TAPPI INTERNATIONAL FLEXIBLE PACKAGING & EXTRUSION DIVISION

2024 FlexPack PLACE Conference

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

5 Things You Need to Know About Oriented Films

Erica Canavesi

Presentation Overview

1. Recyclable packaging and the need for oriented PE Films
2. Oriented PE films vs other oriented films
3. Designing high performance all PE packaging solutions
4. Recyclable packaging case studies using BOPE-HD
5. Market trends and conclusions

Our Purpose

We are Reshaping Plastics for a Better, More Sustainable World

By delivering innovative solutions to make everyday life healthier and safer

By being a catalyst for a low-carbon, zero-plastic-waste future

By unlocking the full potential of our people and partnerships

Recyclability is Impacting Purchasing Decisions

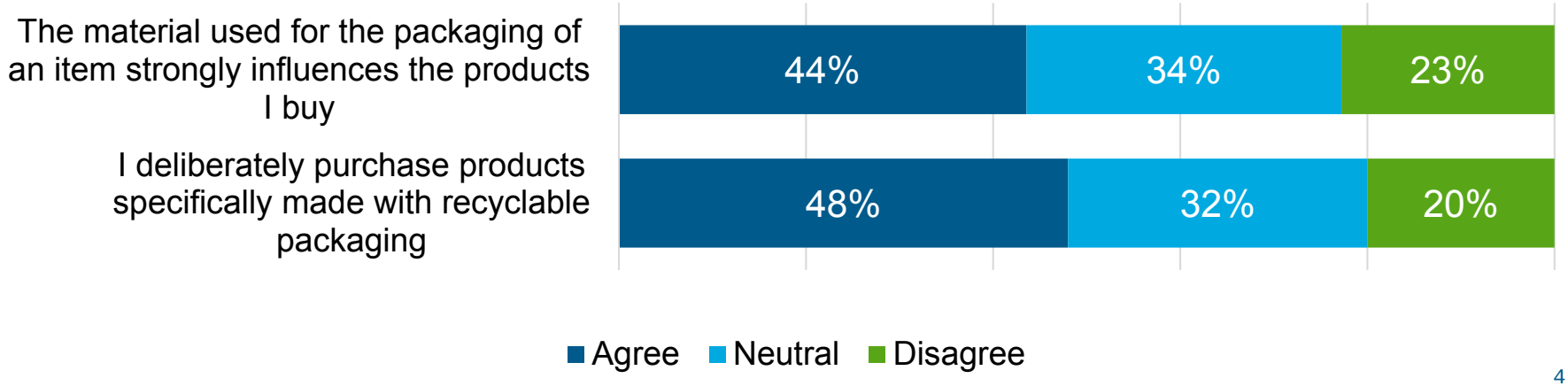
Consumer survey performed by Schmidt Market Research (**funded by NOVA*)

Online survey conducted in May 2023

Consumers in Canada & the US aged 21-60

953 respondents
Canada:418
US:535

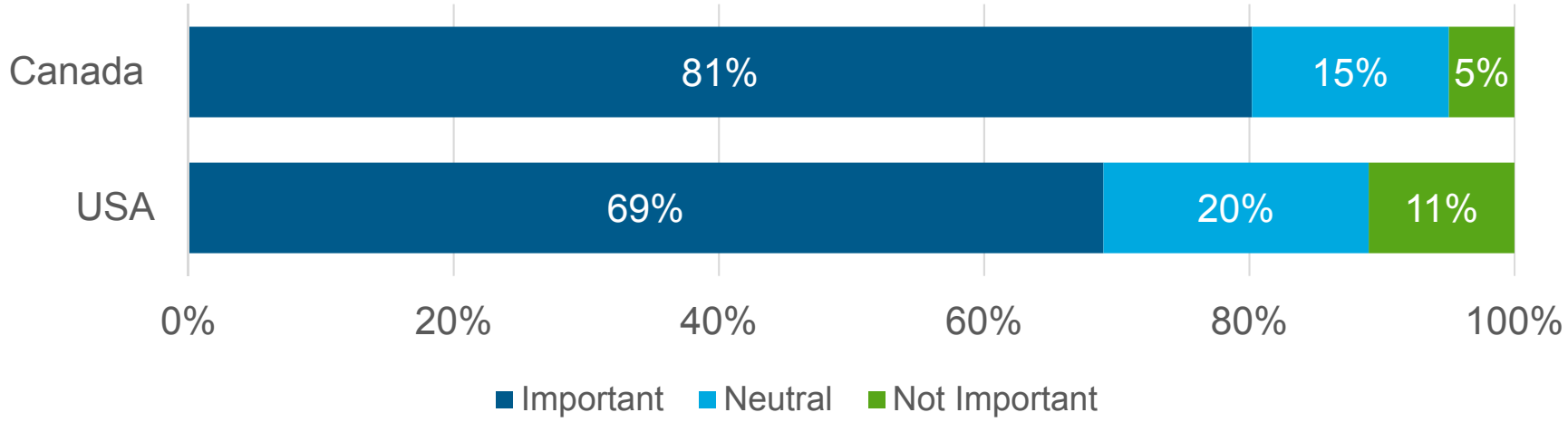
Packaging recyclability is impacting consumer purchase decisions



Recyclability Is A Top Priority for Consumers

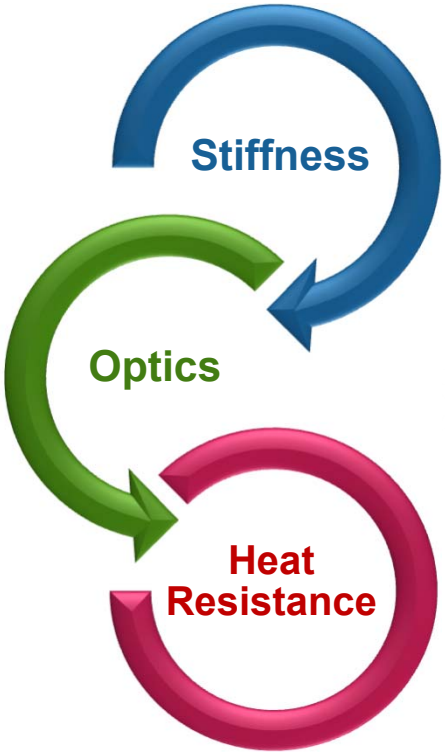
When polled, consumers rank the recyclability of packaging as their top priority among all other aspects

How important are the following aspects of packaging products to you?
Ability to Recycle the Packaging (2023)



Enhancing Film Properties Through Orientation

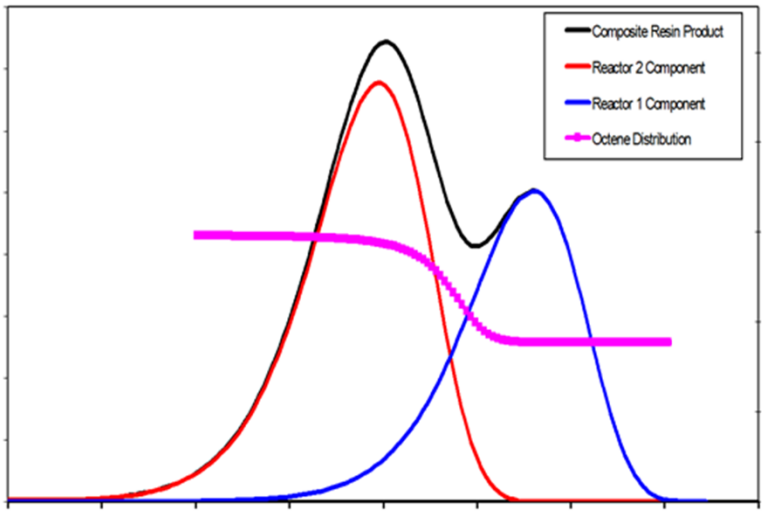
Properties	Blown Film	MDO	BOPE
Orientation	BUR 2.5:1	7 : 1	4 x 8
Target Gauge (mil)	1.0	1.0	1.0
Haze (%)	13	5	2
Dart Impact F_{50} (g/mil)	1180	115	775
Elmendorf Tear MD (g/mil)	285	345	35
Elmendorf Tear TD (g/mil)	460	1200	7
Tensile Strength MD (MPa)	60	170	115
Tensile Strength TD (MPa)	64	24	300
1% Secant Modulus MD (MPa)	160	640	420
1% Secant Modulus TD (MPa)	165	430	595



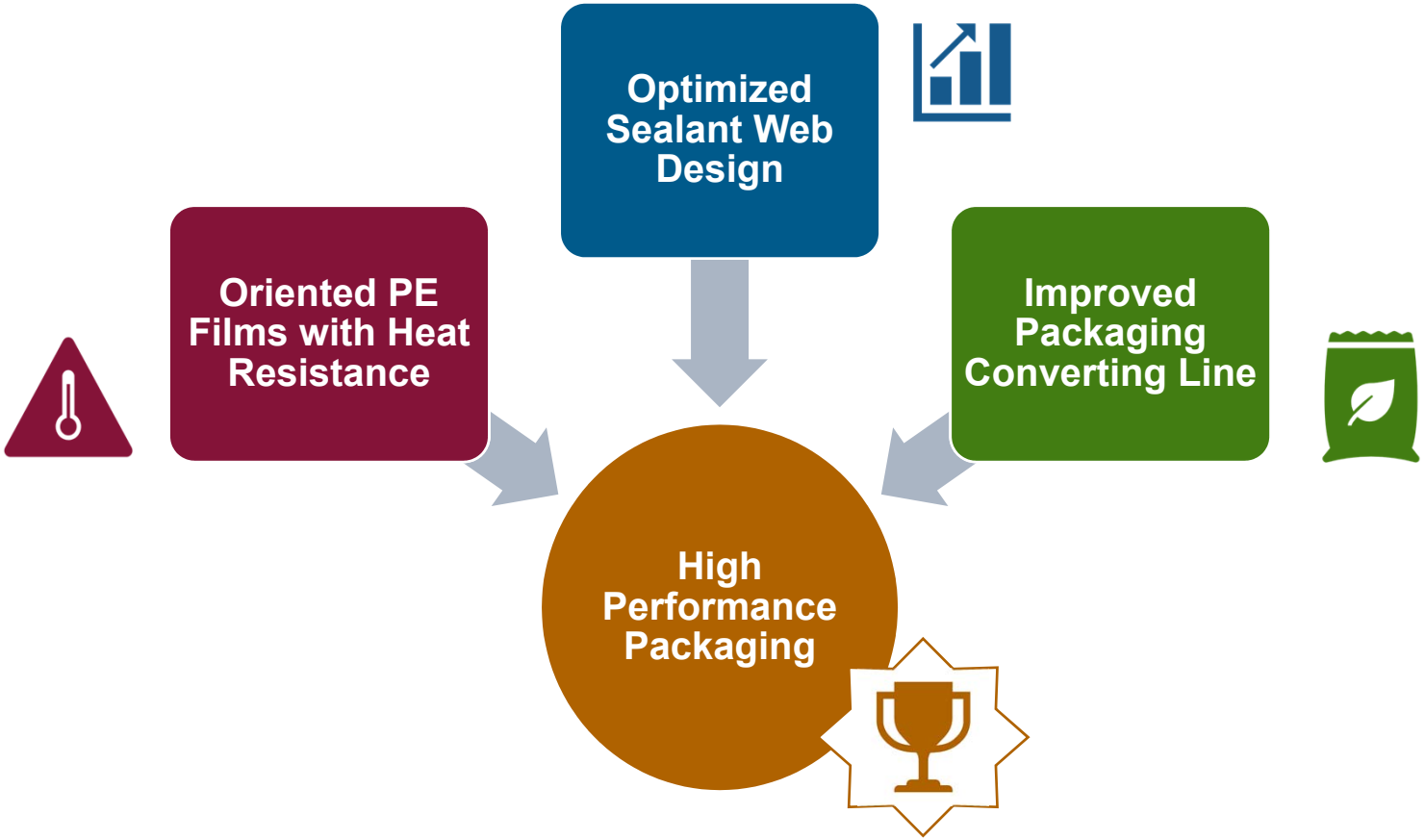
Our Solution Process Technology is Well Suited for PE Orientation

SCLAIRTECH™ and Advanced SCLAIRTECH™ process technologies are ideal for sensitive processes such as mono and biaxial orientation

- ✓ Dual reactor systems allow for optimization of molecular architecture;
- ✓ Removal of catalyst;
- ✓ Resins with low gel level;
- ✓ Customized additive packages to prevent degradation



Key Elements for the Creation of High Performance Recyclable Packaging



Legend of Resins in Following Slides

Grade	Melt Index (g/10min)	Base Resin Density (g/cc)	Ref Name
SURPASS® HPs153-A	1.1	0.954	“153”
SURPASS® HPs167-AB	1.2	0.967	“167”
SURPASS® TX150-A	1.4	0.950	“150”
SURPASS® SPsK919-F	0.85	0.919	“919”
SURPASS® VPs412-A	3.8	0.912	“412”
ASTUTE™ QPsK905-A	0.85	0.905	“905”
SCLAIR® FP020-F	0.75	0.920	“020”

Oriented PE Films with Heat Resistance

Transparent MDO-HD Film

Enabled by “153”
(Density 0.954 / MI 1.1)

- Haze 5%
- Stiffness 2500 MPa
- Excellent heat resistance

Transparent BOPE-HD Film

Enabled by “150”
(Density 0.950 / MI 1.4)

- Haze 5%
- Stiffness 1300 MPa
- Balanced properties

High Puncture Resistance MDO-LLD Film

Enabled by “919”
(Density 0.919 / MI 0.85)

- Puncture resistance 100 J/mm
- Haze 6%
- SIT 100°C

Sealable BOPE-HD and MDO-HD Films

Enabled by ”412”
(Density 0.912 / MI 3.8)

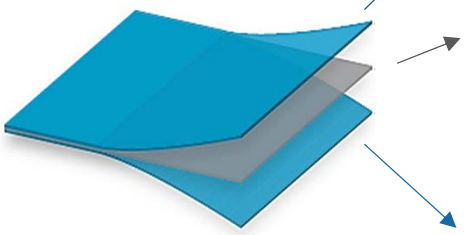
- Haze 8%
- SIT 95°C

Can Oriented PE Films replace PET or BOPP Films?

Property	Commercial Films			Oriented Films Developed	
	BOPP (20 µm)	PET (12 µm)	MDO-MDPE (25 µm)	BOPE Print Web (20 µm)	MDO Print Web (25 µm)
Haze (%)	3.5	2.5	8	5	5
45° Gloss	85	130	75	70	85
ASTM Puncture Force (lb_f)	26	25	2.7	26	8
1% Secant Modulus MD (MPa)	1590	4170	1358	1300	2090
1% Secant Modulus TD (MPa)	2700	4260	1300	1500	1510
Elmendorf Tear MD (g/mil)	5	10	71	8	72
Elmendorf Tear TD (g/mil)	5	15	155	10	275
Tensile Strength MD (MPa)	94	163	150	140	180
MVTR (g /100in^2 /day)	0.7	3.5	0.5	0.5	0.3
CoF (In/In)	0.25	0.20	0.35	0.45	0.30

Optimized Sealant Web Design for All PE Pouch

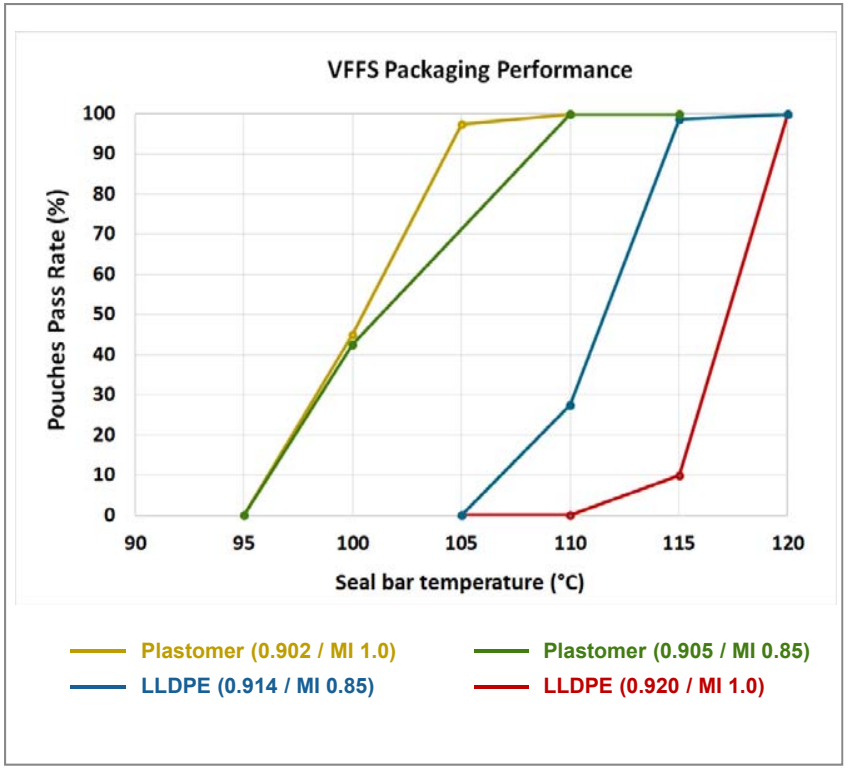
- **Sealant web can be a blown film or cast film product and the film must have good stiffness and low seal initiation temperature.**
- **Blown film example is shown here:**



LLDPE to MDPE:
Material select will depend on desired final heat resistance, stiffness, toughness

High Density (HDPE):
Provides much of the stiffness to the sealant web. Can use high barrier HDPEs to achieve very low WVTR using **"167"**

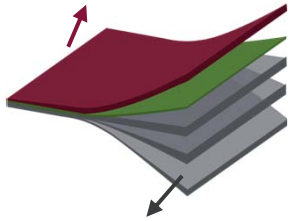
Plastomer:
Recommend **"905"** material with density between 0.900-0.910g/cc for low SIT



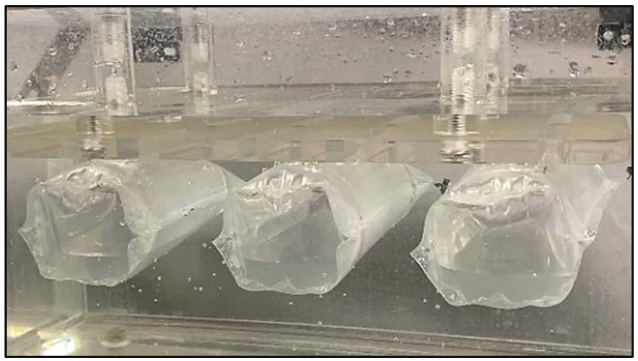
High Performance Packaging Design

HFFS Machine (60 ppm)

Packaging Structure	PE Coex Sealing Layer	Sealing Window (°T)																
PET/PE	LLDPE Octene (0.920 g/cc / MI 1.0)											60°C						
OPE 1/PE	Plastomer (0.905 g/cc / MI 0.85)					15°C												
OPE 1/PE	Plastomer (0.902 g/cc / MI 1.0)				20°C													
OPE 2/PE	Plastomer (0.905 g/cc / MI 0.85)					25°C												
	Vertical T (°C)	100	105	110	115	120	125	130	135	140	145	150	160	170	180	190	200	210
	Point Seal T (°C)	130																



Sealing Layer
(3 mil 9-layer all PE coex film)



Side Seal Bars (2 hits)

Point Seal (last hit)

Key element to avoid leaks in all PE packaging

Improved Packaging Converting Lines

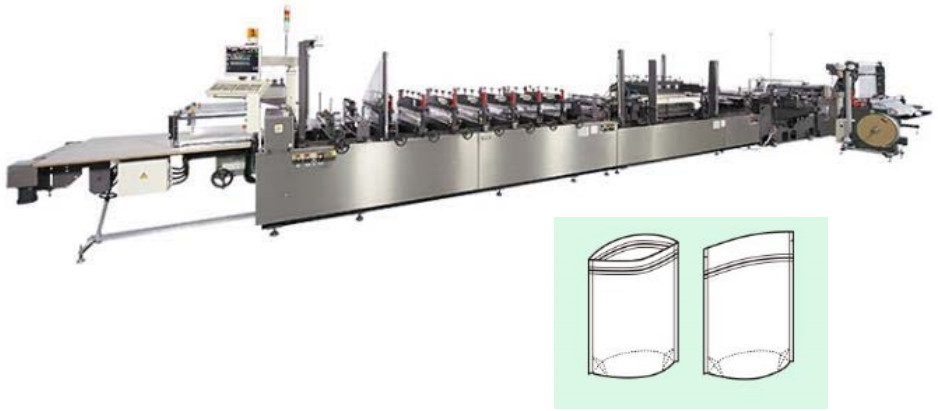
Equipment and material optimizations maximizing line speed for mono-material packaging

CT-40D Premade Pouch Line

Latest technology to improve processing of mono-material structures:

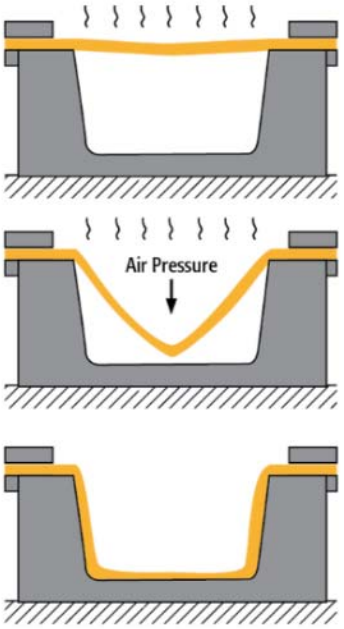
- Air blowers underneath the web when stopped to cool it
- Wider stand-off positions for hot seal jaws to lessen radiated heat
- Moving cross seal jaws that follow the eye marks all through the line if stretching occurs
- Point sealer at the pouch triple point
- Ultrasonic crush seal of the zipper ends

Packaging Structure	PE Coex Sealing Layer	Temperature (°C/F)	Speed (ppm)
PET/PE	LLDPE Octene (0.920 g/cc / MI 1.0)	200-215 390-420	170
OPE 1/PE	Plastomer (0.905 g/cc / MI 0.85)	195-210 380-410	170
OPE 2/PE	Plastomer (0.905 g/cc / MI 0.85)	185-205 370-400	165
OPE 3/PE	Plastomer (0.905 g/cc / MI 0.85)	180-200 360-390	160



Oriented PE Films for Recyclable Thermoforming Applications

- **OPE-LLD + non oriented PE sealant web** in a laminate can allow **removal of nylon** layers for a mono material forming web
- **EVOH can be included to provide oxygen barrier** and "**167" for moisture barrier**
- Runs on **conventional equipment** at normal settings at all stages
- Different thickness BOPE films available for shallow or deep draw applications



Example of OPE-LLD + 3-layer laminate:

Layer	Thickness	Purpose
OPE-LLD	1 mil	Orientation control
"020"	0.8 mil	Toughness
"167"	0.9 mil	Moisture barrier
"914"	0.8 mil	Performance sealant

- Potential to use 5 layers or more for EVOH inclusion

Mechanically Recycled rHDPE in BOPE-HD Film Case Study

SYNDIGO™
recycled polyethylene BY NOVA CHEMICALS

A Plastic with Renewed Purpose

- **Grade: rPE-0860-FC Resin**
- Sourced from natural HDPE milk jugs
- 99% post-consumer content
- 0.960 density | 0.8 MI
- Food contact approved in US
  - B through H conditions of use
  - All food types

rHDPE added to core layer of BOPE-HD film

rHDPE added to sealant web (blown film)

Total rPE loadings in stand-up pouch range from 25-45%

Market Trends & Conclusions

Consumer demand and regulatory pressure for recyclable packaging will fuel growth of oriented films

Oriented PE films are versatile building blocks to create recyclable packaging

- They can be used as a print web to replace BOPET and BOPP

BOPE-HD resin and film development is happening at a rapid pace

- Novel HDPE resin designed for bi-ax process and to match viscosity of PP

OEMs investing to make packaging equipment more efficient when running mono-material packaging alternatives

Recyclable packaging with recycled content can be created by adding mechanically recycled PE to the sealant web

Accelerate Your Transition to Recyclable Packaging

Centre for Performance Applications

9-Layer Extrusion Line

Adhesive Laminator

Shrink Tunnel

Vertical FFS

Horizontal FFS

Thermoformer

Erica Canavesi
Packaging and Application Development Specialist
erica.canavesi@novachem.com

NOVA Chemicals®

novachemicals.com

Responsible Care®
Our commitment to sustainability.