



**LAPOL**<sup>®</sup>  
Enabling Bioplastics

Lapol<sup>®</sup> HDT-P  
Raising the  
Heat  
Deflection  
Temperature  
of PLA

# LAPOL<sup>®</sup> HDT-P BIOPOLYMER COMPOUND TECHNICAL BULLETIN

OCTOBER  
2017

# Poly(lactic acid) (PLA) Biopolymer

## The Front Runner in Bioplastics

- ❑ Biodegradable thermoplastic resin
- ❑ Made from renewable resources
- ❑ Flexible or rigid
- ❑ Processed on standard converting equipment
- ❑ Multiple consumer and industrial applications



# Limitations of Neat PLA Biopolymer

Low Heat Deflection  
Temperature (HDT)  
50 - 60 °C

- Sticking and Deformation During Transport, Storage and Use

Brittleness

- Poor Impact Resistance

Long Mold Times

- Costly to Process

# The Lapol<sup>®</sup> HDT-P Biopolymer Compound Solution

- Lapol compounds its resins to meet the performance and cost requirements for each application.

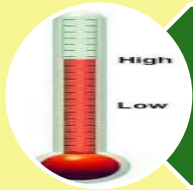
Performance: Lapol compounds its patented HDT-P biopolymer and select minerals into PLA which increases the heat resistance and toughness of PLA to enable it to be cost effectively processed.

Cost: Lapol biopolymer resins are produced in strategic locations in Asia and the United States for specific customers to minimize the materials and shipping costs. Lapol incorporates appropriate additives to meet specifications for cost, color and performance objectives and to assist its customers to be competitive.

- Applications include both disposable and durable goods such as, food service, automotive, electronic devices, credit card stock, etc.

# Lapol<sup>®</sup> HDT-P

## Biopolymer Compound Characteristics



Improved heat deflection temperature of Biopolymers



Compostable and renewable



Food service compliant



Processes on standard plastics converting equipment

# Lapol<sup>®</sup> Compounds Alter the HDT-P Concentration to Optimize Each Application

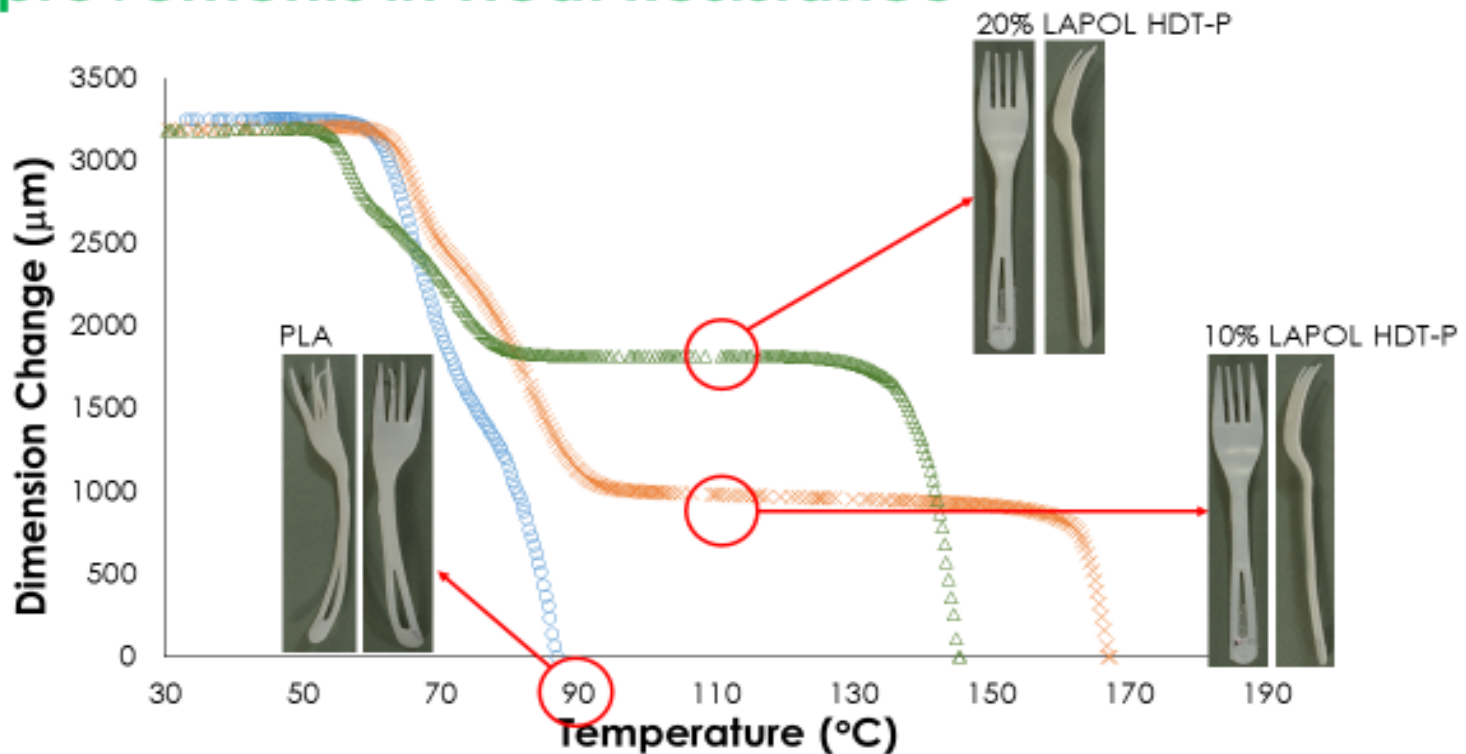
PLA grades respond differently to Lapol<sup>®</sup> HDT-P at lower concentrations, but all show an improvement in their heat tolerance at  $\leq 20\%$ .

Concentrations of 10% show the best combination of cost effectiveness, mechanical and heat tolerance properties.

# Lapol<sup>®</sup> HDT-P Biopolymer Compound

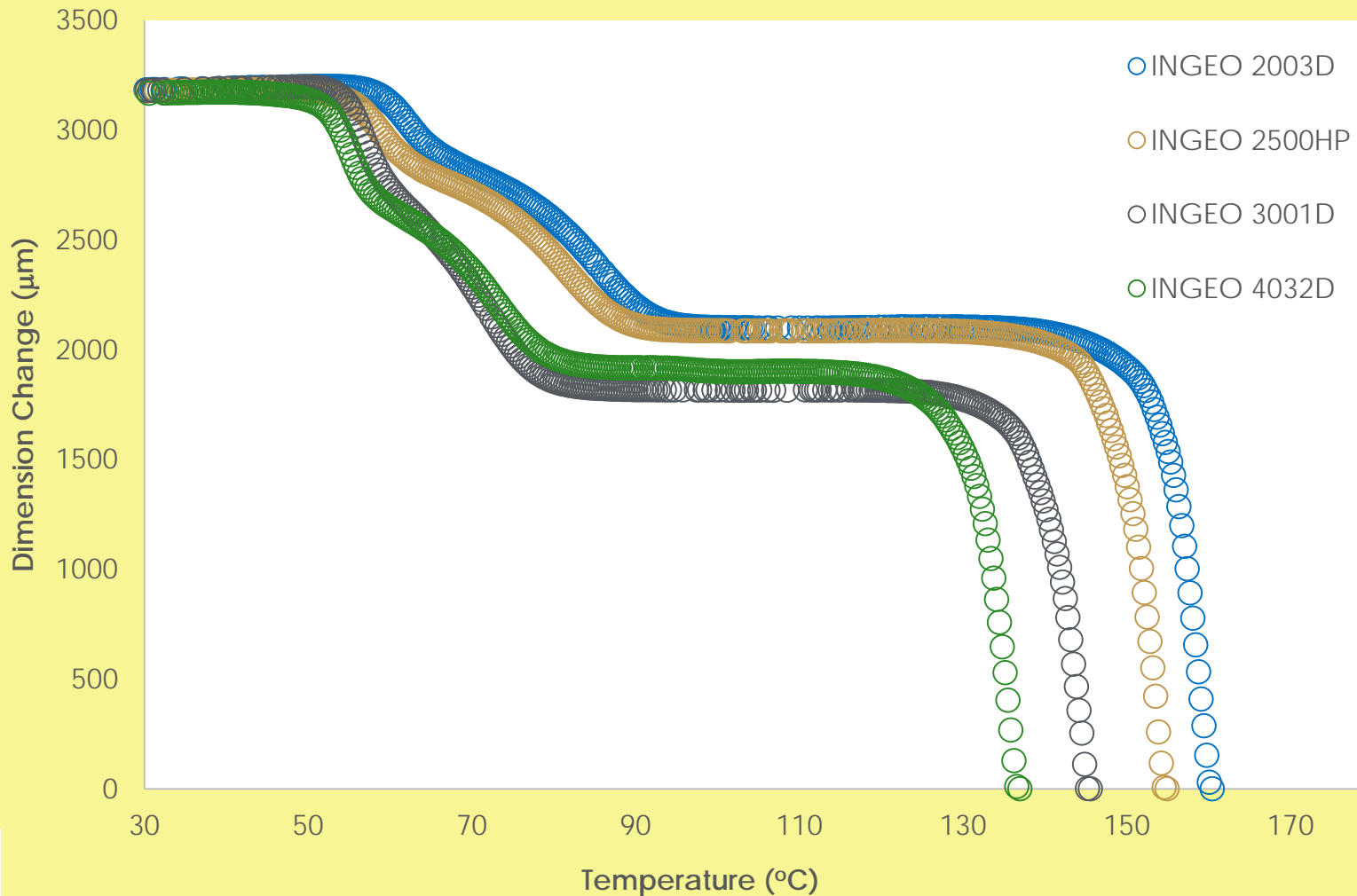
Thermal Mechanical Analysis in Injection Molding Grade PLA

## Improvements in Heat Resistance



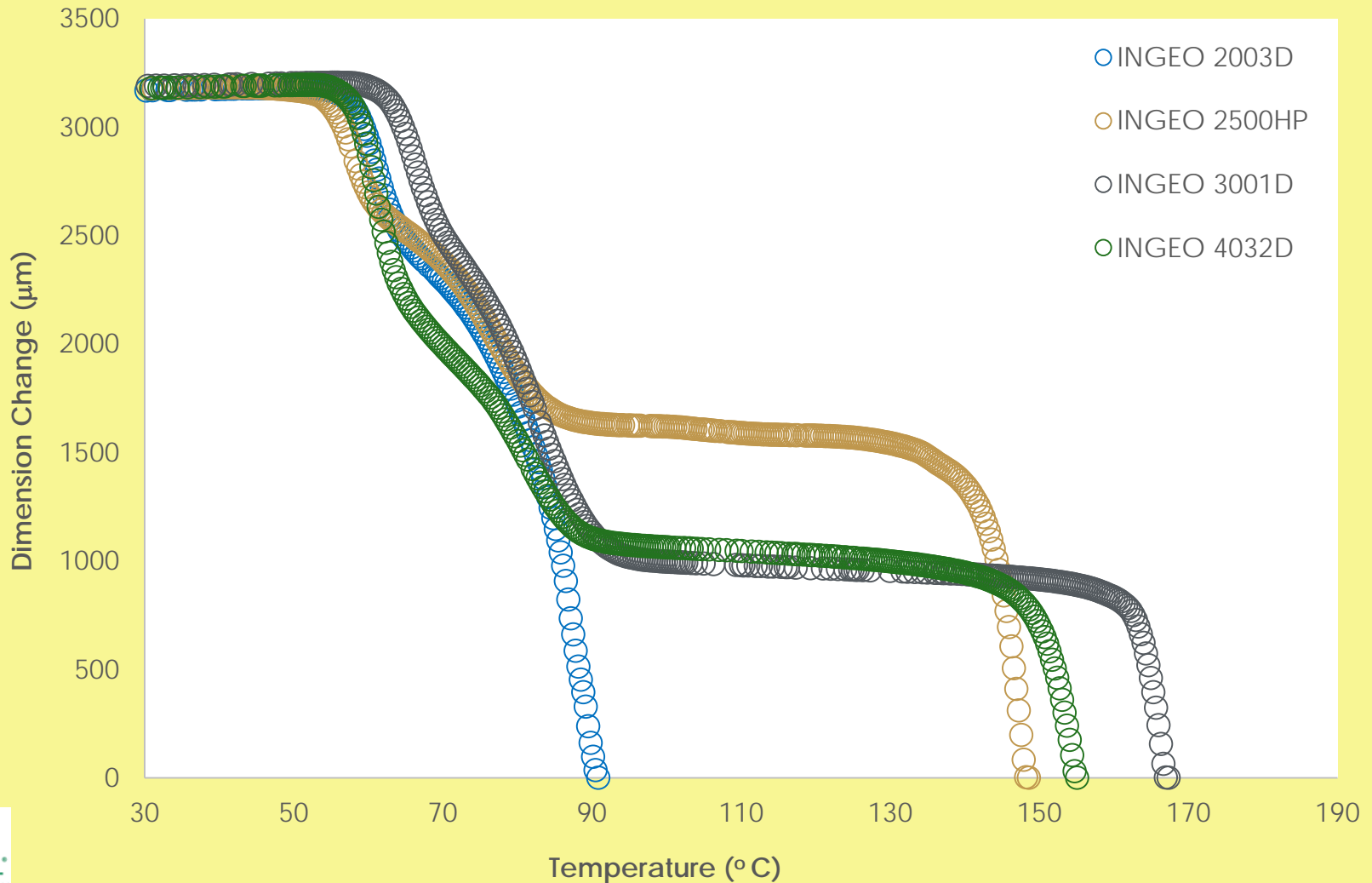
Hot water cutlery application test samples shown

# Lapol<sup>®</sup> HDT-P Biopolymer Compound in Various PLA Biopolymer Grades at 20%





# Lapol<sup>®</sup> HDT-P Biopolymer Compound in Various Biopolymer Grades at 10% Concentration



# Lapol<sup>®</sup> HDT-P Biopolymer Compound

## Mechanical Properties in PLA 3001D

Flexural Properties	PLA 3001D	10% Lapol <sup>®</sup> HDT-P	20% Lapol <sup>®</sup> HDT-P
Modulus (MPa)	2800	2388	4625
Strength (MPa)	90	92	131
Toughness (MPa)	0.882	1.44	1.53

# Lapol<sup>®</sup> HDT-P Biopolymer Compound

## Tensile and Elongation in PLA 4032D

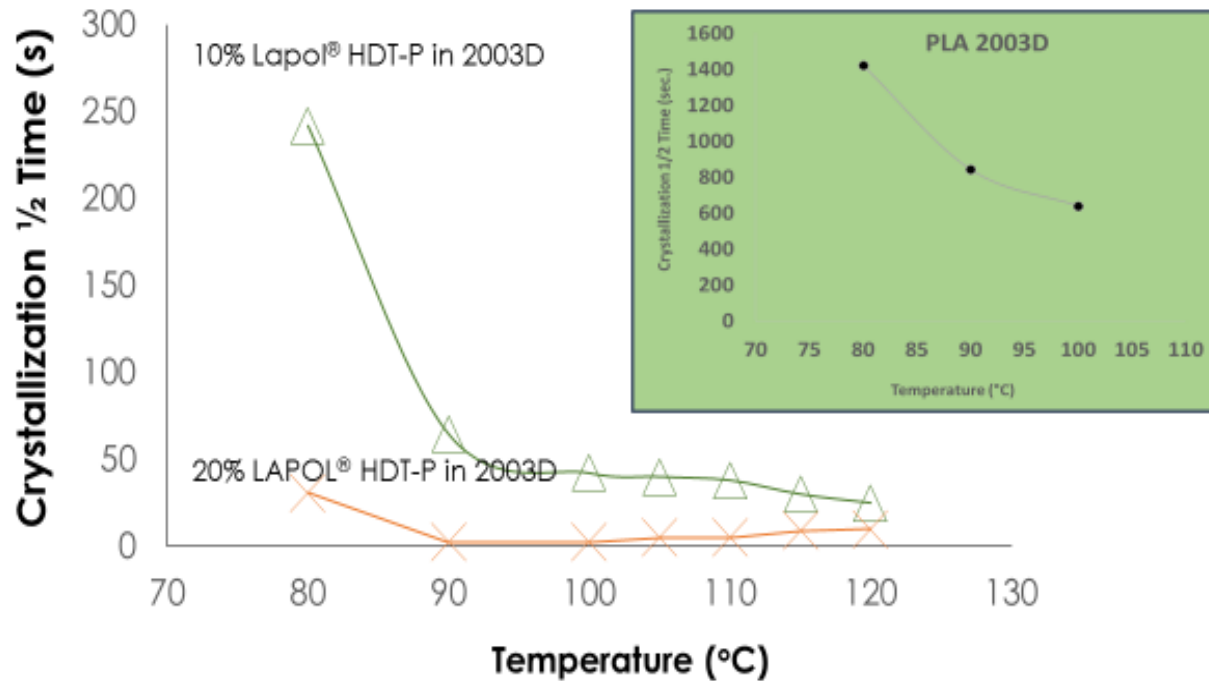
Tensile Properties	PLA 4032D	10% Lapol <sup>®</sup> HDT-P	20% Lapol <sup>®</sup> HDT-P
Tensile Modulus (MPa)	1263	1560	1296
Tensile Strength (MPa)	56	60	54
% Elongation	7	9	9

# Lapol<sup>®</sup> HDT-P Biopolymer Compound

## Tensile and Elongation in PLA 3001D

Tensile Properties	PLA 3001D	10% Lapol <sup>®</sup> HDT-P	20% Lapol <sup>®</sup> HDT-P
Tensile Modulus (MPa)	1276	1787	1138
Tensile Strength (MPa)	53	53	40
% Elongation	7	6	8

# Production Throughput Improvement



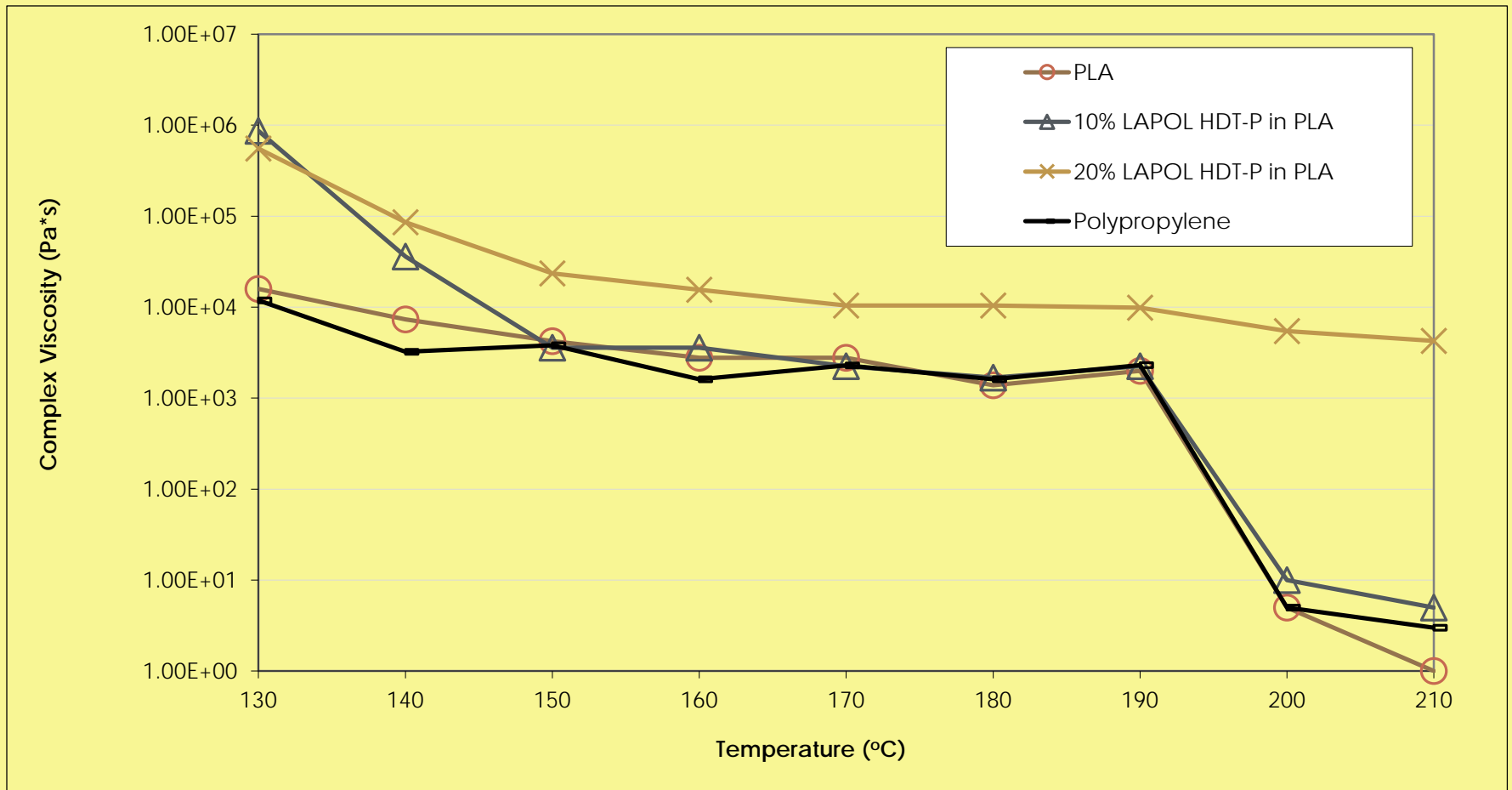
Production throughput rate has been observed to increase by as much as 40% using Lapol<sup>®</sup> HDT-P Biopolymer Compound compared to neat resins.

PLA requires crystallization for increased HDT, but will distort when exposed at elevated temperatures rendering the parts unusable; whereas, Lapol<sup>®</sup> HDT-P Biopolymer Compound does not require crystallization and will not distort under elevated temperatures.



# Complex Viscosity Compared

Neat PLA, Lapol<sup>®</sup> HDT-P Biopolymer Compounds and Polypropylene (130 - 210 °C)



# Lapol<sup>®</sup> HDT-P Biopolymer Compound

## Physical Properties



Properties	Lapol <sup>®</sup> HDT-P Biopolymer Compound
Bimodal Melting Point	110-120 ° C 170-180 ° C
Density	1.3 g/cc
Color	Off White
State	Solid Pellet

- ❑ Excellent Heat Deflection Temperature
- ❑ Improved Toughness of Injection Molded and Thermoformed Articles
- ❑ Food Service Compliant
- ❑ Compostable & Renewable

# Summary

## Lapol® HDT-P Biopolymer Compound Attributes

- ❑ Hi heat deflection temperatures to greater than 150 °C.
- ❑ Improved toughness of formed products.
- ❑ Lapol® HDT-P biopolymer compound does not require crystallizing and will not distort under elevated temperatures.
- ❑ Thermoforming cycle time has been shown to be reduced by 40%.
- ❑ Can be added directly at the thermoformer extruder or injection molding equipment.  
(note: resin must be dried to <700 ppm moisture for optimal processing conditions)

Lapol® HDT-P  
Biopolymer  
Compound is:

- ❑ Renewable
- ❑ Compostable
- ❑ FDA Compliant
- ❑ Cost Effective



[www.lapol.net](http://www.lapol.net)

3757 State Street Suite 2A

Santa Barbara, CA 93105

805-456-7950