

Blow Molding

Injection blow molding is used to produce beverage and milk bottles, as well as other consumer cosmetics and pharmaceutical products and industrial containers. One of the biggest users is the carbonated beverage industry. When first developed, the beverage containers were a failure because the carbonation dissipated through the plastic material and because a basic structural weakness existed. The problems were solved by developing a multi-layer structure of various materials that provided a series of barriers to contend with the range of unique demands on the containers. The inner layer provides a permeation barrier to stop or greatly slow the carbonation loss and to provide taste and aroma protection. The outside layer provides scuff

resistance, printing capability, and an ability to be filled with hot fluids. Structural design changes improved the ability of the bottle to sustain impact and other typical abuse in handling.

Injection blow molding is a two step forming process in a three station machine. First, a *parison*, a short test-tube-like piece is injection molded by a conventional injection molding process, normally with threads or other required features. The parison is then rotated to a station with a blow molding tool. Hot air is injected into the parison, which expands it into the mold cavity. The last stop is a stripper station that removes the finished part.



figure 9-40. injection blow molded HDPE bottle (injection molded trigger assembly)

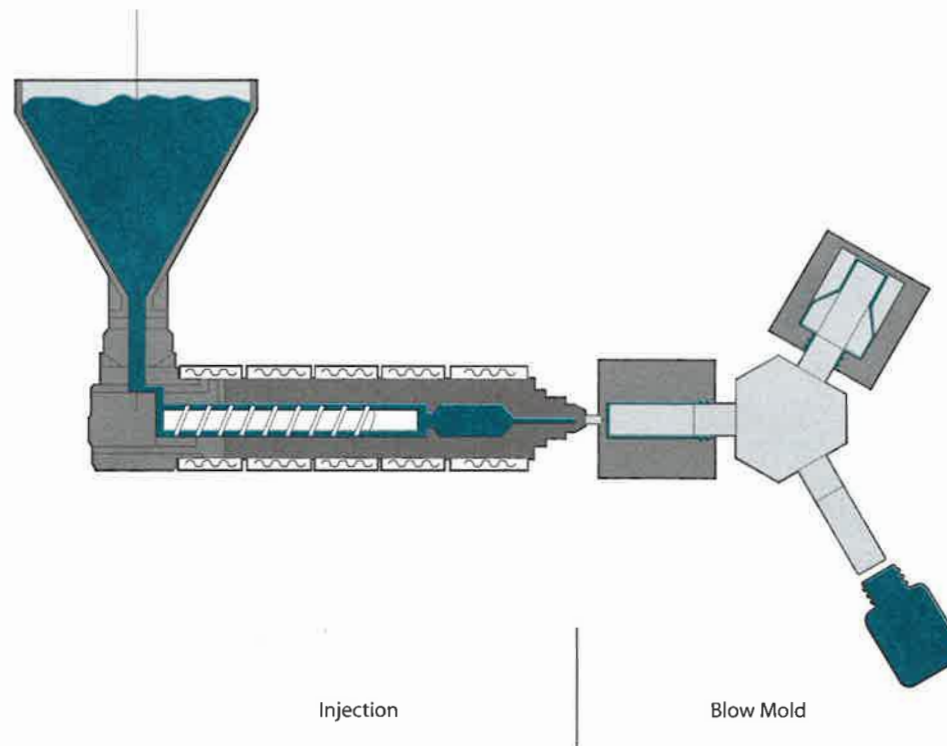


figure 9-41. injection blow molding process

Extrusion Blow

Typical products are small to large machines; large detergent liquid such as bumpers. Other applications is made by continuous tube is extruded. Multilayer blow tubes or parisons.

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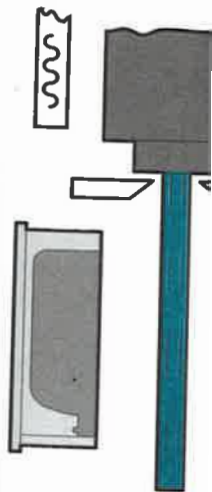


figure 9-42. extrusion

Extrusion Blow Molding Process

Typical products for the *extrusion blow molding process* are small to large double-wall cases for tools and other machines; large hollow plastic containers for chemical and detergent liquids and powders; very large hollow shapes such as bumpers for cars and floorboards for truck beds. Other applications are corrugated pipe and tubing, which is made by continuous blow molding, in which the pipe or tube is extruded horizontally and blown in moving molds. Multilayer blow molding involves the use of coextruded tubes or parisons, allowing the forming of multilayer structures.

In extrusion blow molding, a tube (parison) is extruded. It is then clamped into a tool with a cavity much larger than the tube diameter. Then the parison is blown outward to fill the mold cavity. Blowing is usually done with an air pressure of 50 to 100 psi. The mold halves clamp around the tubing, closing off both ends (often breaking the tube into sections called *pinch-off*). The part is then cooled, the mold halves open and the part is ejected.

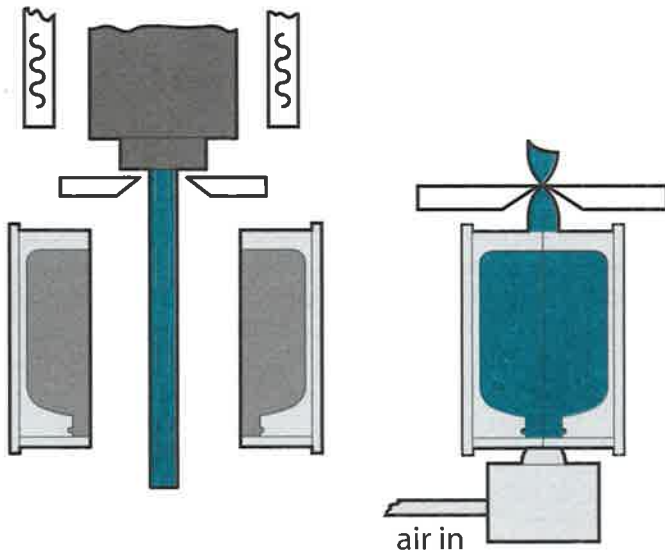


figure 9-42. extrusion blow molding sequence



figure 9-43. extrusion blow molded parts.

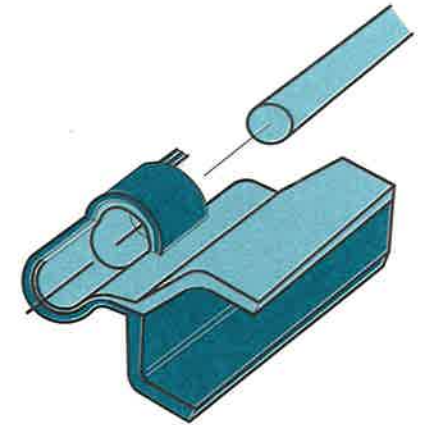


figure 9-44. extrusion blow molding detail: hinge (courtesy of Pappago Plastics Inc.)



figure 9-45. extrusion blow molding detail: tacked rib (courtesy of Pappago Plastics Inc.)

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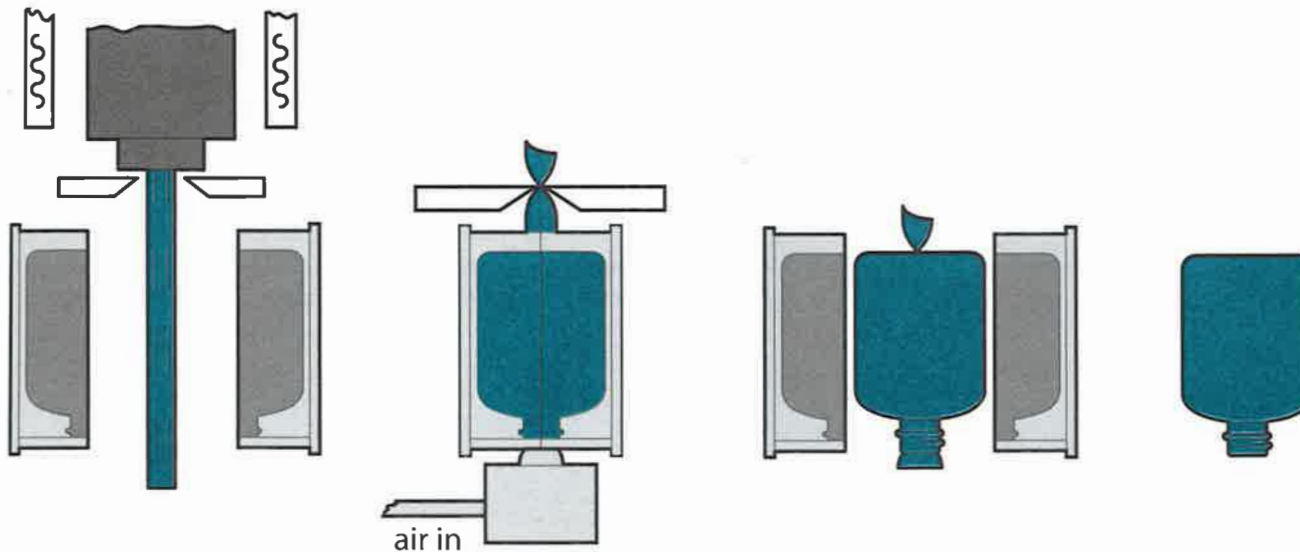


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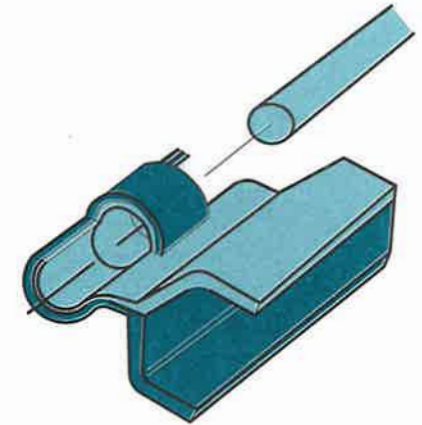


figure 9-44. extrusion blow molding detail: hinge (courtesy of Pappago Plastics Inc.)



figure 9-45. extrusion blow molding detail: tacked rib (courtesy of Pappago Plastics Inc.)



figure 9-46. blow molded modular chemical storage system (courtesy of Bally Design Inc.)

The extrusion blow molding process offers many unique opportunities to design part features such as support ribs (pinch-off) giving the part exceptional strength; integral hinges and handles formed at the part line provide reduced assembly costs and greater strength. In automotive part design the hollow shapes offered by this process provide air and wire ways in dashboard design and exceptional strength to weight ratios in front and rear bumper design. The bumpers are often filled with foam for added strength. A unique feature of blow molded bumpers is that they pop back to their original shape after impact, usually showing little or no damage.

The process is relatively fast when compared to competing processes such as rotational molding. Other features possible with this process are molded-in inserts and the ability to form all the parts of a product that are then cut free, usually by robot controlled machining centers.

9.3 Solid State
Cold forming and equipment design to form thermoplastic materials such as polycarbonate, ABS, and polyethylene are sufficiently ductile at room temperature for processes such as rolling, deep drawing, and coining.