BULLETIN: VENELENE® OCTENE POLYETHYLENE (CAST FILM)

POLINTER

1 Introduction

The application of films represents one of the first commercial uses given to the polyethylene and the segment of greatest demand in these resin markets. From the developments of linear polyethylene in the decade of the sixties and with the expansion of its commercial use during the seventies, a technological evolution process has taken place directed towards improving the performance regarding the processing and properties of this family of products.

Unlike the case of low-density polyethylene obtained in the high pressure process, a second monomer unit is incorporated for obtaining linear polyethylene *(Monomer: Minimum chemical unit which constitutes a polymer molecule)* that allows the product density control. This second monomer unit is called comonomer; while the polymers that have at least two different monomer units are called copolymers.
Commercially, linear Polymer production technologies primarily use three types of comonomers:

- Butene or Butylene: Is widely used in the manufacture of low-density linear polyethylene, with special participation in the product segment for applying films. It stands out due to its flexibility offered for obtaining a wide variety of products as well as their lower cost.

- Hexene: Its use is much less spread out than the case of Butene. It allows obtaining linear Polymers with better properties than those obtained with Butene copolymers. The cost of Hexene copolymers is higher than Butene copolymers.

- Octene: The use of Octene is less disseminated than the previous monomers. The Octene copolymers exhibit better properties than the Hexene and Butene based products, and likewise, have a higher cost.

The Sinclair® technology used by Polinter for obtaining its linear polyethylene allows the use of both Butene as well as Octene comonomers.

The growth in the demand of linear polyethylene for film applications, the expansion of export markets and the constant development of new and more sophisticated packaging structures have favored the commercial introduction of its new Venelene® Octene copolymer line.

The incorporation of this new line of products will allow our clients to obtain a better performance in terms of productivity and quality due to the superiority of the octane copolymers regarding:

- Resistance to Tearing.
- Impact and penetration resistance.
- Hot Tack and cold seal resistance.
- Seal flexibility (Flex Crack) and resistance to the generation of Pin holes.

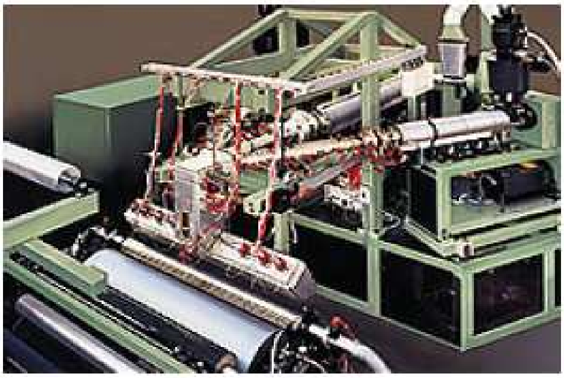


Figure 1. New Venelene® Octene for films.

In order to satisfying the rigorous quality and productivity standards demanded by our clients, leaders in the competitive cast film extrusion market (Cast film), Polinter has developed a new PELB grade copolymerized with Octene under the commercial reference: Venelene® 11S1.

Venelene® 11S1 has been designed to achieve important improvements in those parameters that contribute directly to:

1) Increase in productivity:
   a. High production speed
   b. Excellent thermal stability
   c. Low volatile production.
   d. Decrease of production stoppages due to fails or cracks in the extruded curtain.

2) Decrease in Manufacturing costs:
   a. Higher stretchability.
   b. Use of thinner films.
      - Resistance to Tearing
      - Resistance to Penetration

Venelene® 11S1 complies with the following general properties:

Properties	ASTM[1]	Units	Typical Value [2]	
Melt Flow Index (190°C - 2.16 Kg.)	D1238	dg/min	2.50	
Density	D792	g/cm^3	0.917	
Mechanical Properties under Tension[3]			**MD**	**TD**
Toughness	D882	MPa	100	110
Tensil Strength	D882	MPa	34	31
Tensil Elongation	D882	%	610	710
Elmendorf Tearing	D1922	g	730	970
Impact Resistance	D1709	KJ/m	39	
Punture Resistance	-	g	990	
Optical Properties (3)				
Luminous Transmittance	D1003	%	89	
Haze	D1003	%	3	

(1) Covenin standards are equal to those ASTM applied: Covenin 461-96 Density; Covenin 1152-93 Fluidity Index and Covenin 1357-79 Mechanical Properties.
(2) Typical values comprises of the media obtained in Lab, which are herein shown as reference only and not as specifications.
(3) Properties measured on 35-micro thick film.

This grade counts with an anti-oxidizing formulation especially combined to warrant an excellent performance of its products during the transformation and usage stages.

2 Processing

In industrial terms, Venelene® 11S1 has been notorious given its features:

- High extrusion speed (250 m / min)
- Low Neck-in
- Low level of gel or unmelted material
- Low frequency of tearing in the extruded curtain.
- Low level of fumes at the header.

In order to achieve an optimal performance, it is recommended the use of extrusion profiles as shown in Figure 1.

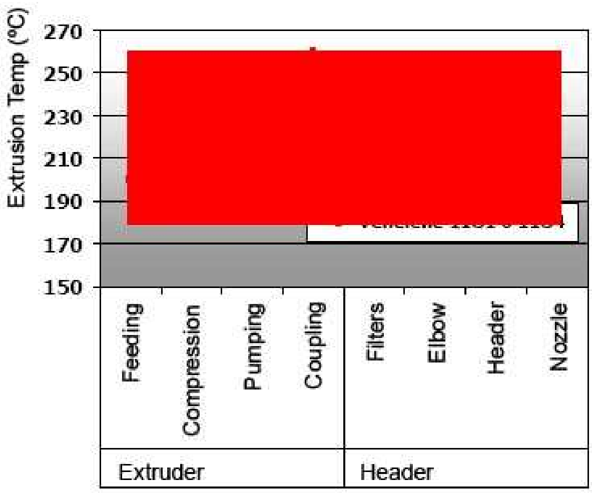
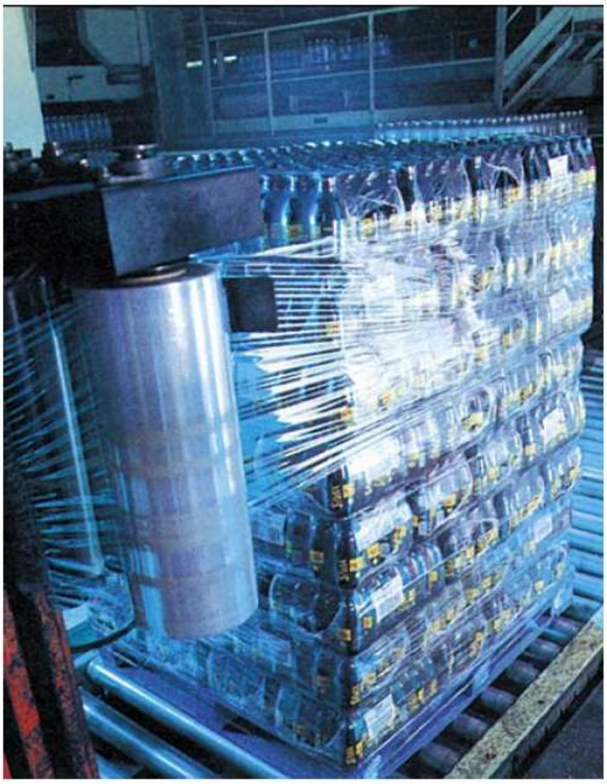


Figure 1. Suggested extrusion temperature profile for linear Octane and low density major mixtures.

3 Mechanical properties

In order to present the outperforming mechanical properties of Venelene® 11S1, two model cases have been taken: the application of a Stretch film for industrial use, and a sanitary use film; by using as comparison patterns in the first case two commercial Octene PELBD, the first was synthesized with Ziegler – Natta catalysts (MFI 2.3 dg/min, density 0.917 g/cc), and the second with metallocenic catalysts (2.7 dg/min, density 0.918 g/cc).



3.1 Stretchable Film (PELB Ziegler-Natta Octene).

Figure 2 shows the comparison between tension and penetration properties (at constant speed) obtained by the coextruded film by using Venelene® 11S1, and the Octene used as commercial reference. As the graphic points out, Venelene® 11S1 combines an excellent performance of rigidness, with a high stretchability and resistance to penetration; a key element for the proper performance of the film in the grouping of heavy loads (boxes, sacks, etc) with sharp edges.

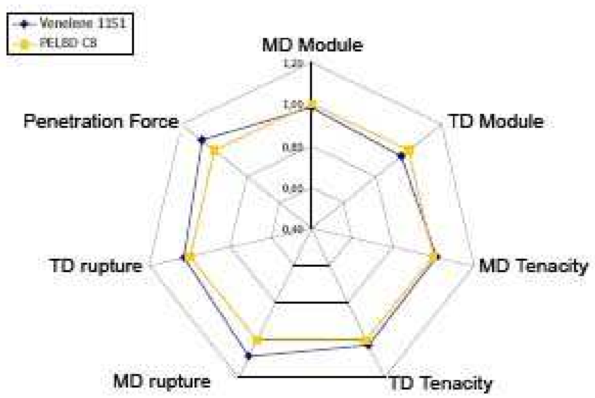


Figure 2. Comparison of properties in tension and penetration of strectchable films obtained with Venelene® 11S1 and a commercial referred Octene.

In Figure 3 we can observe the outperformance of Venelene® 11S1 not only due to its higher force packaging level, but also its minor grade of decadence along the time.

Figure 3 shows the evolution in the retention of the packaging load; a highly relevant feature in the level of final user.

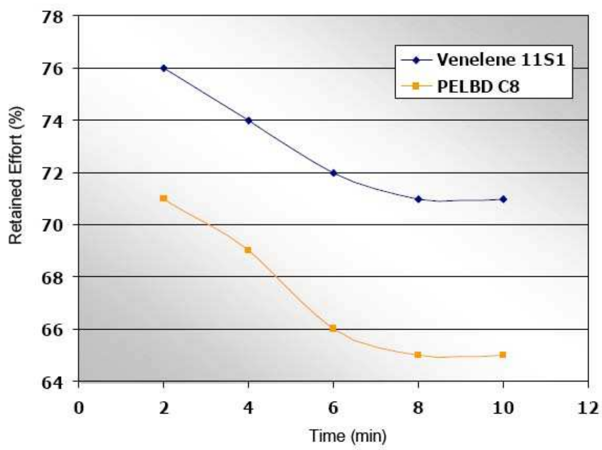


Figure 3. Packaging load variation in stretchable films obtained with Venelene® 11S1 vs. an Octene of commercial reference.

A high level of load retention in packaging warrants that the packed product remains integrally together by the film during storage and transport operations of industrial groupings.

3.2 Stretchable film (PELB Octene Ziegler-Natta vs. Metalocen)

Although Metallocenic catalysts allows obtaining linear polyethylene with a more uniform comonomer distribution, it is feasible to obtain a higher performance level with other catalytic systems by means of adjustment of the molecular architecture of the polymer (molecular weight, distribution of the molecular weight, etc.) and its contents of comonomer.

Figure 4 shows the general comparison among the mechanical properties of a stretchable coextruded film, in which Venelene® 11S1 and the metallocenic octane used as commercial reference have been used in the structural layer of the film (Core). As illustrated in the graphic, the mechanical performance of Venelene® 11S1 is much more competitive in comparison to the metallocenic PELBD, which is more expensive.

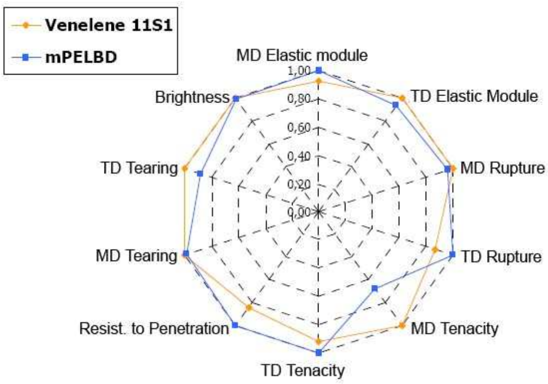


Figure 4. Comparison between the mechanical properties of stretchable films obtained with Venelene® 11S1 and a Metallocenic Octene of commercial reference.

Figure 5 shows the evolution on the retention of packaging load. In the case of this property, it is remarked once again the performance level of Venelene® 11S1 versus the metallocenic product.

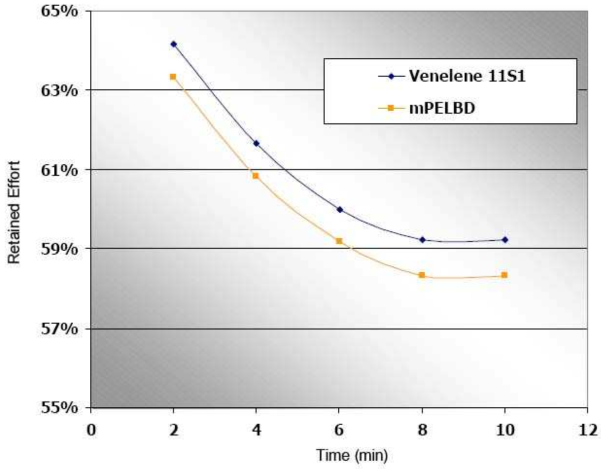


Figure 5 Variation on the packaging load of stretchable films obtained with Venelene® 11S1, and a Metallocenic Octene from a commercial reference.

3.3 PELB Octene Comparison (Sanitary use)

One of the most important commercial uses of copolymerized PELBD with Octene is the production of coextruded cast film for sanitary purposes (diapers, pads, etc.).

In order to illustrate the comparative performance of a film manufactured with Venelene® 11S1, it was taken as a model case a coextruded film embedded for the impervious layer of a disposable diaper. The commercial reference sample used (Standard) is a typical coextrusion tri-layered in which a copolymerized PELBD with mid-density butane (MFI 2.7 dg/min and density 0.937 g/cc) is used. In the reference film obtained with Venelene® 11S1, a 50% of the mid-density Butene PELBD was replaced by a Butene copolymer.

Figure 6 shows how the incorporation of Venelene® 11S1 allows obtaining a film featuring enhanced properties (Improvements in a 90% of transversal tearing resistance). The optimal properties balance from the incorporation of Venelene® 11S1 favor the use of materials in the coextruded structure with a better rigidness (PEAD, PEMD or PP), that contribute to better weights and films with softer textures.

The incorporation of Polinter's Venelene 11S1 consolidates its mixture of products (PEAD, PEBD, PELBD, Butene, Octene PELBD) to fulfill the most demanding expectations of the market of films.

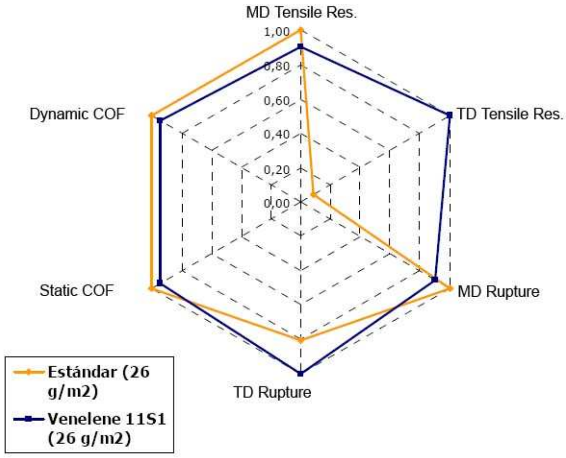


Figure 6. Comparison of mechanical properties of films for embedded diapers obtained with Venelene® 11S1 and Butene PELBD of medium density.

This bulletin has been made by the Marketing Department of Polinter with the support of the specialists of Investigación y Desarrollo, C.A. (INDESCA) and by the Technical Services Department of CORAMER. This is intended for all clients and users of the Venelene® resins and we trust that the information contained herein is helpful and useful.

Please contact us at the following email address, info@polinter.com.ve or through our agent: Corporacion Americana de Resinas (CORAMER), with branch offices in Venezuela, Colombia, Peru, Ecuador and Chile (http://www.coramer.com), should you have any suggestions or comments regarding this issue.

The information described in this document is, to our best knowledge, accurate and truthful. However, since the particular uses and transformation conditions are completely out of our hands, the adjustment of the parameters in order to reach the maximum performance of our products for a specific application depends on and is the responsibility of the user.

In order to obtain more detailed information of the security aspects regarding the use and disposal of our products, we invite you to consult the security pages (MSDS) of the Venelene® Polyethylene.