HANSER

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# Understanding Blow Molding

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Leseprobe

# 2 Basic Process

## 2.1 The Principles of Blow Molding

A simple explanation of the principle of blow molding is a balloon. If you blow air into a plastic tube that is closed on all sides except the point at which the air enters, the tube will expand and take the shape of the mold that is around the tube. As in the case of the balloon, the further the tube is stretched the thinner it gets (Fig. 2.1).

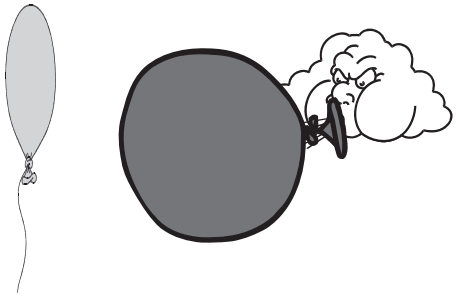


**Fig. 2.1:** Balloons

Parison or pre-form

The process begins with a plastic resin hot tube called a parison or pre-form. The parison is placed within a split mold with a hollow cavity. The mold sides are then clamped together, pinching and sealing the parison tube. Air is blown into the tube, which expands the hot resin wall into the shape of the cavity; the mold is cooled with water solidifying the resin into the shape of the part. Once cooled, the part is ejected from the mold and trimmed (Fig. 2.2).

Basic process

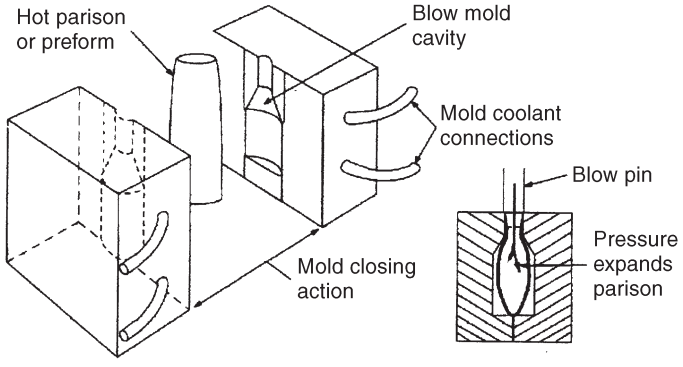



**Fig. 2.2:** Basic process

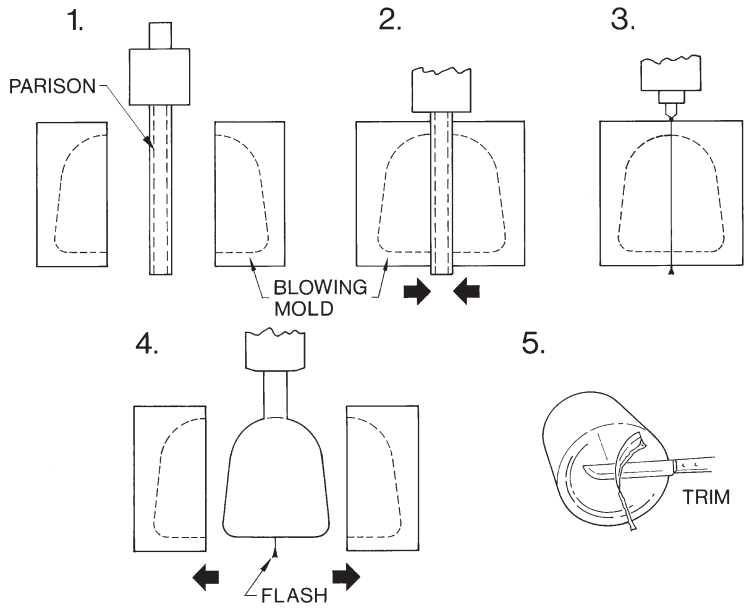



**Fig. 2.3:** Blow molding stages

There are several methods of blow molding plastic parts. However they all have 5 stages in common (Fig. 2.3).

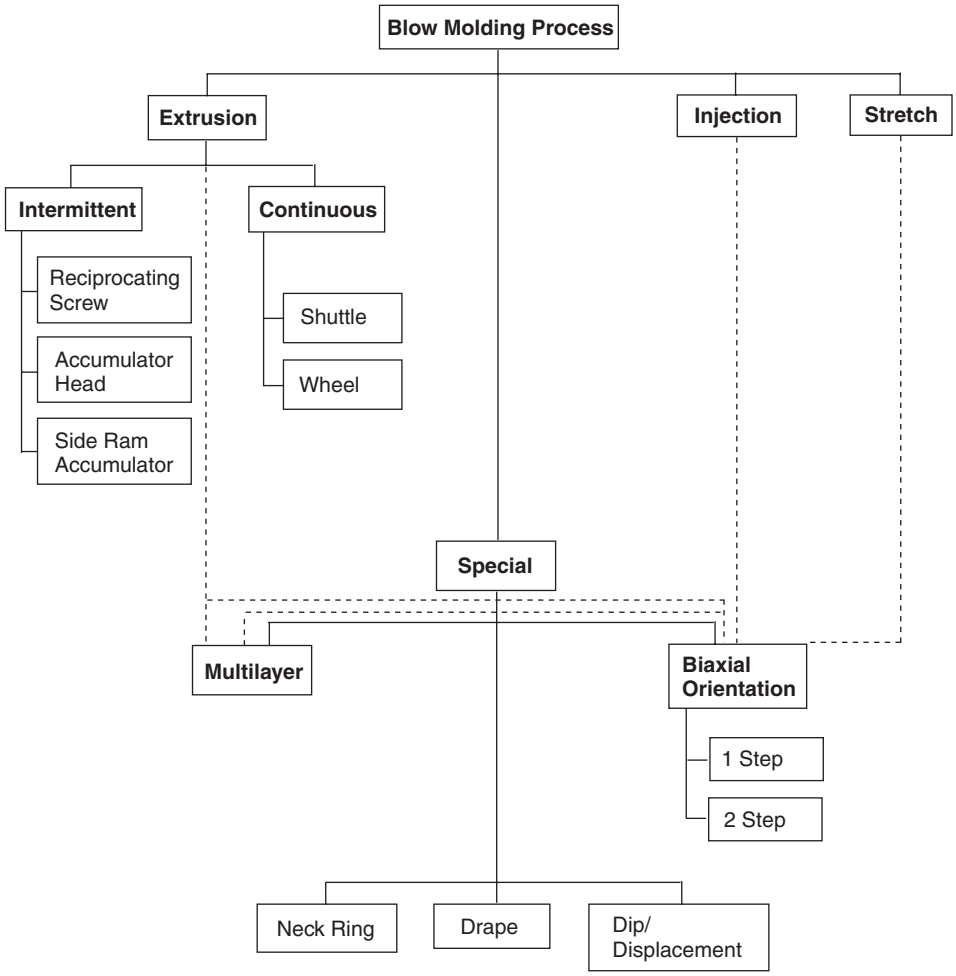
Five stages of blow molding

1. Platicizing or melting the resin
2. Parison or pre-form production
3. Inflation of the parison or pre-form in a mold to produce the end part
4. Ejection of the part
5. Trimming and finishing of the part

The first four steps take place in sequence; the fifth is performed while the other 4 steps are cycling. Exceptions occur when a number of pieces are produced on the same machine, simultaneously, then the four steps may overlap. Most of the cycle time is taken up by the blowing and cooling step. Therefore (step 3) blowing and cooling control the machine cycle. The speed of the machine that melts the resin and makes the parison must be configured to conform to the blowing/cooling time.

## 2.2 Parison Formation

The parison or pre-form is formed by either of two techniques for melting the resin, extrusion or injection molding (Fig. 2.4). This diagram shows the family of today's variation of the blow molding process. Each of the processes to be described has its advantages. The end product and volume to be produced determines the best method for the application.




Various blow-molding methods

**Fig. 2.4:** Flow chart

For small, high production clear parts, injection blow molding would be the process of choice. For larger industrial parts the accumulator method is the process of choice; and higher volume detergent or oil bottles would most likely be produced on a wheel machine.

## 2.3 Blow Molding Development

History

- The first patent issued in the 1850s for blow molding with a material other than glass was issued to Samuel Armstrong. These early items were made from natural latex, mainly novelty items that were unique because of their soft feel.
- The next major advancement came in 1869 with the commercialization of celluloid, which is considered to be the first true thermoplastic material.
- In the 1880s, cellulose nitrate was introduced and was used to produce novelties and toys. This material was softened by steam; the disadvantage was its high volatility, which kept it from being widely used.
- In 1919 a material which was much more stable, cellulose acetate, was available and had much greater acceptance as a commercial material. By 1930 it was available as a squeeze bottle.
- In the early 1930s, Plax Corporation developed the first blow molding machine. This was crude and produced only small quantities. However, from this early beginning a machine to make 25,000 bottles a day was developed. A photograph of the first blow molding machine can be seen in Fig. 2.5.

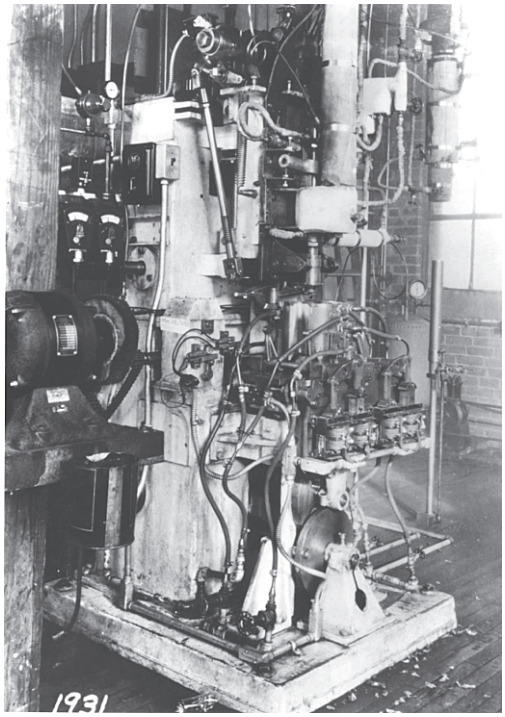



**Fig. 2.5:** First blow molding machine. One of the first automatic blow molding machines developed by Plax in the early 1930s. Courtesy of Innopak Corp.

- In 1939 low density polyethylene was introduced by I. C. I. (England). This material was much more amenable to the blow molding process and opened up the way to further development.
- In the 1940s Plax introduced the first LDPE bottle.
- The first injection blow molding machine was introduced. This hybrid machine featured high precision neck dimensions with tolerances as tight as glass bottles.
- Continental Can was issued a patent for a continuous extrusion blow molder in 1950.
- The beginning of industrial blow molding can be said to have started in 1953 with the development of high density polyethylene. This material was developed simultaneously by Phillips Petroleum Co. in the United States and by Professor K. Ziegler in Germany.
- By 1956 the commercialization of the blow molding process and explosive growth of the industry had begun.
- During the 1950s industrial blow molding machines were developed first in Europe, since Plax and Continental tightly held patents in the United States.
- European machines became available in the United States by 1958. The first machine was bought by Empire Plastics to make toy bowling pins.
- Several individuals and companies built machines, and I was personally involved in converting a Reed injection machine to make a blown baseball bat.
- Ideal Toy ordered six machines built by Walden-Hartig (Hartig machines are now made by Davis Standard), to make doll bodies with a head design from Empire Toys.
- By 1960 with patents now freed ZARN, Inc. made milk bottles on Uniloy machines for Borden Dairy in High Point, North Carolina (Fig. 2.6).
- In the ’70s biaxially oriented polyethylene terephthalate (PET) was developed, which led to the introduction of the twostep process by which pre-forms and final bottles are produced on separate machines by Cincinnati Milacon, U.S.A. in 1977 Nisser, ASB Company (Japan), began to offer biaxial orientation of PET using blow molding equipment based on a one-step process.
- Also during the ’70s, Multilayer blow molding came to the U.S.A with the introduction of the ketchup squeeze bottle.

With the introduction and the application of the microprocessor, resins with a wide range of material properties became available. Also, the availability of larger, more robust equipment and microprocessor technology made the production of a range of industrial products such as automotive fuel tanks, etc., possible. Then too, from Japan and Germany, complex shapes and with irregular contours were possible with the introduction of 3-D blow molding.

**Fig. 2.6:** Cellulose acetate (squeeze bottle). First high-volume LDPE blow molded bottle by Plax Corp.

Today bottles still represent a large share of the blow molding market with an 80 percent share; the other 20 percent are considered to be industrial blow molding.

### *Additional Reading*

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Rosato, D. (Ed), *Blow Molding Handbook*, 2nd ed., (2003) Hanser Publishers, Munich