

5 Compression Moulding

5.1 The Compression Moulding Process

Compression moulding is one of the oldest plastic moulding methods. The process consists of heating a plastic material, which can be in the form of granules or powder, in a mould that is held in a press. When the material becomes 'plastic' the pressure forces it to conform to the shape of the mould. It is a high volume, high pressure method suitable for moulding complex, high strength fibreglass reinforcements. Products manufactured by compression moulding include bottle caps, jar closures, electric plugs and sockets, toilet seats and trays. In the last few years a lot of new processes for compression moulding – especially direct processes have been developed.

The compression moulding machine comprises of a control unit that manages five main elements:

- A hydraulic alignment controlled high speed press
- A heating and cooling system for the mould
- An extruder or plasticising unit for processing un- and reinforced thermoplastics
- A mould unit
- A transfer unit for putting the plasticised material into the mould

5.2 Reducing Energy Consumption in Compression Moulding

In order to reduce energy consumption and costs, increase productivity and enhance corporate competitiveness, organisations should focus on optimising the manufacturing process in compression moulding.

5.2.1 Control Unit

When processing polymers, the control system has to meet safety requirements to

protect the operator from unexpected closure of the press. Process control is necessary for an efficient operation, especially the alignment of the mould parts.

5.2.2 Hydraulic Drive

Hydraulic power is normally generated in a power pack to ensure precise co-ordination and repetition of the machine motions. The power pack provides the power and pressure to work the various motions of the mould. Separate hydraulic drives are needed in most cases for the additional peripheral equipment, including the extruder screws and cutting edges. Stability is maintained by temperature control of the hydraulic fluid, via a heat exchanger connected to a cold water system that offers an opportunity for heat recovery.

5.2.3 Heating and Cooling System

A heating and cooling system provides the controlled supply of thermal oil that flows through the mould and heats up or cools down the mould and the product. The efficiency of the system has a major effect on the overall process time and the energy consumed. When looking to reduce energy consumption across the process, consider using a pendulum storage facility rather than a direct heating and cooling system.

- **Pendulum storage:**

For long cycle time and large moulds, it is necessary to use a pendulum storage facility to reuse the heat and energy input to the mould. The principle of the pendulum storage facility is shown in **Figure 5.1**.

At the start of the heating phase the mould is at a lower temperature. The thermal oil is then heated by the heat exchanger with the stored energy in the pendulum storage. The thermal oil and the mould in the press heat up until no further heat flow from the storage facility is possible. The system is switched to direct heating of the thermal oil with the heating system until the final mould temperature is reached.

After the pressing process, the thermal oil and mould is cooled with the pendulum storage facility until the temperatures are at nearly the same level. The heat in the mould heats up the storage facility and some of the energy is saved for the heating phase of the next cycle. When it is not possible to cool down any further with the pendulum storage, the system is switched to direct cooling of the oil.

With such a system approximately 45% energy savings can be made when producing large parts with long cycle times.