

PET barrier technologies – poised for growth

The need for enhanced barrier performance when packaging beer, juices etc. is well known to users and potential users of PET bottles. There has been renewed development activity and interest in barrier enhancing technologies recently as a result of the lower costs that are now possible. Robert Tremblay of Plastex Solutions, LLC, formerly with Western Container and Constar, summarises the current position.

A number of trends are driving renewed market activity for PET gas barrier technologies:

- The popularity of smaller bottle sizes (i.e. < 500ml). Gas permeation rates are proportional to bottle surface area. Bottle surface area per unit volume of contents increases as bottle size gets smaller.
- Growth of monolayer barrier bottles as a market entry strategy, then switching to multilayer or coating as volumes increase. This is a new staged-entry approach that has not been considered before.
- Consumer demand for healthier beverages (fresh juices, teas, milks and dairy-based beverages) which are often oxygen-sensitive.
- The growing market demand for beer in PET.
- Replacement of glass packaging for sauces and condiments which are often oxygen-sensitive.

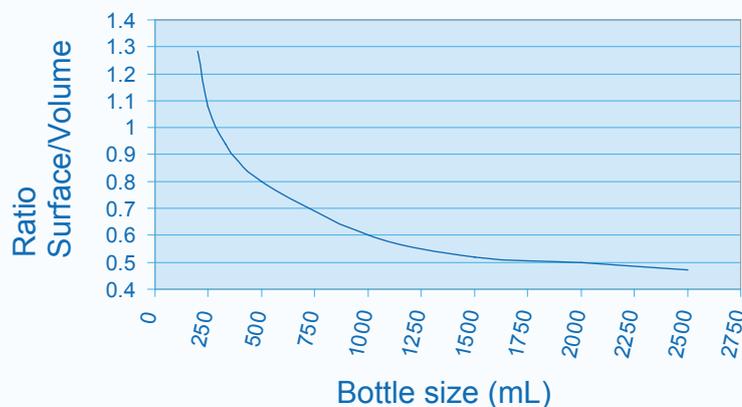
Barrier technologies also offer the advantage of enabling lightweighting to levels that would not otherwise be possible. For many applications today, the lower bottle weight limit is dictated by a minimum wall thickness required to meet minimum barrier performance. For a true barrier bottle the lower weight limit is often dictated by the mechanical properties of the bottle. This lightweighting alone can be enough to offset the costs associated with adding the barrier to the bottle.

Barrier enhancement technologies can be grouped into three categories:

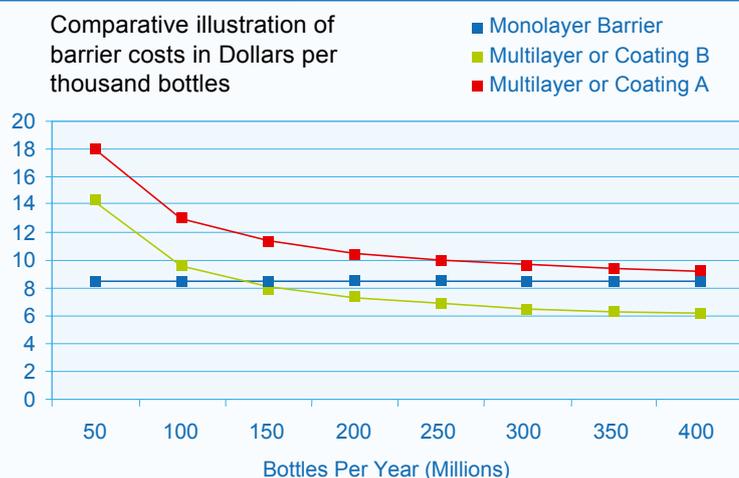
- Coatings (internal or external)
- Monolayer using barrier additives
- Multilayer (co-injection)

Coatings

Barrier coating systems are available from several suppliers, each with their own technology. External coatings have the advantage of not requiring government food contact approval, but may suffer from scuffing and other damage during transport. Internal coatings require food contact approvals but are protected from damage during shipping. Most sys-



Comparative illustration of barrier costs in Dollars per thousand bottles



tems have opted for the internal coating, including Sidel's Actis, SIG's Plasmax and Nano Coating's PlasmaStar. All three of these systems use a plasma deposition approach to create the coating. They differ in several areas, including the precursor material and energy source used to generate the plasma. In all three cases the system gives the operator the flexibility to tailor the level of barrier by adjusting the length of time that the bottle is exposed to the plasma field, as well as adjusting the composition of the plasma itself.

All of the above coatings are applied to blown bottles but the Flow Coating process from Advanced Plastics Technologies (Long Beach, California) is applied as a liquid to the outside of the preform. This reduces shipping costs for businesses that have central preform moulding and satellite blow-moulding plants.



Coated Barrier Bottles

The bottle-coating approach is best suited to manufacturers that want to keep the "high technology" piece of the equation under their own control and to buy standard monolayer preforms on the open market. With today's cost estimates coming in at less than US\$6/1000 bottles, according to supplier Nano Coating, barrier coating technologies certainly look as if they will continue to gain acceptance in the market.

Monolayer with Additives

The approach of simply using additives in monolayer bottles has been gaining market acceptance thanks to new product offerings from material suppliers such as M&G and Invista, both of which are claiming to have largely overcome the poor clarity problems associated with earlier solutions. The low cost of entry of this approach means that virtually any preform moulder can become a supplier of barrier preforms overnight. This same benefit, however, can become a cost disadvantage at high volume production since total cost is driven primarily by the total number of bottles produced with few opportunities available to gain economies of scale. The amount of barrier additive for a given level of barrier performance will be higher for a monolayer container, where it is dispersed throughout the container wall, than for multilayer or coatings where the barrier material can be concentrated in a discrete layer.

Multilayer and coating approaches, while usually more expensive than the monolayer approach at low vol-

umes, become more economical as the number of bottles increases. This is due to the ability to amortise the cost of the equipment and infrastructure over a greater number of preforms and also the ability to use lower amounts of barrier material. As illustrated in the chart above, there is a cross-over point at which the monolayer barrier approach becomes more expensive than other options.



Monolayer barrier bottles with active oxygen scavenger

Multilayer

Multilayer barrier enhancement has been around the longest of all the options available today. It involves injecting a high-barrier resin between the two layers of PET during preform moulding. In the past the barrier material has been a problem for recyclers but a major thrust on developing recycling friendly materials and viable separation technologies is under way. A key advantage of the multilayer approach is that it is a preform-based solution and therefore drops easily into the existing supply chain model. This also means that the barrier technology can be controlled centrally and many satellite blowing and filling operations can benefit from it.



Multilayer barrier bottles

Multilayer preform systems are available from three suppliers: Graham Packaging, Kortec and Otto Hofstetter. Graham's technology is available to other manufac-

12-ounce PET Bottle Cost Compared to Aluminum Cans and Glass Bottles

Costs shown below are per thousand containers.

*Estimate based on information provided by Kortec and Sidel USA
Source: Plastex Solutions, LLC

▪ PET Cost	\$31.70
- 24 gram preform	
- \$.60/lb resin	
▪ Bottle Manufacturing Cost	\$12.50
- 55,000 preforms/hour	
- 70,000 bottles/hour	
▪ 20% Margin	\$ 8.85
▪ Label and Closure	\$12.00
▪ Barrier treatment option	\$ 7.00*
12oz PET bottle Total	\$72.05
12 oz Aluminum can	\$65 - \$75

turers on a licensee basis, whereas Kortec and Hofstetter offer their products without licence. The economics of manufacturing multilayer preforms have improved dramatically since both Graham and Kortec have worked with Husky to launch systems with the same number of cavities and the same cycle time as monolayer systems. There are now several 144-cavity multilayer systems in commercial operation with more already on order.

A new approach from Husky and Kortec is to offer monolayer preform systems that are pre-configured to accept a future upgrade to multilayer. These "Kortec-ready" systems help converters to position themselves to be ready for growth in the market while keeping the initial capital investment low.

According to a cost model developed by Plastex Solutions, LLC, barrier PET containers are now highly competitive with their glass and metal counterparts and so new activity in the small CSD and beer segments is on the horizon.

Based on an article from Robert Tremblay, President of Plastex Solutions, LLC, a consulting firm specializing in plastic beverage packaging

Whatever kind of PET packaging, Magplastic has the right machine...

CSD, Fruit juice & hot fill solutions
Specific design and process, optimizing container performances and shelf life.

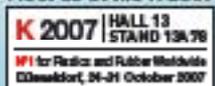
Water containers
The best compromise between bottle weight and performances up to 26.5 L.

Wine & Alcohol bottles
Special bottle and neck design dedicated to high value added products requesting elegance and sophistication.

Pharmaceutical, cosmetics and specialities
Versatility is a key word when producing containers such as wide mouth, small container down to 40 ml, flat bottles with orientated neck.

500 ml, 750 ml, 330 ml, 2.5 L, 1.5 L, 1 L, 25 L, 16 L, 19 L, 5 L, 40 ml

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