4 Rotational Moulding

This chapter describes both the rotational moulding process and some practical ways of improving energy efficiency when using rotational moulding.

4.1 The Rotational Moulding Process

4.1.1 Background to Rotational Moulding

Rotational moulding has been used in limited industrial since the 1940s when it was used to manufacture novelties and decorative items such as toys, mannequins, hollow display items and plastic fruits from polyvinylchloride (PVC) plastisols [1]. In 1961 powdered low density polyethylene was demonstrated to the rotational moulding industry followed by grades of polyethylene specifically formulated for use in rotational moulding which resulted in a rapid increase in the use of the rotational moulding process. Today polyethylene still accounts for the vast majority of plastic used in rotational moulding due to its excellent processing characteristics. Rotational moulding competes with blow moulding, thermoforming and injection moulding for the manufacture of hollow plastic products. The ability of rotational moulding to produce stress free products with highly uniform wall thicknesses and complex shapes [2] makes it ideally suited for the production of parts such as bulk containers, tanks, toys, medical equipment and automotive parts.

4.1.2 The Rotational Moulding Technology

Rotational moulding (also referred to as rotomoulding or rotocasting) is production process for manufacturing hollow, stress free parts of virtually limitless size. A powdered plastic is placed in a mould which is then heated to above the melt point of the plastic whilst being biaxially rotated. The molten plastic flows and coats the inside of the mould. It mould is then cooled down whilst still being rotated to produce seamless, hollow plastic parts. The rotomoulding process can be divided into four separate steps:

1. **Loading the Resin into the Mould:** A split, (i.e., two part) metal mould is filled with a predetermined quantity of plastic powder (the 'charge') equivalent in weight to the product to be produced. The mould is then closed, clamped, mounted into a frame and attached to the rotomoulding machine which is then transferred into an oven chamber.

2. **Heating and Fusion of the Resin:** The complete mould is *heated in the oven* to a temperature above the melting point of the plastic whilst being slowly rotated (typically no more that 12 revolutions per minute) around both the vertical and the horizontal axis. The molten powder lies in the bottom of the mould and as the mould is rotated all the inner surface of the mould comes in contact with the molten polymer which then adheres (*fuses*) to it. This continues until an even layer of molten plastic is formed over the entire inner surface of the mould. By altering the rotation speed around the vertical axis the wall thickness of the product can be controlled.

3. **Cooling:** In the cooling chamber air is blown on to the surface of mould to reduce the temperature of the mould and plastic to below the plastic's melting temperature, (in some rotomoulding configurations water sprays are used to rapidly cool the mould *once the plastic has completely solidified*, see **Section 4.2.2**). Once the plastic has solidified, the mould is then removed from the chamber.

4. **Unloading and Demoulding:** The plastic component is removed from the mould and allowed to finish the cooling process to room temperature unrestricted by the mould.

4.1.3 Advantages and Limitations of Rotational Moulding

Rotomoulding enables the commercial fabrication of single or multi-part hollow plastic parts. It offers a number of advantages and limitations compared to alternative methods such as injection or blow moulding.

The advantages of rotomoulding compared to alternative techniques are:

- **Product Consistency:** Consistent, controllable wall thickness in hollow parts with complex external forms can be repeatably produced enabling optimised material usage and enhanced design freedom.

- **Product Quality:** As the process is virtually shear force and pressure free [3] and avoids inhomogeneous cooling, parts produced by rotomoulding are relatively free of residual stresses, orientation effects and weld lines Thus, reducing defects and improving product service life compared to alternative techniques.