LAYERS OF SUCCESS
Mutilayer Blow Molded Containers
Fight Moisture Better Than Ever
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The demand for multilayer containers continues to grow and the healthcare industry is a prime area of potential.

According to a recently published study by The Freedonia Group: "Plastic bottles will continue to replace glass containers because of their lighter weight and shatter-resistant properties."

At the core of this projected growth, and in other markets such as personal care and specialty chemicals where barrier protection is essential, the processing challenge of preventing unwanted moisture penetration needs to be addressed.

A recent technical paper: “Moisture in Packaging - Selecting the Right Desiccant,” published by Multisorb Technologies, defines the issue as follows. Moisture has four sources that the molder needs to deal with: “the water vapor in the air inside the package; the water vapor absorbed by the materials inside the package; the water vapor
on the walls of the package; and the permeation of water vapor into the package."

To overcome the challenge of unacceptable moisture in packaging applications, material suppliers, machinery manufacturers, and end-users have been creating innovative working relationships.

One such example is the successful joint effort between Wilmington Machinery and Honeywell, the result of which led, in April of 2005, to the commercialization of Aclon™ polychlorotrifluoroethylene (PCTE) resin for multilayer containers, which can be used in the healthcare, personal care and specialty chemicals industries for various packaging applications including oral hygiene products, eye care products, cough medicines, lyophilized drugs, specialty oils and high purity chemicals.

Aclon™ resin currently offers the highest moisture barrier of any clear thermoplastic resins. Multilayer containers using Aclon™ resin as a sandwich between plastic materials or contact layer are crystal clear, shatterproof and lightweight. The resin itself provides a variety of other key properties for clear multilayer containers, including good processability, low coefficient of friction and superior chemical resistance.

Despite its many attributes, however, the successful use of Aclon™ in blow molded applications faced a significant hurdle.
Specifically: Aclon™ displays the property of requiring a processing temperature of 550 degrees F, whereas material between which it is designed to be “sandwiched” as a moisture barrier (polyethylene or polypropylene, for example), possess a lower melt temperature of about 400 degrees F. At this lower temperature Aclon™ simply would not flow properly. In layman’s terms, there were significant processing problems in getting the materials in packaging such as blow molded plastic bottles to “stick together.” This was made even more problematic by the fact that another major use of Aclon™ is on the inside of bottles and not between layers.

Wilmington has been perfecting multilayer machinery and material configurations for many years and, over the course of approximately nine months, working in close tandem with Honeywell, was able to use its laboratory and processing expertise to solve this difficult challenge. The 4-oz. ounce multilayer containers molded with Aclon™ resin met or exceeded all expectations for moisture vapor transmission, oxygen transmission, burst strength and flavor scalping.

How was this accomplished?

The trials were conducted using Wilmington Machinery’s 6-layer coextrusion laboratory wheel blow molding line. This particular coextrusion system uses 6 individual extruders together with a specially designed single parison diehead. The bottle chosen for the trial was a small 4 ounce suitable to pharmaceutical type applications,
for which a set of molds was manufactured. The diehead tooling was only 3/8” diameter due to the need to keep the parison contained within a 28 mm neck. The temperature settings of the diehead and the ability to bring the different temperature resins together near the exit of the diehead were critical to being able to commercialize the process. The materials were brought to the diehead at their standard melt temperature with the diehead set at 400 degrees F. Coatings were added to the tooling and head inserts to improve inside surface finish when the Aclon™ was placed on the inside layer. In addition, when the Alcon™ was run on the inside of the bottle, special mold and bottle design changes were provided to produce the required weld strength.

As a result, when used as the contact or core layer, Aclon™ resin’s barrier properties keep invasive moisture vapor and oxygen out. This barrier, therefore, protects high purity chemicals not only against what is outside the container, but also from the container itself. Because the resin is plasticizer and stabilizer free and chemically inert, the container walls will have extremely low leachables/extractables and will not be affected by the contents. Such multilayer containers have the potential to meet USP Class VI and FDA requirements.

Wilmington Machinery systems used for producing multilayer containers are structurally uncomplex in that they utilize multiple single screw extruders compactly fitted together. A different material
is typically fed from each extruder. The melted materials are then delivered with melt pipes to the stackable multi-layer diehead designed by Wilmington. These can vary from to 7 layer or more depending upon the material structure required. In the case of the Aclon™ trials, both 4 and 6 layer configurations were produced. Precise ratio control of the delivery of the various layers makes the machines capable of equally precise layer formations for the most demanding applications. Wilmington’s multilayer blow molding technology can produce any part that is blow moldable and many times with improved cost, stiffness, appearance or barrier properties. Demanding barrier applications benefit from variable thickness control of any or all layers, resulting in improved uniformity of layer thickness in complex shapes. The benefits extend to a wide range of blow molded products including the demanding fields of healthcare, personal care as discussed above.


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