NEW DEMANDS REQUIRE NEW TOOLS IN THE TOOLBOX

MOLTEN METAL
EQUIPMENT INNOVATIONS

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ARTICLE TAKEAWAYS:

- Aluminum Gigacasting are pushing boundaries in next generation of e-vehicles
- Requires new tools in the toolbox from suppliers to improve productivity
- More metal, higher consistency, and less variation

A prominent business innovation leader said the other day something along the lines of "I have no issues with innovation, my mind generates more ideas than I can act on. My issue is execution." The die casting industry has seen some significant innovation of late in ever larger presses capable of making ever larger parts and eliminating costly assembly, to further drive competitive advantage. The advent of gigacasting or megacasting technology has required the industry to develop new tools for the toolbox to support this type of production. This quote from Volvo is representative of how the automotive industry OEM's are thinking about this trend. "The introduction of mega casting of aluminum body parts for the next generation of electric Volvo models is the most significant and exciting change implemented as part of the investment package. Mega casting creates a number of benefits in terms of sustainability, cost and car performance during the cars life time, and Volvo Cars is one of the first car makers to invest in this process." Volvo is not alone, Tesla has been a leader in this new area and virtually all of the US, European, Chinese and Japanese OEM's are implementing their own strategies to take advantage of the benefits it brings to automotive production. At Molten Metal Equipment Innovations, it caused us to go back to the drawing board, which in our case is a water tank, and get into testing and data gathering mode as we worked to support the needs of a new paradigm in diecasting. It refocused us on the core principles of our technology and how to create a new solution to a very important market need.

OUTLINING THE REQUIREMENTS

The issue at hand was simple in nature, we needed to be able to provide much more metal, much more quickly and in a very consistent manner to meet the needs of new larger die-casting presses. So, at the core, the variables were basic, weight and time. As always with molten aluminum there were far more moving parts in the equation that also needed to be considered. Some of these related directly to the properties of the metal and some of these related to our equipment and how we could get it to do something that we had never asked it to do. Initial testing had to be done in a water tank, as it is impractical to start in a molten aluminum bath, we focused our efforts simply on how much water (by weight) we could move in a certain amount of time. The objective from the beginning was to be able to maintain a 1% or less variation in the weight of the water transferred.

Continued on next page

Date:	4/12/XXXX
Rotor Design	Blocker XXX
Drive Accel time 1	5
Drive Decel time 1	5
Drive Accel time 2	1
Drive Decel time 2	1
Idle Speed (RPM)	285
Dosing Speed (RPM)	440
dosing Run Time (s):	4

low water starting point

Average:	35.1808
Standard Deviation:	0.25
Extreme Spread:	0.88
Standard Deviation %:	0.70%
Extreme Spread %:	2.5%
Farthest Above Avg:	0.4992
Farthest Above Avg %:	1.4%
Farthest Below Avg:	0.3808
Farthest Below Avg %:	1.1%

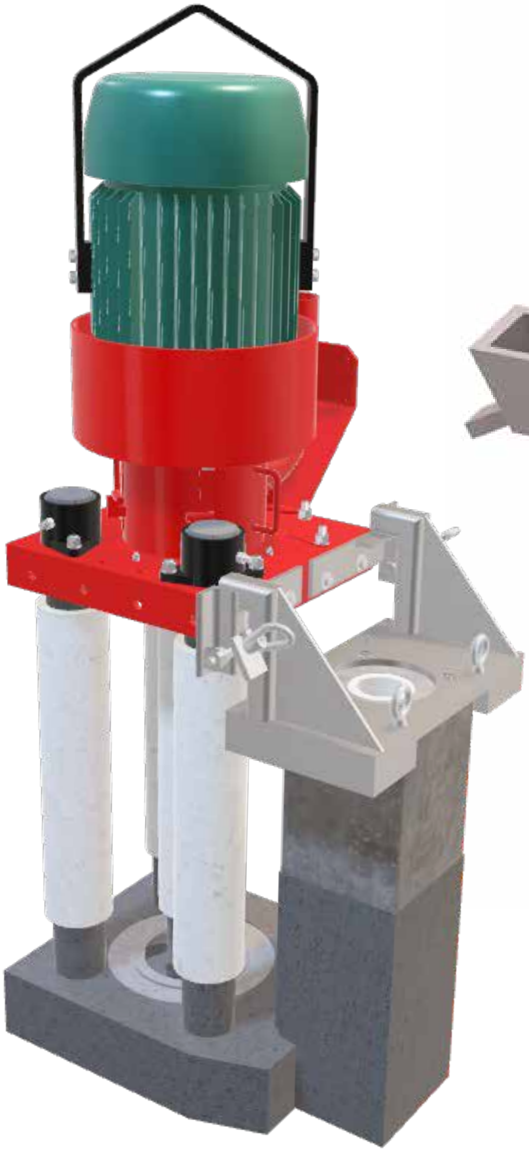
Run Number:	Weight of Water (lb)
1	35.67
2	35.26
3	35.36
4	35.34
5	34.88
6	35.07
7	35.03
8	35.24
9	34.88
10	35.12
11	35.68
12	34.84
13	35.34
14	35.13
15	35.48
16	35.31
17	35.11
18	35.03
19	34.8
20	34.97
21	35.17
22	34.89
23	35.44
24	35.38
25	35.1

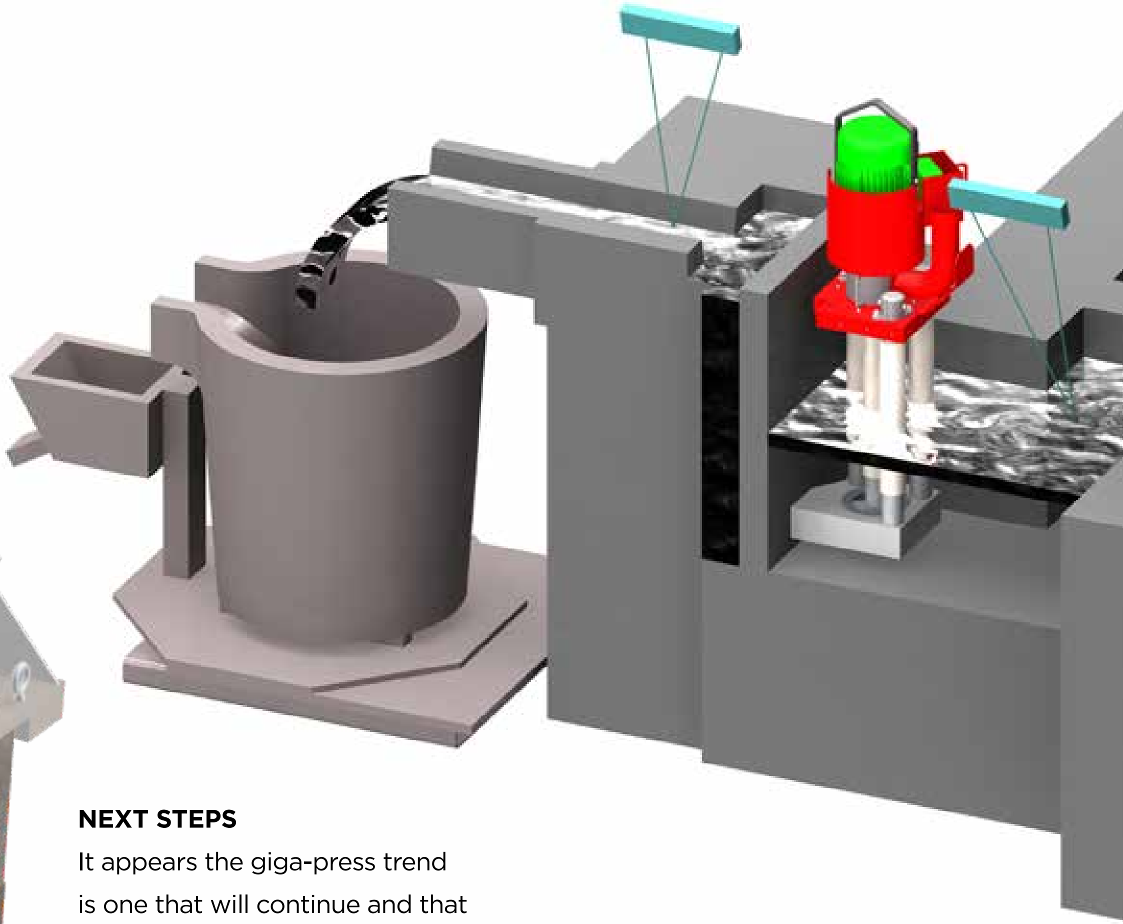
CRANK IT UP

The test we set up had to overcome a major challenge in that we would not have the ability to use a laser to measure a consistent metal level or any type of a molten metal flow meter and thus we would not have the normal feedback loop that we generally design into our systems. This placed the emphasis on being able to establish an initial consistent metal level using other methods that focused on the system design, the system components and the system programming that would all be "new" to us. We could not allow there to be any "leaks" in the system as this would make the metal level control much more difficult. In many of our launder transfer systems, the customer prefers to have the pump mate up with a dividing wall in the furnace, and this inherently allows for some metal to leak back through that port. In this case we designed a new riser that would completely eliminate any potential leak in the system. Over the past many years, we have been working to combine both graphite and refractory materials in a way that now enables us to design pumps that can incorporate both in a way that enables us to achieve new outcomes. Effectively, a new tool in the toolbox. We also had to look at our impellor design along the same lines so that it would generate a more consistent flow given the new system requirement of 1% variation or less. Here again, we made some changes to some of our core impeller designs so that we could test how each would perform. On the other end of the system where we deliver the metal through a launder system, we also made modifications to the shape, slope and size of the launder so that we could better control bias and work towards a much more consistent dose size (with water we used weight to measure, in the aluminum application it would be volume). Lastly, we had to develop new programming parameters to control the pump speeds so that we could improve the consistency of the metal delivery. Leveraging some of our SMART technology, we were able to find improvements that ultimately contributed to the success of the system.

RESULTS

The data we gathered for each of the rotor designs focused on pump speed (idle and dosing), time (initial goal set at 4 seconds) and weight (average over 25 trials). The chart included shows the results for one such trial. We took the standard deviation and the extreme spread to be the two most critical outputs for our testing. We knew we needed to deliver metal consistently within 1% of the target weight/volume in as little time as possible and avoid outliers as this would result in a major issue at the press with shot weight. Short shots needed to be eliminated from the realm of possibility. As we did the





testing and tweaking to the system, we were able to achieve results that gave us a standard deviation of less than 1% and a very consistent dose size that was able to meet the objectives of the test. We learned that pushing the metal faster (higher dosing speeds) resulted in greater consistency in water weight. This was a very positive result and not something we were clear on as we embarked upon the testing.

NEXT STEPS

It appears the giga-press trend is one that will continue and that the automotive manufacturers will push the pressure envelope further resulting in a need for even larger shot sizes. We are excited about working to support that need and to find ways to move even more metal while achieving the same time and consistency goals. It will require more testing and more system ability as we continue to explore how to meet these new requirements. We are also looking forward to moving in the direction of providing smaller shot sizes in the same fast time frame and high consistency zone so as to add that tool to our toolbox as well. We hope that this will enable us to provide similar solutions to a much broader section of the diecasting market and help more of our customers achieve improved results. In all cases, it is clear that we as a company and we as an industry will never get all the way to perfect execution but will continue to move closer in a way that will expand the application range of aluminum usage, and that is good for all of us!

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INNOVATORS IN ALUMINUM PUMPING SYSTEM PERFORMANCE

- Circulation Pumps
- Transfer Pumps
- Degassing/Flux Injection Equipment
- Scrap Submergence Systems
- Pump & Ladle Preheating Stations
- Smart Pump Technology
- Control Systems
- Spare Parts & Service
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