How AG Solved Multiple Performance Issues with a Foundry's Problem Permanent Mold

CASE STUDY

THE PUZZLING PROBLEM

The customer in this case study was struggling with the performance of a permanent mold (see image #1). The mold had two slides that would routinely slow and ultimately stick, resulting in a production shut down. In addition to the sticking issue, the customer was struggling with pre-heating the mold in a reasonable amount of time. It would take 4 to 5 hours to bring the mold up to the correct operating temperature and then the heat was uneven across the mold. Anderson Global (AG) was called in to review the issues and ultimately try to solve the problem. The AG team was onsite for the customer's next run of the mold and recorded all process operating parameters, as well as capturing all activity with video and photographs. The team witnessed and documented the same issues reported by the customer.

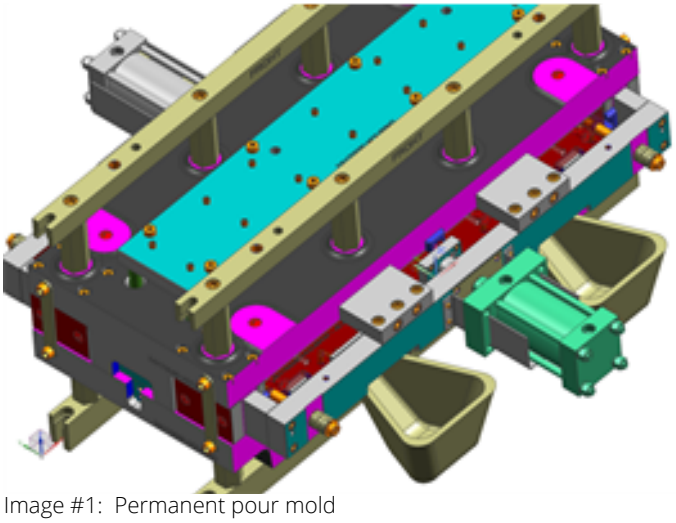

Image #1: Permanent pour mold

THE PROBLEMS IDENTIFIED

The team decided to take the locked-up mold back to AG for disassembly and inspection. They concluded the locked up tool resulted from multiple causes that were interrelated.

Issues discovered by AG Journeymen Patternmakers and Engineers during the disassembly and inspection process:

- Minor casting defects were found
- Hydraulic cylinder had seal failures due to exposure to excessive temperature
- Galling between the slides and upper insert was found due to the combination of minimal clearance and the expansion from the high heat
- The Burner was marginal for the size of mold being heated

AT A GLANCE

The Customer

A medium-sized US foundry looking to grow their permanent mold aluminum casting business

The Problem

The customer was struggling with the performance of a permanent mold (Image #1) and had limited technical resources to diagnose the problem

Why was AG the preferred provider?

AG was able to provide a total solution to this customers problem. By having the engineering design, simulation, and build capability in conjunction with skilled journeyman patternmakers, all under one roof. This customer could come to one place to get their problem solved.

"Our tooling design engineers and journeymen patternmakers are forward thinking, knowledgeable experts with the aptitude to discern complex tooling challenges, anticipate potential tooling and production obstacles, and make revisions before products launch. It's this combination that offers the lowest total cost solution for our customer."

Mick North/CEO
Anderson Global Inc.

THE PUZZLE SOLVED!

The AG Team made the following improvements:

- Minor casting defects that were found were caused by air trapped as the molten aluminum was introduced to the mold. Adding additional venting to the areas where the air became trapped was a logical solution.
- Hydraulic cylinder failures were caused by excessive heat. The team resolved this by replacing the cylinder seals with high temperature versions and at the same time changing the mounting components from steel to a phenolic material that has a much lower thermal conductivity.
- After the seal failure was corrected, the front slide was still marginal. It was therefore decided to increase the size of the front cylinder to a 4-inch diameter (from the previous 2.5-inch diameter cylinder) to increase the retraction force on the sticking slide. (Image #3)

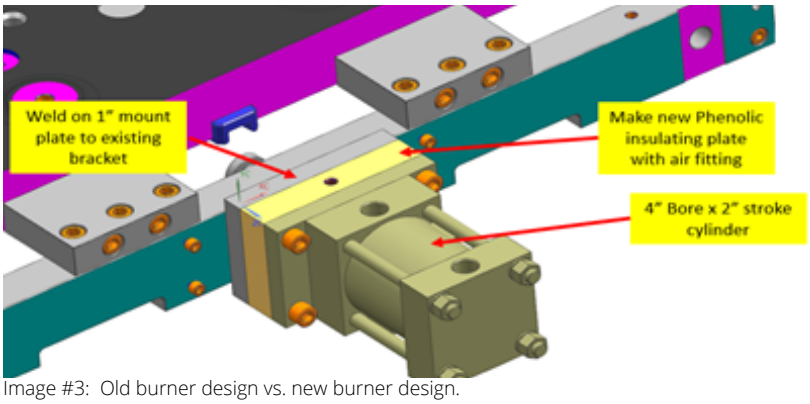

Image #3: Old burner design vs. new burner design.

- After discussion and approval from the end customer of the castings, the draft angles were increased on the final product geometry as much as possible. Example: a small boss that was showing high friction gall marks. (Image #2) had the draft changed from 3 deg to 6 deg, which eliminated the galling on those casting features.
- The permanent mold was then "hot fitted" at operating temperature. (Image #5) This pointed out areas that had minor clearance issues, due to the normal mold heating and expanding. Clearance was added to strategic locations to maintain the design intent of the permanent mold while at the same time, allowing it to function as required.
- To reduce the pre-heat time, uneven heating and excessive weight of the existing burner, a new two-piece burner was designed and built. (Image #7) In addition to higher BTU's from the new burner, additional shrouding and heat shields were also added to help prevent flames from escaping and potentially damaging the hydraulic cylinders and keep the heat inside the mold. (Image #6)

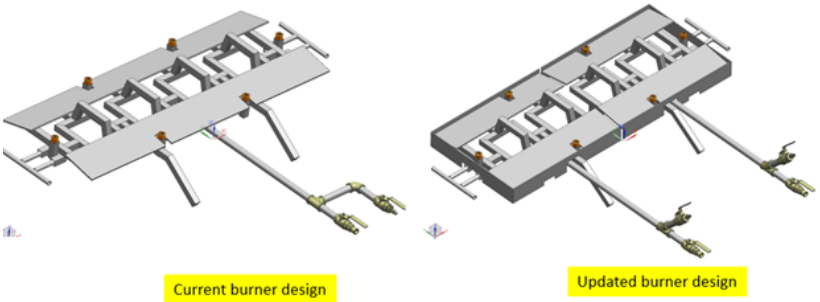

Image #7: Old burner design vs. new burner design.

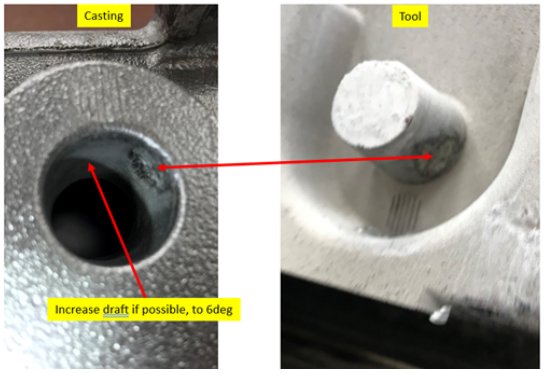

Image #2: Close up inspection of cast part revealed scuff or rub marks indicating high friction as the slide pulls back.

Image #4: Feeler gage being used to assess gap between guide and mold slide.

Image #5: Mold being "hot fitted" by AG Journeymen Patternmaker

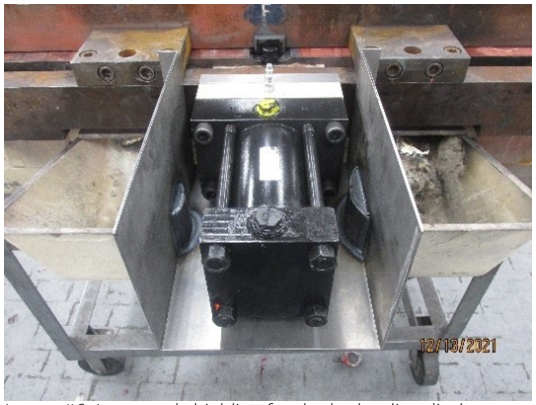

Image #6: Improved shielding for the hydraulic cylinders was built that allowed enough gap so that insulation material could be inserted

THE RESULTS

This type of sophisticated permanent mold was a new challenge for this customer, who was more familiar with sand casting processes. Initial pours revealed that a number of critical process variables had more variation than would be typical for this type of permanent mold. This was resolved with some training for the customer's team to show them what it would take to be successful.

After all of the suggested changes were made:

- The mold pre-heat time was reduced significantly, and heat was dispersed more evenly.
- The cylinders no longer overheated and functioned as they were intended.
- The added venting allowed the mold to fill at a much lower pouring temperature, which in turn allowed the mold to be poured at cooler temperatures. This reduced the normal heat expansion and distortion caused by the high temperatures of the molten aluminum.
- The slides began functioning well and allowed them to move with ease.

The long-term benefits of the solution includes:

- A lower operating temperature will increase the life of the tool and reduce mold stress and tendency to distort.
- Less product variation
- Increase uptime on the mold