

Mold Pressure Feedback Control in Injection Molding

Injection molding is the most common manufacturing process for production of high volume commercial parts. However, injection molding is characterized by extremely complex process dynamics and material properties, which make it difficult to understand and predict the product quality and can lead to unacceptable quality defects. One of the promising solutions to this problem is to measure the mold pressure, compare it with a reference mold pressure and take corrective actions, automatically in real-time, to lower the differences. This feedback control strategy enhances the robustness of the process, reduces the rejects, allows for higher percentages of recycled material, and results in the manufacturing of thousands of parts with consistent material properties. In addition, mold pressure feedback control makes the tooling independent of the injection molding machine.

In view of the above, we have designed and implemented an on-line mold pressure monitoring and feedback control system which:

- evaluates, through finite element analysis or design of experiment, a 'desirable' mold pressure profile. Uses this profile as the reference input to a closed loop system produces consistent molded parts without intervention or guidance from the molder. This is done by
 - determining whether the mold pressure during production satisfies the optimal mold pressure, and
 - re-adjusting the injection molding conditions, during production, so that off-specification (in terms of mold pressure) molded parts are not produced.

The effectiveness of the mold pressure feedback control in an injection molding process is demonstrated in Figure 1 depicting the mold and hydraulic pressure profiles, during the injection process, for a machine under feedback control. Clear from this figure, to maintain the same mold pressure profiles, shot after shot, the hydraulic pressure profile should be readjusted in every shot. The cavity pressure feedback controller does this readjustment, automatically. This is in contrast to the traditional method of controlling injection molding process in which hydraulic pressure profile is maintained unchanged from shot to shot.

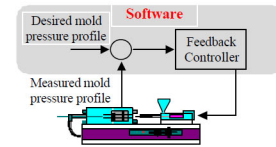


Figure 1. Schematic of a feedback controlled injection molding process

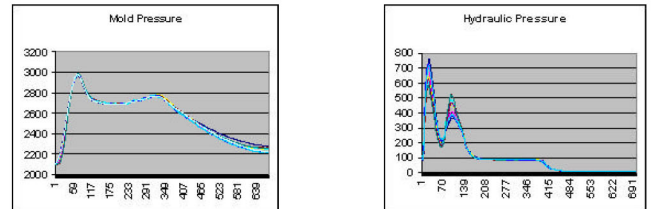


Figure 2. Mold and hydraulic pressure profiles for a feedback controlled injection molding process