NEW ULTRA-HIGH-BARRIER PACKAGING FILM TECHNOLOGY EXTENDS PRODUCT SHELF LIFE AND REDUCES NUMBER OF MANUFACTURING CYCLES

Compatibility with foods made without trans fats creates additional opportunities

By Steve Sargeant, PhD, Director, New Business Development and Ken Chang, Director, New Product Development

Manufacturers of perishable products are well aware that a later “sell by” date on the package can affect a customer’s decision to purchase one brand instead of another. Even if the individual has already made up his or her mind which brand to purchase, there is a natural tendency to look behind rotated stock for the package with the latest “sell by” date, leaving the ones with earlier dates on the shelf to become even less desirable.

The problem is exacerbated by the growing movement to eliminate partially hydrogenated vegetable oils containing trans fats, which are routinely used to extend a product’s shelf life, from food products such as fried snacks, baked goods, and confections. Many of the edible oils used as trans fat replacements are even more sensitive to moisture and oxygen than the fats they replace. This means that if the packaging for the reformulated product does not have better moisture vapor and oxygen-barrier properties than the packaging for the product containing trans fats, the “sell by” date will have to be even shorter, so an even greater risk for loss of profit is created.

In order to achieve low moisture-vapor and oxygen-transmission rates and extend the “sell by” date of perishable products as long as possible, consumer-products-goods manufacturers and converters generally use PVdC-coated polypropylene, barrier metallized polypropylene, or aluminum foil lamination packaging constructions. Indeed, among the three choices, a flat sheet of aluminum foil is essentially impenetrable by moisture and oxygen, as both its Moisture Vapor Transmission Rate (MVTR) and its Oxygen Transmission Rate (OTR) approach zero. However, when
packages made with foil are subjected to the repeated manipulation and handling that are common with manufacturing, cartoning, shelf stocking, and consumer handling in the retail environment, they often develop pinholes and become permeable. They also tend to develop permanent creases and wrinkles, making the package appear older and more “shopworn” than it really is.

Traditionally, PVdC-coated OPP film has been specified for demanding applications because of its unique combination of mechanical, barrier, and aesthetic properties. However, it is also expensive because of its two-step manufacturing process and its higher density which results in lower yield. In applications requiring either moisture- or oxygen-barrier properties, but not both, use of either foil or PVdC can lead to over engineering. There are also environmental issues with PVdC. Mounting global pressure about the use of halogenated materials in traditional plastic applications is driving a desire to remove PVdC from packaging applications and replace it with an alternative that offers the same or improved performance at similar economics.

Today, industry developments in co-extruded Oriented Polypropylene (OPP) film technology offer end users and converters new value-added options for “ultra” barrier protection. New ultra-high-barrier metallized OPP technology has moisture- and oxygen-barrier properties approaching those of foil. In fact, some of the industry’s new, advanced metallized films provide approximately 100 times the oxygen barrier of previous generations of metallized films. This allows food manufacturers not only to gain the advantage of later “sell by” dates but also to realize the economies of more-flexible manufacturing cycles, for when dates are later, store shelves do not have to be restocked so often.

Also important is the development of new high-barrier clear film technology, which now offers significant oxygen-barrier properties, although not moisture-barrier properties, comparable to those of conventional metallized films, presenting end users and converters with more packaging manufacturing options. (It should to be noted that the ultra-high-barrier and high-barrier films’ technologies are considered by film manufacturers, including Toray Plastics (America), Inc., to be proprietary.)
Both the new metallized and clear barrier films available today maintain their outstanding barrier properties as flat laminated films and when formed into flexible packaging. Because of their unique barrier properties, they can be used not only in food product applications, especially those being reformulated to eliminate trans fats, but also for packaging pet foods, as well as for agricultural, chemical, and medical applications. Thus they open the door to even more new business opportunities.

**Ultra-High-Barrier Cold-Sealable Metallized Film**

The new ultra-high-barrier cold-sealable metallized film technology is a bi-axially oriented film that is vacuum-deposited with aluminum on an ultra-high-barrier layer and treated on the other side for laminations and cold-seal applications. It is designed for use as either an inner web of a lamination with converter-applied cold seal, or as the middle ply of a multi-layer lamination where it provides exceptional oxygen- and moisture-barrier properties. It is ideally suited for gas-flushed applications.

---

**Ultra-High-Barrier Cold-Sealable Metallized OPP Film**

![Diagram of Ultra-High-Barrier Cold-Sealable Metallized OPP Film]

Caption: One side of a new ultra-high-barrier cold-sealable OPP film has a layer of vacuum-deposited aluminum over its ultra barrier layer. The other side is specially treated for laminations and cold-seal applications.

The following table shows a comparison of moisture-vapor and oxygen-transmission rates for a new ultra-high-barrier cold-sealable film (UHBF) as compared with a metallized OPP film.

<table>
<thead>
<tr>
<th>Barrier Film</th>
<th>MVTR @ 100°F, 90% RH g/100in²/day</th>
<th>OTR @ 73°F, 0% RH cc/100in²/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metallized OPP</td>
<td>0.010</td>
<td>1.5</td>
</tr>
<tr>
<td>UHBF (Cold Sealable)</td>
<td>0.010</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Typical laminated structures in which a new UHBF might be combined with polyethylene (PE), polyethylene terephthalate (PET), bi-axially oriented polypropylene (BOPP), and other materials include:

- PET/Ink/PE/UHBF/PE
- BOPP/Ink/PE/UHBF/PE
- Ink/Paper/PE/UHBF/PE
- Outer Layer/Ink/Board/PE/UHBF/PE
- Outer Layer/Ink/UHBF/PE-Board/PE

**Ultra-High-Barrier Heat-Sealable Metallized Film**

The new ultra-high-barrier metallized film is a bi-axially oriented film that is vacuum-deposited with aluminum on an ultra-high-barrier layer and is heat-sealable on the other side. It is designed for use as an inside sealant web and provides moisture and oxygen barrier for gas-flushed applications. End users and converters can expect superior formed-bag durability to be maintained after the package is made. It offers superior light protection with a minimum optical density of 2.0, as well as excellent hot tack and a wide heat-seal range.

The following table shows a comparison of moisture-vapor and oxygen-transmission rates for a new ultra-high-barrier heat-sealable film (UHBF) as compared with a metallized OPP film.

<table>
<thead>
<tr>
<th>Barrier Film</th>
<th>MVTR @ 100°F, 90% RH g/100in²/day</th>
<th>OTR @ 73°F, 0% RH cc/100in²/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metallized OPP</td>
<td>0.010</td>
<td>1.5</td>
</tr>
<tr>
<td>UHBF (Heat-Sealable)</td>
<td>0.010</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Typical laminated structures in which this new UHBF might be combined with heat-sealable transparent oriented polypropylene (OPP), heat-sealable PE or an Adhesive (Adh), and other materials include:

- OPP/Ink/PE or Adh/UHBF
- Outer Layer/Ink/UHBF
- Outer Layer/Ink/Paper/PE/UHBF

**High-Barrier Clear Film**

The new high-barrier clear film technology consists of a bi-axially oriented OPP film featuring ultra-high surface energy treatment of its ultra-high-barrier layer on one side and heat sealability on the other side. Designed for use as an inside sealant web, it provides high oxygen barrier and exceptional moisture barrier. This new film technology also offers improved oil resistance, increased puncture resistance, and better stiffness. With its outstanding oxygen-barrier properties, and its suitability for gas flushing, it is an excellent alternative to PVdC-coated OPP.

The following table shows a comparison of moisture-vapor and oxygen-transmission rates for a new high-barrier heat-sealable clear OPP film as compared with moderate-barrier (MB) and high-barrier (HB) PVdC-coated films.

<table>
<thead>
<tr>
<th>Barrier Film</th>
<th>MVTR @ 100°F, 90% RH g/100in²/day</th>
<th>OTR @ 73°F, 0% RH cc/100in²/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>MB PVdC Film</td>
<td>0.27</td>
<td>0.95</td>
</tr>
<tr>
<td>HB PVdC Film</td>
<td>0.16</td>
<td>0.30</td>
</tr>
<tr>
<td>HBF (Heat-Sealable Clear)</td>
<td>0.19</td>
<td>0.67</td>
</tr>
</tbody>
</table>

Caption: New high-barrier clear film features special ultra high surface energy treatment of its ultra barrier layer.
Typical laminated structures in which this UHBF might be combined with OPP or BOPP, PET, PE or Adh and other materials include:

- OPP/Ink/PE or Adh/HBF
- BOPP/Ink/PE or Adh/HBF
- PET/PE or Adh/HBF
- Outer Layer/Ink/HBF

New value-added ultra-high-barrier metallized and high-barrier clear packaging films offer innovative possibilities to converters and end users who want to maintain or extend the shelf life of perishable products and reduce loss in profits. They should also prove especially useful in light of food manufacturers’ interest in replacing hydrogenated vegetable oils containing trans fats with edible oils that are less stable and more sensitive to degradation by moisture vapor and oxygen. When the barrier properties of the packaging film are improved, the need to shorten “sell by” dates of reformulated products can be eliminated.

###

Toray Plastics (America), Inc.’s new advanced barrier technologies include Torayfan® PC5 and Torayfan® PWX5 co-extruded metallized ultra-high-barrier OPP films, and Torayfan® CBS-2 co-extruded clear high-barrier OPP film.

**About the authors**

Steve Sargeant, PhD., Director, New Business Development, Toray Plastics (America), Inc., can be reached at steve.sargeant@toraytpa.com or 401-294-4511, ext. 4442. Ken Chang, Director, New Product Development, Toray Plastics (America), Inc., can be reached at ken.chang@toraytpa.com or 401-294-4511, ext. 3227. Visit the Toray Plastics (America), Inc. web site at www.TorayFilms.com.