BLOW MOLDING POLYPROPYLENE

Polypropylene offers many advantages over other blow molding resins. A high heat distortion temperature allows its use in hot-fill applications. The ability to be autoclaved without excessive haze or color development enables it to be used in medical applications. It also has excellent environmental stress-cracking resistance, as well as chemical-and solvent-resistance.

Polypropylene has good contact clarity, low color, and very low moisture transmission rates, all of which make it ideal for blow molding applications. This report outlines equipment requirements and provides suggested operating ranges and conditions for blow molding polypropylene. It also provides suggestions for troubleshooting the blow molding process.

MACHINE DESIGN

Screw Type A general-purpose, single-stage metering screw is normally adequate.

Compression Ratio The screw compression ratio for polypropylene may vary between 3:1 and 4:1. When a choice of screws is available, 3.5:1 is a good starting point.

Metering Zone The screw should have a rapid transition zone and a long metering zone. The metering zone, typically 8 to 12 flights, is required to ensure melt homogeneity.

Extruder L/D The length:diameter ratio of the screw should be between 20:1 and 30:1, but preferably 24:1 to 30:1

Breaker Plate and Screen Pack The breaker plate's function is to support the screen pack, straighten out spiral melt flow induced by the screw, and develop back pressure. The screen pack filters out foreign material. It also increases back pressure, thus improving mixing, and melt homogeneity.

Die Swell Die swell is not a constant parameter. It can be altered by adjusting temperatures, extrusion rate, and die opening. The greater the degree of die swell, the more the parison will weigh per unit length. Thus, a greater amount of die swell will produce heavier parts than a lesser amount.

Parison Cutoffs A hot-wire knife is preferred for its cleaner cut; however, cutoff blades can also be used.

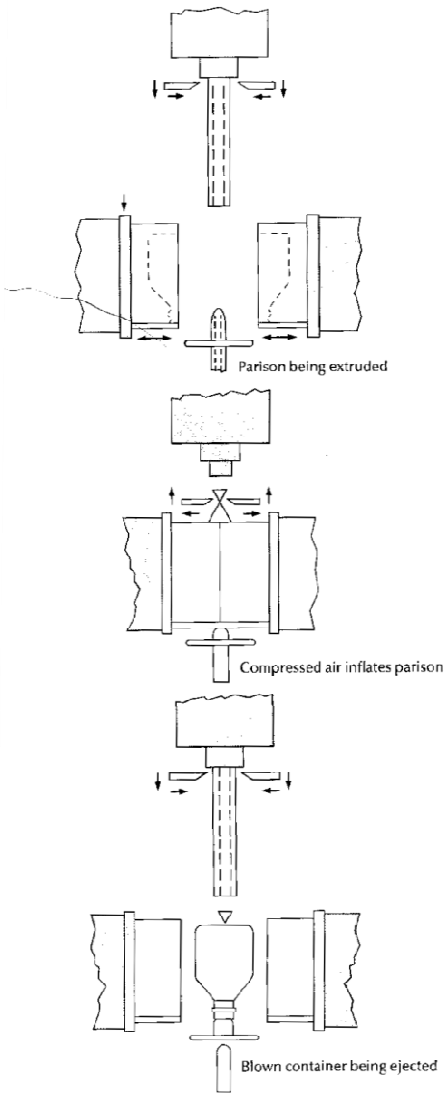
Molds Molds can be made from a wide variety of materials. Steel is by far the most common. However since blow molding requires much lower pressures, compared with injection molding, less costly materials, such as aluminum, can be used.

Extrusion Blow Molding

There are two main types of extrusion blow molding: continuous and intermittent parison extrusion. Both processes are used throughout the world.

The advantages of extrusion blow molding over other types of blow molding include lower tooling costs, greater flexibility in part design, and more economical large parts. The disadvantages include a poorer neck finish, limited wall thickness control, and greater sensitivity to resin variations.

Some of the basic machine requirements for extrusion blow molding polypropylene are as follows:



Extrusion blow molding

PP Extrusion Blow Molding Suggested Starting Operating Conditions

Extruder Operating Conditions

Melt Temperature

The recommended melt temperature for polypropylene is 205°to 215°C. Naturally, optimum conditions will vary for each part; therefore, it is suggested that 210°C be used as the starting melt temperature. Too low a melt temperature will result in a great deal of residual stress in the part. Too high a melt temperature may result in uneven wall thickness, high shrinkage, and long cooling times.

Extruder Barrel Temperature Profile

The particular temperature profile used will vary with each application. A good starting profile could be 200/205/210/210°C, (with the hopper zone 200°C). Adjustments should be made in 5° to 8°C increments.

Die Temperature

It is best to set the die temperatures higher than the stock temperature. This improves surface smoothness and knitting of the parison. The suggested die temperature range is 220°to 230°C

Mold Temperature

The suggested startup mold temperature is in the 15 to 25°C range. The mold temperature has a significant effect on part contact clarity and gloss. Running mold temperatures below 15°C will result in good contact clarity. High mold temperatures (greater than 25°C) give good gloss. Adjustments should be made in 5°C increments.

Blow Pressure

Blow pressure will be different for each part. Generally, the higher the blow pressure, the better the part's surface appearance. A high blow pressure also prevents excessive shrinkage. However, it may also cause thinning at the parting line. It is suggested that the blow pressure starts at 7 Kg/cm^2, and that it be kept in the 5 to 11 Kg/cm^2 range.

OPTIMIZING CYCLE TIME

Cycle time optimization should be approached in the following steps:

1. Reduce cooling time in 1-sec increments until warpage occurs, then add 1 sec.
2. Reduce blowing time in 1/2.sec intervals until incomplete blowing occurs.
3. Adjustments in extruder output (screw rpm) may be necessary to compensate for these changes in cooling and blowing times.

Troubleshooting Common Blow Molding Problems

In troubleshooting any type of process, it is important first to identify exactly what the problem is and then to ascertain in which part of the process it is originating. The problem may either result from improper machine operation or be resin-related. Before processing changes are made, one should make sure the machine is being operated under proper conditions.

If changes in machine conditions are required, they should be made slowly and systematically. Change only one variable at a time, allowing the machine time to stabilize to each new condition before you proceed.