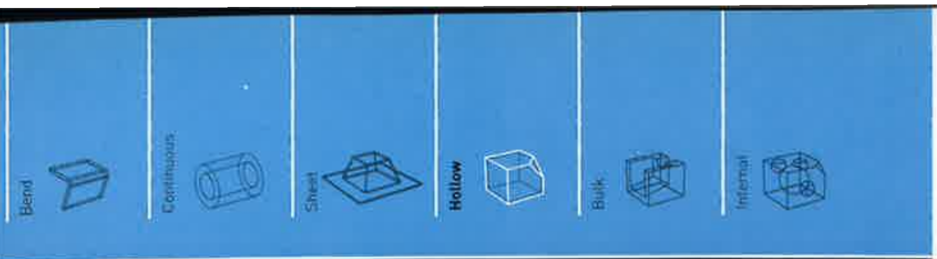


Blow Molding

This group of processes is typically used to mass produce hollow packaging containers. They are a very rapid production method for large volumes of thin walled parts.

Costs	Typical Applications	Suitability
• Moderate tooling costs • Low unit costs	• Chemical packaging • Consumer packaging • Medical packaging	• Suitable only for high volume production runs
Quality	**Related Processes**	**Speed**
• High quality, uniform thin walled parts • High quality surface finish that can be gloss, textured or matt	• Injection molding • Rotation molding • Thermoforming	• Very rapid cycle time (typically 1–2 minutes)

INTRODUCTION

Blow molding is carried out in 3 different ways: extrusion blow molding (EBM), injection blow molding (IBM) and injection stretch blow molding (ISBM). Each of the processes has its particular design opportunities and is suitable for different industries.

EBM is favourable for many applications because it has low tooling and running costs. It is a versatile process that can be used to produce a wide variety of shapes in an extensive choice of materials. Containers can be molded with integral handles and multiple layered walls.

IBM is a precise process that is suitable for more demanding applications such as medical containers and cosmetic packaging. It is used to produce containers with very accurate neck finishes as well as wide mouths.

ISBM is typically used to produce high quality glass clear PET containers such as water bottles. The injection cycle ensures very accurate neck finishes and the stretch cycle gives superior mechanical properties. ISBM is particularly suitable for beverage, agrochemical and personal care applications.

TYPICAL APPLICATIONS

EBM is used mainly in the medical, chemical, veterinary and consumer industries to produce intravenous containers, medicine bottles and vials, and consumer packaging.

IBM is utilized especially for consumer packaging and medical packaging (medicine bottles, tablet and diagnostic bottles and vials).

ISBM is predominant in the personal care, agrochemicals, general chemicals, food and beverages and pharmaceutical industries to produce carbonated and soft drink bottles, cooking oil containers, agrochemical containers, health and oral hygiene products, bathroom and toiletry products, and a number of other food application containers.

RELATED PROCESSES

Thermoforming (page 30), rotation molding (page 36) and injection molding (page 50) can all be used to form the same geometry parts. Even so, blow molding is the process of choice for large volumes of hollow thin walled packaging.

QUALITY

The surface finish is very high for all of these processes. The IBM and ISBM technologies have the additional advantage of precise control over neck details, wall thickness and weight.

DESIGN OPPORTUNITIES

All of the blow molding processes can be used to produce thin walled and strong containers. The neck does not have to be vertical or tubular. Features such as handles, screw necks and surface texture can be integrated into all 3 processes.

The principal reason to select IBM is that there is more control over wall thickness and neck details. This means that a wider range of anti-tamper and other caps can be introduced.

The main advantages of EBM are that a wide choice of materials can be used in this process, and complex and intricate shapes manufactured.

ISBM can be used to produce clear containers with very high clarity. Stretching the pre-form during blowing greatly increases the mechanical strength of the container by aligning the polymer chains longitudinally. These containers also have good gas and solvent barrier properties and so can be used to package aggressive foods, concentrates and chemicals.

DESIGN CONSIDERATIONS

A major difference between these blow molding techniques is the capacity that each can accommodate. IBM is generally limited to the production of containers between 3 ml and 1 litre (0.005–1.760 pints) and ISBM can produce containers between 50 ml and 5 litres (0.088–8.799 pints). EBM can create the largest variety of containers ranging between 3 ml and 220 litres (0.005–387 pints). Blow molding is a complex process with which to work. Expert advice from engineers and toolmakers is required to guide the design process through to completion. There are many considerations that need to be taken into account when designing for blow molding, including the user (ergonomics), product (light sensitivity of contents and viscosity), filling (neck, contents and filling line), packaging (shelf height) and presentation (labelling using sleeves or print, for example).

COMPATIBLE MATERIALS

All thermoplastics can be shaped using blow molding, but certain materials are more suited to each of the technologies. Typical materials used in the EBM process include polypropylene (PP), polyethylene (PE), polyethylene terephthalate (PET) and polyvinyl chloride (PVC), while the IBM process is suitable for PP and HDPE among other materials. Typical materials for the ISBM process include PE and PET.

COSTS

Tooling costs are moderate. EBM is the least expensive, the tooling for IBM is typically twice as much and ISBM is the most expensive.

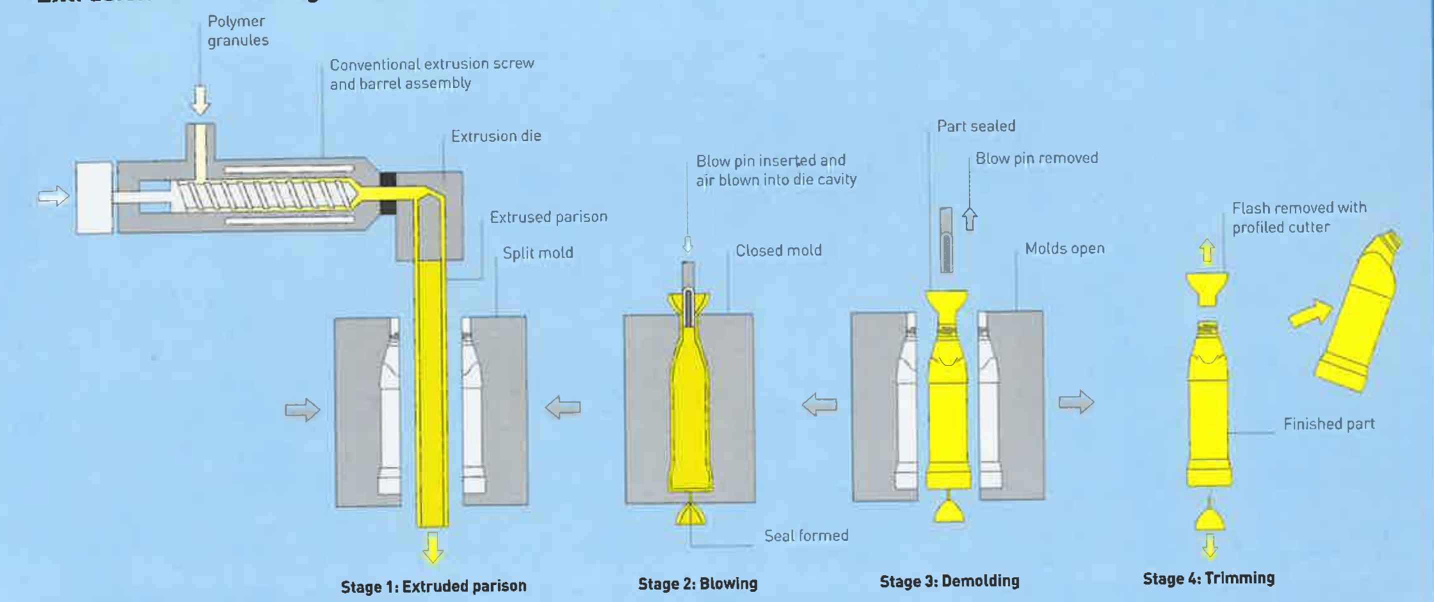
Cycle time is very rapid. A single mold may contain 10 or more cavities and eject a batch of parts every 1–2 minutes.

Labour costs are low, as production is automated. Set-up and changeover can be expensive, however, so machines are often dedicated to a single product.

ENVIRONMENTAL IMPACTS

All thermoplastic scrap can be directly recycled. Process scrap is recycled in-house. Post-consumer waste can also be recycled and turned into new products. Recycled PET is used in the production of certain items of clothing, for example. Blow molding plastics is more energy efficient than glassblowing.

Extrusion Blow Molding Process



TECHNICAL DESCRIPTION

In stage 1 of the EBM process, a conventional extrusion assembly feeds plasticized polymer into the die. The polymer is forced over the mandrel and emerges as a circular tube, known as an extrused parison. The extrusion process is continuous. In stage 2, once the parison has reached a sufficient length the 2 sides of the mold close around it. A seal is formed along the bottom edge. The parison is cut at the top by a knife and moved sideways to the second station, where air is blown in through a blow pin, forcing the parison to take the shape of the mold. The hot polymer solidifies as it makes contact with the cold tool. In stage 3, when the part is sufficiently cool the mold opens and the part is ejected. In stage 4, the container is deflashed using a trimmer.

Extrusion blow molding a cleaning agent container

The PE polymer granules are stored in a communal hopper and coloured individually for each machine (**image 1**). In this case a small percentage of blue granules are added just prior to extrusion. The extrusion process is continuous and produces an even wall thickness parison (**image 2**). The 2 halves of the mold close around the parison to form a seal and the parison is cut to length (**image 3**). A blow rod is then inserted into the neck, and air is blown into the mold at 8 bar (116 psi) forcing the parison to take the shape of the mold (**image 4**). The molds separate to reveal the blown part with the blow rods still inserted (**image 5**). The rods retract and the part is deflashed with a profiled trimmer (**image 6**).

Each batch is conveyed from the blow molding machine to labelling and capping via pressure testing (**image 7**). The EBM bottles pass through the filling line (**image 8**). The caps are screwed on automatically (**image 9**) and the labels adhesive bonded to the bottle (**image 10**). The finished product is packaged and shipped.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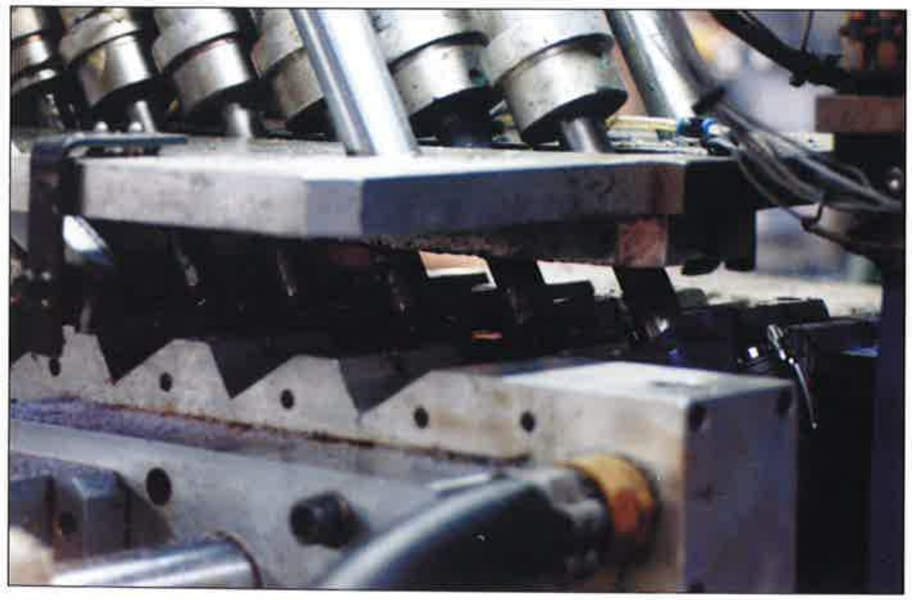
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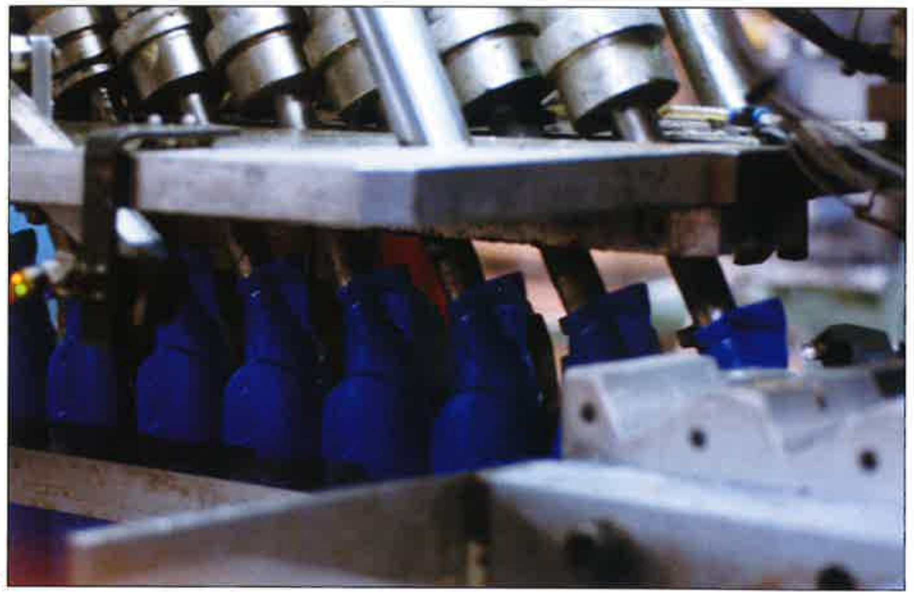
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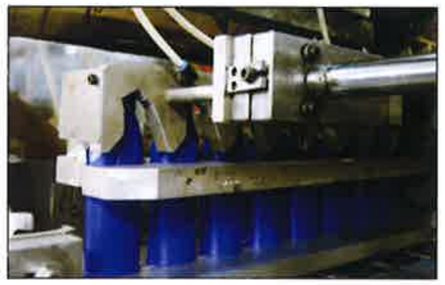
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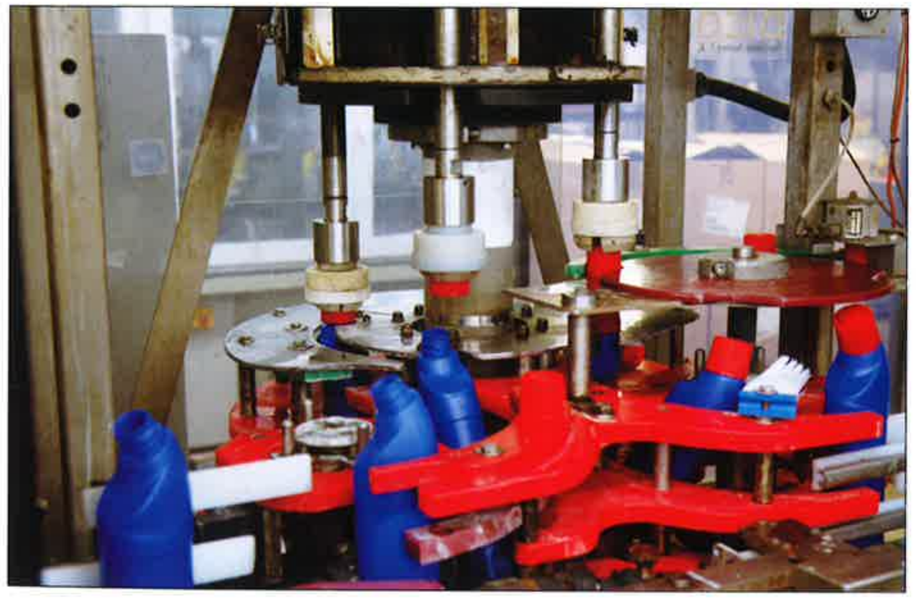
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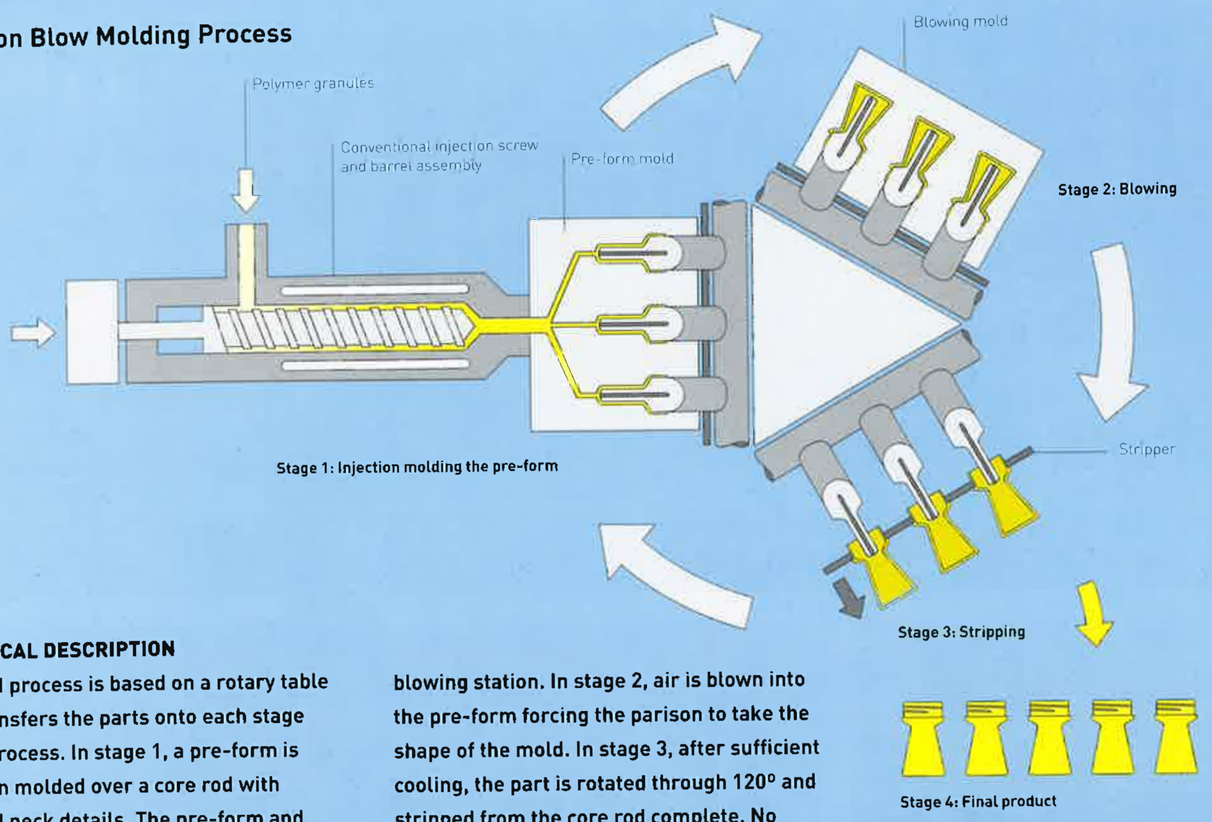
Injection Blow Molding Process



TECHNICAL DESCRIPTION

The IBM process is based on a rotary table that transfers the parts onto each stage in the process. In stage 1, a pre-form is injection molded over a core rod with finished neck details. The pre-form and core rod are transferred through 120° to the blowing station. In stage 2, air is blown into the pre-form forcing the parison to take the shape of the mold. In stage 3, after sufficient cooling, the part is rotated through 120° and stripped from the core rod complete. No trimming or deflashing is needed.

1


Case Study

Injection blow molding a roll-on deodorant bottle

The polished core rods are prepared so the pre-forms can be injection molded onto them (**image 1**). Each core rod is inserted into a split mold and hot molten white PP is molded around it. The neck is fully formed (**image 2**). The parts are rotated through 120° and are inserted into the blowing mold. Air is blown in through the core rod and the plastic is forced to take the shape of the mold cavity. The polymer solidifies when it makes contact with the relatively cooler walls of the mold (**image 3**). The parts are stripped from the core rods (**image 4**), counted by a laser sensor (**image 5**) and pressure tested (**image 6**). The parts (**image 7**) are then fed into a filling and capping system similar to the EBM process.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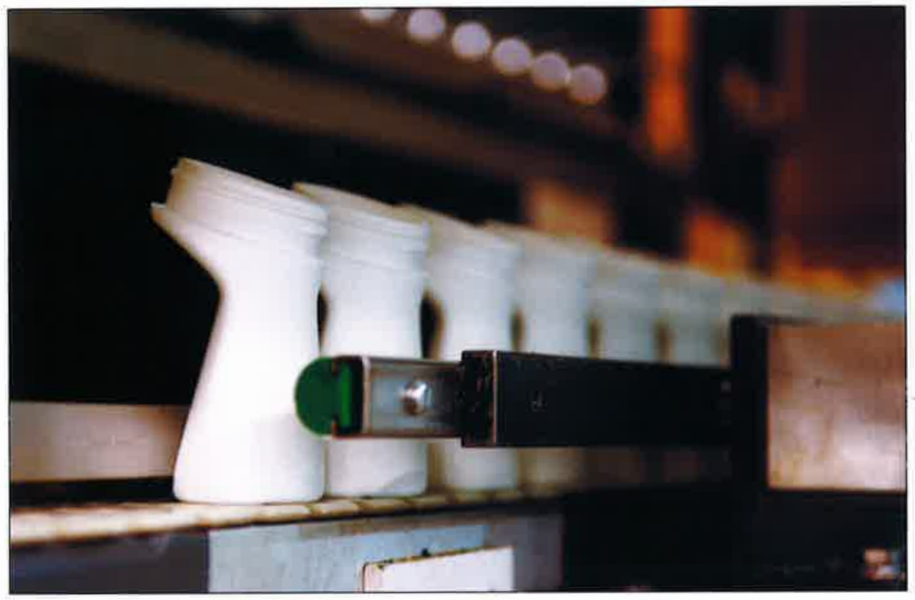
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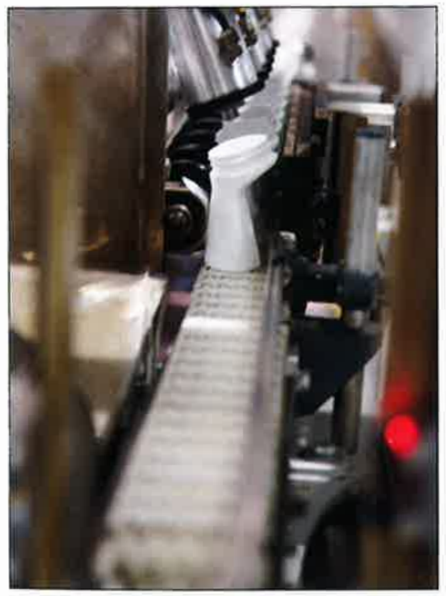
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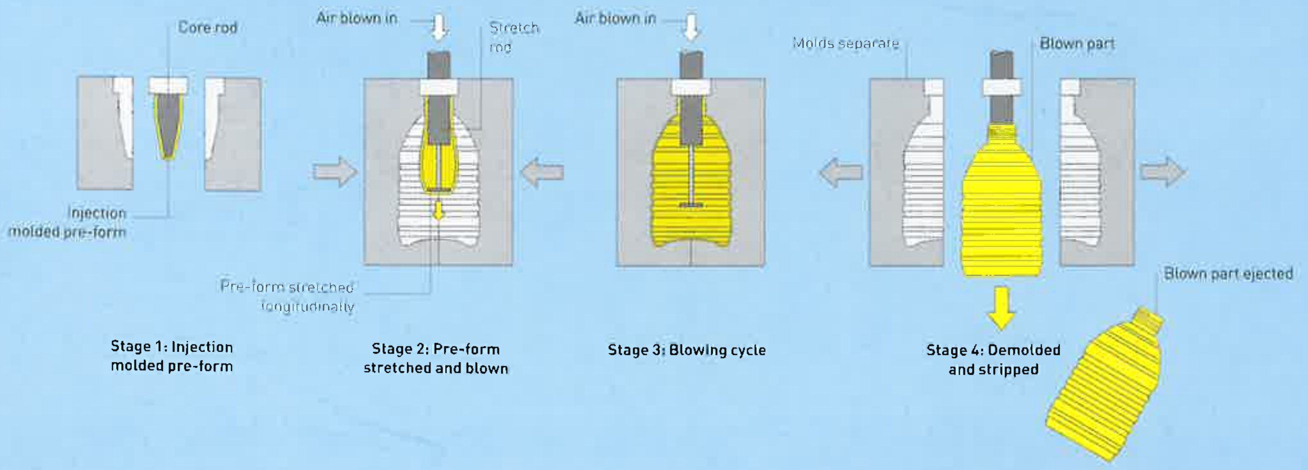
TECHNICAL DESCRIPTION

In stage 1, the ISBM process uses the same technique as IBM, in that the pre-form is injection molded over a core rod. In stage 2, however, in ISBM the core rod is removed and replaced by a stretch rod. The pre-form is inserted into the blow mold, which is clamped shut. In stage 3, air is blown in through the stretch rod, which simultaneously orientates the pre-form longitudinally. In stage 4, the mold opens and the parts are stripped from the stretch rod.

Injection Stretch Blow Molding Process



Case Study

Injection stretch blow molding a chemical container

The pre-form is injection molded over a core rod, which is removed prior to blowing. The injection molded part is thin walled, as demonstrated by the operator (**image 1**). There is not usually operator contact with the parts during production. The pre-form is transferred to the blow molds (**image 2**). The molds close around the pre-form and it is simultaneously stretched longitudinally and blown to form the container (**image 3**). The blown product is ejected and does not require any trimming. It is demolded (**image 4**), pressure tested (**image 5**) and a handle is fitted around the neck of the injection molded container, using an annular snap fit (**image 6**). The container is then sent for capping (**image 7**).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