TAPPI INTERNATIONAL FLEXIBLE PACKAGING & EXTRUSION DIVISION

2024 FlexPack PLACE Conference

April 14-17, 2024 • San Diego, CA • Wyndham San Diego Bayside

CHEMISTRY THAT MATTERS™

VALUE CHAIN COLLABORATION

WITH FOCUS ON HEAVY DUTY SACKS

Erik Dunham – SABIC – Lead Engineer Market Development, Americas

Tony Yaacoub – INDEVCO – Customer Success, Director

TAPPI 2024 FlexPack PLACE – April 16, 2024

INDEVCO PACKAGING SOLUTIONS

BENEFITS OF VALUE CHAIN COLLABORATION

- Efficiency to market
- Stronger value propositions for converters, brand-owners, and end-users
- Robust solution development that fosters innovation
- Sustainability platform access for potential circularity programs
- Practical application testing & feedback for supplier materials
- Supplier material & expertise collaboration for targeted structure evaluations

HEAVY DUTY SACKS DEFINED

Typical Applications

- Granulates, resins
- Building materials
- Chemical intermediates
- Feeds
- Seeds, fertilizer
- Salts

Design Features

- Process speed in extrusion and filling
- High dimension stability (creep)
- Robust impact (drop) performance
- Toughness and tear resistance
- Excellent sealing and hot-tack

Application Needs

- Contain loads up to 110 lbs
- Extended shelf life
- Protection from moisture, sunlight
- Environmental stress crack resistance

Industry Challenges

- Excellent bag integrity
- Sustainable needs, including film down-gauging and recycle usage
- Sealing performance
- Cost effective solutions
- Hot-tack for form-fill-seal processes
- Pallet stacking and stability

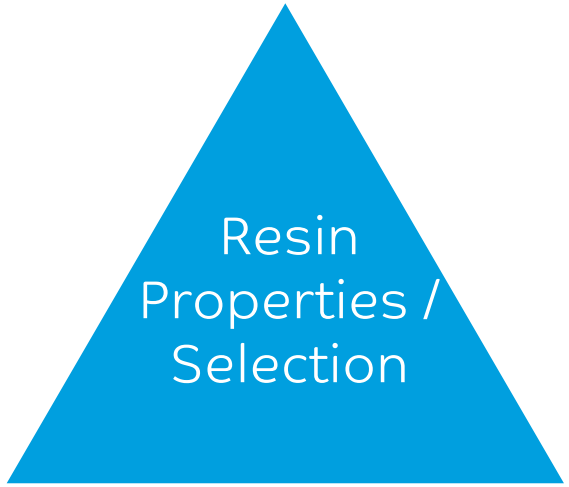
FOUR CONSIDERATIONS

BALANCING NEEDS AND CHALLENGES OF APPLICATION

1) Raw materials
2) Extrusion
3) Packaging
4) End-use

HEAVY DUTY SACK CONSIDERATIONS: 1) RAW MATERIALS

sabic



Resin Supplier & Converter

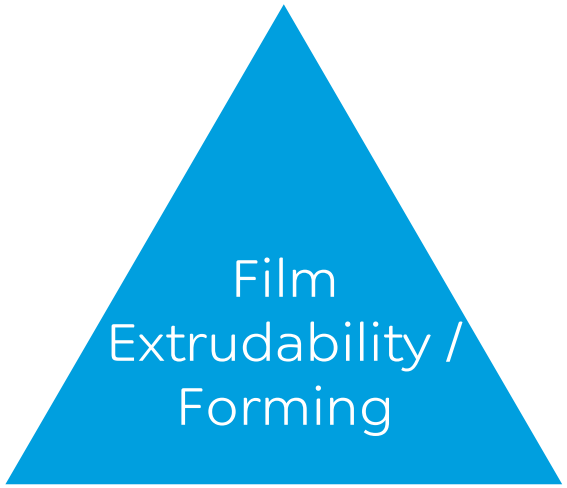
- Resin supplier provides material expertise
  - Physical property data / comparisons
  - Rheology
  - Portfolio of complementary grades
  - Pricing
- Converter provides specification needs
  - Viscosity ranges
  - Sealing, thickness, and film strength
  - Coextrusion – number of layers / needs for each

SABIC

CRITICAL PHYSICAL PROPERTY NEEDS FOR HEAVY DUTY SACKS

Creep Resistance Strength	HDPE	Fractional Melt Index HDPE Also provides moisture barrier, ESCR, and stiffness for stackability
Impact Resistance, Puncture & Tear	LLDPE	0.8 - 1.0 Melt Index LLDPE Density in 0.912 – 0.918 g/cm^3 range
Toughness Strong, Fast Sealing	mLLDPE	Metallocene-catalyzed LLDPE Added strength for downgauging

HEAVY DUTY SACK CONSIDERATIONS: 2) EXTRUSION



Converter

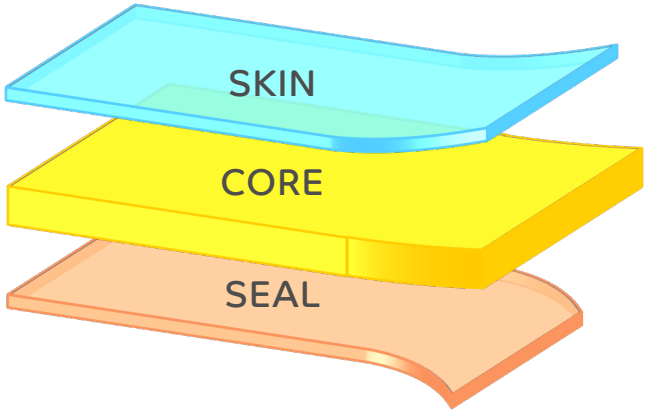
- Extruder
  - Blend uniformity (UV, colorant, and slip/antiblock)
  - Layer and rheological stability
  - Extrusion constraints
  - Processing focused additives
- Film
  - Tube can open easily
  - Bubble smoothly slides over gusseting equipment
  - Surface COF and embossing for handling / stacking
  - Printing considerations

sabic

EXTRUSION – STRUCTURAL CONSIDERATIONS

Outer Skin
- COF high enough for stacking, low enough for gusset openability
- Gloss ideal for marketability
- UV for outdoor storage
- Embossing / perforation

All with processability for:
- Bubble stability
- High line speed
- Adequate thickness
- Smooth appearance



LLDPE, mLLDPE, LDPE, UV, Antiblock

HDPE, LLDPE, mLLDPE, Color, Recycle

mLLDPE, POP, Antiblock

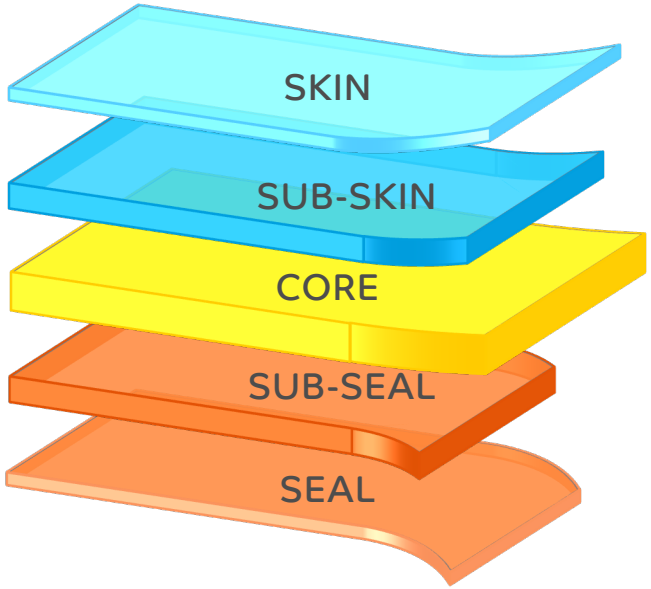
Core
- High stiffness
- High toughness
- Recycle
- Keeps color away from die lips

Inner Skin (Seal)
- Low seal initiation temperature for speed
- High hot-tack strength (VFFS)
- Easy openability of bag

EXTRUSION – STRUCTURAL CONSIDERATIONS

Sub-Skin
- Plastomer for toughness without making skin too tacky
- Put additives here to keep recycle in core

5-Layer Structure



LLDPE, mLLDPE, HDPE, LDPE, UV, Antiblock

LLDPE, mLLDPE, POP

HDPE, LLDPE, mLLDPE, Color, Recycle

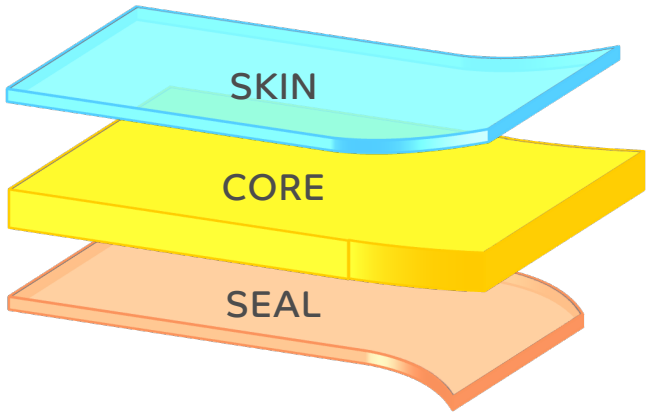
LLDPE, mLLDPE, POP

mLLDPE, POP, HDPE, Antiblock

Sub-Seal
- Potentially use to modify sealing without blocking impact
- Further modify stiffness / toughness with HDPE or LLDPE/POP

sabic

STRUCTURES EXTRUDED FOR ANALYSIS

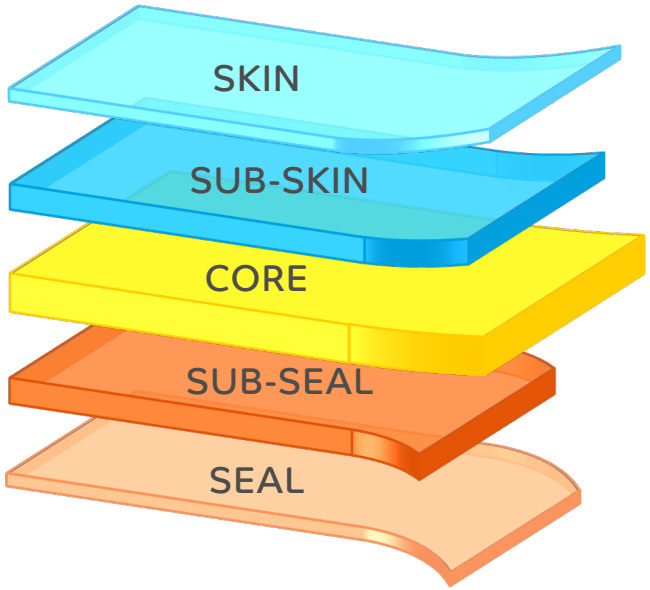


$mLLDPE_1$, Antiblock MB, UV MB

HDPE, **$mLLDPE_1$**, $CaCO_3$, White MB

$mLLDPE_1$, Antiblock MB

Layer Ratio:
25 / 50 / 25



$mLLDPE_1$, **HDPE**, Antiblock MB, UV MB

$mLLDPE_2$

HDPE, **$mLLDPE_1$**, $CaCO_3$, White MB

$mLLDPE_2$

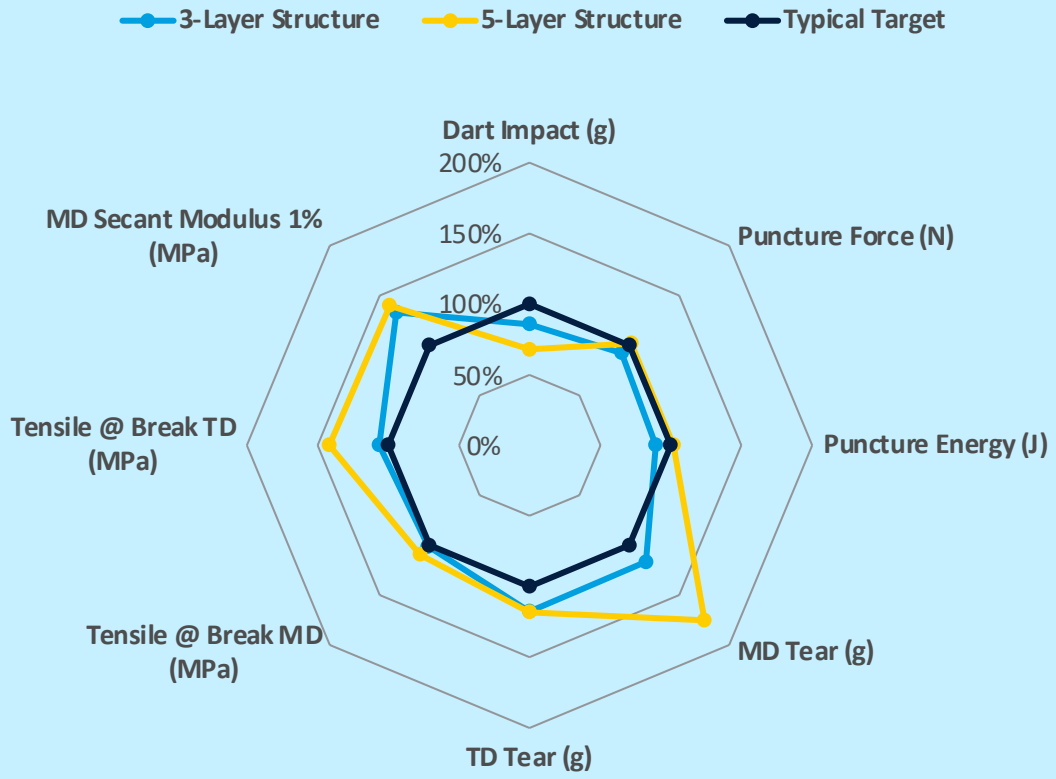
$mLLDPE_1$, **HDPE**, Antiblock MB

Layer Ratio:
10 / 20 / 40 / 20 / 10

Resins Utilized:
HDPE: 0.7 MI, 0.960 g/cm^3
$mLLDPE_1$: 1.0 MI, 0.918 g/cm^3
$mLLDPE_2$: 1.0 MI, 0.915 g/cm^3

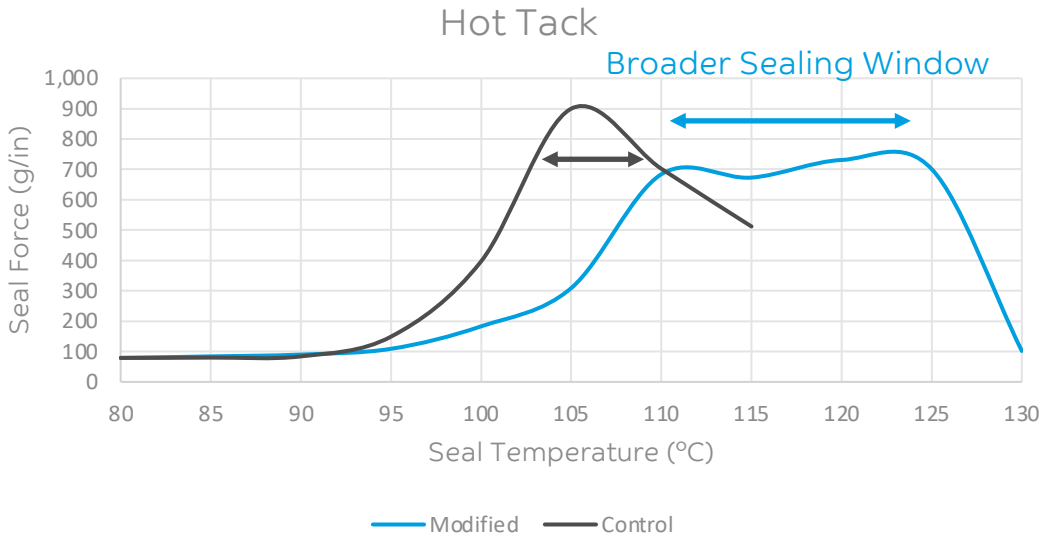
STRUCTURES EXTRUDED FOR ANALYSIS
PHYSICAL PROPERTY BALANCING

Balancing Properties in Heavy Duty Sacks



Balance material ratios and positioning within layers to meet specification needs

Then modify to improve dart, tensile, tear, puncture, or even sealing window



HEAVY DUTY SACK CONSIDERATIONS: 3) PACKAGING

Converter & Copacker

- Filling
  - Tube handling COF
  - Openability
  - Gusset and width compliance for filling
- Sealing
  - Optimized sealing window
  - Seal strength through multiple plies
  - Consistency across lots
  - Passes drop testing
- Stacking
  - Bags stay in place prior to wrap/hood
  - Bag sizing ideal for pallet geometry

FILLING, SEALING, STACKING – COPACKER NEEDS

Drop test – performed flat (pictured) and vertical (standing bag)

Full stacked pallet contained by stretch hood

HEAVY DUTY SACK CONSIDERATIONS: 4) END-USE

sabic

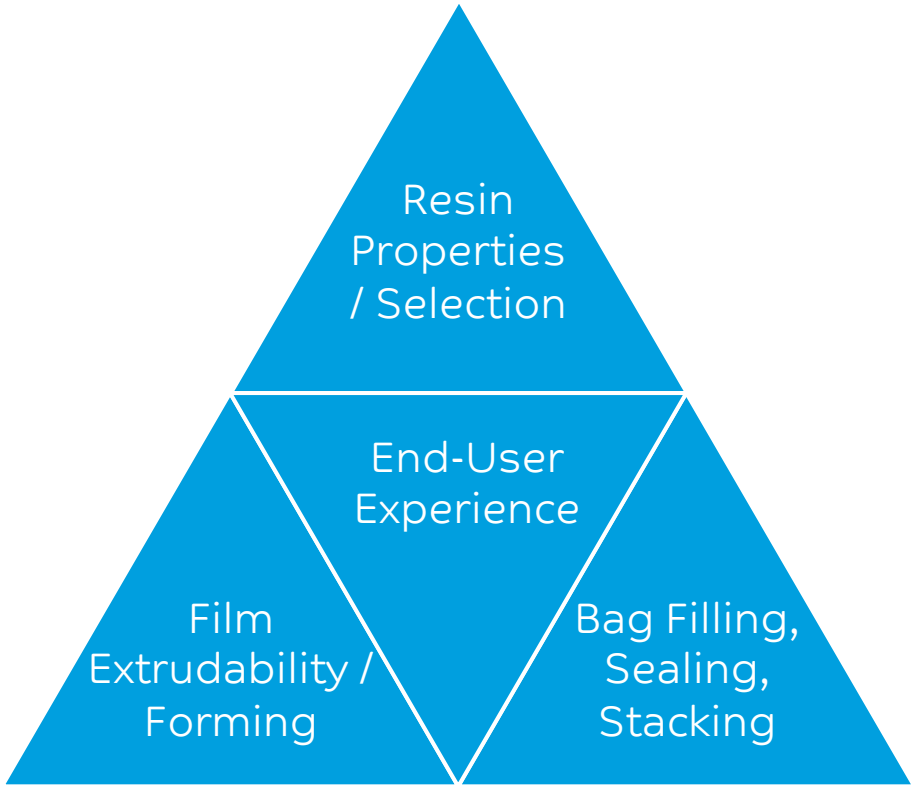
End-User Experience

Converter & Resin Supplier

- No failures in shipment
- Structural integrity and stability during storage
- Bag openability
- Bag appearance

HEAVY DUTY SACK CONSIDERATIONS OVERALL

Collaboration is key in each case

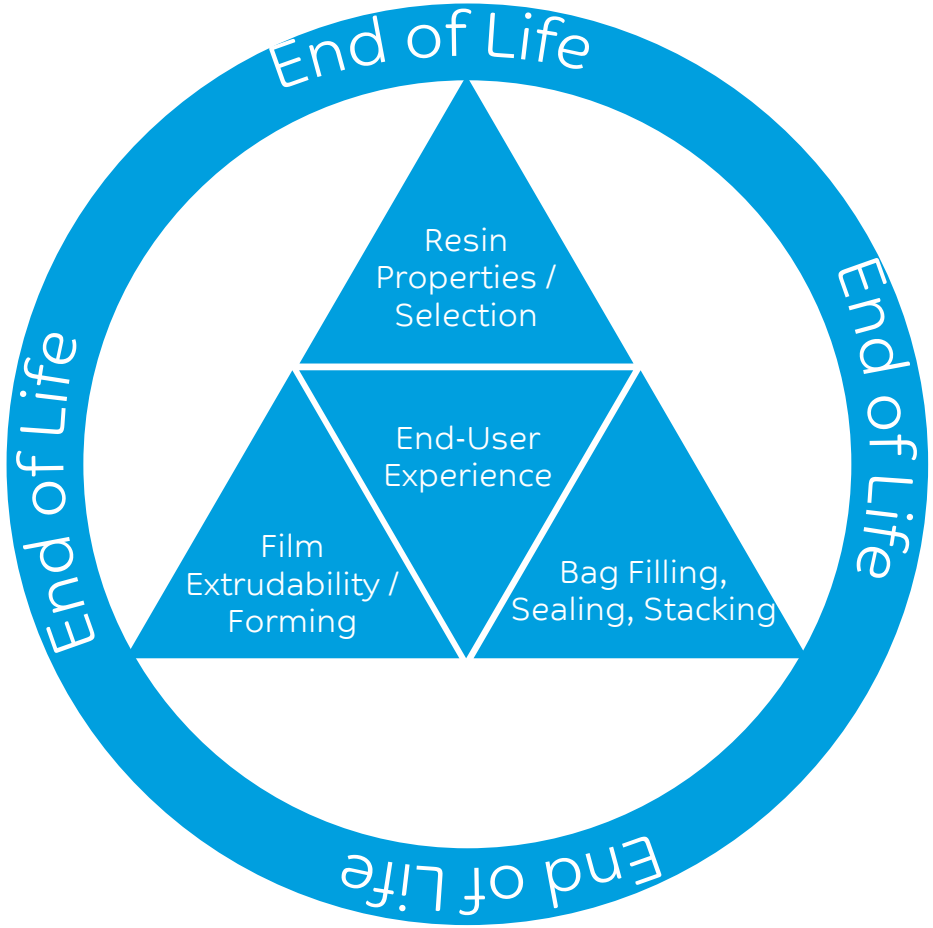


All must come together for the ideal structure

sabic

A FIFTH CONSIDERATION

END OF LIFE

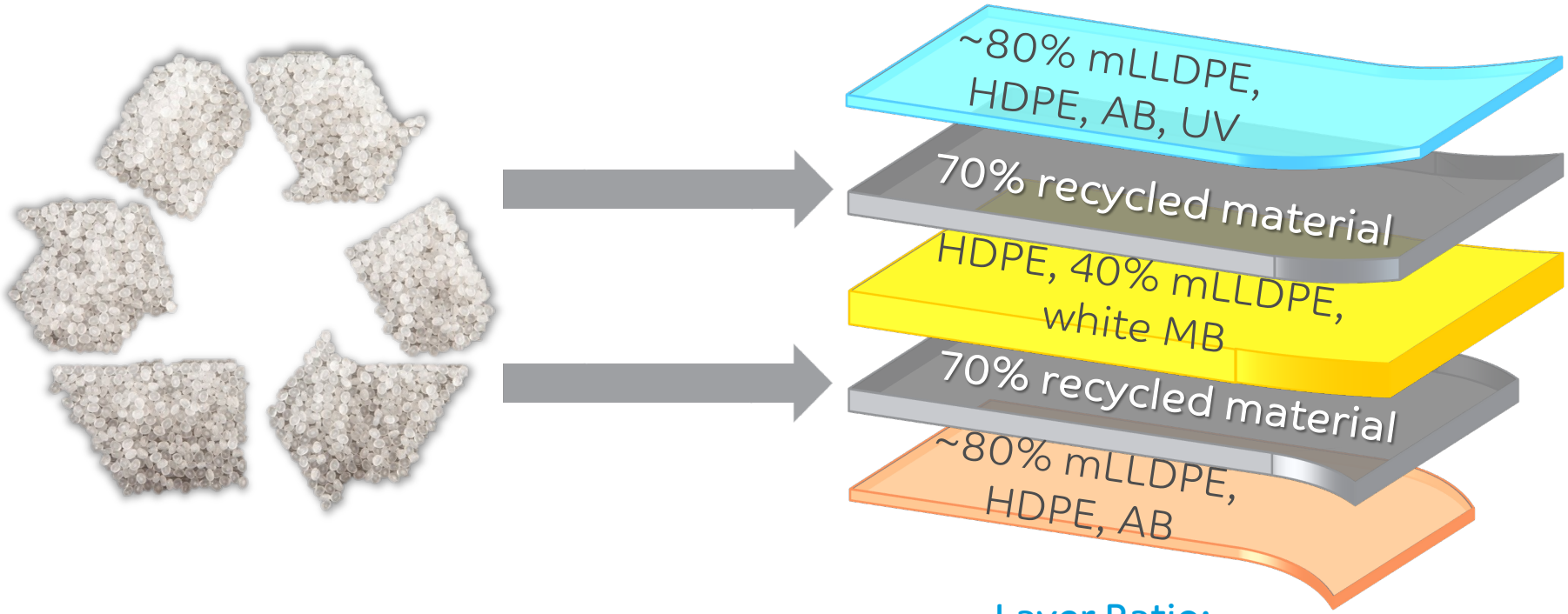


MECHANICAL RECYCLING: KEY ENABLERS DRIVING IMPLEMENTATION

Uncontaminated waste streams	Access to high quality waste streams containing low level of impurities (e.g. other polymer types)
Technology developments	Advances in the area of waste collection and sorting, as well as processing of recycled streams into plastic products
Market adoption	Acceptance of mechanical recycling solutions by brands and consumers
Value chain partnerships	Work along the entire value chain to develop solutions and improve overall recyclability

Let's THINK AND WORK TOGETHER to address main challenges on mechanical recycling

HIGH QUALITY RECYCLE: 28% TOTAL INCORPORATION



Layer Ratio:
10 / 20 / 40 / 20 / 10

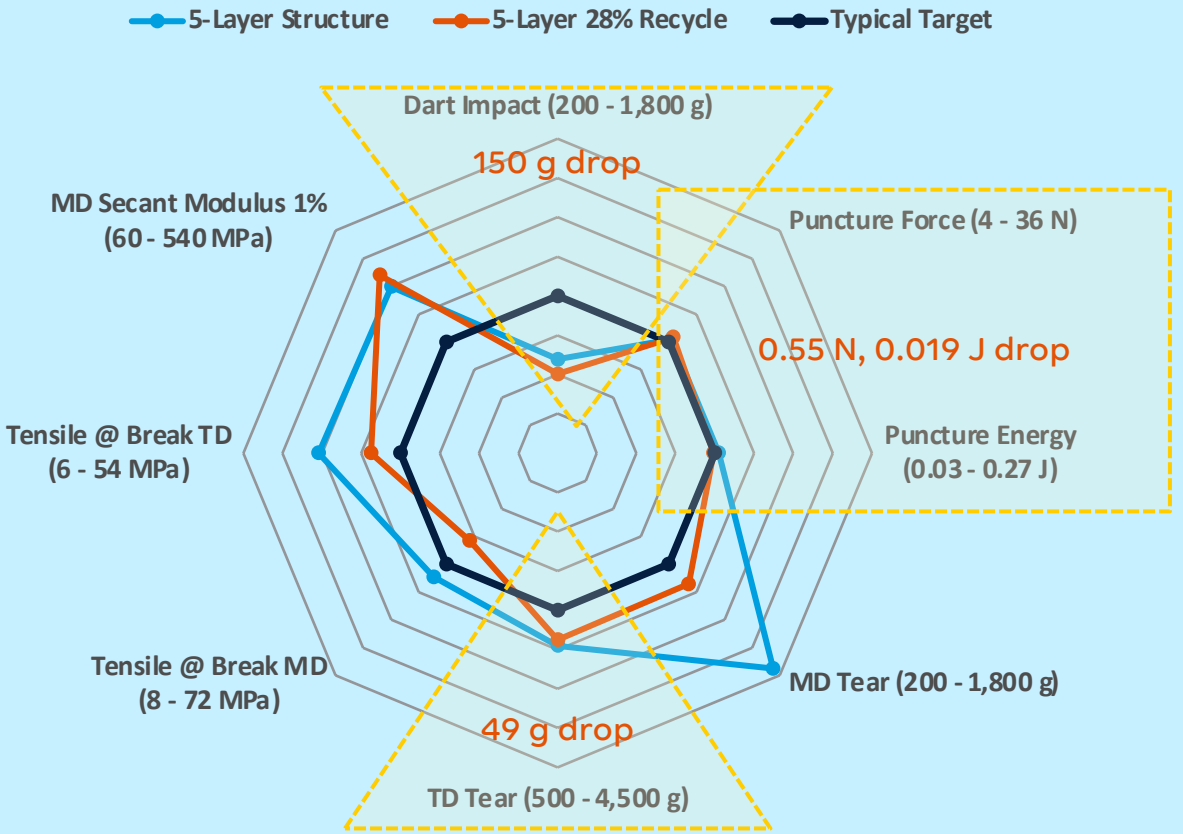
HIGH QUALITY RECYCLE: HIGH PERFORMANCE PROPERTIES

sabic

Going from **Virgin** to **Recycle:**

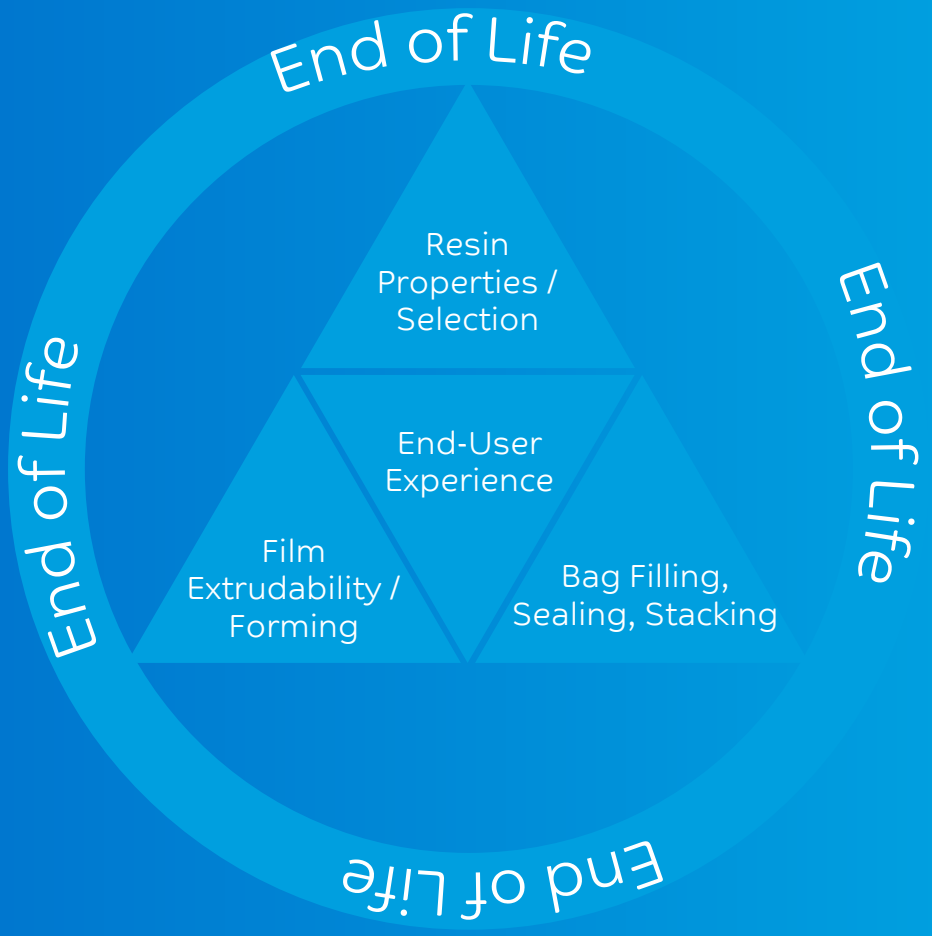
- Minimize **Dart** loss
- Consistent **Puncture**
- Consistent **TD Tear**

Balancing Properties in Heavy Duty Sacks with Recycled Content



VALUE CHAIN COLLABORATION

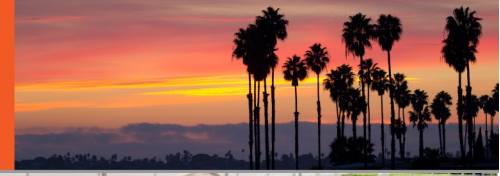
WORKING TOGETHER TO BENEFIT ALL



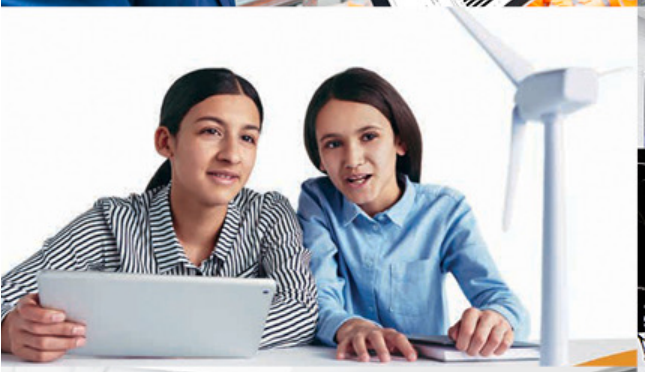
TAPPI INTERNATIONAL FLEXIBLE PACKAGING & EXTRUSION DIVISION

2024 FlexPack PLACE Conference

April 14-17, 2024 • San Diego, CA • Wyndham San Diego Bayside



THANK YOU



IN COLLABORATION WITH

INDEVCO

PACKAGING SOLUTIONS