Waterlines 101: The basics

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It isn't rocket science to understand that a mold is really a heat exchanger. The heat you put into the plastic to melt it must be removed enough not to shrink or warp a part. Most people put in 7/16-inch-diameter waterlines. Why? Two rules of thumb:

- The drill size for a 1/4-inch pipe tap is 7/16 inch, which allows you to put in the quick disconnect nipple without having to redrill the hole in order to tap the threads.
- Waterlines control heat within three diameters of themselves. The 7/16-inch size is a happy medium between many small lines and the fact that larger lines don't particularly increase the heat exchange benefit. With a minimum of 1.5 gal/min through this circuit we will get turbulent flow-the optimum cooling situation.

Yet, simply having the right diameter waterline is only one of the three elements of good cooling. Assume you have a thin tube-shaped part, about 3 inches long. One end has an ID of 1/4 inch and the lower end is about 3/4 inch in diameter. A good tool designer, moldmaker, or molder would immediately say these cores should probably be made of P-20 or beryllium copper. (While on its face many people would reject beryllium copper because of its insufficient hardness, recent developments have allowed this metal to be almost as hard as P-20.)

Cooling the Core

With the core cut to configuration, we now need to cool it (our second element). Conventional cooling choices are either a baffle or a bubbler. Here is where most people tend to fall into a trap. If the water is directed up the tube with the bubbler or on one side with a baffle we still have to maintain the cooling characteristics with turbulent flow. We must be sure our bubbler or baffle is not so constrained that the entire system is strangled and turbulent flow stops.

The next concern with this insert is proximity. If we can't get the water close enough to the heat, it won't make any difference if it's turbulent or not. This is especially a problem with thin protruding cores. If you can't get the waterline near the source of heat, bring the heat to the waterline. This is done with the use of gas pins-hollow pins that contain a low-boiling liquid (sometimes Freon). One tip of the pin is heated, and it immediately transmits the heat to the other end of the pin, which should be located in the middle of the waterline.

Managing Heat

Two other important factors are where to put waterlines, and how to hook them up. Nearly everyone cools the cores and cavities, but the most common mistake is not getting sufficient cooling to the runners, sucker pins, stripper plates, and (most importantly) the sprue-whether it is a hot runner or conventional design. Anywhere there is heat it should be managed. If you have a stripper plate on the ejector side with sucker pins holding the runner and it is not cooled, it's just a matter of time before (1) it heats up and starts galling the pins because of thermal expansion, or (2) the sucker pins are so hot and the plate is so warm that the runner will not stick to the sucker pins and will come off the plate like a wet noodle.

Internal looping should be serial. The water circuit should be able to enter the mold and find its way out again without splitting into separate paths. When water circuits are split internally in the mold, turbulent flow can be measured on the in and out, but how do you know this is what’s happening in the mold? Water will always take the path of least resistance. Therefore, if there is a parallel circuit but one leg is constricted and the other isn’t, the water will have a tendency not to flow into the restricted portion.

Parallel circuits, which are a form of an internal manifold, should be avoided at all costs. The machine manifolds work because they are usually fed by 2-inch or larger lines. So long as the plant water can maintain the pressure, the parallel machine manifold will deliver pressure to each line equally. Bringing a waterline to the mold and then making a small manifold or splitter to allow that one line to be split into multiple lines will only work if the pressure and flow out of your mini-manifold is equal to the pressure of the line in.

While this is possible, it is also difficult. If you must have a manifold on the mold, put it on externally with large pipes as the inlet, and split it into smaller lines to the mold so that the circuits can be balanced before the handles of the valves are taken off and welded into place.

Waterlines and water circulation in a mold are easy. However, simple oversights like the ones mentioned here can turn the best mold into a loser.