



Innovations in Film Stiffness-Toughness Balance

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What's Driving Today's Packaging Market?



Brand Owners

- More sustainable packaging
- Lighter weight
- On-the-go lifestyles
- Single-serve packaging
- Cost-effective



Converters

- Down-gauging
- Tougher films
- Processability
- Reduced Equipment Fouling



OEMs

- Faster running equipment
- Efficiencies



Innovation Model: Engagement Across the Value Chain





What is INNATE™?



INNATE™ precision packaging resins are born from breakthrough catalyst and process technology that allows **accurate** and **consistent** control of the resin chemistry for extraordinary film properties and...

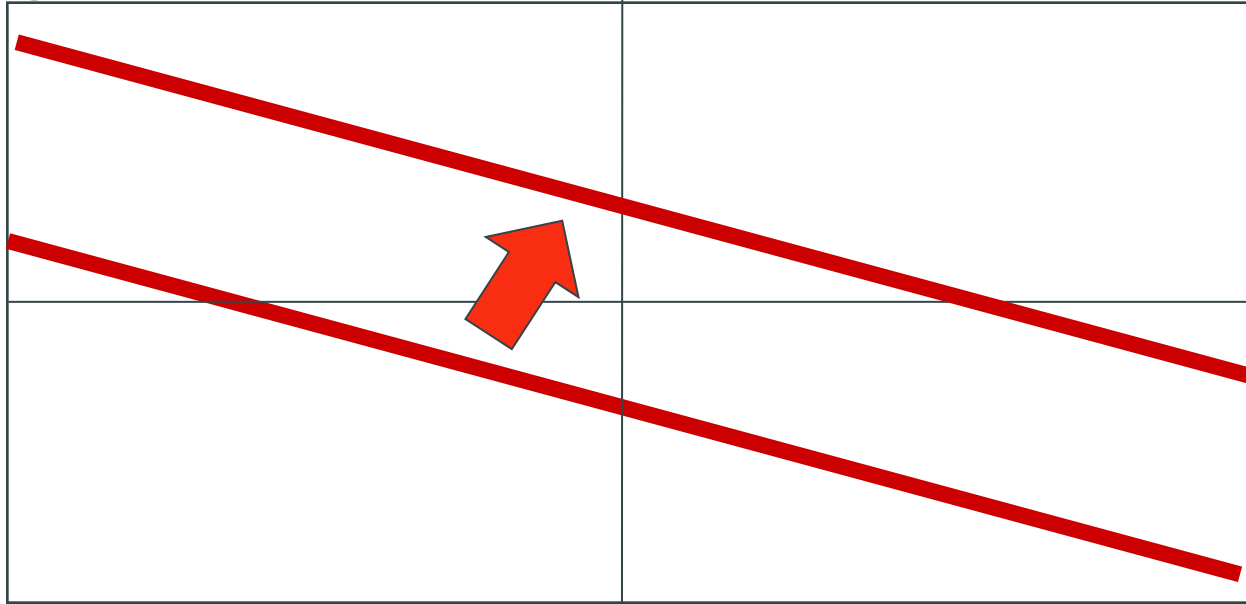
- Filling unmet packaging needs
- Creating new market spaces
- Offering superior packaging performance



Stiffness-toughness balance



Toughness



Stiffness



End benefit

Stiffness & Toughness



InnateTM

precision packaging resins

ST 50

(0.85 MI, 0.918 d)

INNATE™ Precision Packaging Resin Delivers Superior Toughness Performance



INNATE™ ST50 (0.85 MI, 0.918 d) delivers

- Unprecedented stiffness/toughness balance as compared to competitive metallocene resins while maintaining other key performance attributes
- Improved processability & output rates vs. competitive metallocene resins
 - Higher melt strength
 - Excellent shear thinning for low amps, back pressure, and melt temperatures



INNATE™ Product Overview



Product	MI (g/10 min)	Density (g/cm ³)	Applications
INNATE™ ST50	0.85	0.918	<ul style="list-style-type: none">• HDSS• Construction film• SUP• Protective packaging• General converter films
XUS 59910.04 ⁽¹⁾	0.85	0.915	<ul style="list-style-type: none">• Liquid Bag-in-box• Medium performance sealant• Protective packaging
XUS 59910.03 ⁽¹⁾	0.85	0.912	<ul style="list-style-type: none">• Low temperature (e.g. frozen food)• Liquid packaging Bag-in-box• Medium performance sealant

¹ Developmental product of The Dow Chemical Company





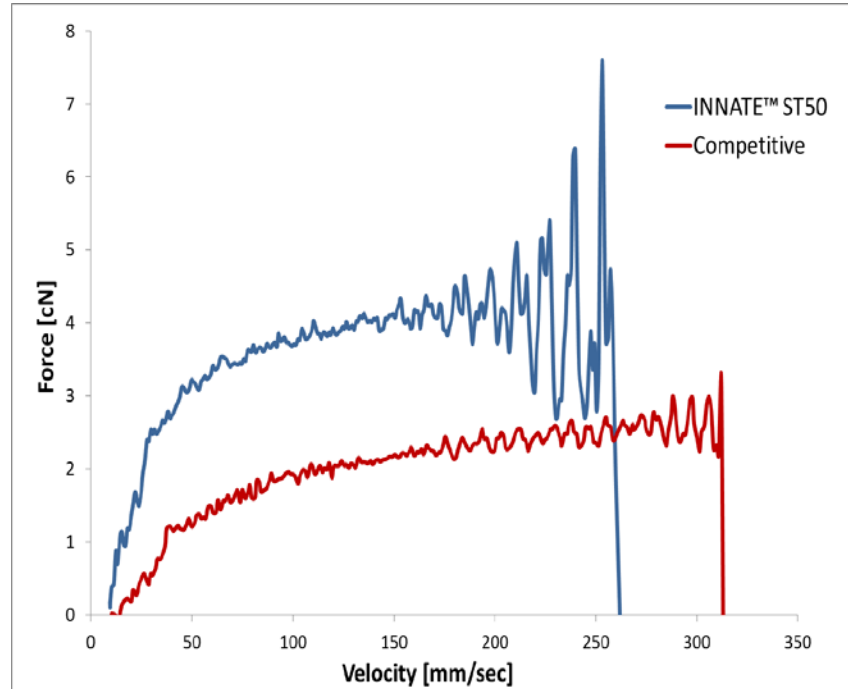
FILM PERFORMANCE



Improved Processability

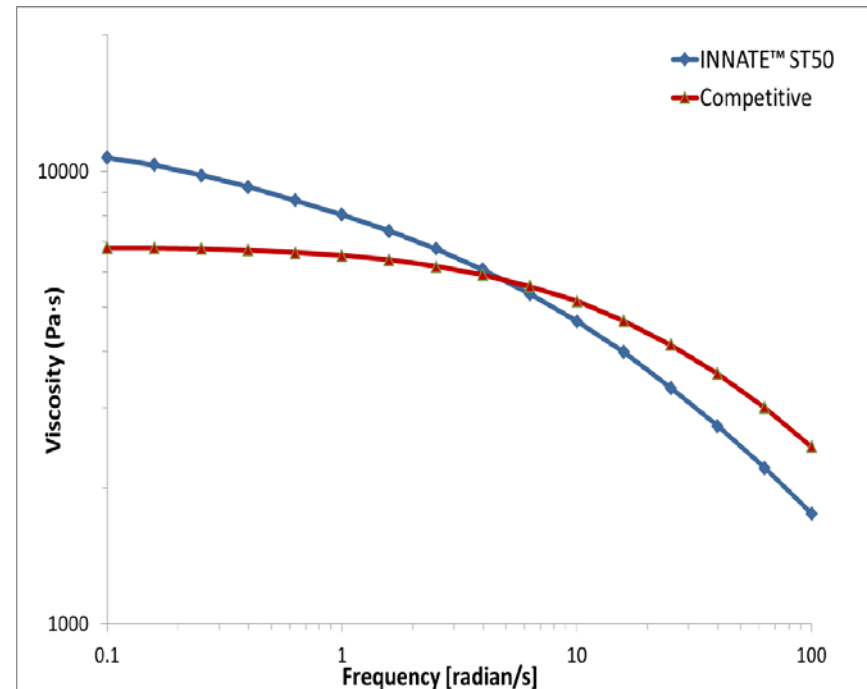


Melt Strength



- Better melt strength for improved processability and output rates vs. competitive mLLDPE (1 MI, 0.918 d)

Viscosity

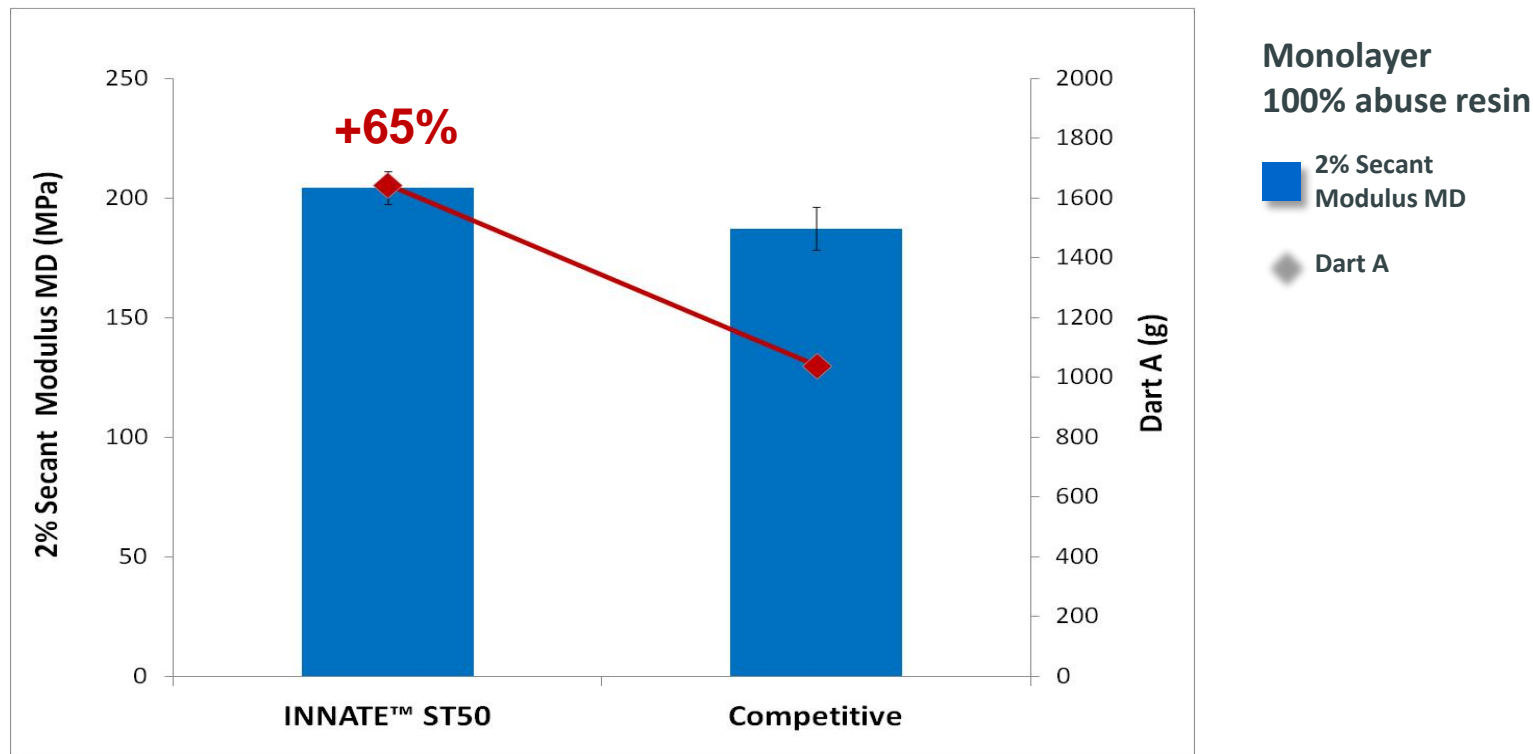


- More shear thinning for lower melt temperatures, amps & back pressures

Unprecedented Toughness Performance (1 mil film)



2% Secant Modulus MD and Dart A



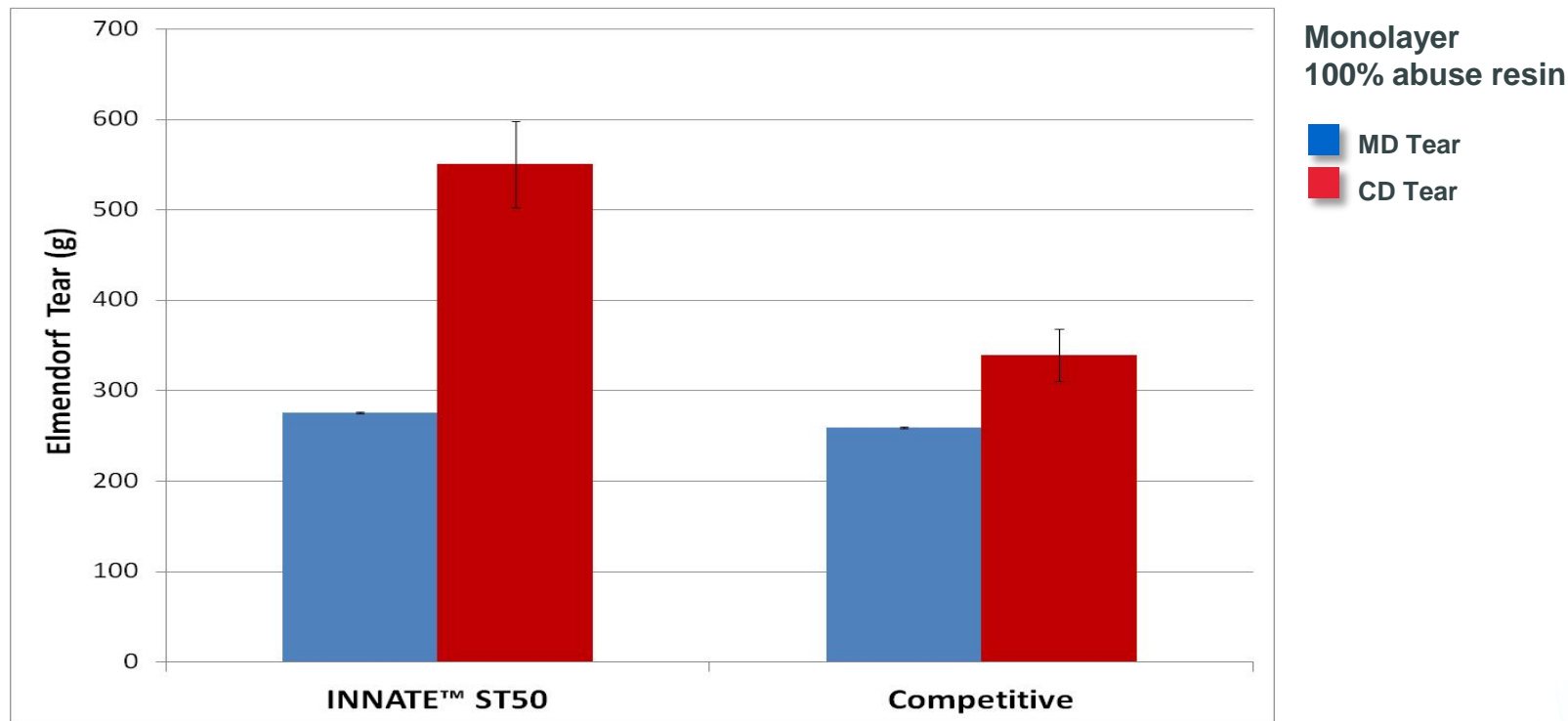
INNATE™ ST50 (0.85 MI, 0.918 d) delivers significantly higher dart performance at similar modulus vs. competitive mLLDPE grade (1 MI, 0.918 d).



Excellent Tear Performance (1 mil film)



Elmendorf Tear



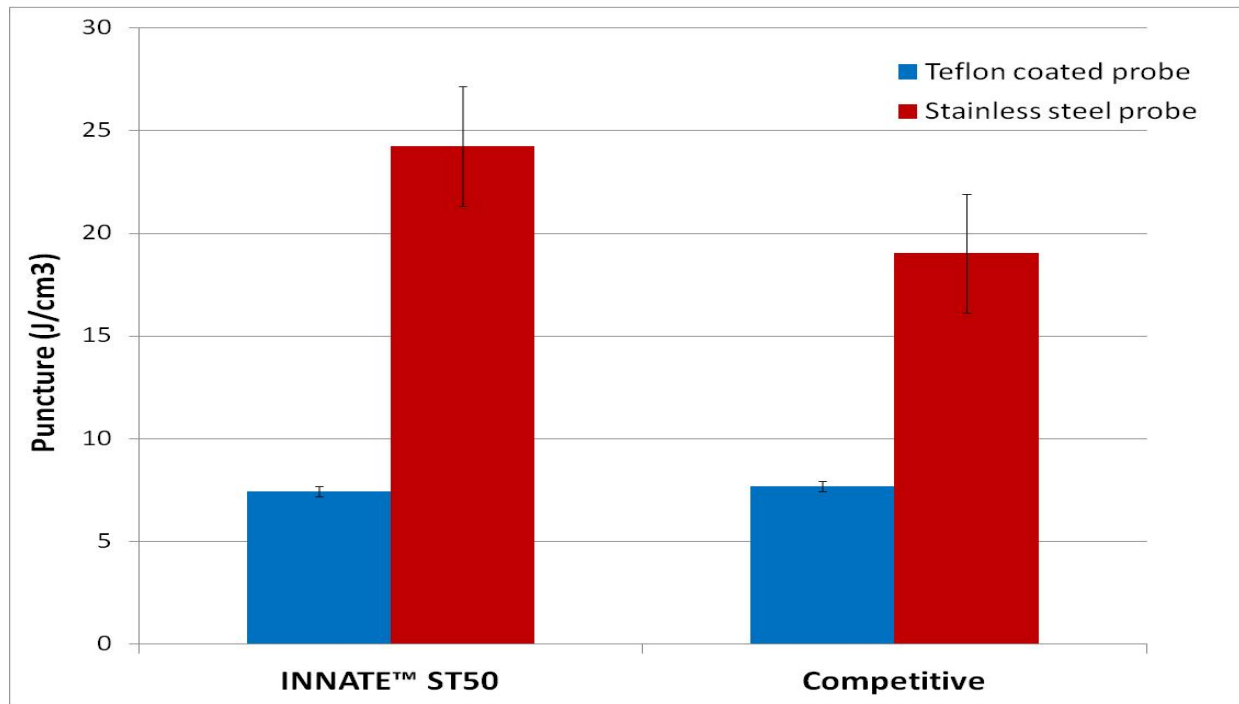
INNATE™ ST50 (0.85 MI, 0.918 d) is similar or better in tear performance vs. competitive mLLDPE grade (1 MI, 0.918 d).



Excellent Puncture (1 mil film)



Puncture



**Monolayer
100% abuse resin**

■ Stainless steel probe
■ Teflon coated probe

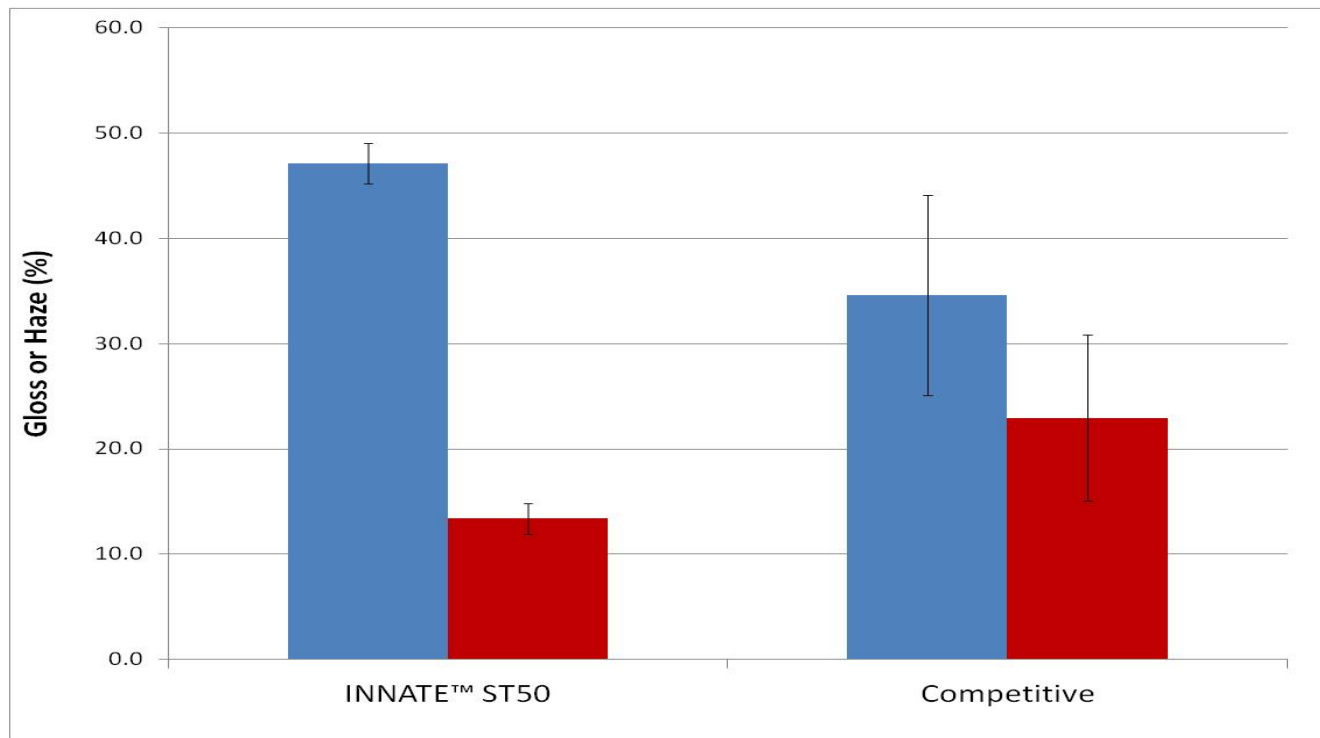
INNATE™ ST50 (0.85 MI, 0.918 d) provides comparable or higher puncture to competitive mLLDPE grade (1 MI, 0.918 d).



Good Optics Performance (1 mil film)



Optics



**Monolayer
100% abuse resin**

■ Gloss, 45 deg
■ Haze

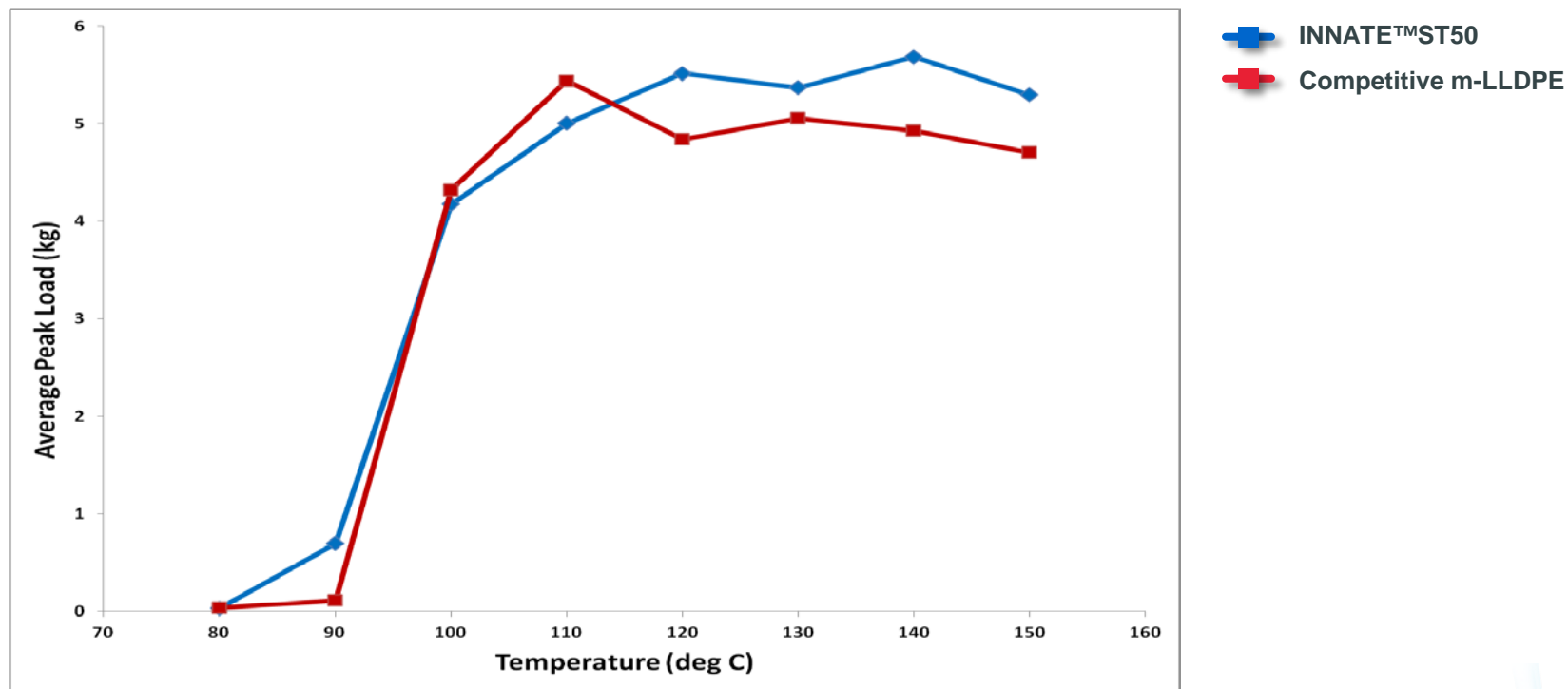
INNATE™ ST50 (0.85 MI, 0.918 d) exhibits better optics vs. competitive mLLDPE grade (1 MI, 0.918 d).



Robust Heat Seal Performance (1 mil film)



Heat Seal



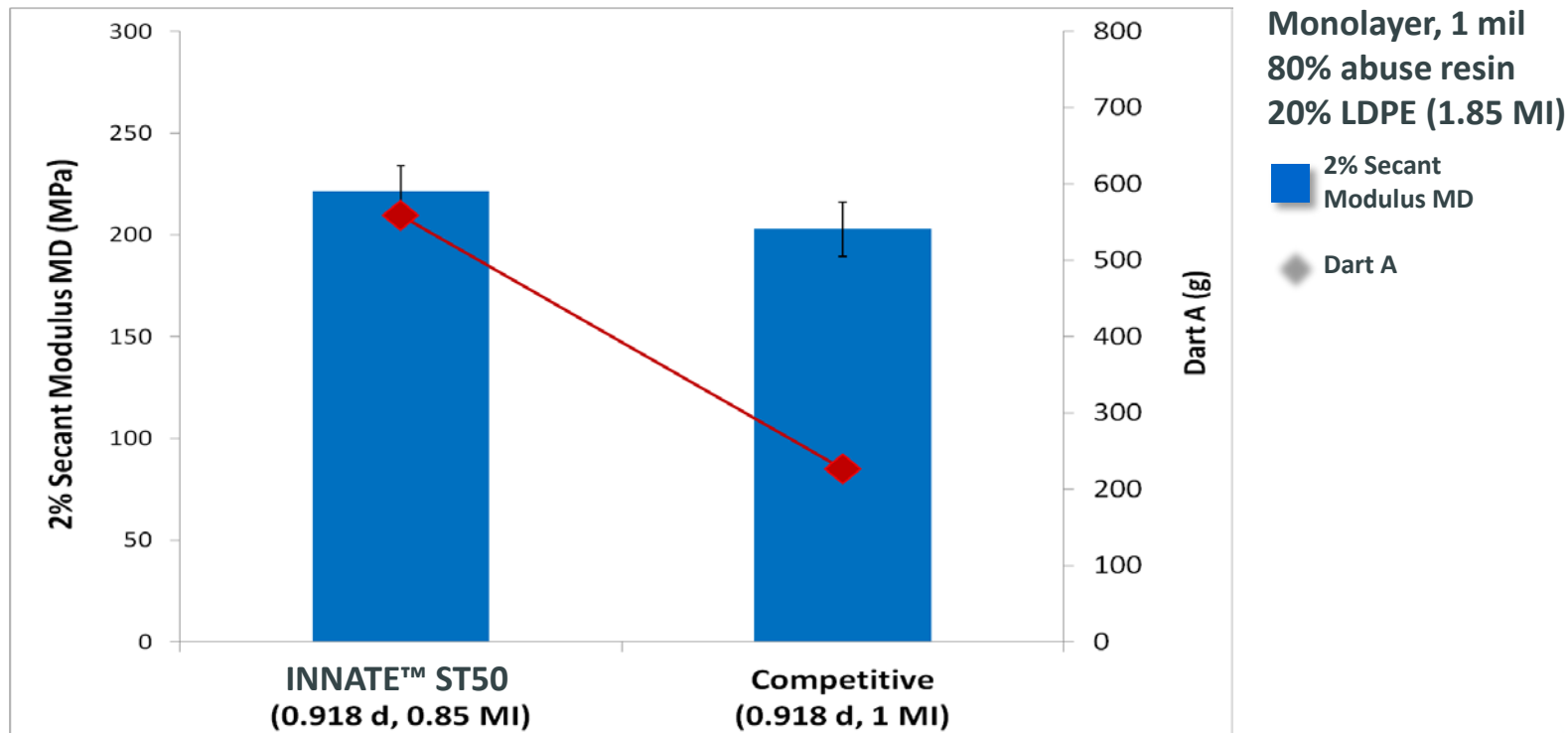
INNATE™ ST50 (0.85 MI, 0.918 d) has similar heat seal performance vs. competitive mLLDPE grade (1 MI, 0.918 d).



Unprecedented Stiffness-Toughness Performance (LDPE blends)



2% Secant Modulus MD and Dart A



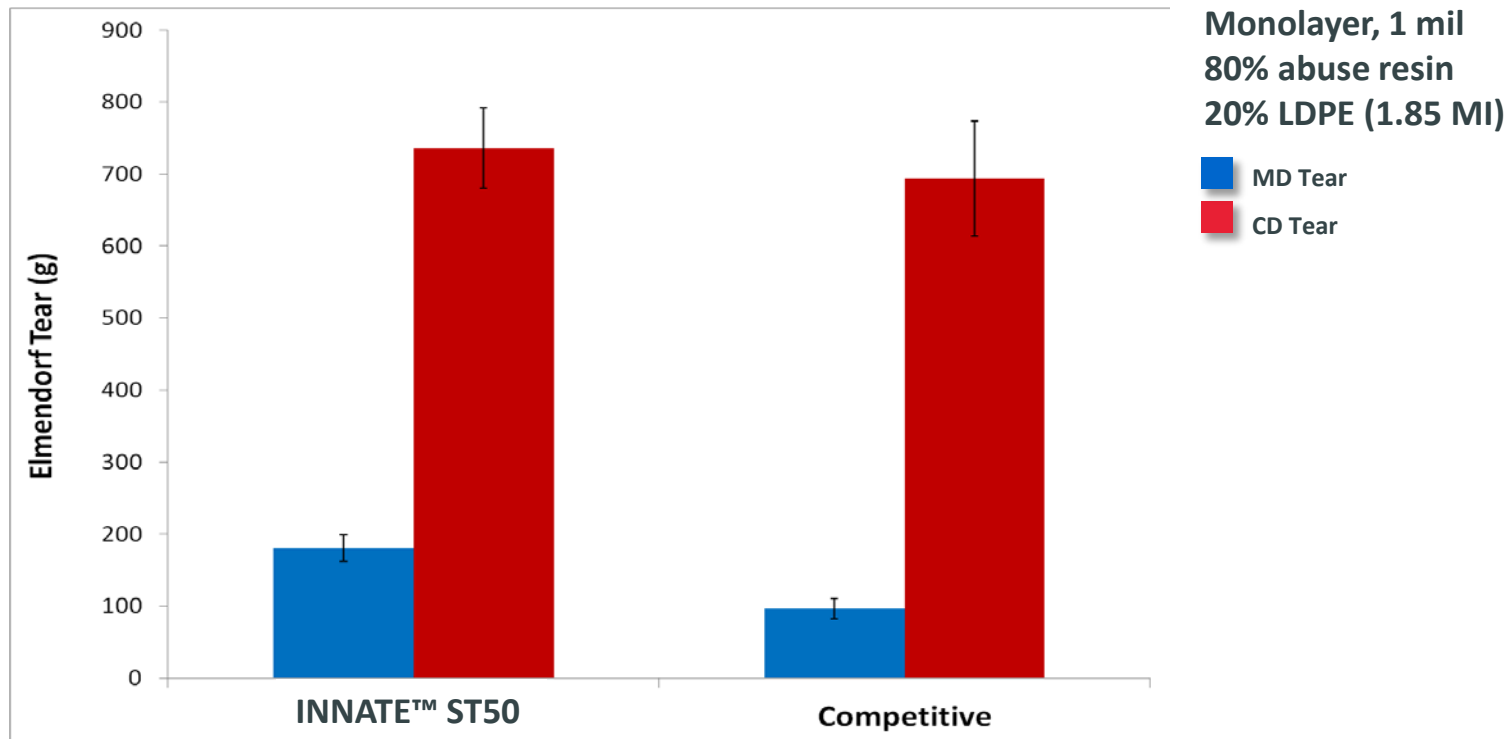
In LDPE blends, INNATE™ ST50 exhibits significantly higher dart performance at similar modulus vs. competitive mLLDPE grade.



Excellent Tear Performance (LDPE blends)



Tear

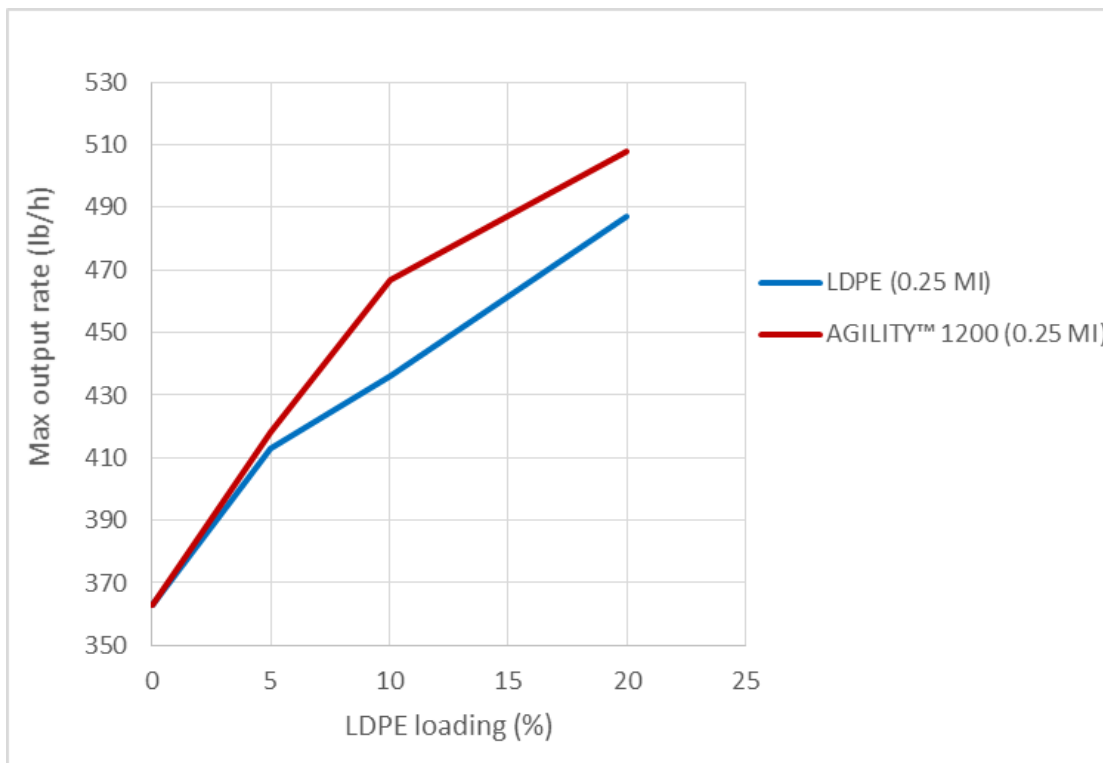


INNATE™ ST50 (0.85 MI, 0.918 d) provides similar or better in tear performance vs. competitive mLLDPE grade (1 MI, 0.918 d).





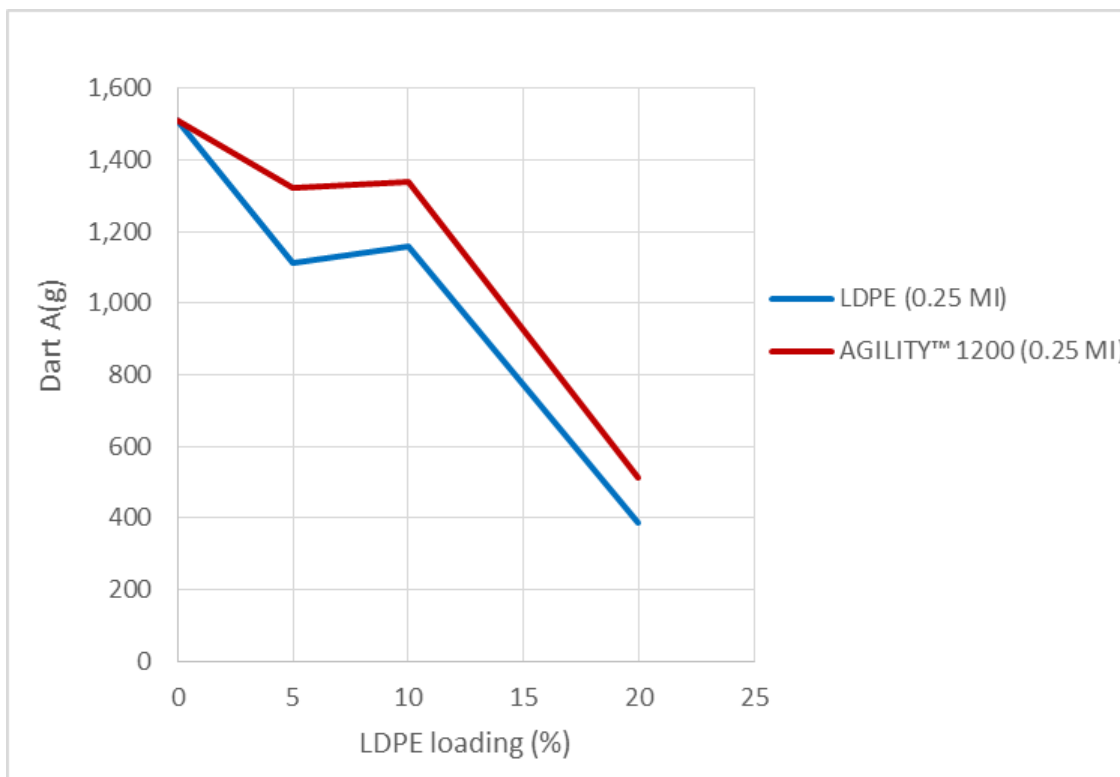
INNATE™ ST50 + AGILITY™ LDPE Synergy



INNATE™ ST50 + AGILITY™ LDPE blends exhibits higher output rate vs. blends with conventional LDPE



INNATE™ ST50 + AGILITY™ LDPE Synergy



INNATE™ ST50 + AGILITY™ LDPE blends exhibits higher dart impact vs. blends with conventional LDPE





HEAVY DUTY SHIPPING SACKS



Heavy Duty Shipping Sacks



For HDSS needing ***improved film mechanics and/or down-gauging***, INNATE™ Precision Packaging Resin provides unprecedented stiffness/toughness balance vs. traditional mLLDPE with excellent processability and ***robust bag drop performance with up to 10%* reduction in thickness.***

Product:

INNATE™ ST50 Precision Packaging Resin

*Down-gauging values based on Dow testing and is specific to the film structure. Users should confirm results by their own tests.

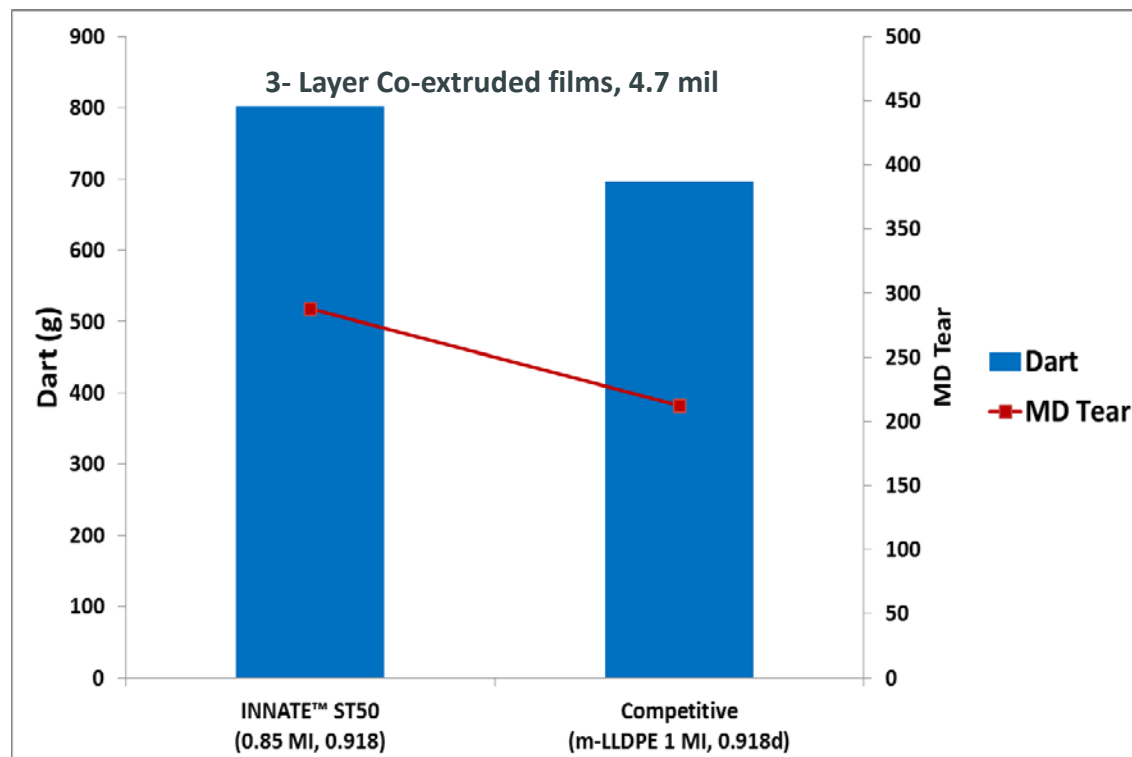
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HDSS - Outstanding Toughness Performance



A/B/A Structure
A = LLDPE / LDPE
B = LLDPE / HDPE



INNATE™ ST50 provides better dart / tear balance vs. a competitive grade at the same density



HDSS – Down-gauging Case Study



Bag Drop Setup



Bag Drop Test Procedure

- ✓ Drop bags using Lansmont Drop Tester in Pack Studios
- ✓ Drop Height ~ 5 ft, 3 drops for each bag : Side, bottom and face
- ✓ Pass/Fail Test: Any failure which results in significant resin leak from bag

Down-gauged Drop Test Results (Drop height 5 ft, 63F)

Sample	MI (g/10 min)/ Density (g/cc)	Gauge (mil)	# of Pass	Success Rate (%)
INNATE™ ST50	0.85/0.918	4.23	5/5	100
Competitive	1/0.918	4.23	3/5	60

INNATE™ ST50 provides improved bag drop performance compared to competitive grade





LIQUID PACKAGING



Liquid Packaging – Bag-in-Box



For bag-in-box liquid packaging needing ***robust flex crack performance and toughness***, INNATE™ Precision Packaging Resin provides excellent stiffness/toughness balance vs mLLDPE with ***down-gauging potential of up to 18%****.

Products:
XUS¹ 59910.03
XUS¹ 59910.04

*Down-gauging values based on Dow testing and is specific to the film structure. Users should confirm results by their own tests.

¹Developmental product of The Dow Chemical Company

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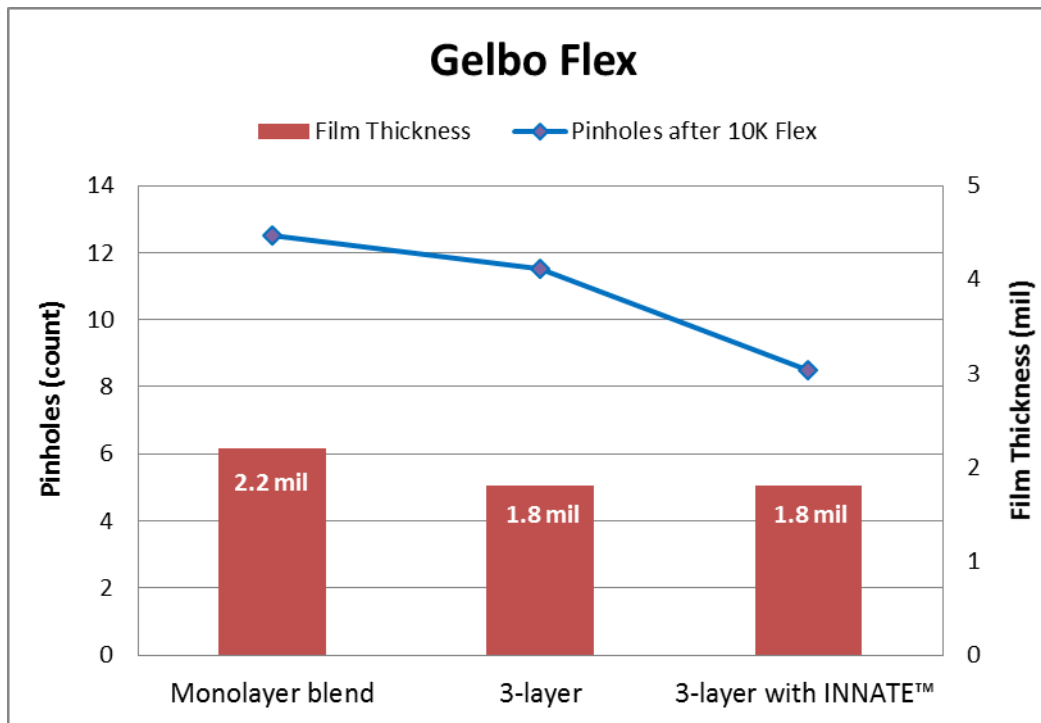
Liquid Packaging: Robust Flex-crack Performance



Monolayer 2.2 mil (LLDPE blend)

3-layer coex 1.8 mil (competitive m-LLDPE/LLDPE/competitive m-LLDPE 10/80/10)

3-layer coex 1.8 mil (INNATE™/LLDPE/INNATE™ 10/80/10)



Down-gauging with INNATE™ exhibited a significant reduction in the occurrence of pinholes during flex crack evaluations.



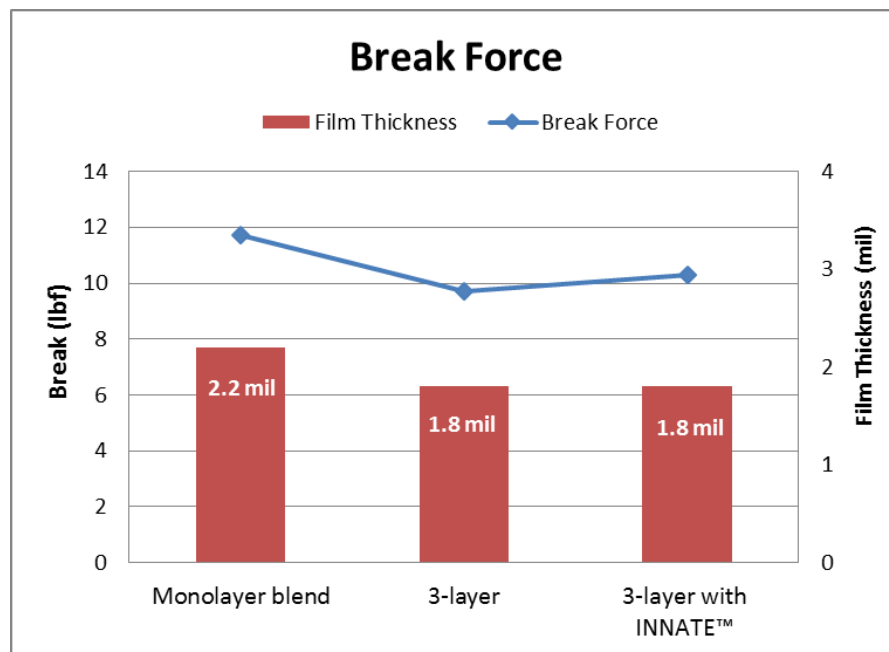
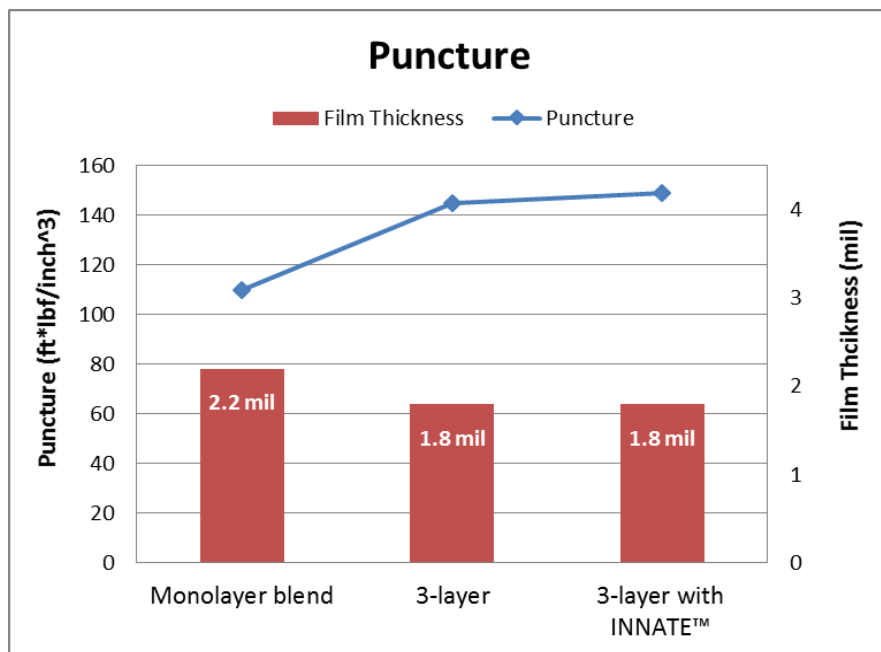
Liquid Packaging: Comparison of Puncture



Monolayer 2.2 mil (LLDPE blend)

3-layer coex 1.8 mil (Abuse /LLDPE/Abuse 10/80/10)

3-layer coex 1.8 mil (INNATE™/LLDPE/INNATE™ 10/80/10)



- **INNATE™ based structure exhibited improved puncture energy.**
- **The puncture load at the break of the down-gauged film decreased slightly.**



¹Developmental product of The Dow Chemical Company

INNATE™ Precision Packaging Resins Offer:



- Film toughness without compromising stiffness and other key properties
- Excellent sustainability profiles due to light-weighting potential
- Opportunities for new packaging efficiencies through material substitution
- Up to twice the abuse resistance in co-extruded films compared to tested standard polyethylene resins on the market
- Processing ease with excellent bubble stability
- Excellent blending capabilities (esp. with AGILITY™ LDPE) to increase film performance



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