



# Circular Economy for Flexible Packaging



March 17, 2021  
10:00 a.m. – 1:00 p.m. E.S.T.  
**Virtual Conference**  
**REGISTER TODAY**

## Designing Collation Shrink Films to Achieve Aspirational Sustainability Targets

**Fraser Waldie**

Technical Service Specialist



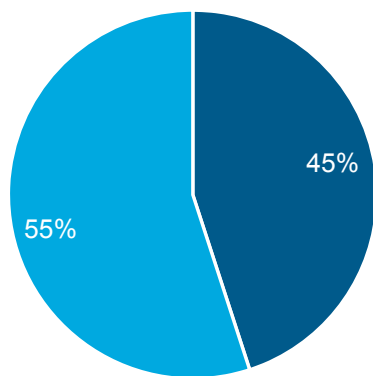
## Presentation Overview

---

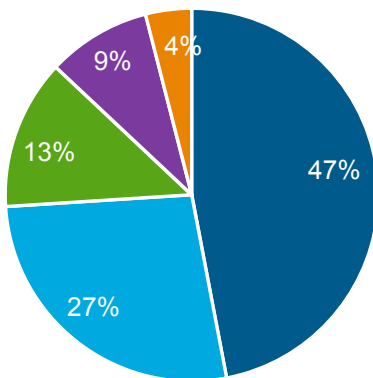
- Shrink Film Market Introduction
- Shrink Film Design Considerations and Performance Criteria
- Sustainability Drivers
- Case Studies
- Future Opportunities and Value Proposition

# Applications of Collation Shrink Films

Shrink Film Volume Estimates by Application\*



- High Performance Collation
- Commodity Industrial Collation



- Beverage
- Food
- Health Care
- Household
- Industrial



# Diversity of the Collation Shrink Film Applications



## BEVERAGE

- Bottles, cans, etc.
- Package sizes ranging from 6 to 24+
- 60% printed – High performance for visual display/advertising



## FOOD

- Cans, boxes, etc.
- 15% printed – mostly used as transit packaging with moderate performance requirements

## HOUSEHOLD, HEALTHCARE, INDUSTRIAL

- Varying demands
- Package sizes range in weight, material, and geometry



# Collation Shrink Film Design Criteria

---

## Productive Tunnel Output

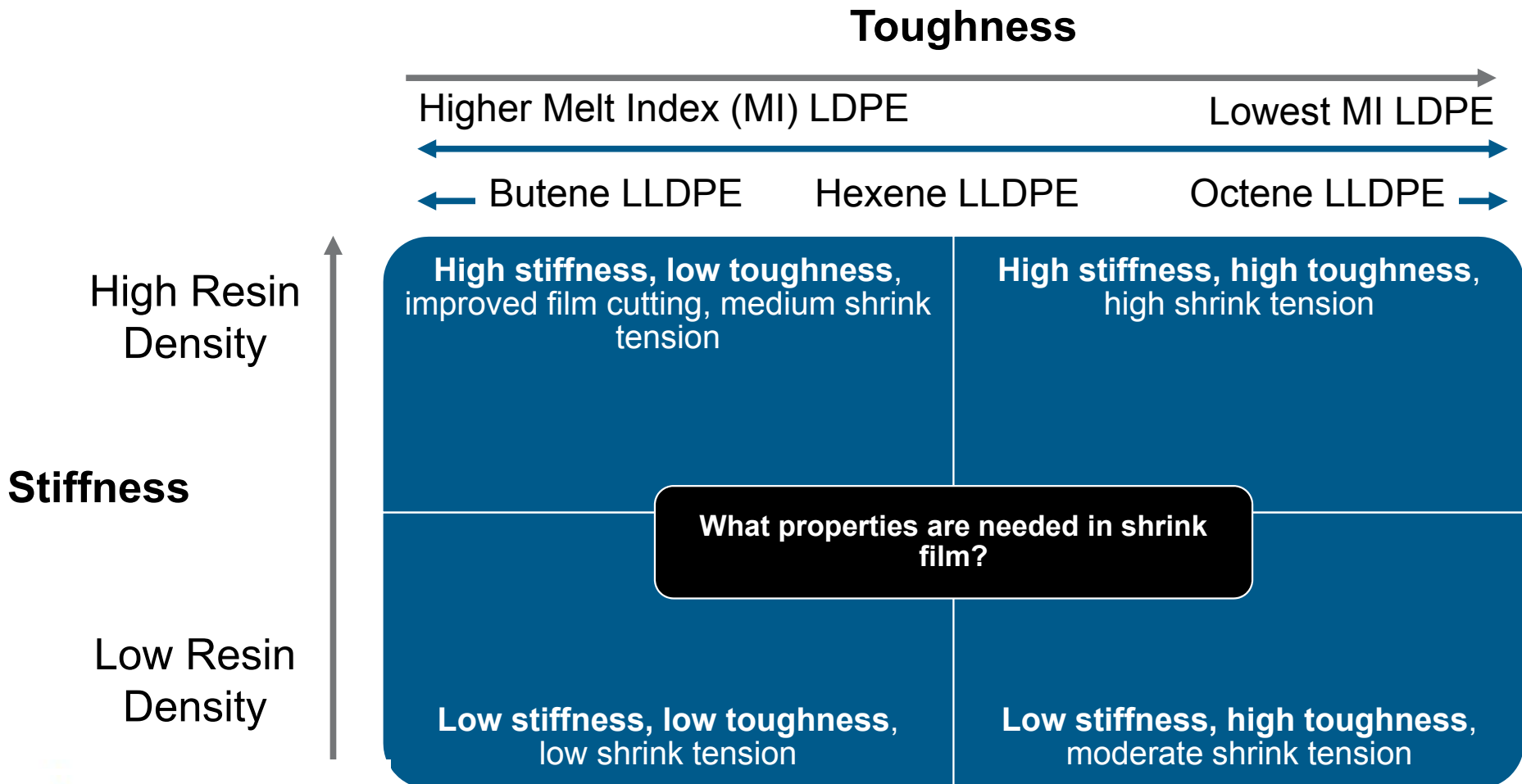
- Shrink rapidly and tightly
- Suitably applied shrink force to avoid crushing the wrapped product
- Quality bullseye formation (round, wrinkle-free)
- Accomplish a fused lap seal

## Aesthetically Pleasing

- Film molds around product during shrinkage
- No stretch holes, minimal wrinkling



# Performance Criteria – Negotiating Stiffness/Toughness Balance

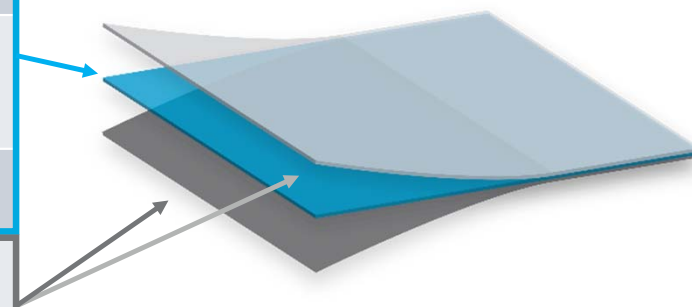


## Meeting Application Demands with Co-extruded Films

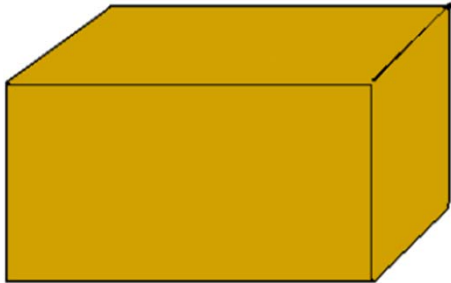
Using a combination of HDPE, MDPE and LLDPE resins allows for downgauging and performance improvements when compared to mono-layer LDPE films

Material	Suggested Location	Purpose	Layer Percent
Fractional melt index LDPE	Core layer	Shrink energy and speed	30-50% core
MDPE	Core layer	Stiffness and toughness	20-30% core
HDPE	Core layer	Stiffness	20-30% core
Clarity LLDPE	Skin layers	Toughness and Optics	100% of inner and outer

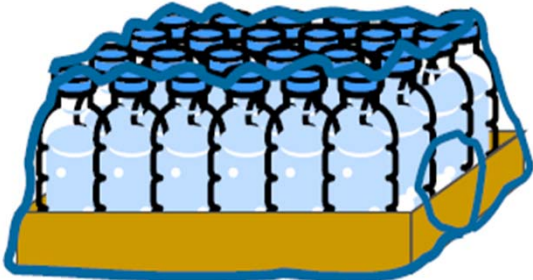
15/70/15 Layer Ratio  
Co-ex Shrink Film Example



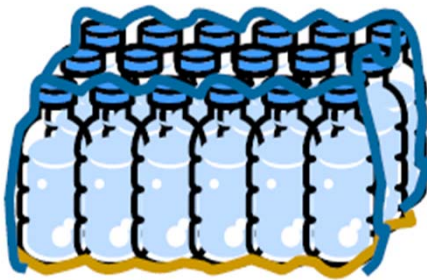
# Sustainability Drivers for Collation Shrink Film



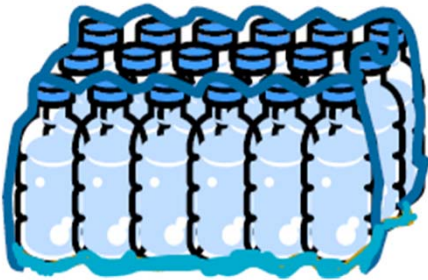
Corrugated Packaging



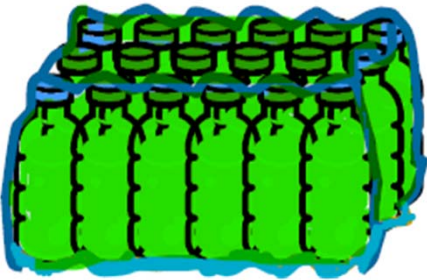
Corrugated Tray + Shrink Film



Corrugated Base + Shrink Film



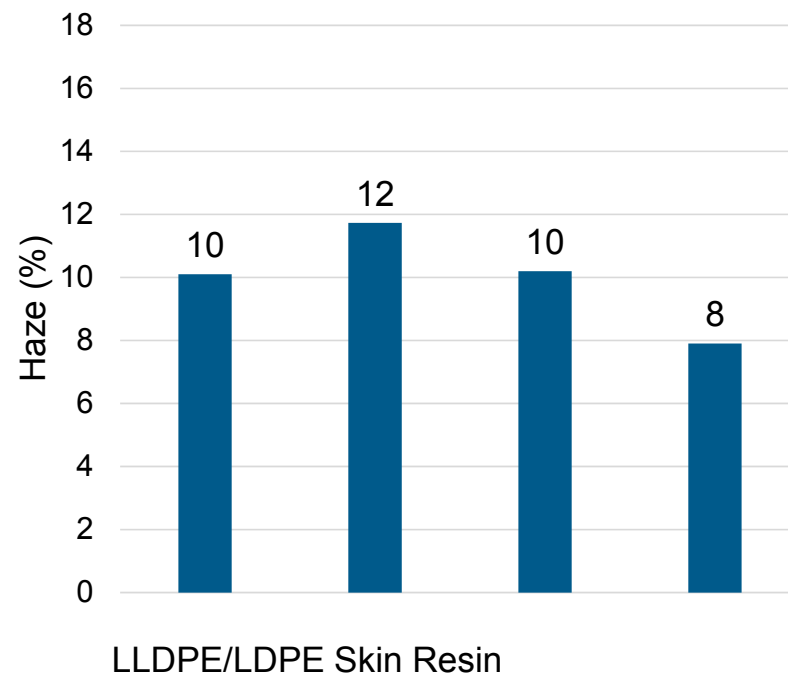
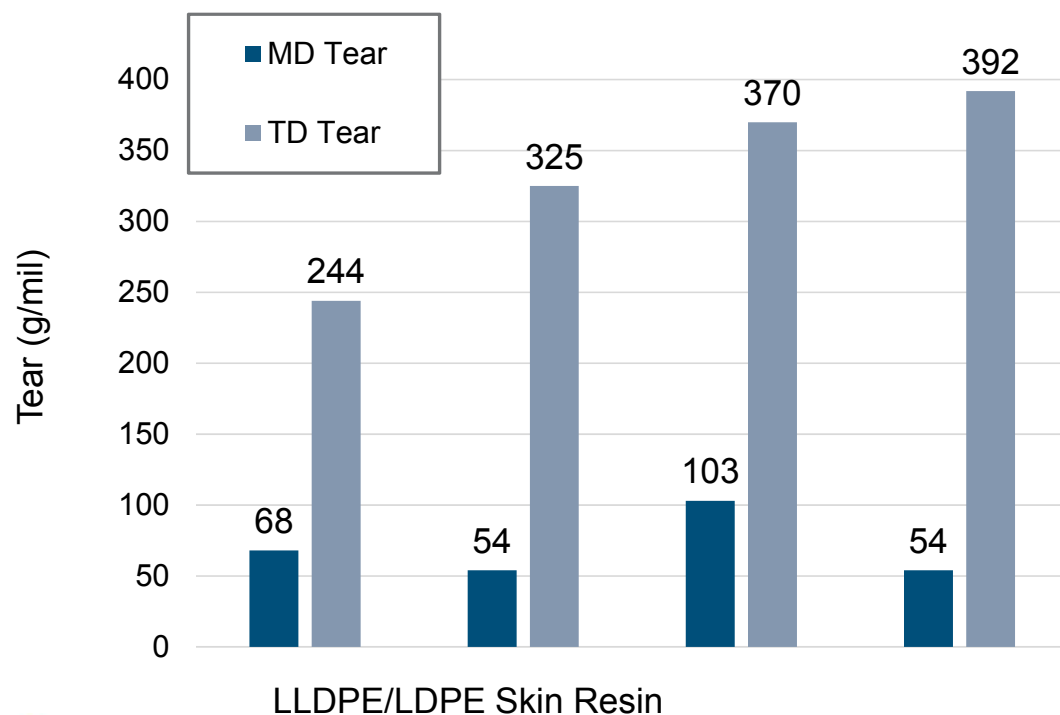
Shrink Film Only



Incorporation of Post Consumer Resin (PCR)

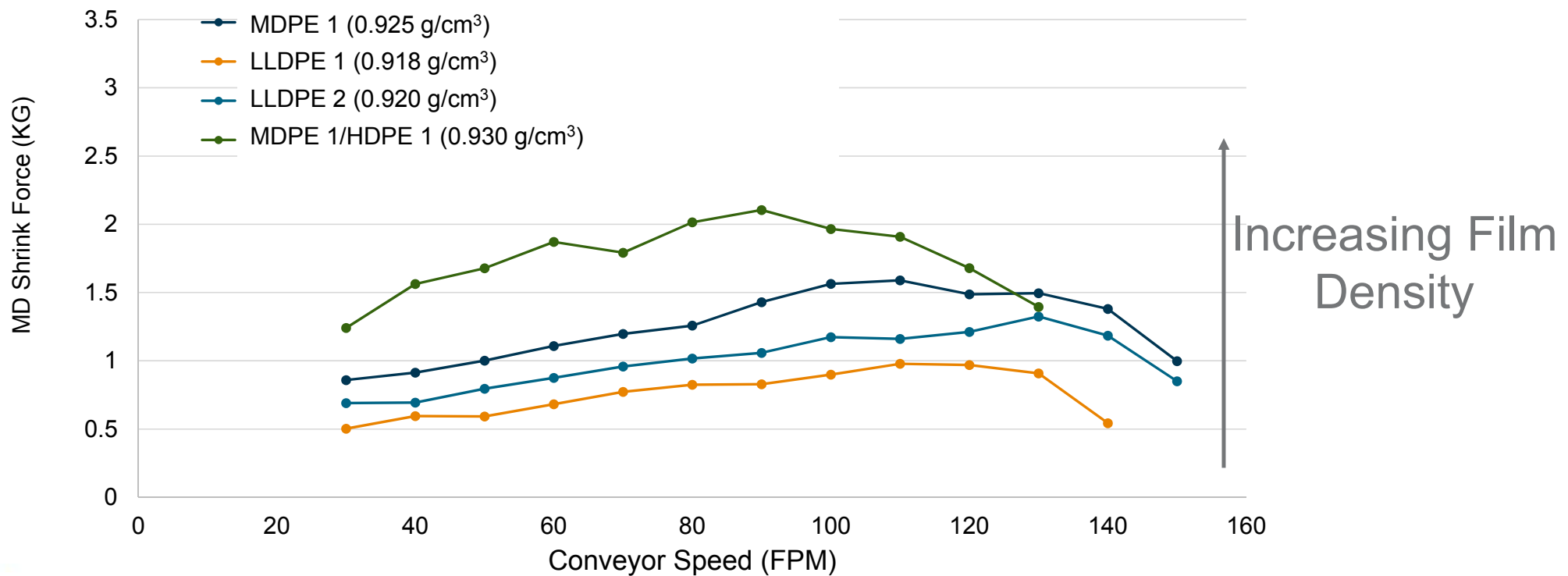
## Modification of Skin Layer Resins

- Skin layer resin selection impacts physical properties and optical properties
- 2.2 mil, 15/70/15 - layer ratio, core layers contain 40% LDPE and 60% MDPE



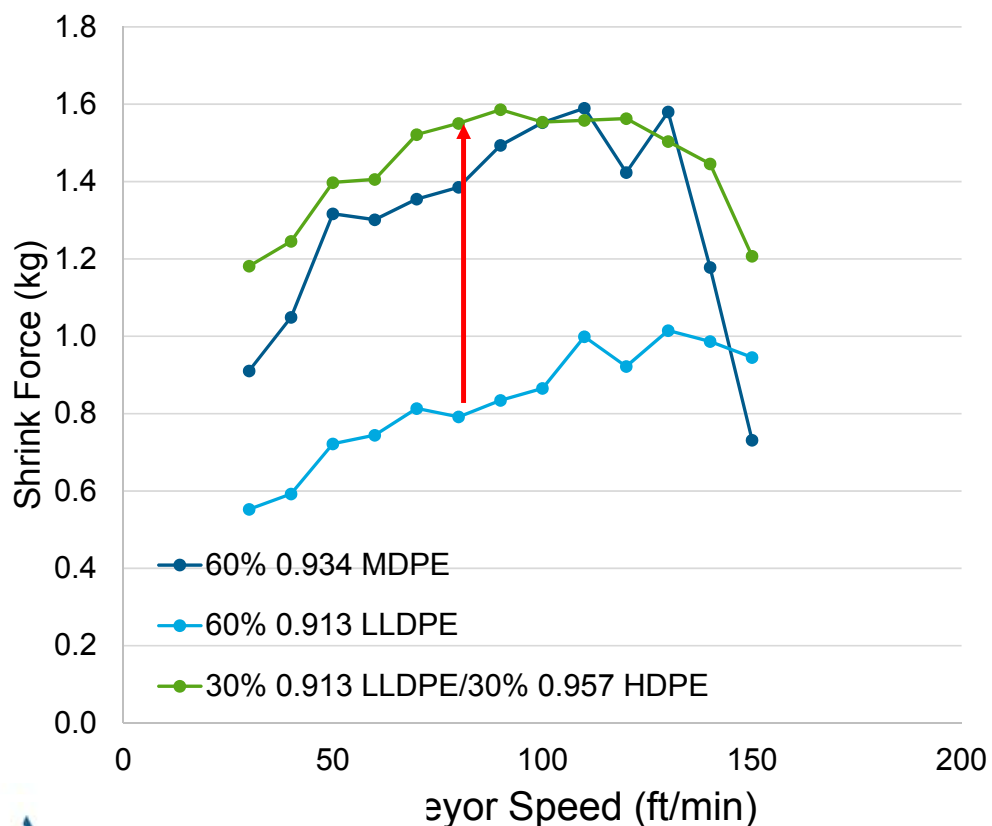
## Modification of Core Layer Resins

- Adjusting density of companion resins in 60% of core layer has profound impact on shrink force
- 2.2 mil, 15/70/15 - layer ratio, same LLDPE skin resin, 40% LDPE in core



## Not All Film Structures are Created Equally

2.2 mil, 15/70/15 – layer ratio, same LLDPE skin resins, 40% LDPE, remaining 60% of core is composed of either LLDPE, MDPE, or LLDPE/HDPE blend



	MDPE	LLDPE	LLDPE/HDPE
Tear MD (g/mil)	97	175	148
Tear TD (g/mil)	337	799	548
Tensile Strength MD (MPa)	31.8	35.7	30.8
1% Sec Mod MD (MPa)	230	164	213
Dart (g/mil)	128	228	146
Lubricated Puncture (J/mm)	19	35	24
Haze (%)	10.1	5.7	9.5
Density (g/cm <sup>3</sup> )	0.925	0.916	0.925

## Incorporation of Post-Consumer Resin (PCR)

Many brand owners and packaging producers are increasingly pursuing the incorporation of PCR into their products to further enhance sustainability

- **The quality of PCR is largely dependent on the quality of the feed stream**
- **Rigid Products/HDPE have more established recycle streams**
  - Typical melt flow and density of these products make them perfect stiffening agents for Shrink Films
- **Recycled LDPE/LLDPE resins offer potential for high incorporation levels**
  - Critical to understand composition and consistency



**Milk and water jugs**  
(small part blow molding)



**Pail and Crate**  
(injection molding)



**Mixed Film**  
(cast/blown film)

## Incorporation of HD-PCR (rHDPE)

PCR was incorporated into the core layer of 3-layer co-extruded films

2.2 mil, 15/70/15 – layer ratio, 2.5:1 BUR, 60 mil die gap

### 40% High-Shrink Efficiency LDPE

0.920 g/cm<sup>3</sup>, 0.25 g/10 min (virgin)

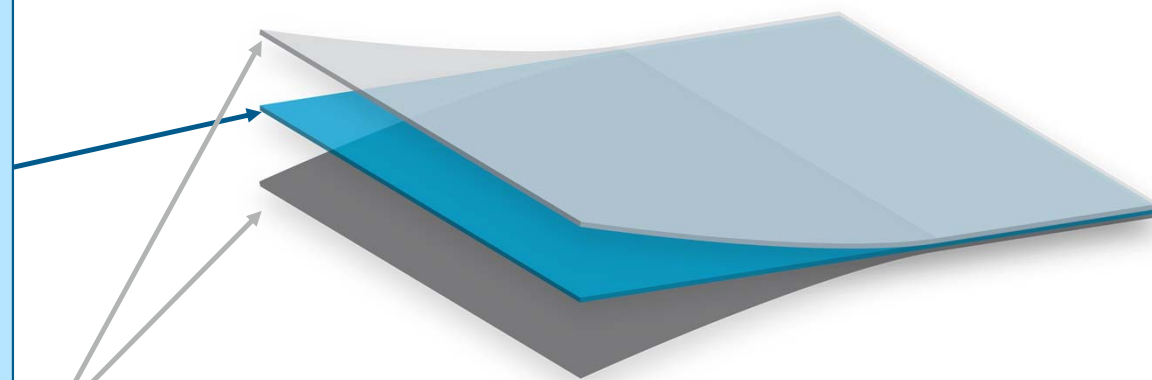
### 30% High-Performance MDPE

0.928 g/cm<sup>3</sup>, 0.75 g/10 min (virgin)

### 30% HDPE Stiffening Resin

0.960 g/cm<sup>3</sup>, 0.72 g/10 min

0.960 g/cm<sup>3</sup>, 0.65 g/10 min (HD-PCR)

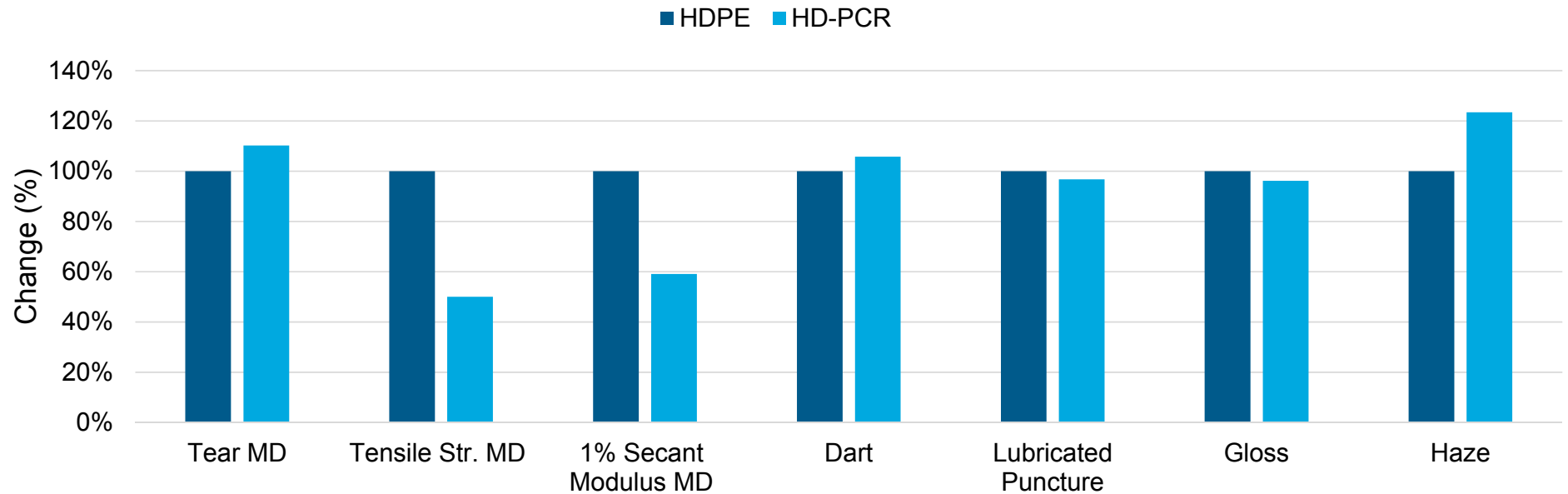


### High-Performance LLDPE skins

0.919 g/cm<sup>3</sup>, 0.85 g/10 min

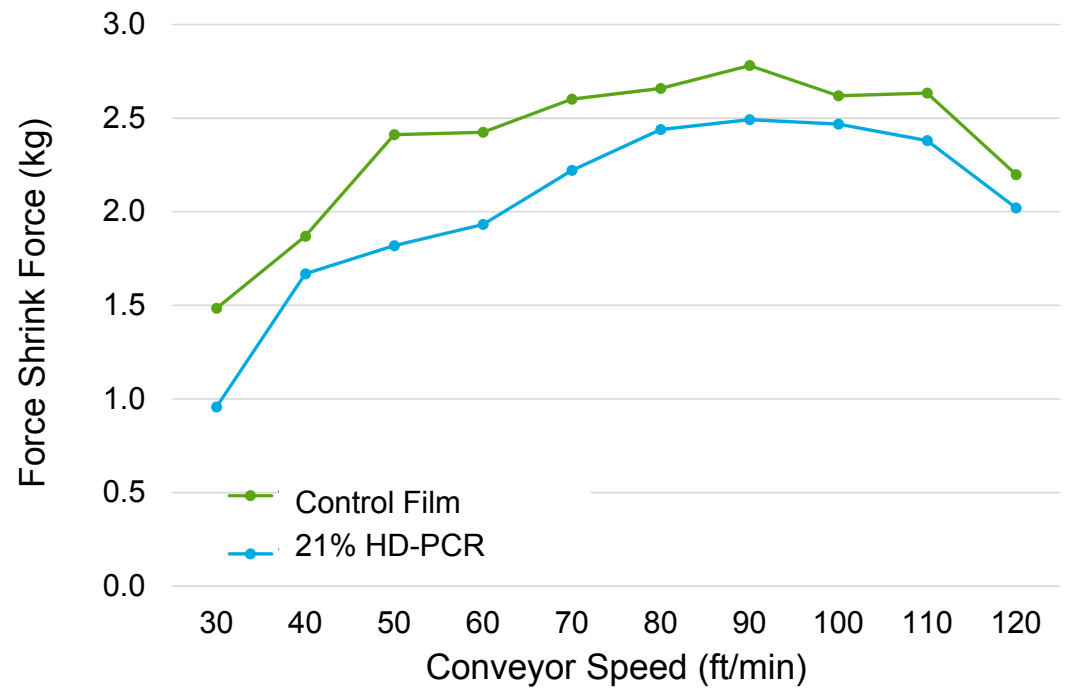
## Incorporation of HD-PCR – Physical Properties

- 2.2 mil, 15/70/15 – layer ratio, 2.5:1 BUR, 60 mil die gap
- Displace HDPE stiffening resin – 21% PCR Incorporation



# Incorporation of HD-PCR – Shrink Properties

## 21% HD-PCR Incorporation



## Incorporation of LD-PCR (rLDPE/LLDPE)

PCR was incorporated into the core layer of 3-layer co-extruded films

2.2 mil, 15/70/15 – layer ratio, 2.5:1 BUR, 60 mil die gap

### 40% High-Shrink Efficiency LDPE

0.920 g/cm<sup>3</sup>, 0.25 g/10 min (virgin)

0.925 g/cm<sup>3</sup>, 1.7 g/10 min (LD-PCR)

### 30% High-Performance MDPE

0.928 g/cm<sup>3</sup>, 0.75 g/10 min (virgin)

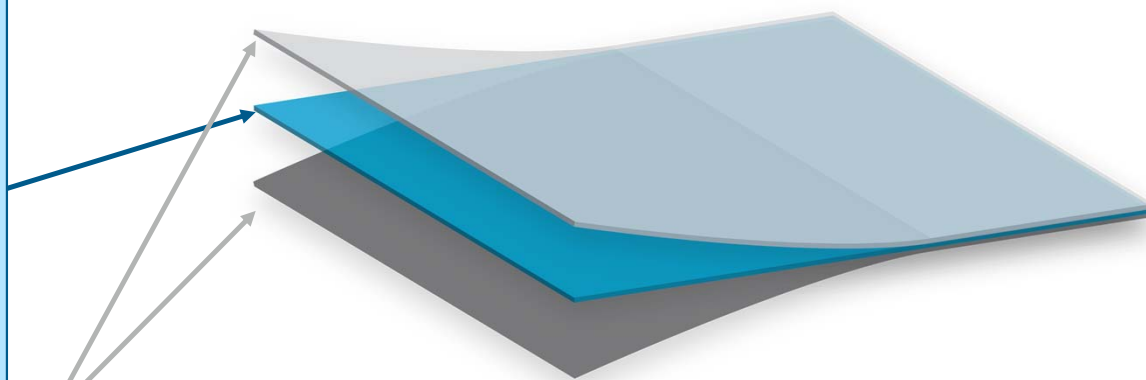
0.925 g/cm<sup>3</sup>, 1.7 g/10 min (LD-PCR)

### 30% HDPE Stiffening Resin

0.960 g/cm<sup>3</sup>, 0.72 g/10 min

### High-Performance LLDPE skins

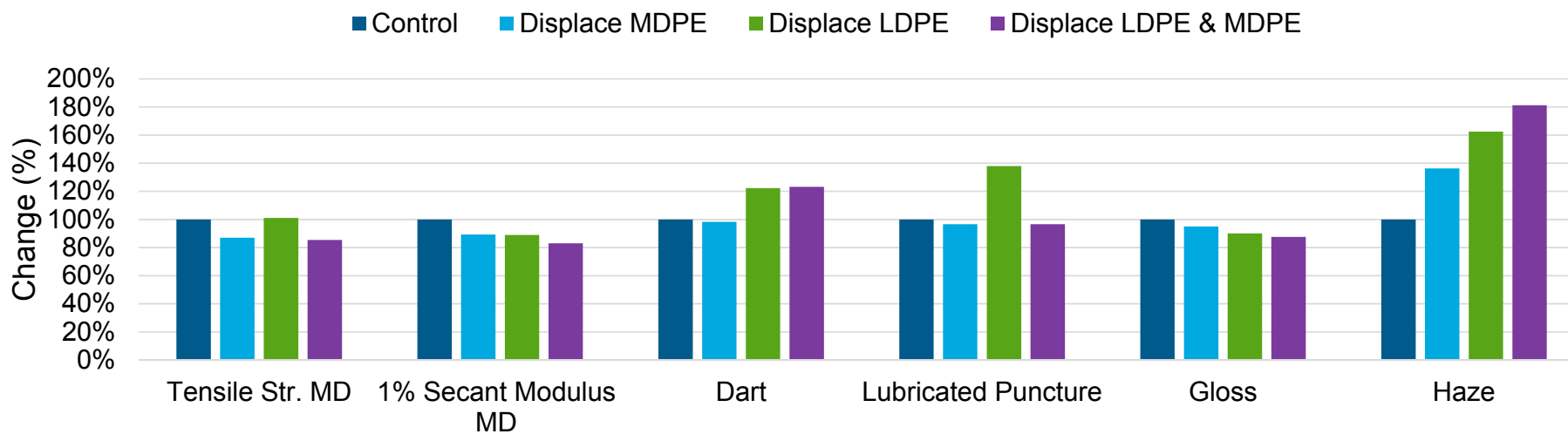
0.919 g/cm<sup>3</sup>, 0.85 g/10 min



# Incorporation of LD-PCR – Physical Properties

## Displacement of LDPE and MDPE Components

	Control	Displace MDPE	Displace LDPE	Displace LDPE & MDPE
Density (g/cm <sup>3</sup> )	0.931	0.931	0.932	0.931
PCR (wt%)	n/a	21%	28%	49%



# Incorporation of LD-PCR – Shrink Properties

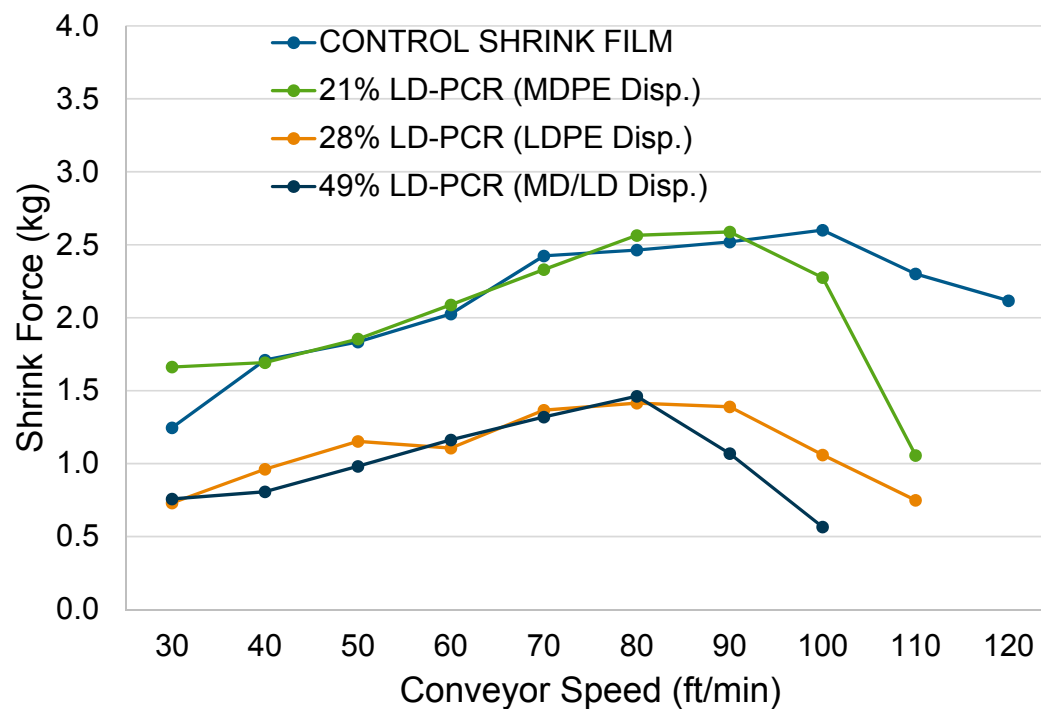
## 21%, 28% and 49% LD-PCR Incorporation



LLDPE Displaced Film



LDPE Displaced Film



## Incorporation of LD-PCR – Optimization

PCR was incorporated into the core layer of 3-layer co-extruded films

2.2 mil, 15/70/15 – layer ratio, 2.5:1 BUR, 60 mil die gap

### 30% High-Shrink Efficiency LDPE

0.920 g/cm<sup>3</sup>, 0.25 g/10 min (virgin)

### 50% High-Performance MDPE

0.928 g/cm<sup>3</sup>, 0.75 g/10 min (virgin)

0.935 g/cm<sup>3</sup>, 0.30 g/10 min (LD-PCR 1)

0.920 g/cm<sup>3</sup>, 1.50 g/10 min (LD-PCR 2)

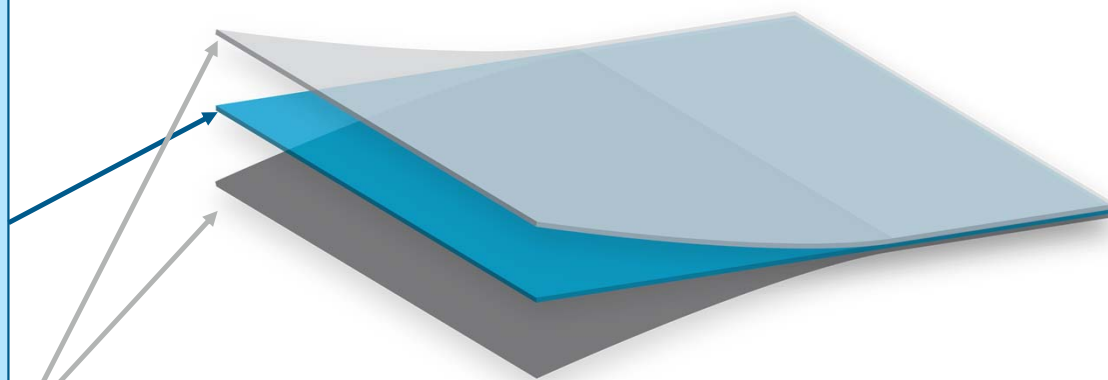
0.930 g/cm<sup>3</sup>, 0.45 g/10 min (LD-PCR 3)

### 20% HDPE Stiffening Resin

0.960 g/cm<sup>3</sup>, 0.72 g/10 min

### High-Performance LLDPE skins

0.919 g/cm<sup>3</sup>, 0.85 g/10 min



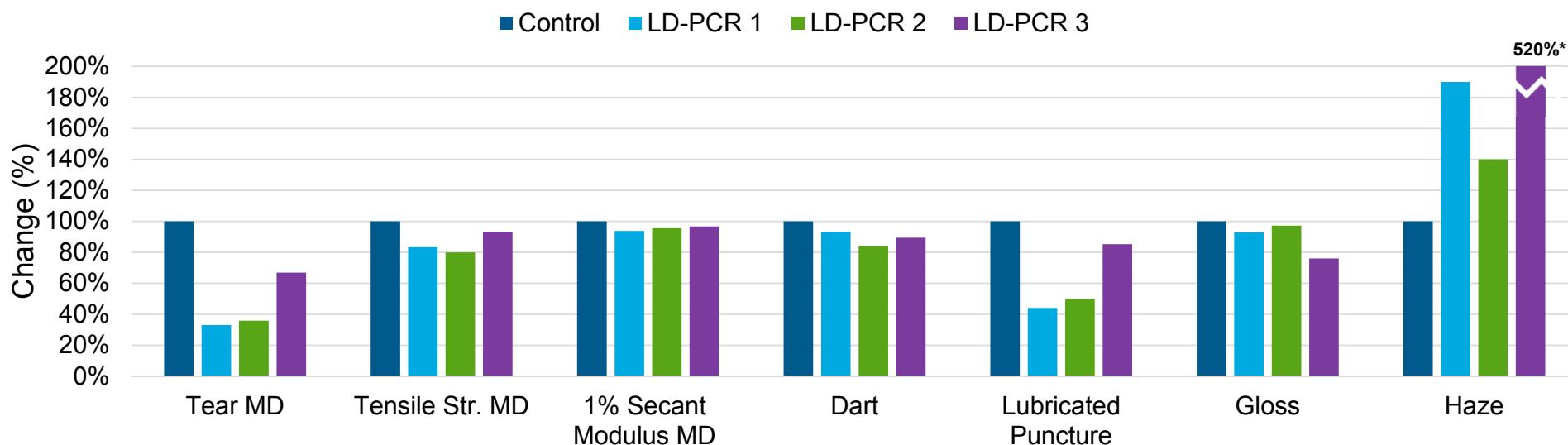
# Optimized LD-PCR Structures – Physical Properties

## Displacement of LDPE and MDPE Components

Decreasing LDPE Content →

	Control	LD-PCR 1	LD-PCR 2	LD-PCR 3*
Density (g/cm <sup>3</sup> )	0.929	0.934	0.929	0.930
PCR (wt%)	n/a	35%	35%	35%

\*LD-PCR 3 is a white PCR pellet



# Optimized LD-PCR Structures – Shrink Performance

## 35% PCR incorporation with various grades of LD-PCR



Control



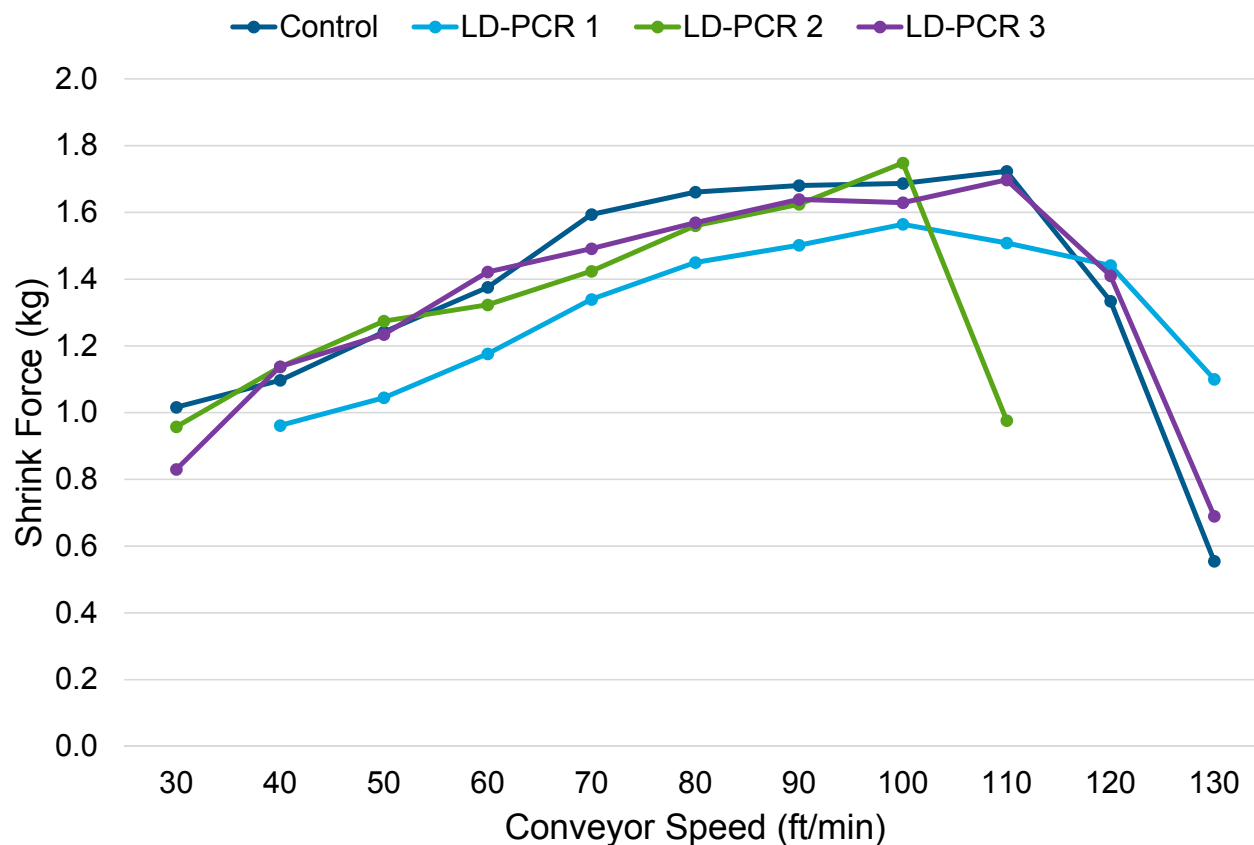
LD-PCR 1



LD-PCR 2



LD-PCR 3



## Collation Shrink Summary

---

Collation shrink film is excellent for product branding while also being a highly sustainable packaging format

- **Viable for material replacement** – weight reductions by a factor of 10 (relative to cardboard or rigid polyethylene structures) which reduces shipping weight and CO<sub>2</sub> emissions
- **Highly recyclable** – prepared from 100% all-polyethylene films
- **Highly tunable** – shrink force and properties can be adjusted through rational film structure design which reduces the need for secondary packaging such as slip pads and trays
- **Capable of incorporating recycled materials** – e.g. PCR and PIR, through intelligent film design



[novachemicals.com](http://novachemicals.com)



**© 2020 NOVA Chemicals - All rights reserved.**

The information contained herein is provided for general reference purposes only. By providing the information contained herein, NOVA Chemicals makes no guaranty or warranty and does not assume any liability, with respect to the accuracy or completeness of such information, or product results in any specific instance, and hereby expressly disclaims any implied warranties of merchantability or fitness for a particular purpose or any other warranties or representations whatsoever, expressed or implied. Nothing contained herein shall be construed as a license to use the products of NOVA Chemicals in any manner that would infringe any patent. Nothing herein shall be copied, reproduced, distributed or otherwise used without the express written permission of NOVA Chemicals.

NOVA Chemicals' logo is a registered trademark of NOVA Brands Ltd.; authorized use/utilisation autorisée.

Responsible Care® is a registered trademark of the Chemistry Industry Association of Canada (CIAC).