Four steps to perfect mouldings

In the second of his articles on process optimisation, moulding expert **John Goff** identifies the four critical elements that take a pellet through to a quality end-product

In the first article we discussed the types of process variables available to the injection moulder in order to produce components to the required cost and quality. In order to demonstrate that effective selection of such variables form an integral part of the process conditions used, it is important that we consider the basic elements of the moulding process.

The injection moulding process is fundamentally broken down into systematic elements, each of which collectively and individually play an important part. Without doubt, each element needs detailed attention to achieve the required outcome. Lack of such detail will result in a non-optimised process.

1) Conversion of the polymer from its solid state, commonly granular or powder, to a liquid of uniform temperature and consistency (viscosity). If the liquid polymer does not contain solid or semi-solid parts, then the resultant melt is classed as being homogeneous.

2) Manipulation of the polymer melt into the required shape (moulding) with the correct attributes of mechanical strength, visual requirements, minimal frozen layer and correct volume (extent of fullness).

3) Compaction of the molten material within the filled mould cavity (impression) to achieve the desired product, for example fulfilling the necessary physical, dimensional, visual and shape requirements.

4) Effective solidification of the molten core within the shaped and compacted component.

The manner in which the heat energy is dissipated or removed from the molten core via the outer frozen skin of the moulding into the adjacent metal mould tool surfaces has a significant effect on the resultant mouldings. Correct heat removal leads to mouldings produced at the correct cycle time, achieving the necessary dimensional values, shape and stability, together with the correct visual/physical properties. By contrast, problematic and poor-quality mouldings tell a different story.

Control of the surface temperature of each cavity/core within defined limits forms the basis of efficient melt solidification and economic component manufacture. Solidification that is too fast or too slow leads to component quality and part cost issues.

By suitably completing the four elements above in the correct order, the moulded component is now in a condition to be removed from the opened mould by gravity or robotic means. Each element therefore plays an instrumental part in the production of injected-moulded components. If one element is not suitably addressed, then optimal performance of both the process and product is not achieved.

Furthermore, the selection of controllable process variables can be identified under the headings of temperature, time, pressure, speed/velocity and volume/distance. These need to be synchronised so that a synergistic effect is achieved.

The injection moulding process primarily centres round the temperature variable where heat energy is needed to produce a homogenous liquid. Upon producing the required shape, such energy has to be removed to create a quality component. Furthermore, the primary controllable temperature variables to achieve the necessary homogeneity would be barrel set, hopper or throat and material intake. These variables would then be combined with others such as screw rotation speed and screw back pressure.

The conversion of the polymer from its solid state will be discussed in greater detail in the next article.

This is the second introductory part of John Goff's series of articles looking at process optimisation and troubleshooting. The first part can be seen ***here****.*

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Mould filling, compaction and solidification are all critical elements of the moulding process