THE MADISON GROUP
PLASTIC CONSULTING ENGINEERS

From the TMG Solutions Archives: Optimizing Cooling Analysis

Keywords - Moldflow, Simulation, Cooling, Optimization, Mold Design

The Problem

Toolmaker Carlson Tool and Manufacturing had to determine if their proposed cooling line layout would achieve turbulent flow and maximize cooling efficiency in a twelve-cavity injection mold. The Madison Group used injection molding simulation to investigate the cooling layout design and determine how much coolant was required to maximize the efficiency of the proposed design.

Evaluation

Efficient cooling of multi-cavity molds can be difficult to achieve due to limited space, and the use of parallel cooling circuits. The key to maximizing the efficiency of any cooling line layout is to ensure that the coolant is able to achieve turbulent flow. Turbulent flow allows new coolant to continually come into contact with the mold wall of the cooling channels and results in significantly greater heat removal efficiency, compared to laminar flow, Figures 1 and 2. While turbulent flow is necessary for efficient cooling, it is generally recognized that ideal cooling occurs with a Reynolds number of 10,000.

The Madison Group used injection molding simulation to determine the minimum flow rates required to achieve turbulent flow through all of the channels in the toolmaker's design, Figure 3. Specifically, this simulation provided useful information regarding the predicted mold and coolant temperature distributions and head pressure requirements. While the baseline simulation indicated that all circuits would achieve turbulent flow, it also predicted that the mold surface temperature would vary on the core side of the mold. Subsequent simulations revealed that a more uniform mold temperature could be achieved by increasing the amount of coolant flowing into the tool.

Conclusion

Injection molding simulation enabled the problem areas in the tool design to be identified prior to being built, and ensured that the cooling efficiency of the proposed design can be maximized with the customer's achievable processing conditions.

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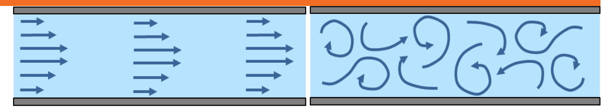

Figure 1: Illustration of laminar (left) and turbulent (right) flow.

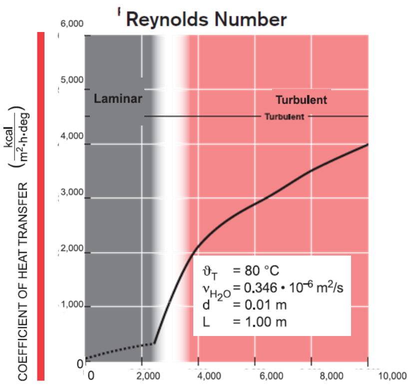

Figure 2:Chart showing the effect of the Reynolds number. (x-axis) on the coefficient of heat transfer (y-axis).[1]

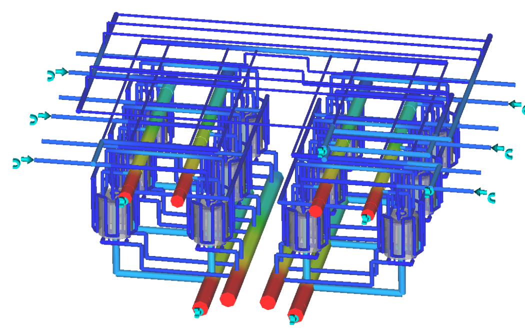

Figure 3: Macro view of the flow rates in the cooling system. Red indicates the highest flow rates, and blue indicates the lowest.

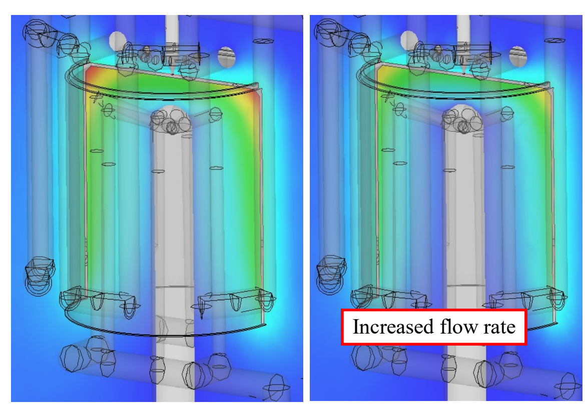

Figure 4: Result highlighting that the increased coolant flow rate leads to a more uniform mold temperature.

[1] *LANXESS Part and Mold Design Guide*, LANXESS Corporation, 2007.