ASHLAND

Cycletime Tips - General

Volume 22: Nozzle Tip Sizing and its Effects

By Wayne R. Gladin

This month I'd like to discuss the role of the nozzle tip as a key element in optimizing your molding process and establishing run-to-run repeatability. As the nozzle tip affects both the shear rate of the plastic flow as well as the pressure drop across the system, it is vitally important for process consistency that we consider the tip as part of the mold, and that we always use the same tip with the same mold.

First, let's review some basics. Most nozzle tips come in one of two radii, 1/2" or 3/4", and with orifices of between 1/6" and 3/8". The radius of the tip you use will depend on the mold's sprue bushing: a 1/2" radius sprue bushing calls for a 1/2" tip, and a 3/4" sprue bushing a 3/4" tip. Matching these radii provides maximum contact area between the mold and the injection unit, thereby minimizing the chance of leakage or blow-by during injection.

By the way, a 1/2" tip is not a universal tip for all occasions. While it appears to mate with both types of sprue bushings, the contact area with 3/4" sprue is only a fraction of that provided by a 3/4" tip, and your chances of a leak are greatly increased. Match the radius of the tip to the sprue and stop trashing nozzle heater bands and thermocouple leads — it's good for the environment and your bottom line!

While we are on the subject, if you can see your nozzle deflect as it makes contact with the sprue (and I've seen some deflect by as much as 1/2", although never in my shops, of course), you need to align the injection unit's sled to the sprue. Again, these things are radiused to provide maximum contact area, not to be self-aligning. This condition, in addition to causing leaks between the mold and injection unit, will result in some pretty significant and asymmetrical (read that as "no Brody ring in the world will fix!") wear on your screw and/or barrel.

After we have selected a correctly radiused tip, we must consider the orifice diameter. Obviously the tip orifice should be smaller than the sprue opening, or we run the risk of having the sprue stick. Conventional thinking holds that the tip orifice diameter should be 1/6" smaller than the sprue's, the idea being that this choice keeps the sprue from sticking while minimizing the pressure drop across the tip. Keep an eye out for future results of a study challenging this belief - but for now, in the absence of data to the contrary, we'll assume this to be true.

So now we have correctly matched up our nozzle tip with our widget mold, we've gotten the tool up and running, and after determining that we have a robust process, we create a setup sheet. The job runs great, we pull the mold at the end of production, and we file the

setup sheet for future use. Two months later we have an order for more widgets, we hang the mold in the same press as before and, using the same setup as before, we can't make a single good part. After suffering through an hour or more of downtime, we finally have a new process that is making good parts. What happened?

In our haste to get into production, the mold hanger left the tip from the previous job in the nozzle. The nozzle in our original setup had a 1/4" orifice while the new tip had a 1/8" orifice. The smaller orifice affects our processing in two contradictory ways. First, it increases the shear rate of the plastic, which decreases its viscosity, which changes the flow pattern of the material (this effect is at its worst in multi-cavity tools). Second, the smaller orifice imparts a greater pressure drop across the system, which will decrease the plastic pressure in the cavity, which can lead to shorts, sinks, surface blemishes and voids. Could these two opposing changes cancel each other out? Sure, in some cases they could, but in most cases they won't. Also given the cost of the potential scrap and downtime, I am of the opinion that five minutes spent matching a nozzle tip to a sprue bushing is time well spent.

How do we ensure that we always match the correct tip with the mold? One way is to specify on the setup sheet the tip's type (general purpose, nylon, etc.), radius and orifice diameter and invest in some gauges, which will allow your setup people to check both radius and diameter. Then, or course, sit back and hope that they have the time to inspect the nozzle tip, and that they remember to do so. A better way is to purchase some half jamb nuts (just a low profile nut available from many supply catalogs and well-stocked hardware stores) with a 7/8-14 thread and tack weld it to the top of your molds. Then, store your tips with our molds, ideally purchasing a dedicated tip for each. Now before you complain about the costs involved, think about how quickly (and how often!) you can generate $30 worth of scrap/downtime from installing the wrong nozzle tip.

If any of the scenarios discussed above hit home, I'm sure doing this will have paid for itself after the second run. I hope you found this helpful. Good luck and good molding.

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