

MACRO Letter

Announcing
Solutions For
Flexible Film

Spring 2008



Plastimagen 2008
Booth 94
April 8-11, 2008
Mexico City, Mexico



Chinaplas 2008
Booth W1J37
April 17-20, 2008
Shanghai, P R China

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Multilayer Milk & Beverage Films

By Dr. Harinder Tamber
& Andrew Erskine

When dealing with food packaging, the film used must be designed to satisfy a number of criteria at all stages of the film's useful life. During production, the film processor must ensure the film stands up to the mechanical stresses imparted on the film, such as temperature stresses during extrusion and physical stresses when winding. For the food processor,



Typical Multilayer Juice/Punch Bags

the film must meet government food safety approval standards for its barrier and compositional properties. In addition, the film must also have acceptable seal-ability, it must be suitable for sterilization, and must be processed at a packaging speed fast enough as to not hinder production. Once the product is packaged and leaves the food processor's plant, the packaging must stand up to the abuse of transport, including effective impact and puncture resistance, and adequate barrier properties to prevent contamination. Finally, a long shelf life for the product when at the retail store is a must. All of these challenges require careful consideration when designing an effective packaging film, especially to keep costs low.

Coextrusion

The processor's best tool for designing such a film without losing its competitive edge is coextrusion. Coextrusion is the process where two or more polymers are extruded together to make a composite film. The result is a layered structure that reaps the cumulative functional benefits specific to each of its layers. In other words, this process allows for polymers with distinct functional properties such as abuse resistance, gas and moisture barrier, bonding, and seal-ability to be combined to form a single multi-functional film.

Table 1: Water and Oxygen Transmission Values of Typical Barrier Resins

Material	OTR ¹	WVTR ²
HDPE	150	0.35
Cyclic Olefin copolymers	---	0.07
Nylon 6	2.60	20.0
Nylon 6/6,6	2.40	22.0
EVOH-32	0.025	3.80
EVOH-38	0.036	2.40
PVdC	0.08	0.05
LLDPE	400	1.2
PP	180	0.6

¹ Oxygen Transmission Rate (cc-mil/100 in²-day-atm @20°C and 65% RH)
² Water Vapour Transmission Rate (g-mil/100 in²-day @40°C and 90% RH)

With the price of resins constantly on the rise, it is in the processors best interest to produce films with as little disposable materials as possible, and like so many other types of packaging, as thin as possible. Through well planned coextrusion, high-performance barrier films can be produced in a cost-effective manner by optimizing (minimizing) the amount of costly barrier and tie resins used and using less expensive PE resins to make up the bulk of the film.

Milk and Beverage Packaging

A typical application of Macro's 5-layer and 7-layer BXL blown film coextrusion lines is the production of multilayer barrier films used for milk and beverage packaging. Not unlike the packaging requirements for many other types of foods, to be successful these films must meet a variety of uncompromising criteria to protect the quality of the product. For milk and beverage applications, these criteria usually always include the need to provide a barrier to oxygen, aromas and moisture, and facilitate a long shelf life, particularly without the need for freezing.



7-Layer BXL Barrier Blown Film Line

Table 2: Milk and Beverage Film Requirements and Commonly Used Resins

Property Group	Requirements	Pertinent Resin
Barrier Properties	High barrier to oxygen	PVdC, EVOH
	High barrier to water vapour	PVdC, HDPE, PP
	High barrier to aromas	EVOH, Nylon, PVdC
Physical/Mechanical Properties	High tensile, tear and impact strength	LLDPE, mLLDPE
	Strong puncture resistance	mLLDPE, plastomers
Heat Sealing Properties	Hot tack and heat seal range and strength	LLDPE, mLLDPE
Surface Properties	For films that will be printed the surface energy must be high enough to allow the ink(s) to bond. This is aided by means of corona treatment. Treatment level can be reduced by utilizing resins in the outside layers that are more easily printed on.	Print-friendly resins such as LLDPE, in combination with corona treatment.
	Low friction. The sealing layer should have high slip (COF <0.2) for VFFS applications.	LLDPE with slip additives

Milk packaging machinery

To process film on the processor's converting equipment/filling machinery, several factors are vital including film quality, film gauge and the film's dimensions.

Film Quality

Leakers, those tiny pinholes that slowly let the package's contents leak out, commonly originate from flex cracking and edge splitting at the folds and seals of the package. Careful resin selection, particularly with the high-barrier resins that are less flexible, is very important to avoid these problems.

Film Gauge Control

An additional cause of leakers that originate from the film used in beverage packaging is deficiencies in gauge control.

To convert and fill the film with a minimal amount of leakers the film must be created with excellent gauge. Common practice is the use of automatic dies and/or air rings that perform frequent, small adjustments to maintain consistent gauge across the width of the film during production.



Typical Multilayer Milk Bags



D10 PRO Automatic Dual Lip Air Ring

$$\begin{aligned} \text{BUR} &= \frac{0.637 \times \text{Layflat Width}}{\text{Die Diameter}} \\ &= \frac{0.637 \times 900\text{mm}}{350\text{mm}} \\ &= 1.64 \end{aligned}$$

Specific Width Calculations for Milk Packaging Machines

Milk packaging machines typically require a film width of 900mm. With different die sizes and varying blow-up ratios (BUR), the optimal film width can be achieved.

With a 350mm (14") blown film die and a BUR of 1.64:1, the layflat width of the film (flattened bubble) will be 900mm. The flattened film may then be slit at the edges to produce two 900 mm wide films, which can be wound into rolls on two separate winders.



ACCUPRO Automatic Gauge Control Die



Trimless Slitting Assembly



Macro's Automax-S Blown Film Surface Winder

If the die diameter is 550mm (22”), a BUR of 2.1:1 is required to produce a film width equaling 1800 mm, which means two rolls of 900 mm wide film can be produced per winder.

$$\begin{aligned} \text{BUR} &= \frac{0.637 \times \text{Layflat Width}}{\text{Die Diameter}} \\ &= \frac{0.637 \times 1800\text{mm}}{550\text{mm}} \\ &= 2.1 \end{aligned}$$

Typical Milk Film Structures

This section provides example structures for milk film produced on 5- or 7-layer blown film lines.

The first example is for 5-layer film produced on a 350mm (14”) diameter die, with a total thickness of 90 microns, a BUR of 1.64:1, and film width of 900mm.

Table 3: 5-Layer 90 micron Milk Film Structure

Layer	Composition	Thickness (microns)
1	PE Blend	36
2	Tie	6
3	EVOH-38	7
4	Tie	6
5	PE Blend	36

The second example is for a 7-layer film structure, produced on a 350mm (14”) diameter die, with a total thickness of 90 microns, a BUR of 1.64:1, and a film width equaling 900mm.

Table 5: Example 7-Layer Blown Film Milk Film Structures

Layer	1 (outer)	2	3	4	5	6	7 (inner)
Resin	PA 6	Tie	PA 6	EVOH	PA 6	Tie	LLDPE
	PA 6/66	Tie	PA 6/66	EVOH	PA 6/66	Tie	LLDPE
	LDPE	Tie	PA 6	EVOH	PA 6	Tie	LLDPE
	LLDPE	LLDPE	Tie	EVOH	Tie	LLDPE	VLDPE
	LLDPE	LLDPE	PP (random copolymer)	PP (random copolymer)	PP (random copolymer)	LLDPE	mLLDPE
	PP (random copolymer)	LDPE	LDPE/HDPE	LDPE/HDPE	LDPE/HDPE	LDPE	LLDPE

Table 4: 7-Layer 90 micron Milk Film Structure

Layer	Composition	Thickness (microns)
1	LLDPE	25
2	PE + White MB	11
3	Tie	6
4	EVOH-38	7
5	Tie	6
6	PE + White MB	11
7	LLDPE	25

Layer Configurations for 7-Layer Films

For the production of 7-layer milk packaging films on Macro's BXL 7-layer lines there are many layer combinations that can be used to make up the film, some of which are indicated in Table 5, below.

Looking for More?

Macro offers blown film technology (5 – 9 layers) to process resins such as LLDPE, mLLDPE, plastomers, LDPE, tie, cPP, EVOH and Nylon to make barrier films for milk and beverage packaging. For more information regarding the production of these and other types of barrier films, please contact us. Macro helps its customers achieve their processing goals with a complete technology transfer, such as technical know-how to process resins, film property testing and new formulation development.

Record Breaking Sales in Q4 2007

By Andrew Erskine



Jan. 11, 2008, Mississauga, Ont. - Over the short stretch of time between the start of K-2007 in late October to the end of 2007 Macro's sales for complete extrusion systems saw tremendous growth. The quick succession of high-value orders placed during the fourth quarter of 2007 has brought in record setting sales. "The sales total from projects to be delivered in 2008 has already doubled that of total sales in 2005 and we've just stepped into the new year" stated Mirek Planeta, Macro's president.

Headlining the recent sales is an order for a 9-layer BXL blown film coextrusion line sold in mid November 2007 to Kopejsky Plastic, one of the largest milk film manufacturers in the Ural area of Russia.

The line is designed for the production of high-barrier, 9-layer laminating and thermoforming films with Nylon and EVOH with an output of 340 kg/hour. At the heart of the line will be a 9-layer MacroPack stackable die equipped with the ACCUPRO automatic gauge control system. The line will also feature nine MacroPlast extruders, a D10 air ring, and Macro's popular Automax-T bidirectional turret winders.

Nearing the conclusion of K-2007, Macro announced its entry into the Indian market with orders for two extrusion lines: a 7-layer BXL blown film line equipped with Macro's encapsulation technology, which will enable the processor to produce 9-

layer structures, and a specialty cast PVC film line. "We've just recently started to promote Macro's products and services in this part of the world and the initial response has been terrific," said Dr. Harinder Tamber, Macro's Technology Manager and sales representative for India. "These milestone projects should help solidify Macro's reputation in the Indian market as a technology leader. Following the successful installation of these projects along with our excellent global reputation Macro's future in India will look very promising."

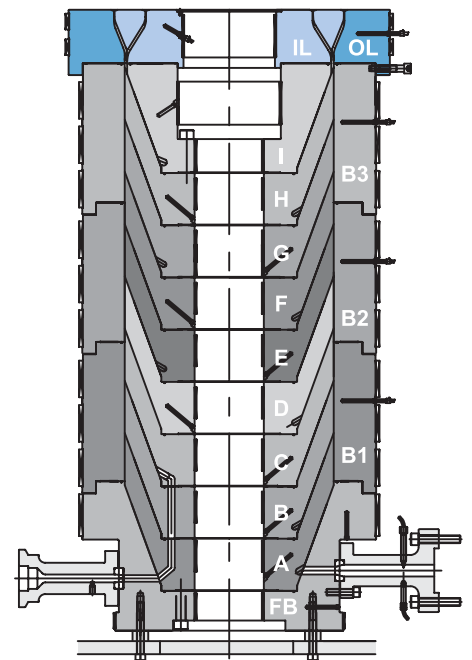
Downward extrusion lines have also been in demand from Macro with orders for three custom double-bubble lines sold to a processor in Eastern Europe and another order for a 5-layer DXL double-bubble line destined for China.

Other orders placed during this time period include a 3-layer BXL blown film line sold to a processor in Moldova, and various custom-built machinery projects.

"The projects keep rolling in" said Planeta, "We're busier than ever with upcoming extrusion projects. These projects combined with our custom engineered projects, such as specialty winders and custom-built sheet lines will keep us very busy well into 2008."

9-Layer MacroPack Coextrusion Die

FB: FEEDBLOCK
 IL: INNER LIP
 OL: OUTER LIP
 B1, B2 & B3: OUTER BODY SECTIONS
 A, B, C,... H, I: MANDRELS FOR 9 LAYERS



Macro will be participating in the following upcoming exhibitions:

Argenplás - Buenos Aires, Argentina
(March 25-29, 2008)

Plastimagen - Mexico City, Mexico
(April 8-11, 2008)

Chinaplas - Shanghai, PR China
(April 17-20, 2008)

Plastindia - New Delhi, India
(February 4-9, 2009)

NPE 2009 - Chicago, USA
(June 22-26, 2009)

Visit our website for more details.

www.macroeng.com

Macro Engineering is a global supplier of extrusion and coextrusion systems for barrier and specialty films, including equipment for custom coating, winding and web handling applications.

