

Micromoulding - Alternative Technology Developments

B Murray, S Histed: Rondol Technologies Ltd, UK

Bench-top machine design

Novel technologies for miniature injection moulding have recently been developed in the UK. Design considerations, in which particular machine-related issues were identified for injection moulding of miniature products, included:

- Cleanliness.
- Control.
- Platen Design.
- Design of Screw and Barrel.
- Tip and Nozzle Design.
- Flexibility and Ease of Operation.

The principles of design – simple & compact, easy to use were given physical expression in the form of a 5-tonne clamp force, table-top injection moulding machine with:

- Small physical dimensions – platen area, yet with tie-bars for stability.
- All electric with direct drives.
- Two motors and single phase.
- Intuitive plc Control.
- Flexible Screw, Barrel, Plunger design.
- Energy efficient using toggle clamp advantage.

A novel approach was taken connecting the functions of injection and mould open/close, exploiting the toggle movement for both functions. In this design, the screw rotates in the barrel to plasticise polymer, but then does not reciprocate; instead, the barrel moves over the screw, its movement associated with mould closing via the toggle system. Figure 1 shows the layout of this machine.

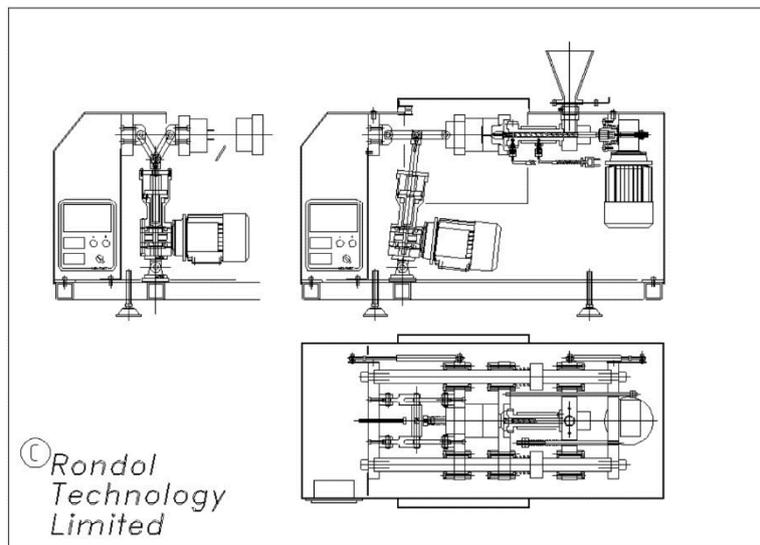


Figure 1 Miniature injection moulding with novel toggle-driven clamping and injection functions.



Figure 2 Mark 1 machine, with 2 tie bars.



Figure 3 Plasticisation unit

Initial validation of design indicated that this machine was accurate and repeatable and energy efficient (all electric). It required minimal installation, and offered flexibility – ease of change over of materials and moulds, together with low maintenance. The simple data acquisition and self-diagnostics were adequate for the size of machine, and it was certainly cost effective.

Enhancements were identified, which led quickly to the Mark II design. This features a larger more rigid frame, with 4 tie bars in place of 2, increased torque on the screw drive and a higher speed range; adjustable mould height; higher wattage heaters for better stability and enhanced precision through a digital servo drive on a modified geometry toggle.

Minor changes included 3 zones of heating on the barrel, up and over access guard, optional shut off nozzle for nylons etc, plus a full touch screen/ data acquisition module. Figure 4 shows aspects of the new design.



Figure 4 Mark II machine, showing tie bar and toggle features

Materials premixing

Ancillary equipment includes a premix station for micromoulding materials formulation (Figure 5).



Figure 5 Premix station for micromoulding.

In line Compounding

Based on the original concept from the IRC at Bradford University, a Micromoulding In line Compounding system was developed to sit on a 16mm co-rotating twin screw extruder at the IRC laboratories. This employs a dual piston system, one for metering, one for injection. The plasticising unit is the twin screw extruder. The control system for the injection unit is interfaced with that of the extruder. In the 'proof of concept' version shown in Figure 6, a manual mould clamping arrangement is employed.



Figure 6 Micromoulding In line Compounding system.

Acknowledgements: The authors gratefully acknowledge the support of the IRC in Polymer Science & Technology, University of Bradford, for aspects of the machinery developments.