Less weight and waste in food packaging

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DuPont de Nemours International

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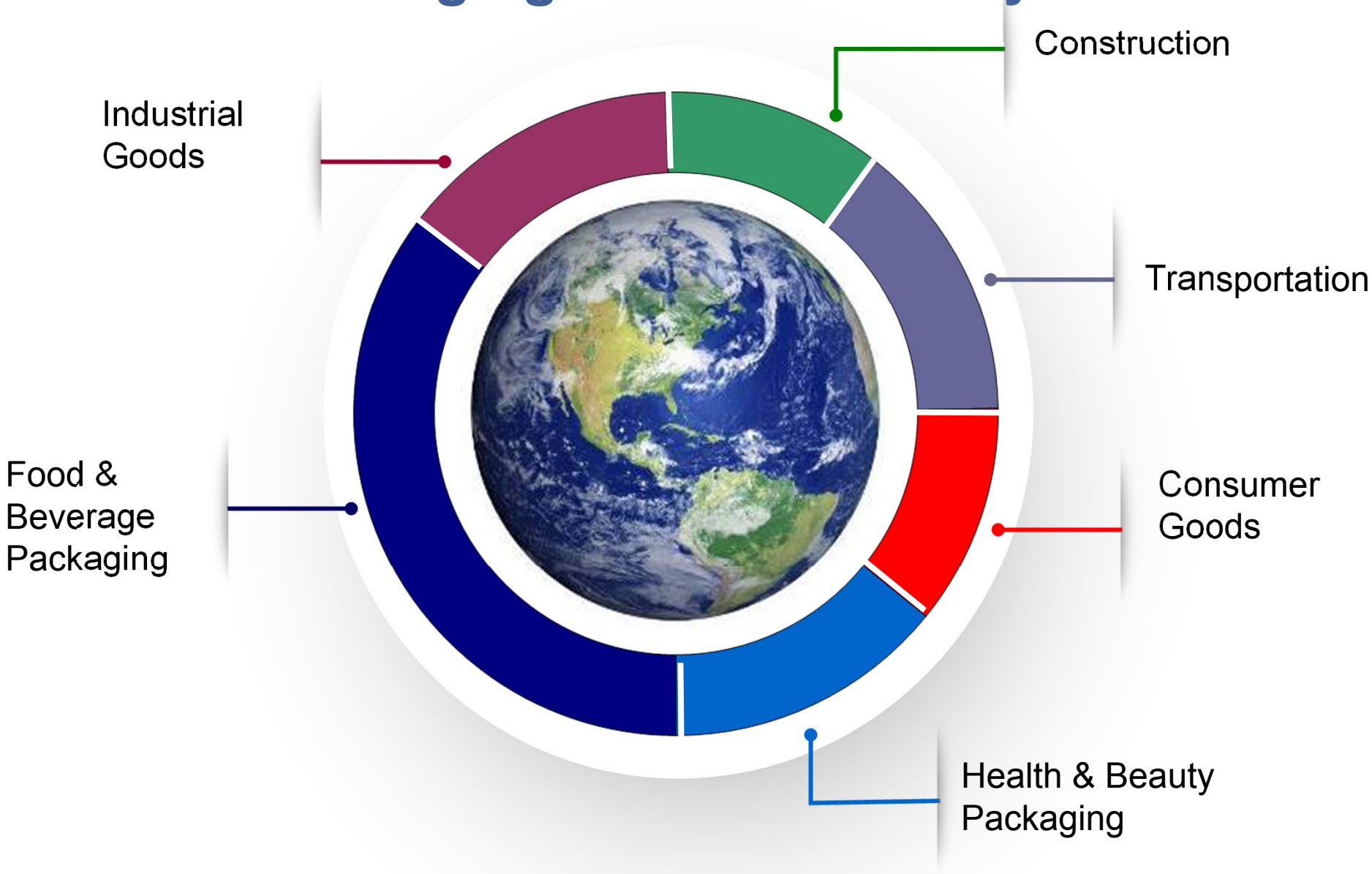
The miracles of science™

DuPont Packaging & Industrial Polymers



Six Major Market Areas --- Over Thirty Segments

DuPont Packaging & Industrial Polymers

Our portfolio

20 Series PE	High Purity LDPE Resins for tubes and medical grade bottles/vials
Appeel®	Peelable Sealants
Bynel®	Coextrudable Adhesive Resins
Conpol®	Surface Modifier Additives Used In Surlyn® Or Nucrel® Resins
Elvaloy®	Additives To Improve Flexibility, Toughness And Weatherability
Elvaloy® AC	Impact Modifiers For PET And PP, Masterbatch Carriers
Elvax®	Low Temperature Sealants
Entira™	Performance Enhancing Resins
Fusabond®	Tougheners, Compatibilizers, Coupling Agents
Nucrel®	Sealant Resin & Adhesives To Foil, Nylon, Paper And Others
Selar®	Barrier Resins
Surlyn®	High Performance Sealant & Molding Resin

Areas of Focus for DuPont Packaging

Reduce Food Waste

- *Food waste impacts carbon footprint*
- *Leakers affect brand image*
- *Waste is a strong cost factor*

Reduce Carbon Footprint

- *Reduce packaging weight*
- *Recycle*
- *Use renewable materials*

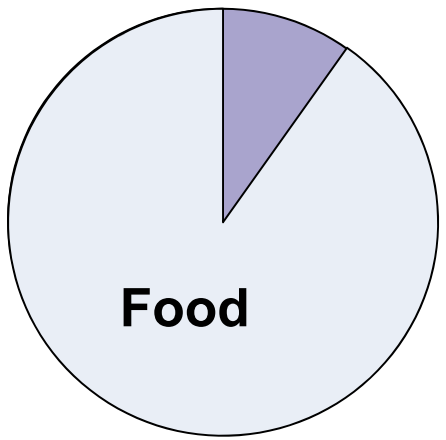
Delight the Consumers

- *Convenience*
- *Food safety*

DuPont offers solutions for all areas

Food Waste Issue

- **1/3 of the food produced is wasted every year***
  - From farm to fork
  - 1.3 billion tonnes of food wasted
- **Every kg food lost is a kg lost to feed people**
- **Food waste is the single largest contributor to GHG emission****
  - About 9 times more than that of wasted food packaging
- **Food waste is a major cost factor = high saving potential**



GHG Emission of wasted food

**Report from the Food and Agriculture Organization of the United Nations*

*** Study from the Stockholm Environmental Institute*

Food Waste Issue

DuPont Surlyn® applied as a sealant is the best package integrity insurance. In meat packaging provides lower possible leaker rate.

- Improved seal performance (low SIT, high hot tack)
  - Seal through contaminants
  - Outstanding puncture resistance in the presence of bones, etc.
  - Fat resistance

Food Waste Issue

- **Extended shelf life for fresh and processed meat due to Surlyn® adhesion to meat and its ability to form secondary seal. Internal purge or leakers are greatly reduced**
- **Leakers, defects, poor optical properties on top of severe reduction of the shelf life also affect brand image**

Surlyn and PE as a Sealant

Reduce packaging weight

Reduction of package weight is today everybodys concern along packaging value chain.
The issue is multi-dimensional: direct cost reduction, less GHG emission, less energy consumed in manufacturing and transportation, smaller packaging fees and more.
Generally reduction of packaging contributes to sustainability, trend present and discussed in a lot of fields nowedays.

Len Sauers, PhD
Vice President, Global Sustainability
The Procter & Gamble Company

Reduce packaging weight

We will discuss how to reduce weight of flexible packaging materials, but let us not forget that being in this segment we are already offering the most sustainable packaging solution ! !

Ratio of the package weight to the weight of packed food is roughly from 1:40 to 1:150 and more for flexible packaging, from 1:10 to 1:40 for rigid plastic packaging and from 1:1 to 1:3 for glass !!

So principal message is:

Go Flexible !

Reduce packaging weight

However, being in most sustainable packaging segment does not relieve us of the further weight reduction efforts.

What are the options?

A. **Redesigning and optimize structures within traditional technologies**

B. **Think about step change technologies – combine innovative film production technology and resin technology**

Reduce packaging weight

Within option A there is a clear trend to reduce packaging weight , BUT without sacrifizing stiffness, which creates impression of package solidity and substantiality.

We observed growing interest in using MDPE, HDPE and also co-polyesters in multilayer packaging structures.

This trend reveals also new features of Surlyn ionomer resins. For quite a long time Surlyn was perceived as excellent sealant. But ionomers are also unique among ethylene copolymers with regard to stiffness.

For typical ethylene copolymers, both polar like EVA or non-polar as metallocenes, stiffness drops with the increase of comonomer. 28% VA content EVA has stiffness 6-7 times lower than LDPE.

For ionomers, increased comonomer content and simultanously increased level of neutrlization is causing increase of stifness , up to 3 times of that of LDPE.

Reduce packaging weight

Below is real market assesment of replacing thick layer of LDPE with 3-layer film, HDPE/Nucrel/Surlyn in a classic triplex PET/Al/PE . Calculation uses stiffness model methodology of DuPont.
New structure provides basically same stiffness at comparable price with 25% thickness reduction.

Layer Description	Layer Modulus [MPa]	Layer Thickness [microns]	Layer Density (gms/cm3)	Layer Material Cost per kgm	Calculated Material Cost per sq. meter
OPET	**3450**	**12**	**1,35**	**2**	**0,032**
AL	**69000**	**6,35**	**2,7**	**4**	**0,068**
LDPE	**190**	**80**	**0,92**	**1,3**	**0,096**
layer 4	0	0	0	0	0,000
layer 5	0	0	0	0	0,000
layer 6	0	0	0	0	0,000
layer 7	0	0	0	0	0,000
layer 8	0	0	0	0	0,000
layer 9	0	0	0	0	0,000

Total Thickness =	**98,35**	**microns**	
Stiffness Factor =	**3,69**		
Total Material Cost =	**0,196**	**€/sq. meter**	
Neutral Axis=	**15,7337**	**microns**	

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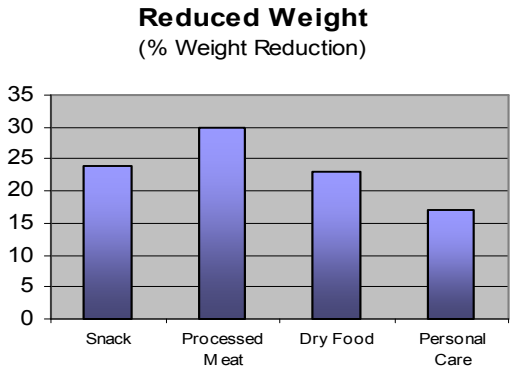
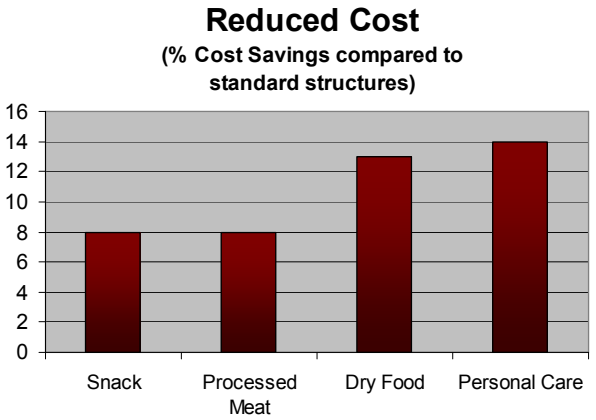
OPET	**3450**	**12**	**1,35**	**2**	**0,032**
Al	**69000**	**6,35**	**2,7**	**4**	**0,068**
HDPE	**1200**	**35**	**0,96**	**1,3**	**0,044**
Nucrel 0903	**110**	**5**	**0,93**	**2,5**	**0,012**
Surlyn 1605	**350**	**15**	**0,95**	**3,2**	**0,046**
layer 6	0	0	0	0	0,000
layer 7	0	0	0	0	0,000
layer 8	0	0	0	0	0,000
layer 9	0	0	0	0	0,000

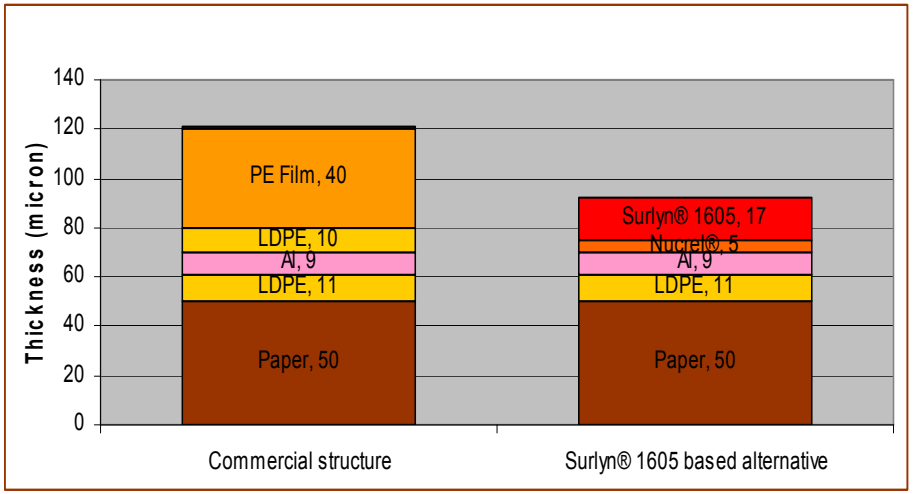
Total Thickness =	**73,35**	**microns**	
Stiffness Factor =	**3,63**		
Total Material Cost =	**0,202**	**€/sq. meter**	
Neutral Axis=	**16,6483**	**microns**	

Reduce packaging weight - other Surlyn® downgauging examples, Option A



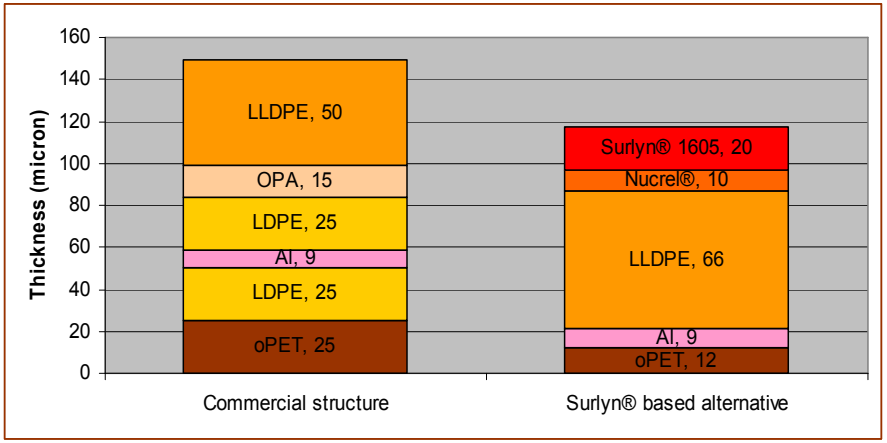


Dry Food: Paper Based sachets



23% Weight Reduction

Personal Care : Liquid soap sachet



17% Weight Reduction

Oriented Barrier Films

Oriented Films

Oriented films, like OPET, OPP,OPA are succesfully conquering packaging market since more than 50 years, being today one of main pillars of this discipline.
Main benefits they provide are stifness and lightweightness. Can be made more barrier by coating or metallization, but principal technology which enables to obtain useful packaging structures using them is lamination. Frequently repeated more than once.
Popular structures as PET//Al//LDPE, OPP//met OPP or PET//metPET//LDPE are made by lamination.

Barrier Coextrusion

Simultanously, we are observing from 2-3 decades dynamic development of blown and cast film coextrusion.
Thanks to coextrusion we get the chance to combine a lot of interesting properties offered by various polymers:
- barrier with EVOH,
- barrier and mechanical resistance with PA,
- sealability with various PEs and their copolymers,
- retortability with PP, etc

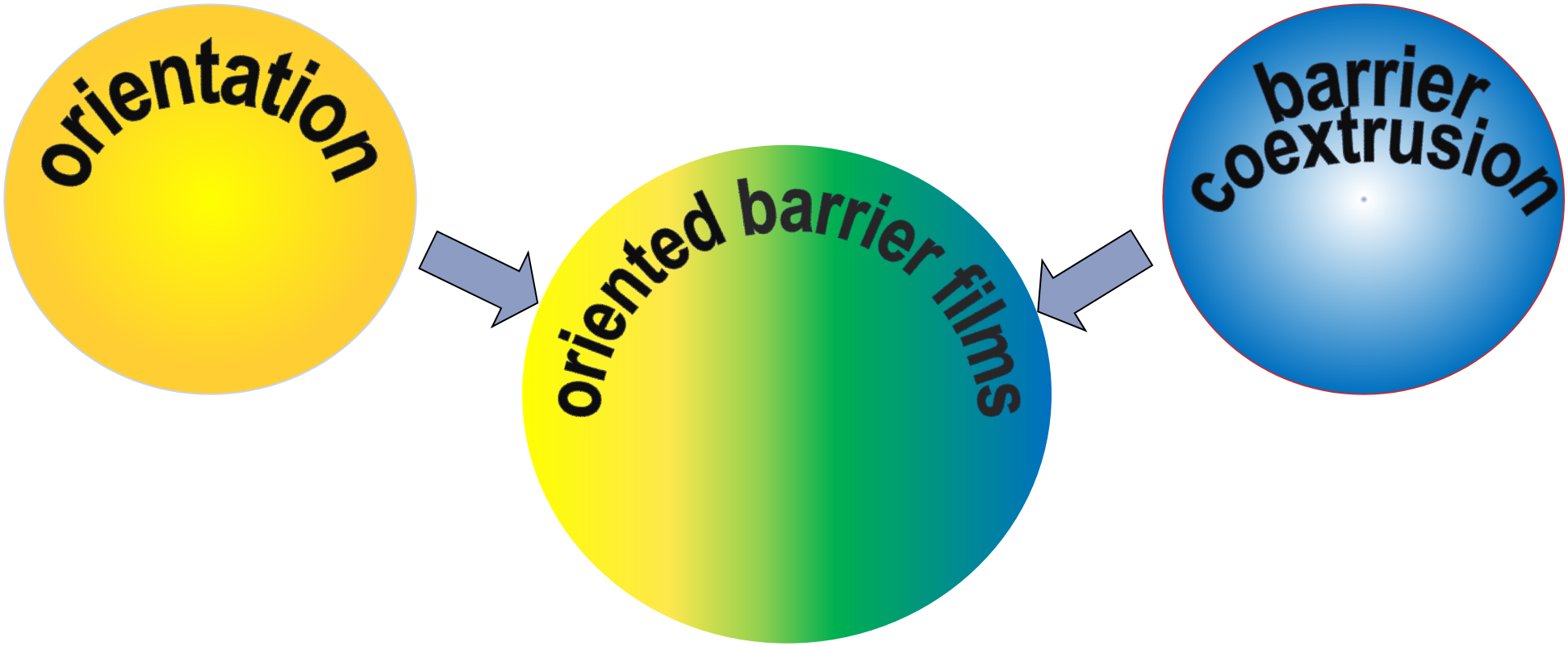
<u>only in one operation</u>

Oriented Barrier Films

Can we then combine benefits of both types of packaging materials in one technology ?

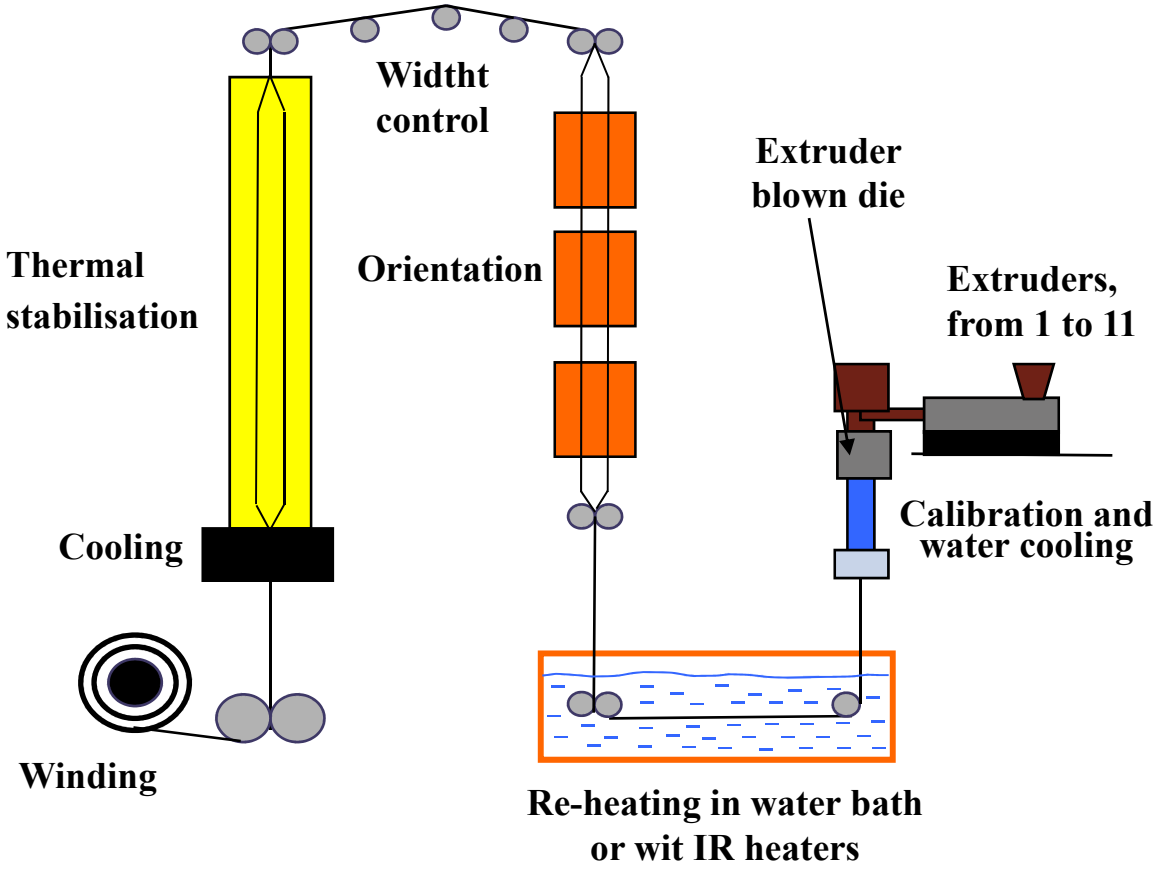
YES, WE CAN.

By Tripple Bubble Technology



Oriented barrier films

Scheme of Tripple Bubble Production Line

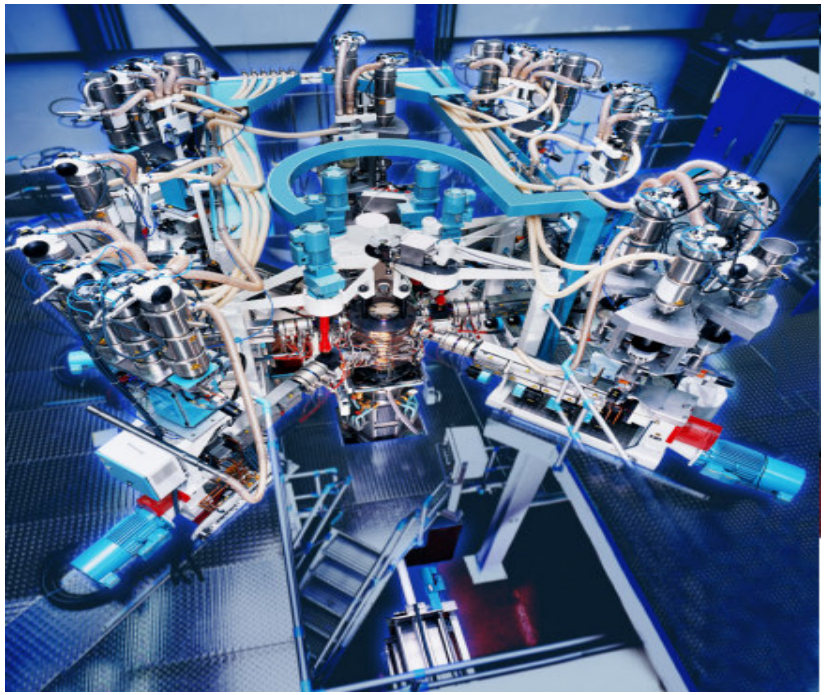


Tripple Bubble Technology Evolution

- 1996 – first lines for oriented monolayer PA6 sausage casings commercially available
- Next 5 years – development of 3-7 layers sausage casing lines based on PA6 and EVOH
- 2002 – first 7-layer line for barrier shrink bags launched
- 2009 and beyond – lines for production of barrier oriented films 1000 mm wide, increase of film layers to 11

Oriented Barrier Films

- Technology of barrier blown film orientation makes possible obtaining very thin film but still possessing excellent toughness. Barrier and optical properties are enhanced in orientation process.
- Thickness reduction may reach 70%.



- Very important stage in the production of oriented barrier films by tripple bubble is thermal stabilization. Depending how this phase is carried out, it may result in getting:

❑ High shrinkability films, = > 50%

❑ Medium shrinkability films, about 30%

❑ Casings, 10-15% shrink ,

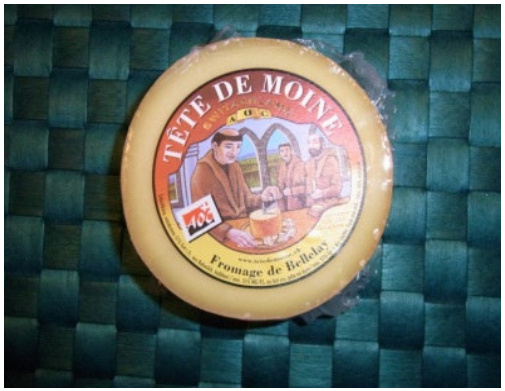
❑ Non shrinkable films, which can be used at form-fill-seal machines and as a lidding films on trays.

This way we have two distinct area of application of oriented barrier films:

- high performance shrink bags,
- Oriented multilayer films for typical packaging operations

Barrier Shrink Bags by Tripple Bubble

Shrink bags from this process when using funcional layer of Surlyn offer high shrink, up to 50% in both directions.
Typical end use market is packaging of meat (fresh, frozen and processed) followed by cheese and snacks



Oriented Barrier Films

- **Popular triplex O-PET//Al//PE with total thickness 70 mic (12/8/50), which requires 5 operations to make, can be possibly replace in many applications by 43% thinner, 40 mic structure from only one operation:**

O-PET/Bynel/PE/Bynel/PA/EVOH/PA/Bynel/PE/PE/sealant (2/2/5/1.5/2/3/2/1.5/8/8/4),

example of which can be lidding of cheese MAP pack on right below

or basically equivalent structure:

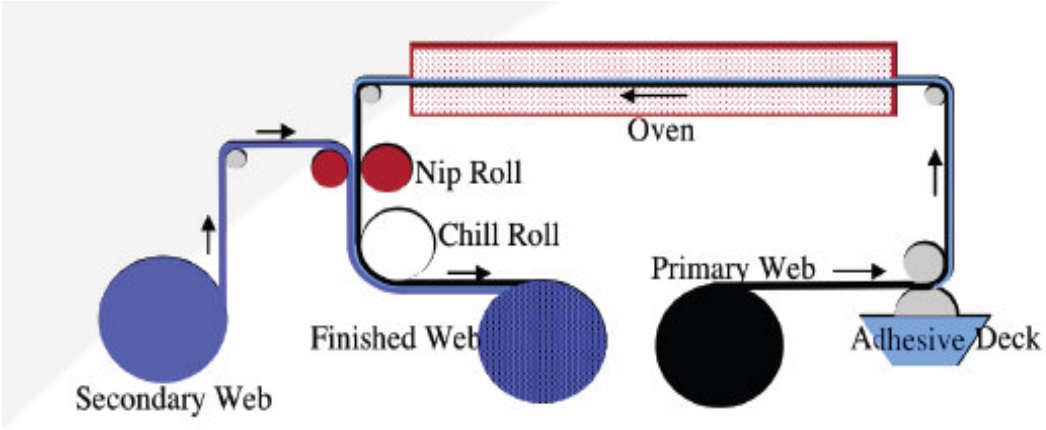
O-PET//metO-PET/Bynel/PE/Bynel/PA/EVOH/PA/Bynel/PE/sealant

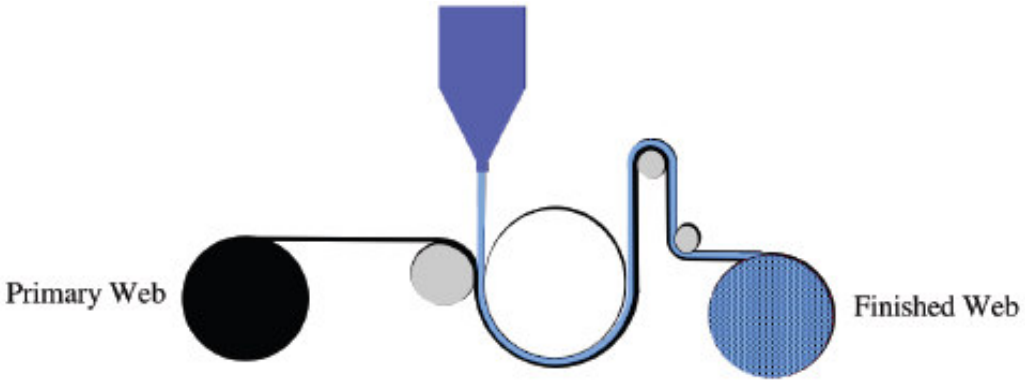
still requiring less operations and 25% thinner.

The latter can be any of barrier packaging, not excluding these for ground roasted coffee

Easy Opening is here to stay !

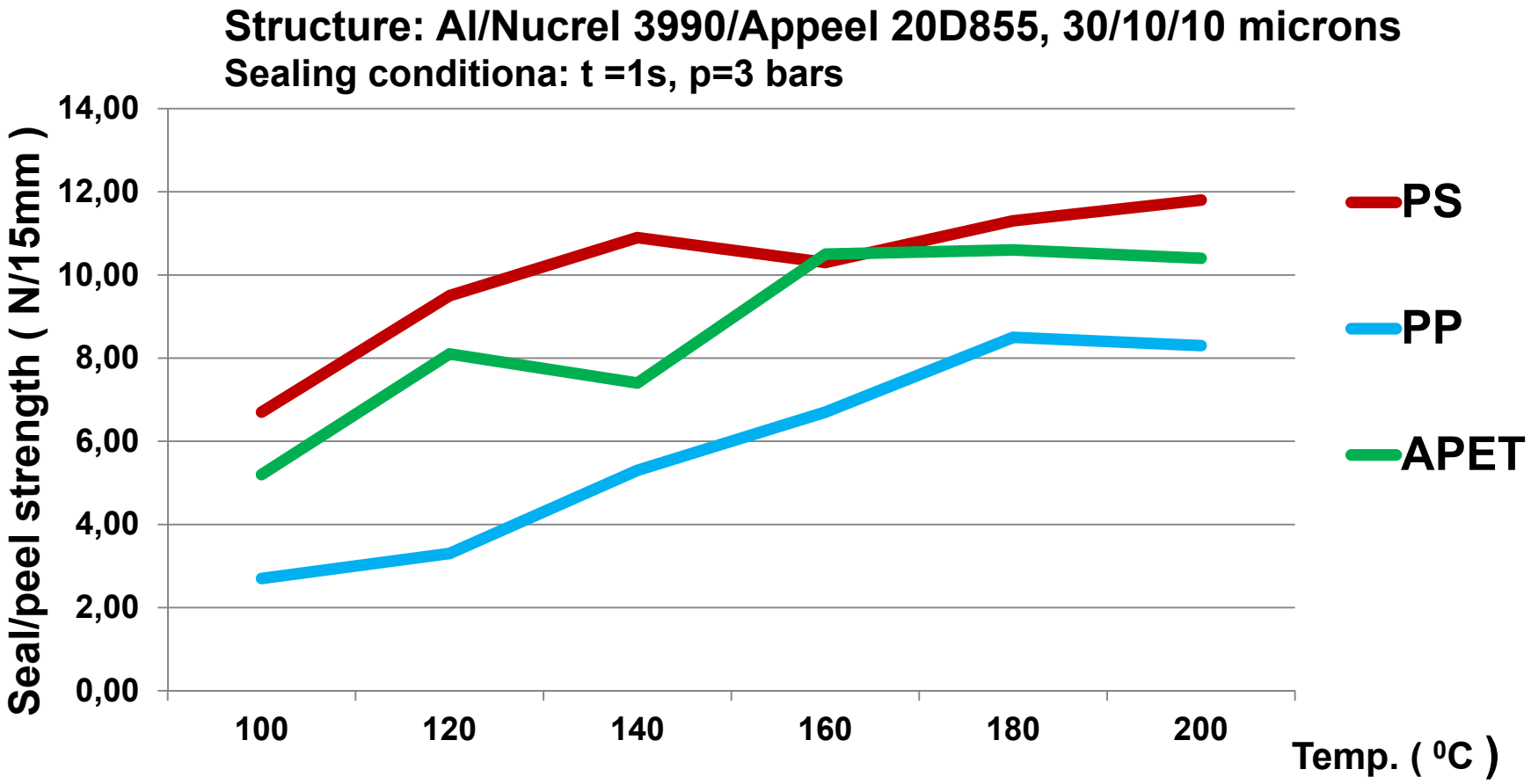
- **Easy peel structures represent mega trend in today packaging – convenience and are becoming standard solution.**
- **Variety of structures exist, essential is to combine in economical way sealable easy peel layer with substrate and, if needed, with barrier.**
- **Two principal methods of producing peelable structures are adhesive lamination on right and coextrusion coating below**





Easy open solutions – versatility of Appeel®

Our offering consist of several grades, offered under common name Appeel. Most of our Appeel resin have universal character, have been tailored to provide reliable seal/peel to commonly used tray materials as APET, PP or PS. as demonstrated below for Appeel 20D855, one of most popular grades.

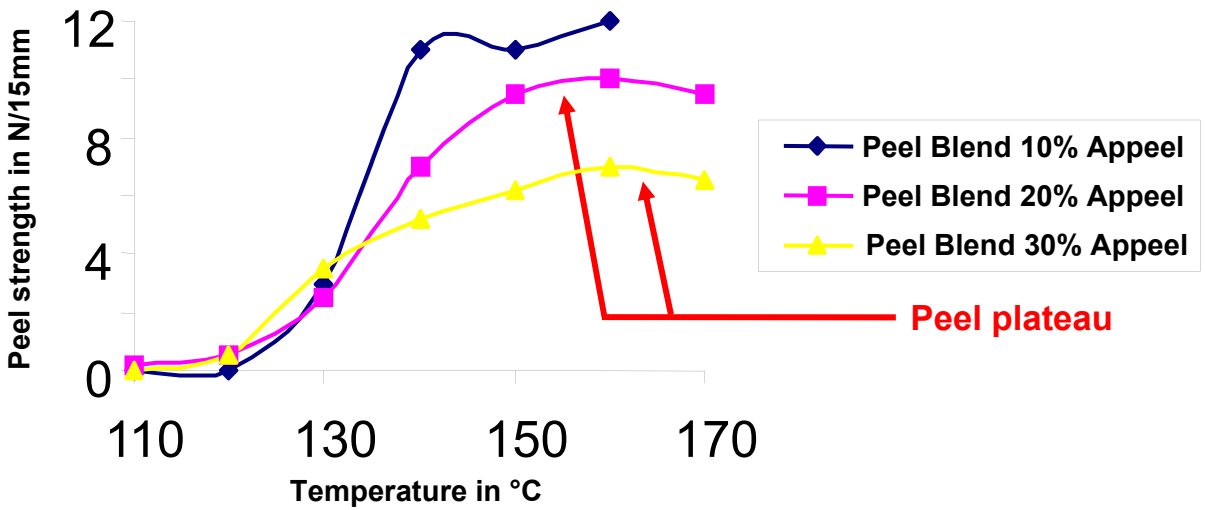


Easy Open Solutions - Appeel® 22D843 modifier for PP

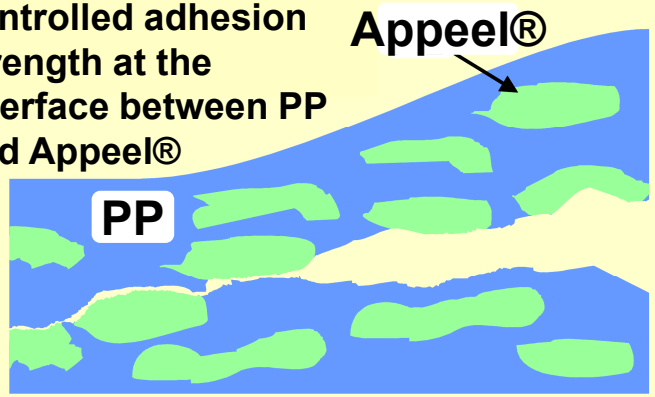
- **Appeel 22D843 is to be blended with PP forming sealing layer of tailored peelability**
- **Increasing content of Appeel® 22D843 in the PP sealant layer reduces peel force of the film**
- **Excellent optical properties of PP maintained, ability of package to be steam sterilized**

Film structure: homoPP / Blend PP+22D843, (42mic / 8 mic)
Sealing: Blend to Blend
Sealing conditions: 1.5sec. , 0.3MPa

◆ ***Selection of the Blends***



controlled adhesion strength at the interface between PP and Appeel®



high adhesion strength within the PP matrix and the Appeel® islands

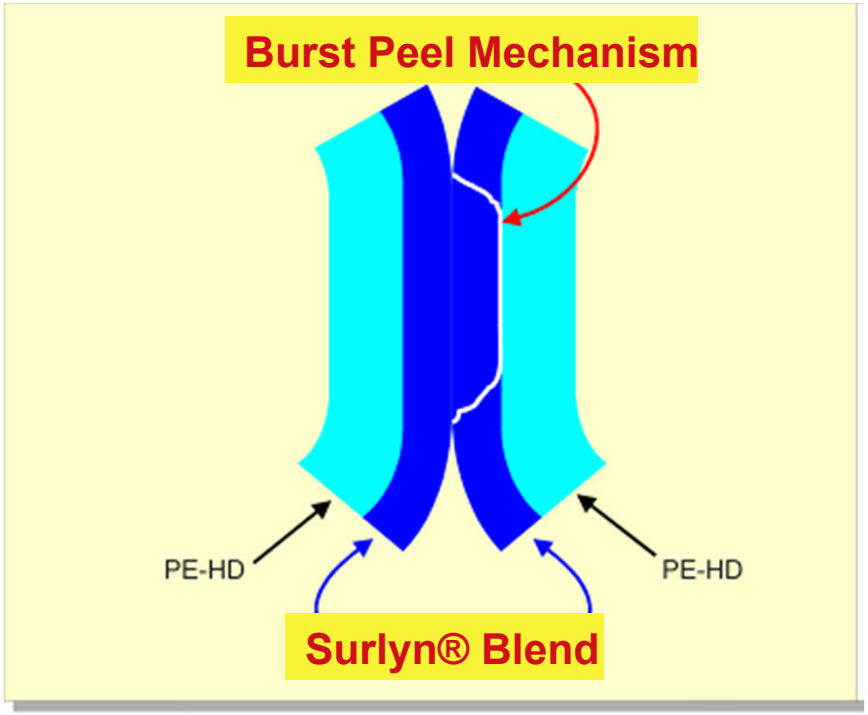
Easy open solutions- why polymeric Appeel®, not solvent lacquers

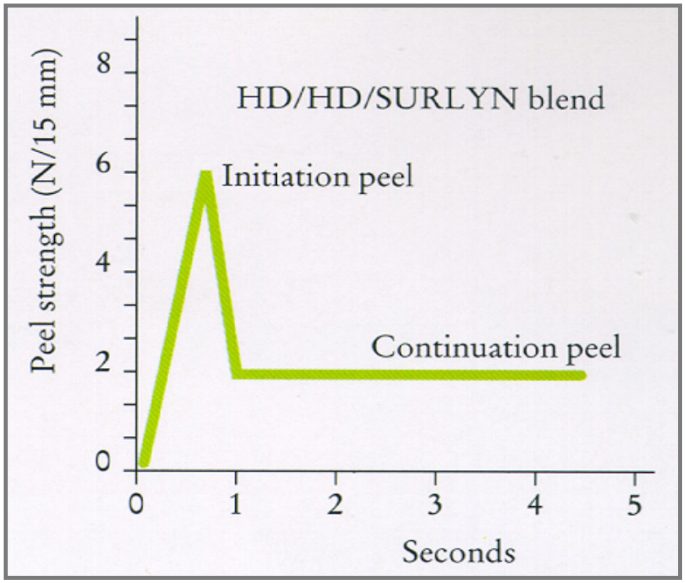
- Can be used more freely with other substrates than Al, for instance with paper (organic, natural look).
- Reduction of solvent emission, no risk of pick up smell if residual solvents present.
- Lower sealing temperature, so less risk of tubs distortion or possibility of their downgauging.
- Lower cost if we compare universal and environmental friendly (dispersions) solutions.

Surlyn® Burst Peel Technology - another concept

Attributes :

- **Outstanding Heat Sealing Properties (Hot-Tack)**
- **Strong peel initiation force**
- **No tear propagation outside seal area**





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