Fiber Spinning

Key Issues:
- Use screen pack to eliminate defects
- Spinneret can have 10,000 holes
- Solidification in water or air
- Orientation can produce high modulus
- Instabilities
  - Raleigh disturbances
  - Draw resonance
  - Melt fracture
Film casting.
Elements of Film Casting Line

- Die inlet
- Cast film die
- Air gap with molten web
- Stripping roll
- Idler roll
- Edge trim slitter
- Pull rolls
- Wind up rolls
- Casting roll
Blown Film Die and Extruder

**Key Issues:**
- Inflation until solidification occurs
- Biaxial stretching promotes orientation
  - Strength
  - Low permeability
- Polyolefins are processed this way
- Low viscosity polymers [PA, PET] are better made with cast film.

1. Schematic of a cross-head tubing die used in film blowing.
Spiral Die for Homogenization of Blown Film Feed
The Blown Film Process
Blown Film Line

- Nip rolls
- Guide rolls
- Wind-up system
- Air cooling unit
Extrusion Blow Molding
Dimensional Changes from Parison to Bottle in Blow Molding
Injection Blow Molding
With Shaped Parison
Stretch Blow Molding

1. Heating
2. Mold closed
3. Stretch
4. Blow
5. Eject
Plug Assist Thermoforming

**Key Issues:** Tooling costs are much lower than injection molding, leading to growing popularity of this method, especially for packaging.
Reverse Draw Thermoforming with Vacuum
Calendering
Arrangements

Key Issues:
• Squeeze polymer between rollers to produce sheet
• Orient filler particles, i.e. clays
• Low residence time minimizes stabilizer requirements
• Uniform thickness can be a challenge
Compression Molding

Charge

Mold cavity

Upper platten

Lower platten
Compression Molding of Fiber Glass Reinforced Floor Tiles

Figure 6.90  SMC production line.
Foamed Polymer Structures
With Density Profile

Key Issues:
• Polyolefins are often foamed to reduced mass (cost and weight issues)
• Most common foaming agent is azodicarbonamide
• Physical blowing agents may also be used, gas dissolved in polymer is released as extrusion pressure is released.
• Functional applications include noise reduction and thermal insulation,
• Many low density foams (PS, Polyurethane) are made with pentane foaming.

\[ \text{NH}_2\text{CON} = \text{NCONH}_2 \]