5.3 Processing of Plastics

- The processing of plastics involves operations similar to those used to form and shape the metals.
- Plastics can be moulded, cast, formed, machined, joined and processed into different shapes with ease and in few operations only.
- As the plastics melt at relatively low temperatures, they are easy to handle and require less energy to process.
- The properties of plastic components are largely affected by the method of manufacture and by the processing parameters hence it is necessary to control these conditions.
- Generally plastics are shipped to manufacturing plants as pellets (granules) or powder and they are melted just before the shaping process (for thermo-plastics).
- Plastics are also available as rod, plate, sheet, tubes, etc. which may be formed into a different products.
- The processing of plastics can be grouped as follows (Refer figure.5.1).

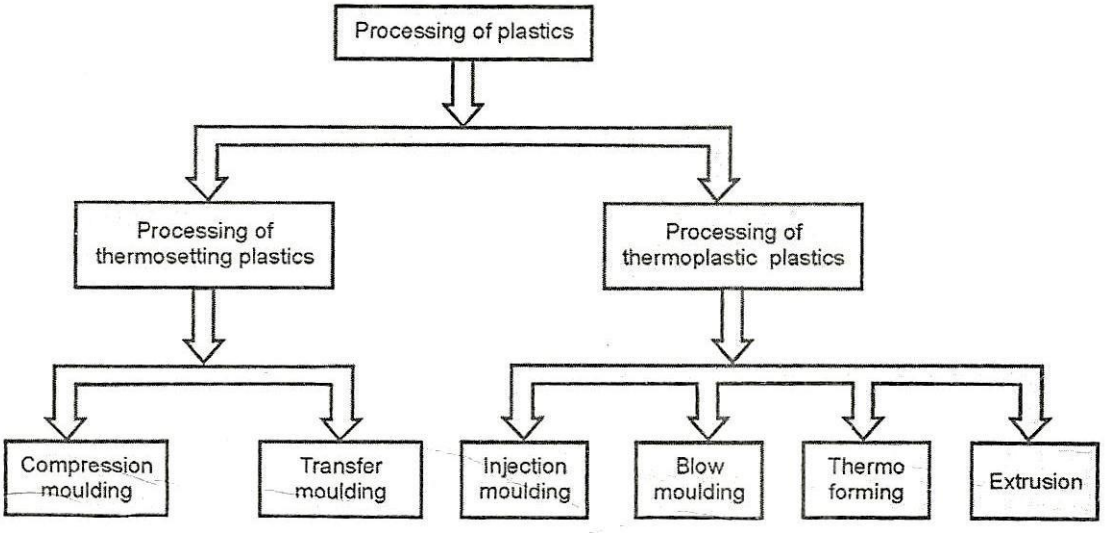

Figure 5.1 Classification of Processing of Plastics

5.4 Processing of Thermosetting Plastics

For processing thermosetting plastics following processes are most commonly used:

- Compression moulding
- Transfer moulding

5.4.1 Compression Moulding

- Compression moulding is mainly used for moulding thermosetting materials.
- In this moulding method, a material is generally in powder or pre-form shape and it is loaded directly into the hot die cavity.

- A measured amount of plastic powder or a viscous mixture of liquid resin and filler material is placed in the lower female cavity which is continuously heated by either steam or electricity.
- The upper half of the die compresses the material which melts and fills the die cavity.
- This combined effect of pressure and temperature caused the plastic to flow into the mould cavity.
- After compression the component solidifies (polymerises), the upper half of the die opens and the component is removed with the help of ejector pins. Refer figure 5.2.

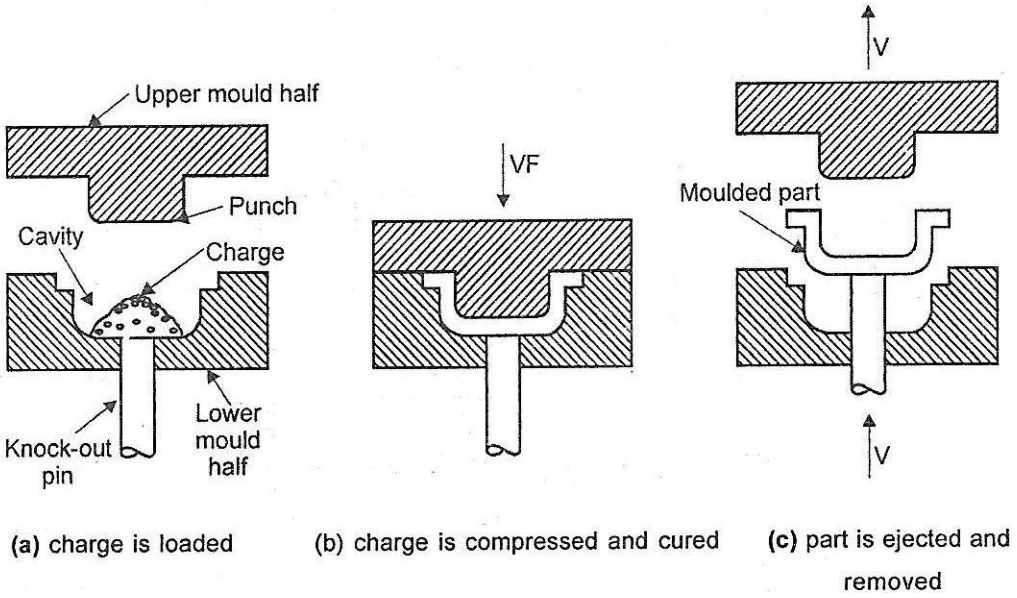

Figure 5.2 Compression Moulding

- Pressure used in the process varies from 0.5 MPa to 50 MPa depending upon the size and material of the component.
- Temperature during the process is from 125^{o}C to 250^{o}C.
- The curing time depends upon the material, geometry and thickness of the components.
- Generally the curing time is between 0.5 minutes to 5 minutes.
- Following are the four primary factors in a successful compression moulding process.
    - Quantity of material
    - Heating time and technique
    - Force applied to the mould
    - Cooling time and technique

Materials that can be processed by compression moulding are phenolics, melamine, urea-formaldehyde, epoxies, urethanes, elastomers, etc.

In compression moulding, the mould structures are of three types

i) Positive type ii) Semi positive type iii) Flash type

- **Positive type** compression moulding is used for high density parts of composite sheet moulding components, bulk moulding compounds or impact thermosetting materials.
- **Semi-positive type** compression moulding is used for closer tolerance work or when design involves changes in thickness.
- **Flash type** compression moulding is used for shallow parts but results in higher material losses.

Advantages of Compression Moulding

- The moulds used in the process are simple and less expensive. Also they require low maintenance.
- Low residual stresses in the moulded parts.
- Initial set-up cost is low.
- Time required forest-up is low.
- This process is capable of producing large size parts of complicated shapes.
- Good surface finish is obtained by this process.
- Wastage of material is relatively low.

Disadvantages of Compression Moulding

- Cycle time of the process is long.
- This method is having low production rate.

Applications of Compression Moulding

- Compression moulding is used for making flatwares, gears, buttons, buckles, knobs, handles, dishes, container taps and fittings.
- Also used for moulding of electrical and electronic components, washing machine agitators and housings.

5.4.2 Transfer Moulding

- Transfer moulding is used for the processing of thermosetting plastics.
- Transfer moulding is also called as gate moulding.
- This method is an advanced method of compression moulding.
- This is the process of forming articles in a closed mould, where the fluid plastic material is conveyed into the mould cavity under pressure from outside of the mould.
- The material is generally in a preheated form and placed in a heated transfer pot. Refer Figure 5.3.
- When the material is sufficiently softened, the plunger forces the fluid plastic through the sprue into the closed mould, where the final cure takes place.
- Curing time for transfer moulding is generally less than compression moulding.
- An intensity of pressure Varies from 20 MPa to 100 MPa.

- Once the plastic component has been cured, the plunger moves up and the component is ejected from the lower portion of the mould cavity with the help of ejector pins.
- This process is used for producing complicated components having varying wall thicknesses with high accuracy and economical rates.
- Transfer moulding is closely related to compression moulding because it is utilized on the same types of polymers.

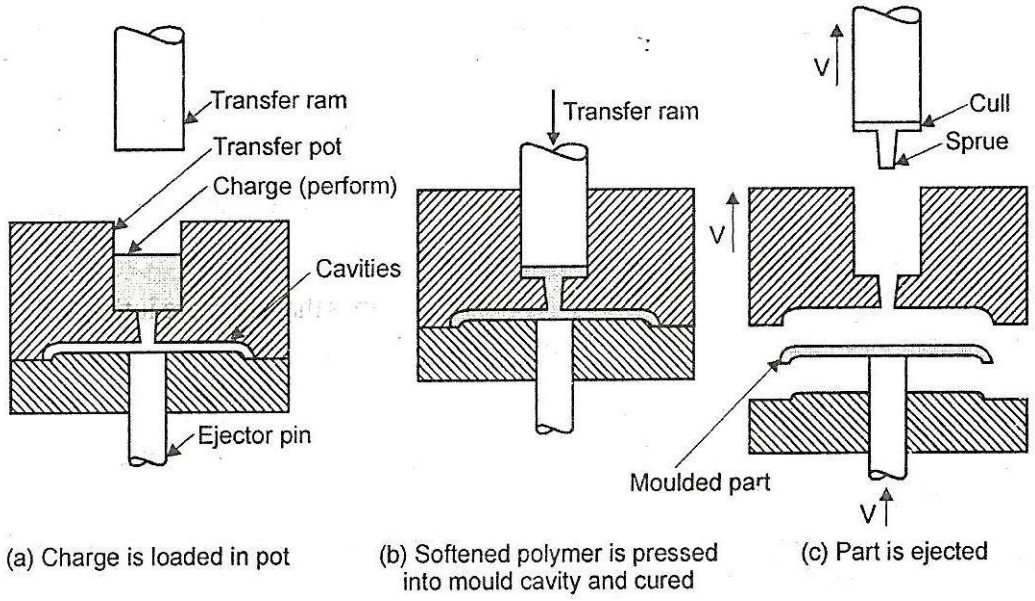

Figure 5.3 Transfer Moulding

Advantages of Transfer Moulding

- One of the main advantages of transfer moulding over compression moulding is that, different inserts, such as metal prongs, semiconductor chips, dry composite fibers, ceramics, etc. can be placed in the mould cavity before the polymer is injected into the cavity.
- Product consistency better than compression moulding, hence more intricate parts with high accuracy can be produced.
- Speed of Production is higher than compression moulding.
- Maintenance cost is lower than injection moulding.

Limitations of Transfer Moulding

- The main limitation of the process is that, initial cost of the mould is high.
- In this process wastage of material is more.

Applications of transfer Moulding

- This process is mostly used for manufacturing of integrated circuit packaging and electronic components with moulded terminals, pins, studs, connectors, etc.