Plastic Injection Molding Production Control with Non-Contact/NDT Inspection

ZEISS Industrial Quality Solutions

The quality of plastic parts manufactured using plastic injection molding depends on many influencing factors. From the injection mold itself to the various process parameters to the type of plastic used, many things can go wrong during a high-volume, mass-production process.

With an increasing focus on quality standards and time to market, manufacturers have concerns about repetitive platen deflection. These deflections can happen during high-pressure buildup and transmit into molds, weakening the mold structure and affecting parts quality.

Minimizing mold deflection is essential for plastic manufacturers when producing high-quality parts that must meet tight tolerances, especially complex parts and products used in critical applications. Verifying dimensions on parts to track mold deflection can determine when to swap out molds that have reached the end of their lifecycle, optimizing your injection molding processes.

Ensuring Quality and Acceptability Throughout Production

Quality systems enable plastic manufacturers and end-users to examine and evaluate their material or product to ensure quality and acceptability towards safe utilization. Although injection molding is a proven process today, strict quality specifications still challenge the production process.

The benefits of a strong quality program for plastic injection molding go beyond part quality alone and can improve efficiency:

- Quick mold setups
- Rapid cycle times
- Low rejection rate
- Increased productivity
- Long mold/molding machine life
- Elimination of secondary operations like machining
- Ease to procure mating parts
- Possible conversion of metal parts to plastic

The result is simple and satisfying: reduced lead time, lowered carrying costs, increased customer satisfaction and greater profitability.

Understanding Mold Deflection

If tight tolerances throughout the process are not maintained, parts and products could underperform or possibly fail, resulting in customer dissatisfaction and necessary tooling and/or process overhaul. A possible indicator that tolerances are not being maintained is mold deflection.

Most molds have two back plates, one on the fixed side and one on the moving side, that use clamps to hold the mold in the molding machine. The back plates form part of the runner system and support the entire mold against excessive platen deflection.

If the back plates are too thin, repetitive deflection can occur during each cycle, eventually causing part quality problems such as:

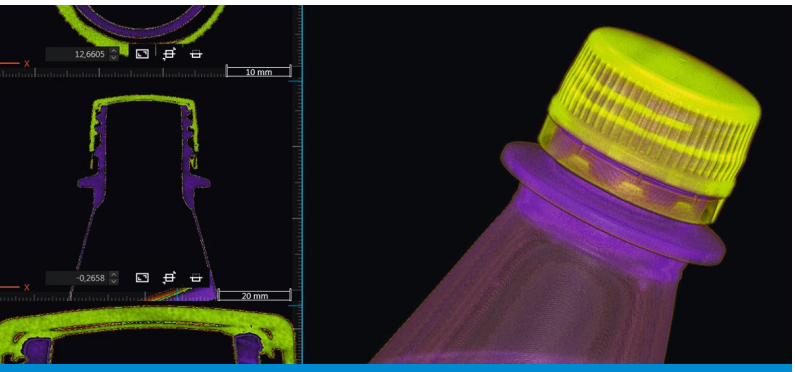
- Flashing of excess material
- Runner system balancing issues
- Incomplete filling of mold cavities, known as short shots
- Weight fluctuation
- Voids and sink marks

These quality problems occur because the plates do not provide enough support to stabilize the mold against cavity injection pressure and clamp tonnage, resulting in wear inside the mold. While during the injection molding process most machines will have some amount of platen deflection, if platen deflection is extreme, then part quality will deteriorate over a period of years, months or even weeks.

Understanding mold deflection during injection molding is, therefore, critical for determining the final geometry of the part and for secondary processes such as the in-mold coating process.

Implementing Quality Inspection into the Production Chain

Quality inspection of polymeric and plastic compound materials requires simple and reliable methods which can be easily implemented into a production chain. With a type of in-line surveillance, the processing of raw materials and fabrication of components can be instantaneously adapted and improved, and the reject rate can be decreased.



"The selection of the evaluation method(s) depends on the specific type of plastic, type of flaw to be detected, environment of the evaluation, effectiveness of the evaluation method, size of the structure, and economic consequences of structural failure," - Injection Molding Handbook.

"Conventional evaluation methods are often adequate for baseline and acceptance inspections. However, there are increasing demands for more accurate characterization of the size and shape of defects that may require advanced techniques and procedures and may involve the use of several methods." explains D.V. Rosato and Marlene G. Rosato in the Injection Molding Handbook.

Take, for instance, food-grade plastics such as pouches for applesauce and juice and caps for the pouches. A company producing such products can determine if a mold needs to be switched out by tracking mold deflection on the parts.

Within those parameters, non-destructive testing (NDT) and non-contact testing are the best ways to track mold deflection. Non-contact measurements of complete surfaces of injection molded parts can inspect any object size and shape. In contrast to tactile measuring techniques, this method even captures complex freeform contours quickly and completely.

Go a Step Further with Multi-Sensor Measurement

A multi-sensor measuring machine enables each characteristic of a plastic component to be measured optically or by contact. In the past, traditional vision systems performed 2D measurements with a regular camera and added a probe for 3D inspection. With the intricacies of small plastic parts and products, a 2D vision-only system can't achieve all of your goals.

"ZEISS takes it a step further," says Joshua Loewenguth, O-INSPECT Product Sales Manager for ZEISS Industrial Quality Solutions. "With O-INSPECT, not only can size and dimension be captured, but also form, such as unique features of how flat a part is and whether it's parallel to another surface."

O-INSPECT models offer up to three different measuring methods: the ZEISS VAST XXT scanning contact sensor, the ZEISS Discovery. V12 zoom lens and the DotScan white light distance sensor. "While it's a vision system," says Loewenguth, "it's a coordinate measuring machine first."

This flexibility in enabling seamless integration of the camera and probe system on the same machine to complete measuring tasks quickly is the great advantage of O-INSPECT.

The VAST XXT scanning and single point measurement sensor, and DotScan chromatic white light sensor, are particularly appropriate for NDT testing of food-grade plastics. The scanning sensor features minimal measuring forces, making it ideal for true 3D measurements of sensitive workpieces such as thin-walled, injection-molded plastic parts. The white light sensor, as well, utilizes non-contact testing to acquire contours or contour elements and to capture reflecting surfaces.

CALYPSO is easily programmed and captures visual and contact inspection results quickly and reliably, all from a single source measurement plan. When used in combination with ZEISS PiWeb — professional and interactive reporting software with customizable templates — you will have a complete system for web-based quality data management.

Conclusion

Non-destructive, non-contact metrology can boost the competitiveness of plastics manufacturers by decreasing lost money and time due to part failures. With ZEISS O-INSPECT, you can properly allocate and interpret measuring results of unconventional plastic parts, visualizing the actual status, displaying nominal and deviations simultaneously.

Through reliable 3D accuracy, you can execute corrective action on problematic factors like mold deflection and maintain tight tolerances. With O-INSPECT, detection and identification of the cause of errors, such as wear and tear on molds, is streamlined and can help your quality program deliver results to the bottom line.

P: +1 800 327-9735 | **E:** info.metrology.us@zeiss.com | **W** www.zeiss.com/metrology