Characteristics of Forming and Shaping Processes for Plastics and Composite Materials

TABLE 18.1

Process	Characteristics
Extrusion	Long, uniform, solid or hollow complex cross-sections; high production rates; low tooling costs; wide tolerances.
Injection molding	Complex shapes of various sizes, eliminating assembly; high production rates; costly tooling; good dimensional accuracy.
Structural foam molding	Large parts with high stiffness-to-weight ratio; less expensive tooling than in injection molding; low production rates.
Blow molding	Hollow thin-walled parts of various sizes; high production rates and low cost for making containers.
Rotational molding	Large hollow shapes of relatively simple shape; low tooling cost; low production rates.
Thermoforming	Shallow or relatively deep cavities; low tooling costs; medium production rates.
Compression molding	Parts similar to impression-die forging; relatively inexpensive tooling; medium production rates.
Transfer molding	More complex parts than compression molding and higher production rates; some scrap loss; medium tooling cost.
Casting	Simple or intricate shapes made with flexible molds; low production rates.
Processing of composite materials	Long cycle times; tolerances and tooling cost depend on process.

Plastics

Materials that can be reshaped (remolded) by applying heat and pressure. Most plastics are made from synthetic resins (polymers) through the industrial process of polymerization. Two main types of plastics are thermoplastics and thermosets.

Two basic types of plastics

Thermoset- Heat hardening/ Undergoes chemical change
Thermoplastic- Heat softening/ Undergoes physical change

1.Thermosets

General properties: more durable, harder, tough, light.
Typical uses: automobile parts, construction materials

Examples:

Unsaturated Polyesters: lacquers, varnishes, boat hulls, furniture
Epoxies and Resins: glues, coating of electrical circuits, composites: fiberglass in helicopter blades, boats, …

2. Elastomers

General properties: these are thermosets, and have rubber-like properties.
Typical uses: medical masks, gloves, rubber-substitutes

Examples:

Polyurethanes: mattress, cushion, insulation, toys
Silicones: surgical gloves, oxygen masks in medical applications joint seals

3. Thermoplastics

General properties: low melting point, softer, flexible.

Typical uses: bottles, food wrappers, toys, …

Examples:
Polyethylene: packaging, electrical insulation, milk and water bottles, packaging film
Polypropylene: carpet fibers, automotive bumpers, microwave containers, prosthetics
Polyvinyl chloride (PVC): electrical cables cover, credit cards, car instrument panels
Polystyrene: disposable spoons, forks, Styrofoam™
Acrylics (PMMA: polymethyl methacrylate): paints, fake fur, plexiglass
Polyamide (nylon): textiles and fabrics, gears, bushing and washers, bearings
PET (polyethylene terephthalate): bottles for acidic foods like juices, food trays
PTFE (polytetrafluoroethylene): non-stick coating, Gore-Tex™ (raincoats), dental floss

Advantages
Light Weight
High Strenght-to-Weight Ratio
Complex Parts - Net Shape
Variety of Colors (or Clear)
Corrosion Resistant
Electrical Insulation
Thermal Insulation
High Damping Coefficient
"Low" pressures and temp required

Disadvantages
Creep
Thermally Unstable- Can't withstand Extreme Heat
U-V Light Sensitive
Relatively low stiffness
Relatively low strength
Difficult to Repair/Rework
Difficult to Sort/Recycle

Plastic Manufacturing Processes
A wide variety of plastic manufacturing processes exist

- Extrusion
- Lamination (Calendering)
- Thermal Forming
- Foaming
- Molding
- Expansion
- Solid-Phase Forming
- Casting
- Spinning

Source : http://nprcet.org/e%20content/mech/MT.pdf