ELECTRONICS MANUFACTURE-Common processes-Making mouldings

Compression moulding

Compression moulding is a process where a resin is placed in a heated mould which is then closed, and heat and pressure are applied, causing the material to flow and fill the mould. If the material is a thermoplastic, the mould is cooled and the part removed; if a thermoset or an elastomer, then it is left in the mould to cure and removed after the resin has cured sufficiently to have hardened. Compression moulding has a low part cost, provides fast production rates, and produces little waste. It is not suitable for intricate parts, close tolerances, undercuts, or delicate inserts.

Injection moulding

Injection and transfer moulding are processes which are conceptually similar to each other, and can be described by the schematic diagram and flow chart of Figure 1.

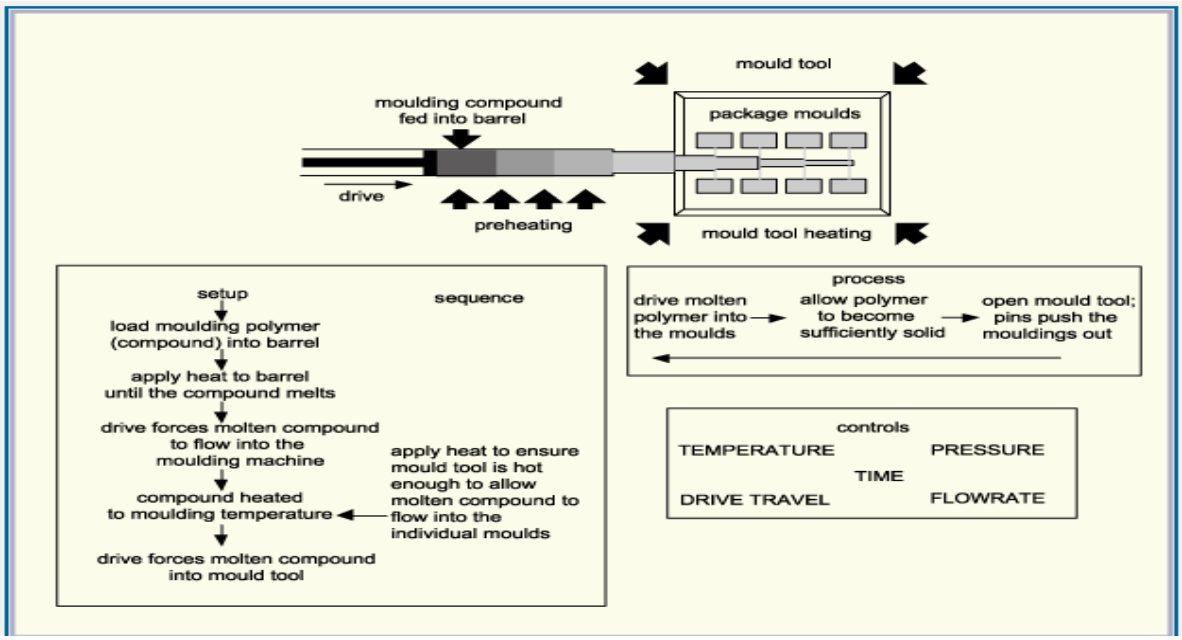

Figure 1: Schematic and flow charts of a generalised plastic moulding process

The process sequence involves driving molten polymer into the moulds, allowing it to cure or solidify and cool slightly, and then opening the mould to be able to remove the mouldings.

In injection moulding, a thermoplastic polymer is preheated to reduce its viscosity so that it will flow easily, and is then forced under pressure through a nozzle into a closed mould cavity. A schematic of injection moulding equipment is shown in Figure 2.

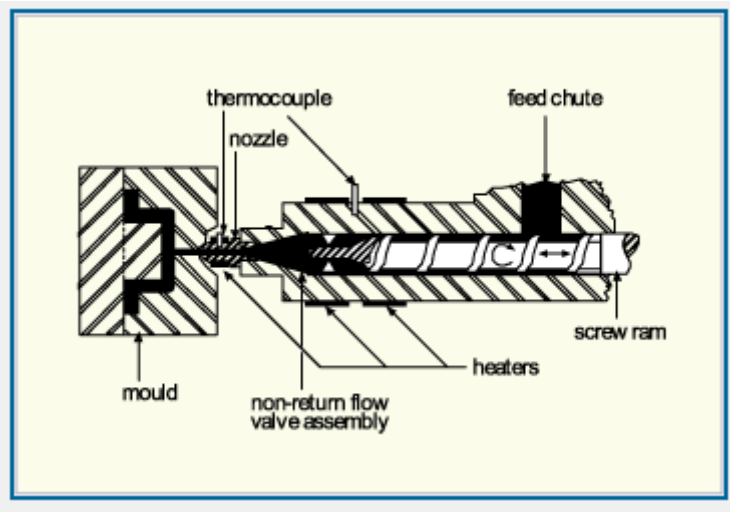

Figure 2: Screw ram cylinder section (injection moulding)

Source: Grandilli 1981

Transfer moulding

In transfer moulding, a pre-measured quantity of thermoset material such as phenolic or epoxy resin is placed in a heated cavity and forced into the mould proper once the desired viscosity is attained. The process sequence is shown in Figure 3. The material may be fed into the press in granular form or loaded as a single pre-moulded pellet, to improve process control.

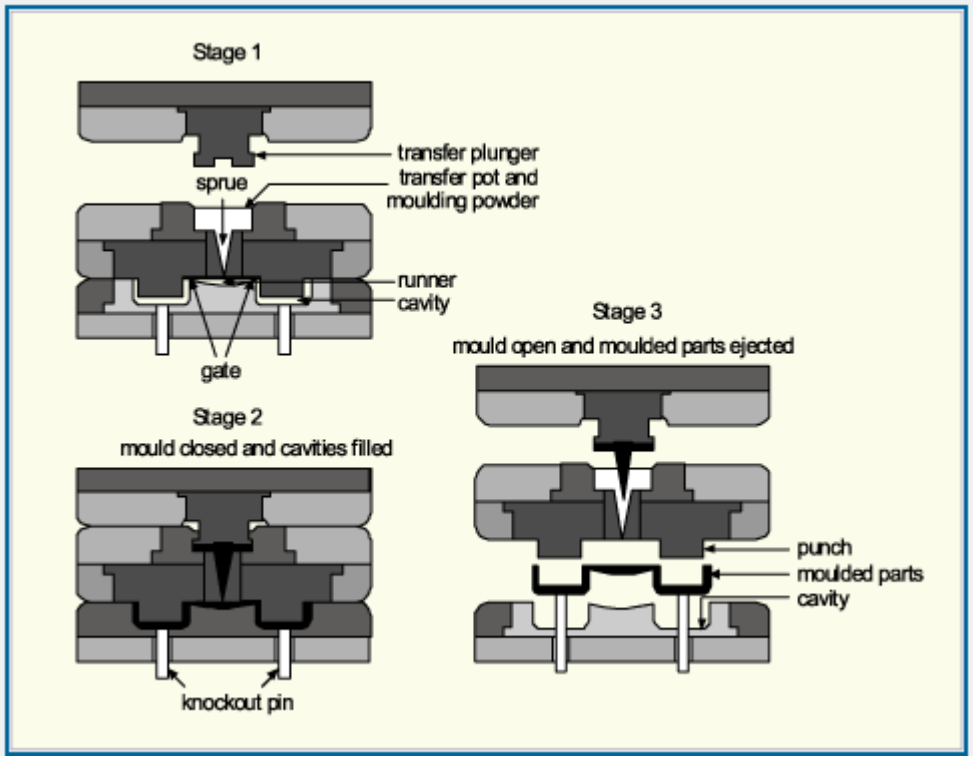

Figure 3: Pot or sprue type transfer moulding of thermosets

In both cases, the mould is opened, and the part ejected once the resin has solidified sufficiently. For thermoplastic materials, the mould has to remain relatively cold; thermoset resins are held under pressure in a hot mould until cured, but the partially cured part can be ejected while hot.

Advantages over compression moulding are that there is better control of material flow, parts have good dimensional accuracy and reproducibility, with little finishing of the part required, and thin sections and delicate inserts can be moulded easily. The very high production rate and low part cost are, however, offset by high tool and die costs. There are also size limitations resulting from the fact that injection pressures are high (up to 2,000 bar) and the press has to hold together the two halves of the mould against substantial internal forces. As a result, moulding presses generally have capacities in the 20 to 1,000 tonne range.

Cooling is particularly important for improving efficiency in the moulding process, as this stage often accounts for 80% of the cycle length. Heat from the hot plastic passes through the body of the mould by conduction to cooling channels filled with circulating fluid, generally water, which absorbs and carries off the excess heat. Improper cooling can affect the integrity (shrinkage and warping) and strength of the part. Cooling system design has to take into account the size, shape, and mass of the part being formed, and the thermodynamic behaviour of the plastic and the

mould material, as well as the physical configuration and constraints of the existing equipment.

Moulding is affected by variations both between material batches, and over time during a run, when machine parameters (especially mould temperature) tend to drift. Production machines vary greatly in the degree and sophistication of their control over this process. The more recent high-speed automated systems use closed loop process control, where the critical parameters of temperature and pressure are adjusted by providing feedback from the moulding results to achieve tighter control and less process variation.

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Source: http://www.ami.ac.uk/courses/topics/0240_mold/index.html