Blow Molding

Fig. 7.40. Extrusion-blow moulding (after Crawford).

VENTS ARE CRUCIAL

VENT IN CORNERS

100-200 MM

VENTS

GENERALLY VENT IN THE "TRAPPED" LAST PLACES OF THE MOLD TO FILL.

Blow Molding
STRETCH-BLOW MOLDING


Figure 4-6. Two-stage reheat blow molding.

PRODUCES BIAXIAL ORIENTATION (GREATLY IMPROVES STRENGTH)
Blow Molding

INJECTION-BLOW MOLDING

No pinch-off scrap
Excellent thickness control
Fewer surface defects
Blow Molding

BLOW MOLDING DEFECTS

Axial thickness variations in parison

Surface defects: Mottle, Extrusion Die Lines

Pinch-off scars, trimming

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**TABLE 5-3** Advantages and Disadvantages of Blow-Molding Operations

<table>
<thead>
<tr>
<th>Operation</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrusion blow molding</td>
<td>High production rates; low tooling costs; wide selection of equipment</td>
<td>Large amount of scrap; uses recycled scrap; limitations on wall thickness; trimming facilities needed</td>
</tr>
<tr>
<td>Injection blow molding</td>
<td>No scrap; excellent thickness control; accurate neck finishes; outstanding surfaces, can produce low volume of products</td>
<td>High tooling costs; larger objects not possible</td>
</tr>
<tr>
<td>Stretch blow</td>
<td>Economically; improved properties; accurate control of wall thicknesses; reduced weights allowed</td>
<td></td>
</tr>
</tbody>
</table>

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4
Blow Molding
PARISON SAG

Stress due to parison’s own weight:

\[ \sigma_e = \frac{lA\rho g}{A} = l\rho g \]

Strain Rate \[ \dot{\varepsilon} = \frac{\sigma_e}{\eta_e} = \frac{\sigma_e}{3\eta_0} = \frac{l\rho g}{3\eta_0} \]

Sag Velocity \[ v = \dot{\varepsilon}l = \frac{l^2\rho g}{3\eta_0} \]

To minimize sag:
1. Use short parison
2. Use polymer with a high zero-shear viscosity
Blow Molding

NECK RING BLOW MOLDING PROCESS

Figure 1-9 Neck ring process. (a) Body section open, neck section closed, neck section retracted. (b) Neck section extended to mate with parison nozzle (plastic fills neck section). (c) Neck section retracted with parison tube attached. (d) Body section closed, making pinch-off (parison blown to body sidewalls). (e) Body molds open, neck molds open, bottle about to be ejected. Courtesy of John Wiley and Sons.
Blow Molding

STRETCH-BLOW MOLDING OF SOFT-DRINK BOTTLES

Branched vs. Linear rheology
Branched have higher $\eta_0$

Linear \hspace{1cm} $\eta_0 \sim M_W^{3.4}$

Branched \hspace{1cm} $\eta_0 \sim M_W^{5-6}$

Branched are more shear-thinning

at high $\dot{\gamma}$ \hspace{1cm} $\eta \sim \dot{\gamma}^{-(1-n)}$

\begin{align*}
  n &\approx 0.3 \quad \text{for linear} \\
  n &\approx 0.2 \quad \text{for branched}
\end{align*}

Branched polymers are better blow molding resins