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PLASTIC INJECTION MOLDING

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MOLD SHRINKAGE

TECHNICAL ARTICLES | PROPERTIES OF PLASTICS

Accurately determining the exact amount of mold shrinkage is difficult. While there are many resources to consult, they are not without their limitations. Despite these challenges, the amount of mold shrinkage can be reduced through processing techniques. If part shrinkage cannot be mitigated through these techniques, tool modification can be completed to accommodate for nearly the exact amount of shrink.

Why is mold shrinkage nearly impossible to quantify? The difficulty involves applying homogeneous thermal properties to a material that responds to heat in a highly variable way! This, in turn, creates a range of temperatures that cause change to the plastic material; which is why a plastic does not have a definitive melting point, yet rather a melting range. The melting range affects three distinct mold shrinkage steps that occur during processing:

- As the melt solidifies, contraction occurs.
- Polymers may crystallize (shrink) below the processing temperature (each polymer will crystallize at different rates and to different levels).
- Thermal contraction will take place as the plastic cools.

The variables in thermal properties get magnified through each step in the melting process. Cumulatively, this can cause a wide range in what is actually measured when the part is processed compared to the dimensions in the tool steel itself!

Processing parameters do affect mold shrinkage. Controlling the injection temperature, mold temperature and pack pressures will help mitigate shrinkage concerns. Generally, a low injection temperature, cool mold temperatures and a high pack pressure will reduce part shrinkage. Additionally, extended injection time will mitigate shrink[1].

Why do these variables help reduce shrink?

- Low Injection Temperature and Cool Mold Temperature – allows for a smaller thermal difference between the plastic and the tool, which in turn creates less shrink.
- High Pack Pressure – forces more polymer into the tool, thus decreasing the available space for the plastic to shrink.
- Extended Injection Time – keeping the plastic in the tool for a longer duration allows the tool steel to prevent the part from shrinking on itself.

Certain applications will still exhibit excessive shrink despite the above efforts. When this occurs, a tooling modification should be considered. Yet, how does one determine the appropriate adjustment?

This will be the topic of the next article.

[1] Campo, E. Alfredo, *The Complete Part Design Handbook*, Hanser, 2006.
[2] Strong, A. Brent, *Plastics: Materials and Processing*, Prentice Hall, 2000.

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