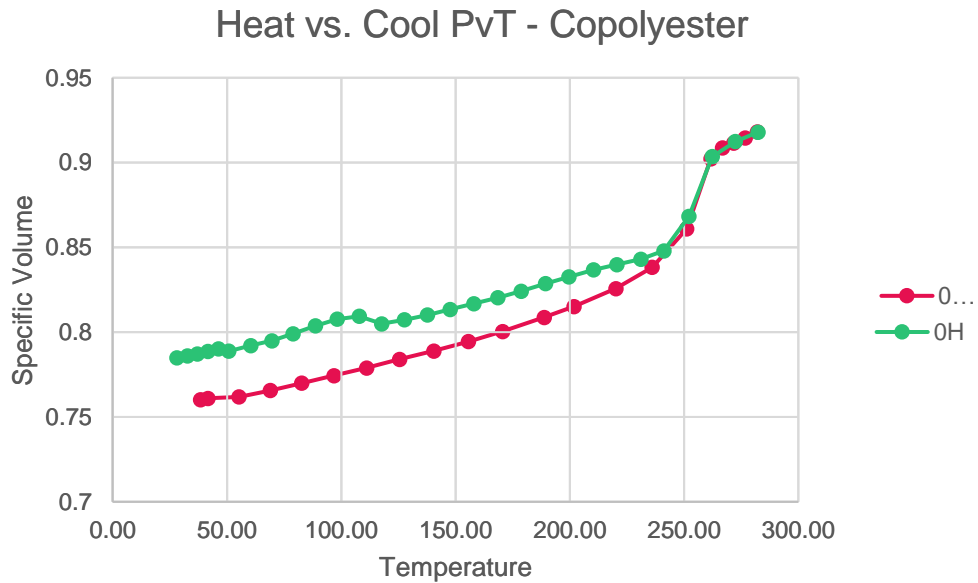


Slow Crystallization: Fitting Strategies for Copolyesters

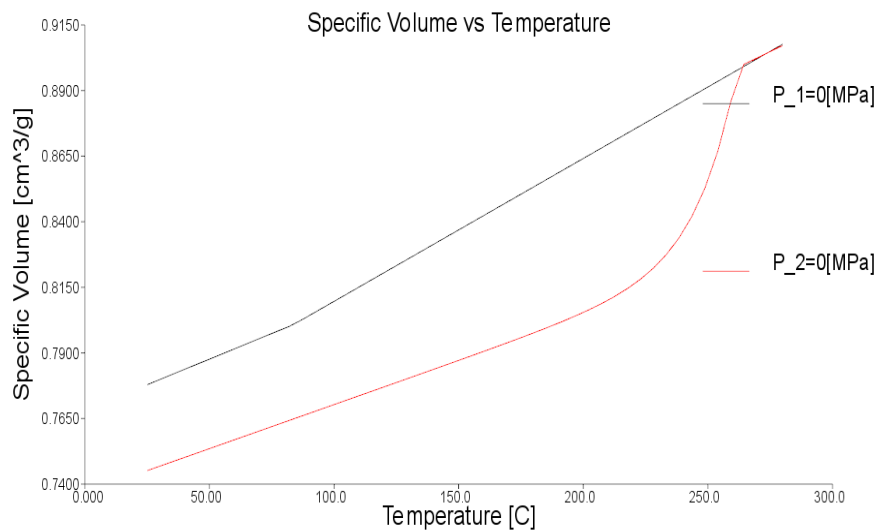
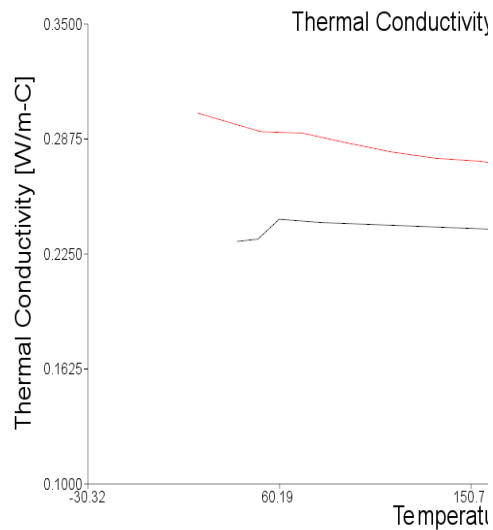
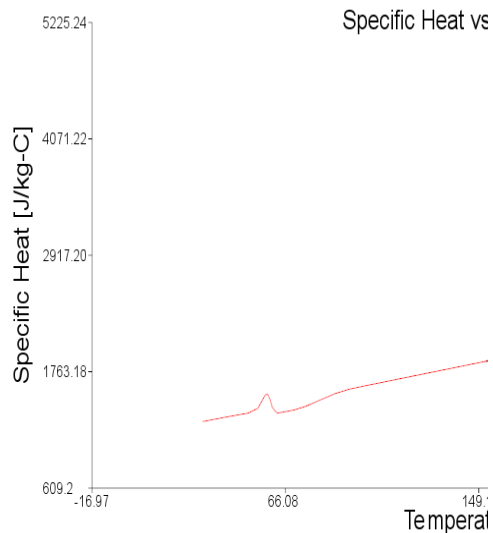


Slow Crystallization: Fitting Strategies for Copolyesters

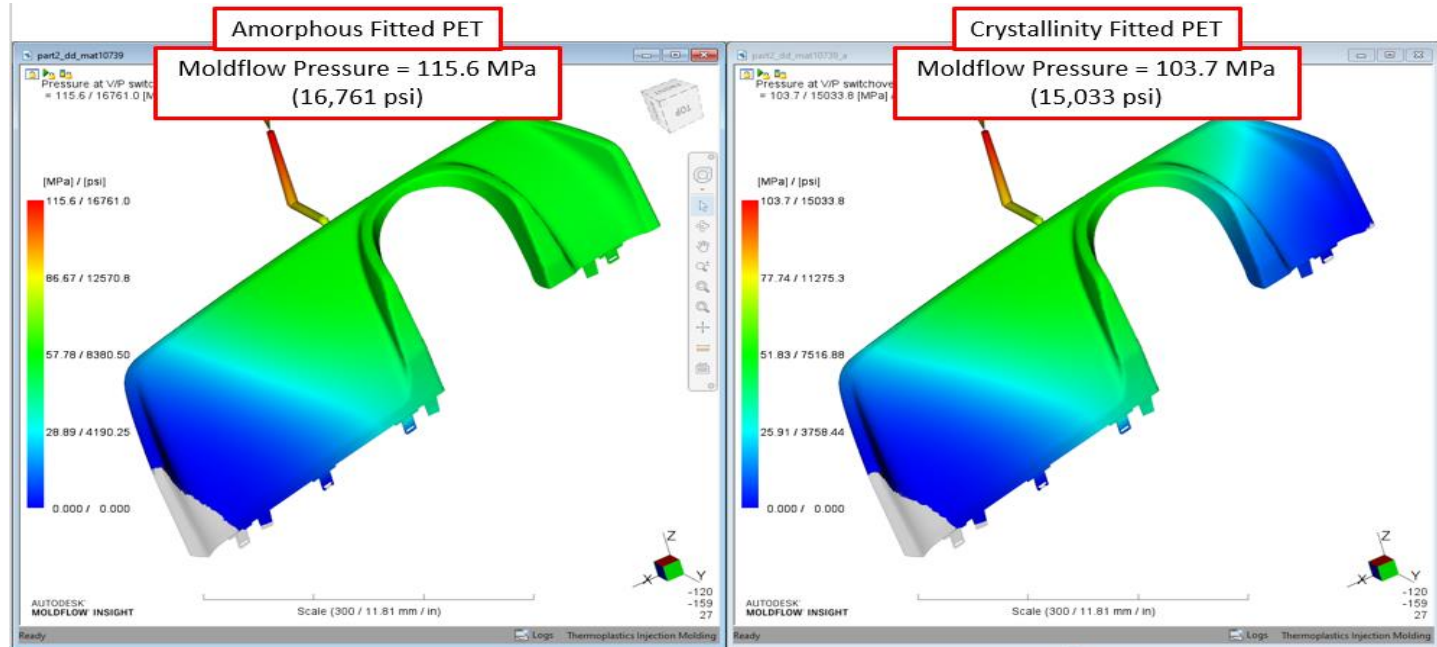
- Standard cooling curve
- Heating Curve



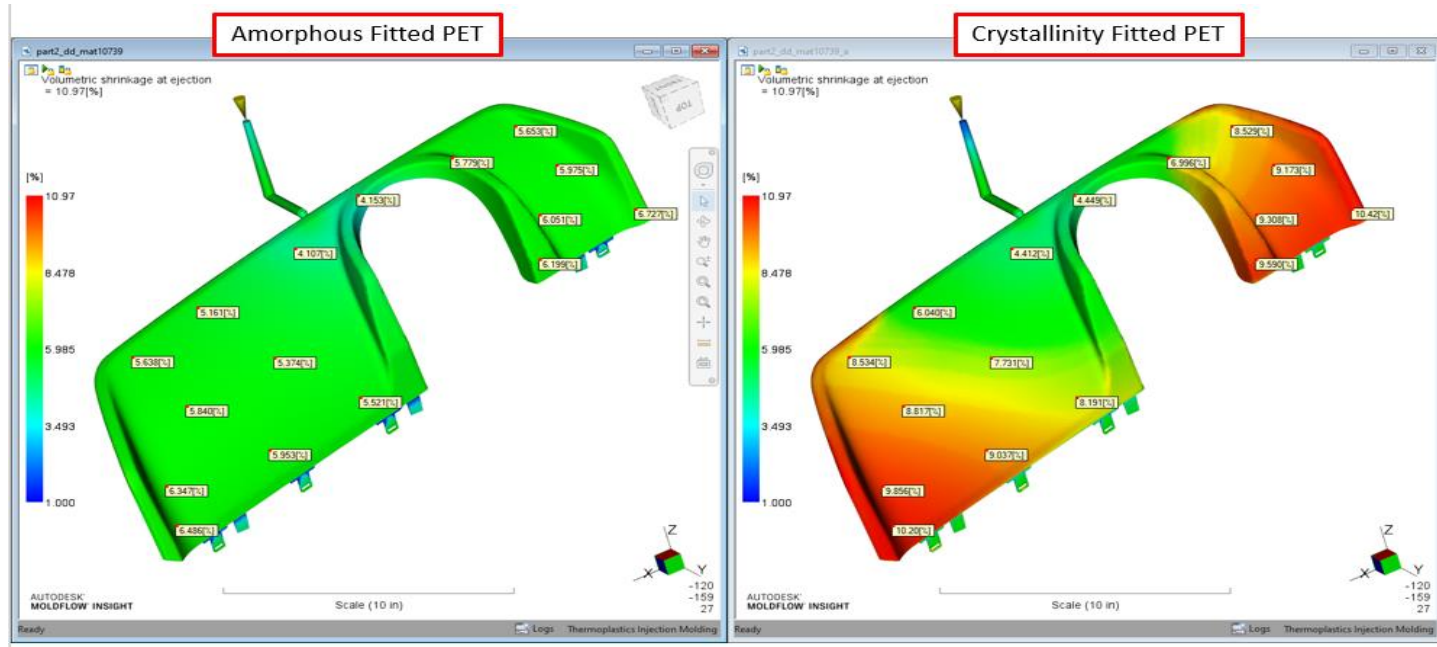
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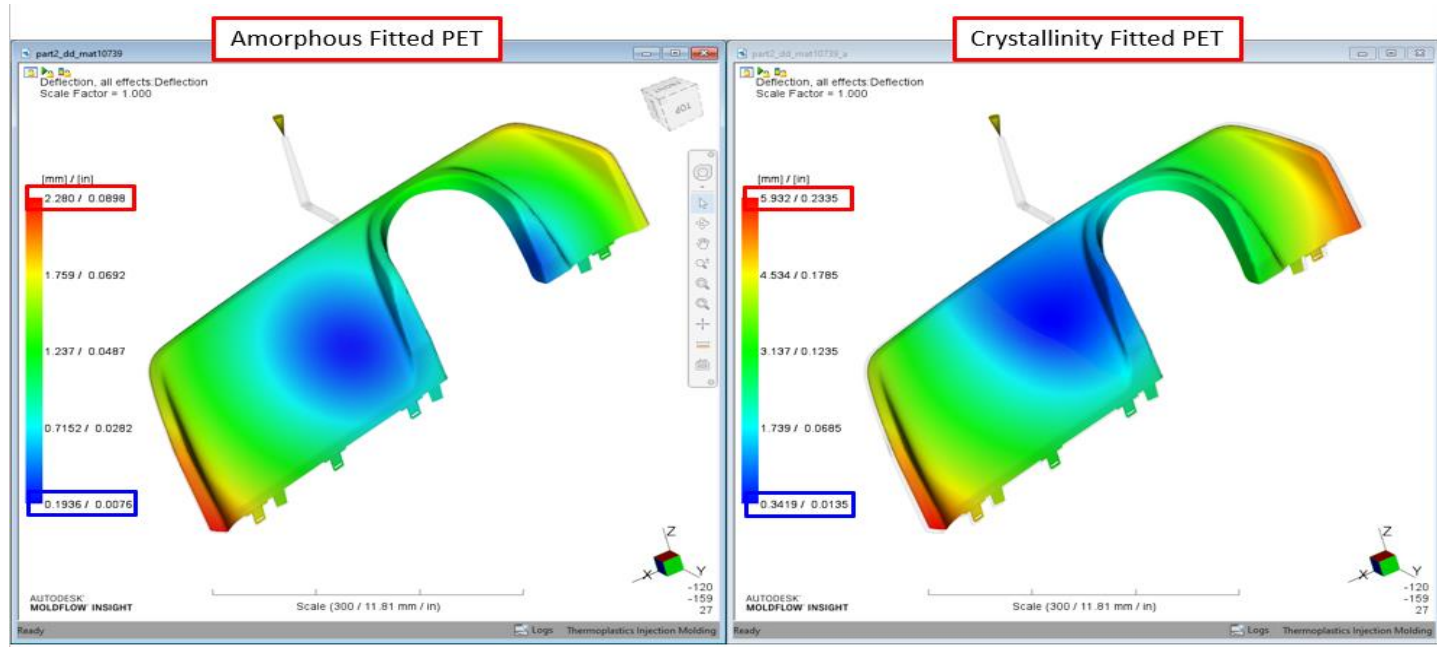
Slow Crystallization: Fitting Strategies for Copolyesters



Slow Crystallization: Fitting Strategies for Copolyesters



Slow Crystallization: Fitting Strategies for Copolyesters



A close-up, low-angle shot of a car's front end, focusing on the chrome trim and headlight area. The chrome is highly reflective, showing bright highlights and reflections. The car's body is a light color, possibly silver or white. The background is a plain, light color.

Thank You



Make Anything