Chapter 6 Plastic Moulding

❖ Introduction
- Plastics are commonly known as synthetic resins or polymers. In Greek terminology, the term polymer comprises ‘poly’ means ‘many’ and ‘mers’ means ‘part. Some natural polymers like starch, resins, shellac, cellulose, proteins, etc. are very common in today’s use.
- They are recognized by their extreme lightness, good corrosion resistance and high dielectric strength
- Plastic is defined as non-metallic material which can be moulded in to any desired shape
- Plastic moulding products: jars, protective caps, plastic tubes, toys, bottles, cases, utensils etc

❖ Properties of plastics
The properties of plastics are given as under.
1. Plastics are light in weight and at the same time they possess good toughness strength and rigidity.
2. They are less brittle than glass, yet they can be made equally transparent and smooth.
3. They resist corrosion and the action of chemicals.
4. The ease with which they can be mass-produced contributes greatly to their popularity as wrappers and bags.
5. They possess the property of low moisture absorption.
6. They can be easily moulded to desired shapes.
7. They can easily be made coloured.
8. They are bad conductance of heat.
9. They are hard, rigid and heat resistance.
10. They possesses good deformability, good resistance against weather conditions, good colourability, good damping characteristics and good resistance to peeling

❖ Types of plastics
Plastics are broadly classified into following parts
1. Thermoplastics
2. Thermosetting plastic

❖ Thermoplastics
- Those plastics which can be easily softened again and again by heating are called thermoplastic.
- They can be reprocessed safely.
- They retain their plasticity at high temperature, i.e. they preserve an ability to be repeatedly formed by heat and pressure. Therefore, they can be heated and reshaped by pressing many times.
- On cooling they become hard
- **Types of Thermo Plastics**
  1. **Polystyrene**: used for make disposal spoons, fork etc, soft packaging materials
  2. **P.V.C (Polyvinyl chloride)**: electrical cables, floor and wall coverings, credit cards
  3. **Polycarbonate**: non-stick coating, raincoats etc.
  4. **Polyethylene**: Packaging, electrical insulation, milk and water bottles, packaging film
  5. **Polyamides (Nylon)**: textile and fabrics, gears, bushings, washers, bearing
  6. **Polyacetal**: paints, fake fur etc
  7. **Polypropylene**: Carpet fibers, automotive bumpers, microwave containers, prosthetic body parts of human body

- **Thermosetting plastics**
  - Those plastics which are hardened by heat, effecting a non-reversible chemical change, are called thermo-setting. Alternatively these plastics materials acquire a permanent shape when heated and pressed and thus cannot be easily softened by reheating.
  - They are commonly known as heat-setting or thermosets.

- **Thermosetting resins**
  1. Phenol-formaldehyde resins
  2. Urea-formaldehyde resins
  3. Melamine-formaldehyde resins
  4. Polyester resins
  5. Epoxy resins
  6. Silicone resins
  Other thermosetting compounds are phenol furfural, polysters, alkyds, and polyurethanes. The most common thermosetting compound is phenol formaldehyde.

- **Plastic Moulding Methods**

  Following are the plastic moulding processes
  1. Compression Moulding.
  2. Transfer Moulding
  3. Injection Moulding.
  5. Extrusion Moulding
  6. Calendaring.
  7. Thermoforming.
Compression Moulding

- In compression moulding, the raw material is placed inside the mould in semi-solid or solid (i.e. as granules, or a single piece called a plug).
- The mould is heated and closed using pressure, and the plastic flows to fills the cavity.
- Excess material may leak out from the parting lines creating flash, which must be trimmed away.
- If the part shape is more complex, transfer moulding may be used.

![Compression Moulding Diagram](image)

Fig. shows Compression moulding

- **Process:**
  1. Load moulding material as loose powder, granules in to heated die cavity
  2. Temp. varies between 150°C to 180°C
  3. Close the split mould between the press platens
  4. Open the split mould
  5. Eject the product from the mould manually or automatically
  6. Lubricate the tool to perform next moulding
  7. Repeat the process

- **Applications:** To make dishes, handles, toilet seats and covers, cups and plates, electrical switches.

Injection Moulding

![Injection Moulding Diagram](image)

(a) Using heated manifold and heated torpedo
• Injection moulding is perhaps the most common and important of all plastic processing processes.
• The process is extremely versatile, and can produce very complex shaped parts, with the use of multi-sided moulds.
• This process is commonly used in mass production

➤ **Process**
1. The process consists of granular moulding material (melted plastic) is loaded into a hopper from where it is taken out in a heating cylinder by a feeding device.
2. The exact amount of material is delivered to the cylinder which is required to fill the mould completely.
3. The injection ram pushes the material into a heating cylinder and due to this a small amount of heated material goes other end of cylinder through the nozzle and into cavities of the closed mould.
4. The metal cooled in rigid state in the mould. Then mould is opened and piece is ejected.
5. Material heating temp. is usually between 180°- 280°C. Then last mould is cooled in order.

➤ **Advantages:**
1) High production rate with lower cost per piece
2) Parts after process requires no further machining
3) It can produce complex and difficult shapes.

➤ **Disadvantages:**
1) The process is limited to thermoplastics
2) Die and cylinder should be non corrosive

➤ **Applications:**
Plumber fittings, cups, containers, housing knobs, toys, house ware buckets, bowls, telephone receivers, washing machine parts, car components etc.

❖ **Extrusion Moulding**

![Extrusion Moulding Diagram](image)

Fig shows. Extrusion Moulding
• It is a continuous process
• Generally all thermo plastic materials are suitable for extrusion in to various shapes such as rods, tubes, sheets, film, pipes and ropes.
• Thermosetting plastic is not suitable for extrusion moulding.

➢ Process
1) In this process the powder polymer or monomer is fed through hopper and is fed in to the heated chamber by a rotating screw along a cylindrical chamber.
2) The rotating screw carries the plastic and forward and forces it through the heated orifice of the die.
3) As the thermoplastic powder reaches towards the die, it gets heated up and melts.
4) It is then forced through the die opening of desired shape as shown in the fig.
5) On leaving the product from the die, it is cooled by water or compressed air and is finally carried by a conveyor or belt.

➢ Advantages
   1) The process is very fast and more economical than any other process.
   2) High rate of production
   3) Produce any kind of shape
   4) Material thickness can be controlled

➢ Applications: To make various shapes like tubes, sheets, films, pipes, ropes, rods, window frames, electrical cables etc.

❖ Vacuum Forming (Thermo – forming)
This method is also known as thermo – forming

\[ a = \text{Heater} \]
\[ b = \text{clamp} \]
\[ c = \text{plastic sheet} \]
\[ d = \text{mould} \]
\[ e = \text{vacuum line} \]

**Fig shows vacuum forming (Thermo – forming)**

➢ Process
   ▪ It is a technique that is used to shape a variety of plastics
   ▪ It is used to form thin plastic, usually plastic like polythene and Perspex.
   ▪ A sheet of plastic is clamped in a frame of mould and heated until it becomes stretchy
   ▪ Then it is pulled in to the mould by the vacuum line as shown in fig.
   ▪ After pulling it forms a desired shape, this is how this process carried out.
   ▪ The mould has been placed in a vacuum former and compressed plastic sheet has been placed on it
   ▪ The plastic is heated and vacuum formed to the shape of the mould.
- **Applications:**
  Cosmetic containers, hot water bottles, refrigerator door liners, refrigerator inner panes,
  It is also used to make for packaging for chocolates, biscuits, cosmetics and some disposal cups

❖ **Blow Moulding**
- Compressed air is used to perform this operation
- A little bit hot plastic is squeezed in to the mould

The process is divided into three stages

1) The injection blow moulding machine is based on an extruder barrel and screw assembly which melts the polymer. The molten polymer is fed into a manifold where it is injected through nozzles into a hollow, heated split mould. The split mould forms the external shape and is clamped around a mandrel (extruder die) which forms the internal shape of the product.

2) The split mould opens and the extruder die is rotated and clamped into the hollow, chilled blow mould. The extruder die opens and allows compressed air into the mould, which inflates it to the finished article shape.

3) After a cooling period the blow mould opens and the extruder die is rotated to the ejection position. The finished product is taken out of the mould and leak-tested and then packed.

- **Applications:**
  To manufacture beverage bottles, tubes, containers, automobile heater ducts, plastic cans, small toys.
Calendaring

- It is an important method for making of films and sheets
- Calendaring is a finishing process applied to textiles and papers

Process

- In this process rolls of the material (plastic) are passed between several pairs of heated rollers as shown fig. to give a shiny surface.

Like as rolling process the heated rollers are arranged as shown in fig.
Rollers are rotated opposite to each other
Between these rollers the plastic material is passed to make thin sheets
Extrude PVC sheeting is produced in this manner as well other plastics.
It is a final process in which heat and pressure are applied to a fabric by passing it in between rollers
Lustre increases when the degree of heat and pressure increased

Applications:
1. Flexible PVC products like rain ware, shower curtains etc.
2. Rigid PVC products like trays, laminates and credit cards etc.
3. Floor tiles from vinyl, cellulose acetate sheets and films