How to Become a Plastics Guru: What You Need to Know (Part 3 of 3)

By Jeremy Williams, Trainer/Consultant at RJG, Inc.

There are those who are good at what they do, and then there are those who are the absolute best. The gurus. The late NASCAR legend, Dale Earnhardt is a great example of one such guru. He was so good, in fact, that it's thought that he could see the air moving around the car to better understand what move he should make next.

If you've had the honor of meeting a plastics guru, you'd know how brilliant they are. How are they so good? What do you need to know to be on that higher level?

Over these three segments, we have reviewed several of the often overlooked technical arenas that are vital to understand in order to become a plastics guru. In segment 1 and segment 2, we reviewed mechanical, electrical, fluid dynamics, and thermodynamics. This segment, we will review matallurgy and statistics.

Metallurgy

There is metal everywhere! And here I thought we were making plastic parts... Actually, there is a surprisingly significant amount of metal that is used in the manufacturing of plastic molded parts.

On the molding machine, one key area that must be considered is the screw and barrel assembly. It takes a significant amount of energy to melt plastic through mechanical friction, but the type of resin being melted impacts the steel selection.

For general purposes (materials like polypropylene), a standard steel will work just fine. However, not every material is as easy to work with. Materials that have glass fillers can quickly erode a soft steel selection, reeking all kinds of havoc on part quality. For aggressive materials, such as a 33% glass filled PA, it's recommended the screw and barrel assembly be constructed of a CPM 9V or similar type steel, which has a higher wear resistance.

Tie bars are another important feature on the molding machine. Tonnage is created when these massive steel rods are stretched in tensile. All four rods must stretch equally to provide even clamping forces across the mold surface. If the difference is large enough, it can cause premature failure of the mold or even cause a tie bar to snap. Speaking from experience, neither of these situations is pleasant. In Image 2, there is a visual gap between the back of the platen and the tie bar nut. In this example, the machine was set to run at 50 tons. With 4 tie bars, each should provide 12.5 tons of force, however due to improper torque, the tie bars were stretching at different rates.

Image 2: Gap between platen and tie bar nut

Platen stiffness is critical to the overall longevity of both the mold and the machine. Platen must be stiff to provide a rigid structure for the mold to be pressed against during injection. This is completed with two factors: the type of metal that is selected and the shape of the support structure opposite the mold mounting surface. If the platen is not properly designed, the mold will typically flash around the sprue. This is because the highest pressure is at the sprue and the least amount of support is typically in the center of a toggle type clamping system (shown in figure 4).

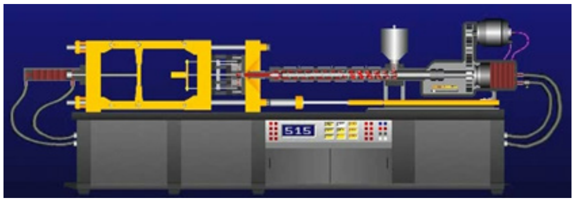


Figure 4: Toggle molding machine unsupported in the center of the moving half

Understanding the material that is going to be processed also impacts the cavity and core steel selection. When processing materials that are abrasive, like the 33% glass filled nylon mentioned earlier, choosing the appropriate mold steel is critical. In this instance, selecting a steel like H13 with a high Rockwell Hardness will improve the overall durability. Conversely, if we are molding a PP resin, a P20 likely will be the correct choice for the application—they are softer and transfer heat more effectively. One item to always keep in mind is that there is a balance between hardness and thermal conductivity (Table 4).

Material	Thermal Conductivity (W/m°K)	Rockwell (HRC)
P20 (1.2311)	31.5	28 to 32
H13 (1.2344)	24.3	48 to 52
420 Stainless Steel (1.2085)	16.0	36 to 40

Table 4: Common steels used for injection molds

In certain circumstances, like in the medical arena, our hand might be forced into using something like stainless steel, which does not transfer heat well. For injection molders, time is money. When a steel is selected that doesn't transfer heat well, the ability to achieve cycle times becomes increasingly difficult.

Statistics

One of the least favorite topics for many people is math and statistics. But a plastics guru needs to have an understanding of it because they are likely responsible, at least in part, for the qualification of a new part.

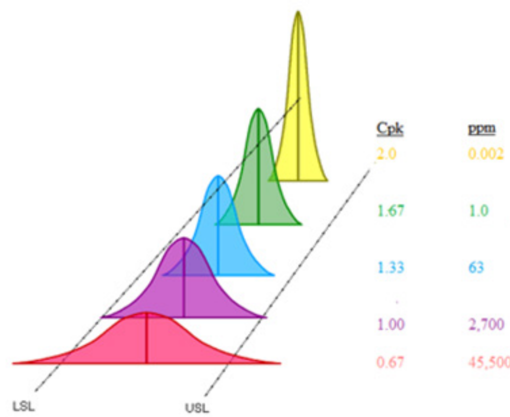
Before we get too far along, we need to clear up some of the acronyms that are frequently dropped by quality engineers.

Upper Specification Limit (USL): The largest a given dimension can be

Lower Specification Limit (LSL): The smallest a given dimension can be

Cp: Indicates how consistent the process or measurement is (a taller bell curve or smaller distance between peaks and valleys yield a higher Cp)

Cpk: Compares how centered the process or measurement is compared to USL and LSL, which can be seen in Graph 2



Graph 2: The taller the Bell Curve the higher the Cp value and more likely to achieve a high Cpk

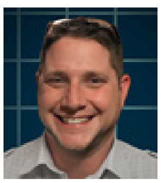
It's important to understand these statistical values to help determine if the process is repeatable (Cp). With low Cp values, an investigation into why this is occurring is required. A few areas to focus on are the incoming material consistency, machine repeatability, process strategy, and gauging method. Any one of these individually or a combination of any could be the root cause for low Cp values. If all the previously mentioned topics are performing consistently, a steel adjustment to the mold may be required.

In addition to qualification, there will need to be process adjustments made along the way to account for changes with incoming materials. Understanding how to read trend data on a run chart can greatly assist with troubleshooting and getting back to running quality parts quickly.

Conclusion

Don't be fooled—plastics gurus possess no super powers. They may not even be masters of all of these areas. But they do have a firm understanding of each area and its influence over the process as a whole. Gurus are able to see plastics from many different perspectives, which allows them to better understand the situation and how to apply the appropriate solution. You, too, can become a guru with enough training and practice.

About the Author:



Jeremy Williams has over 17 years of experience in the plastics industry serving the medical, automotive, furniture, and appliance industries. He previously worked as a Principal Engineer, taking projects from design concept to saleable products. Jeremy earned his Master Molder II qualification in 2011, became an RJG Qualified Trainer in 2012, and started at RJG in 2015. In addition to his extensive manufacturing background, he holds degrees in plastics and business. Currently Jeremy is a Consultant/Trainer with TZERO®.