Benefits of Using Highly Exothermic Blind Risers

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Introduction

With the rising prices of raw materials and labor, steel foundries must focus now more than ever on saving money wherever they can to keep costs low for their customers. One way Badger Alloys has implemented savings is by using high-yield exothermic risers, focusing on HA's Tele-Feeders and ASK's Mini Risers. These risers feed a much higher percentage of their volume to the casting compared to standard blind risers, up to 75 percent.

Yield improvement is the goal for a couple of reasons: price of raw materials, the ability to pour larger parts within our pouring capacity, and restrictions on returns used in specific materials. The main restriction is with CD4MCuN(CD4) with which Badger Alloys can only use 50 percent returns due to carbon control and cannot use CD4 returns in other materials due to the copper content. CD4 represents 15 percent of the total annual tonnage for Badger Alloys and is its third most popular material poured. The goal is an overall average of 50 percent yield across its CD4 jobs. Badger Alloys is currently at 42.2 percent yield on these alloys, representing a target weight savings of 32,000# annually.

To start Badger Alloys' exploration into these highly exothermic, high-yield risers, we first looked at HA's Tele-Feeders via Chemex. The main benefit of these risers is that they provide a higher percentage of feed volume compared to the other risers currently used, such as straight insulated sleeves, necked down insulated sleeves and blind insulated sleeves. They also reduce the cutoff area on the casting with their two-piece design with the necked down contact, as seen in Figure 1 below. The overall external size of the riser is greater than that of a traditional blind riser due to the amount of exothermic material. Fitment in confined spaces may become a problem.

Figure 1: Cross section of Tele-Feeder

Base Case

To evaluate these risers, Badger Alloys used a medium size, 238-pound stock billet casting. We chose this route because we had recently run a job through the shop and wanted to use these risers on heavier section castings. Badger Alloys ran a simulator with a standard straight insulated sleeve and zero safety margin, which represents the maximum yield possible out of a traditional straight-sleeved riser. All trials were run in CF8M with pep set binder system @ 1.0 percent, zircon wash, and the same parting line gating system.

The base case was a ø7" x 10.5" straight sleeve right on the castings. This resulted in a pour weight of 409 pounds with 60 percent yield. This riser size was determined by running in Magma, and that size gave Badger Alloys a "fed" casting with zero safety margin and a risk of shrink, as seen in Figure 2 below. During the casting trial, the riser sucked down but did not pipe. Badger Alloys cut this riser and casting in half to investigate for shrink, as seen in Figure 3. There was evidence of feeding in the riser and no visible signs of shrink in the casting.

Figure 2: ø7" x 10.5" sleeve, Magma porosity results [10.00%-100.00%]

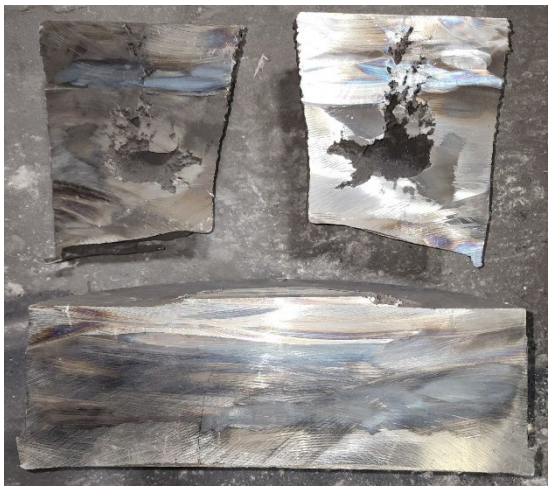

Figure 3: Base case sectioned riser and casting

Tele-Feeders by HA/Chemex

Magma simulations were run with the Tele-Feeders to determine what size Badger Alloys would like to use. The decision was made to go with two different sizes. The first offered some safety margin and was the recommended size. The second riser trial was the bare minimum size with no safety margin, similar to the base case. Riser #1 (tele-feeder 1600-60) is seen in Figure 4, Riser #2 (tele-feeder 1200-60) is seen in Figure 5)

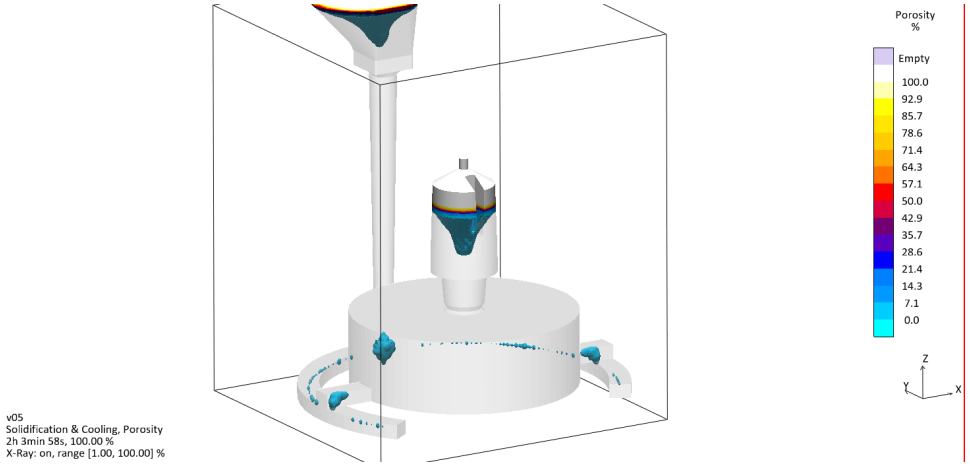

Figure 4: 1600-60(80) Tele-Feeder, Magma porosity results [10.00%-100.00%]

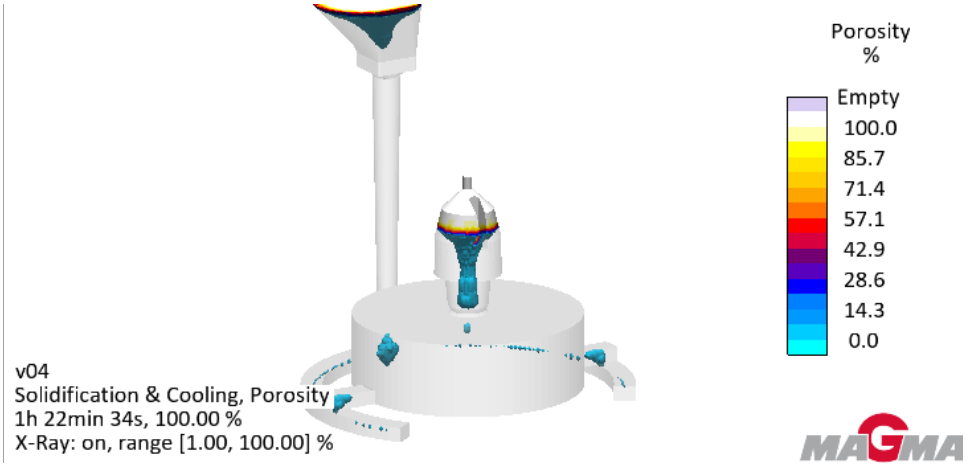

Figure 5: 1200-60(80) Tele-Feeder, Magma porosity results [10.00%-100.00%]

The larger of the two was the 1600-60(80), which was the recommended size. The pour weight was 334 pounds with 74 percent yield. In the casting trial, the riser showed good piping. We cut the riser and casting in half, which showed the riser fed a significant amount of its volume and there was no visible shrink in the casting, seen in Figure 6. The smaller Tele-Feeder was the 1200-60(8), which was the riser with no safety margin. The pour weight was 327 pounds with 75 percent yield. After cutting in half, the riser piped completely through to the casting surface and the casting had bit of shrink at the contact, but nowhere inside the casting.

Figure 6: 1600-60(80) tele-feeder trial cut in half

Mini Risers by ASK

Along with testing HA's Tele-Feeders, Badger Alloys evaluated ASK's mini risers. They have a similar concept to the Tele-Feeders, with the main difference being that it is a one-piece riser without a reduced down contact. ASK recommended a riser size for this job. Badger Alloys ran the recommended riser through magma to confirm that Magma showed proper feeding. The KMV-3100 riser gave Badger Alloys a pour weight of 356 pounds with 70 percent yield, seen in figure 7.

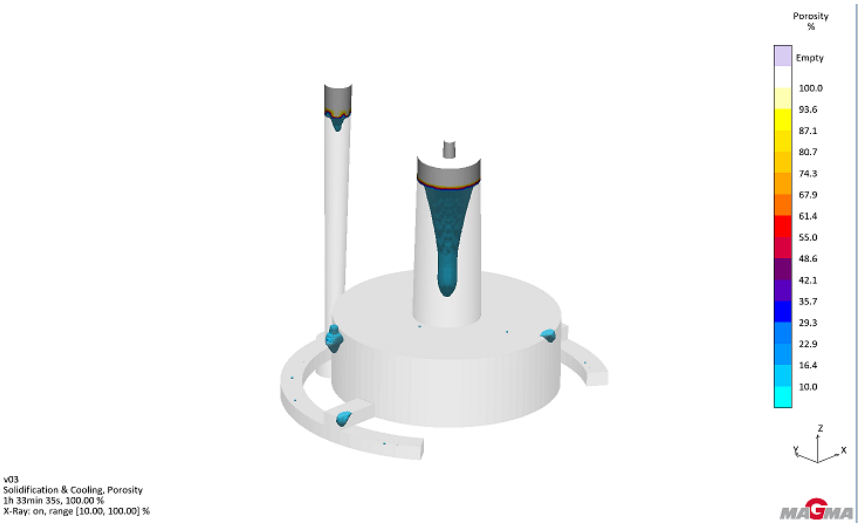

Figure 7: KMV-3100 Mini riser, Magma porosity results [10.00%-100.00%]

In the casting trial it was observed that the riser had no piping and very little suck down. After sectioning the casting and risers though, there was evidence of feeding in the center of the riser - i.e., spongy hollowness in the center. Looking at the casting there was not any major visible shrink. Badger Alloys may need to do other testing to see if there is shrink in the casting.

Conclusion

HA's Tele-Feeders worked very well on heavy section castings and had good correlations to the results observed in Magma. On the other hand, while the ASK Mini Riser did not show shrink in the casting, the correlation with Magma was quite off, which would make product reliably questionable, especially when running simulations beforehand. As seen in the reference chart below, these risers worked well in improving yield, most notably HA's Tele-Feeders. While the risers did work well, the setup needs to be catered to these risers specifically. With the smaller contact area of the risers, it limits the feed range, which could mean more risers need to be used. Due to these factors, these risers would be best used in high production, thick section castings.

Riser	Pour Weight	Yield
Base Case (ø7" x 10.5")	**409 lbs.**	**60%**
1600-60(80) tele-feeder	**334 lbs.**	**74%**
1200-60(80) tele-feeder	**237 lbs.**	**75%**
KMV-3100 mini riser	**356 lbs.**	**70%**

Future Work

Badger Alloys plans to continue to evaluate different sized Tele-Feeders on various casting sizes and shapes. We will also do a few more tests with the mini risers to see if the results obtained are consistent. Additionally, we want to review the possibility of using these risers as side risers, as that offers the most yield-savings potential. Finally, Badger Alloys plans to perform a cost benefit analysis to determine if the savings obtained are worth the cost of the risers. This will determine how big of a role these risers would play in the foundry going forward.