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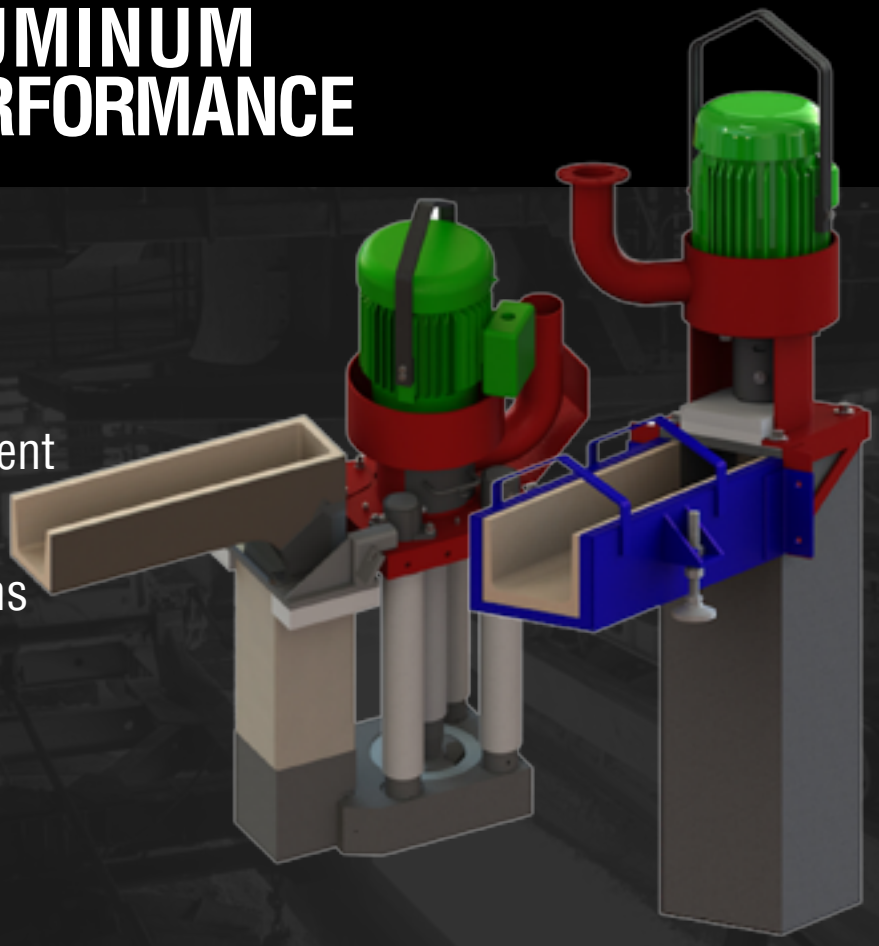

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ALWAYS TRYING TO MAKE IT BETTER

MOLTEN METAL EQUIPMENT INNOVATIONS

JEFF KELLER
CEO
Molten Metal Equipment Innovations

ARTICLE TAKEAWAYS:
- Molten metal transfer has a major impact on metal quality
- Better metal transfer from improved graphite, refractory & ceramic pumps
- Newer technologies have amplified the advantages of using a mechanical pump

The transfer of molten metal is a fundamental process used in virtually every stage of making nonferrous cast parts. Like most industrial processes, it has evolved over time as innovators have introduced new ways of doing things. In the beginning, gravity was the primary technology deployed in the process of getting molten metal from point A to point B. It is still used today, but as Mr. Newton taught us, it has limitations. To overcome the primary limitation of moving molten metal across a flat surface or even "uphill", new technologies were invented. Mechanical pumps, pressure pumps and electromagnetics are all ways to move metal where gravity cannot. Gravity and tap out plugs used in reverberatory furnaces have other limitations and negatives that have further fueled the development of new ways to transfer molten metal. Most notably, tap out plugs can be very dangerous, they don't allow control of the flow of the metal in an accurate way and the turbulent flow creates aluminum oxide which reduces the amount of useable aluminum and destroys value. I would like to focus on mechanical pump technology and highlight some new developments that make it work even better!

A TOUGH PLACE TO WORK

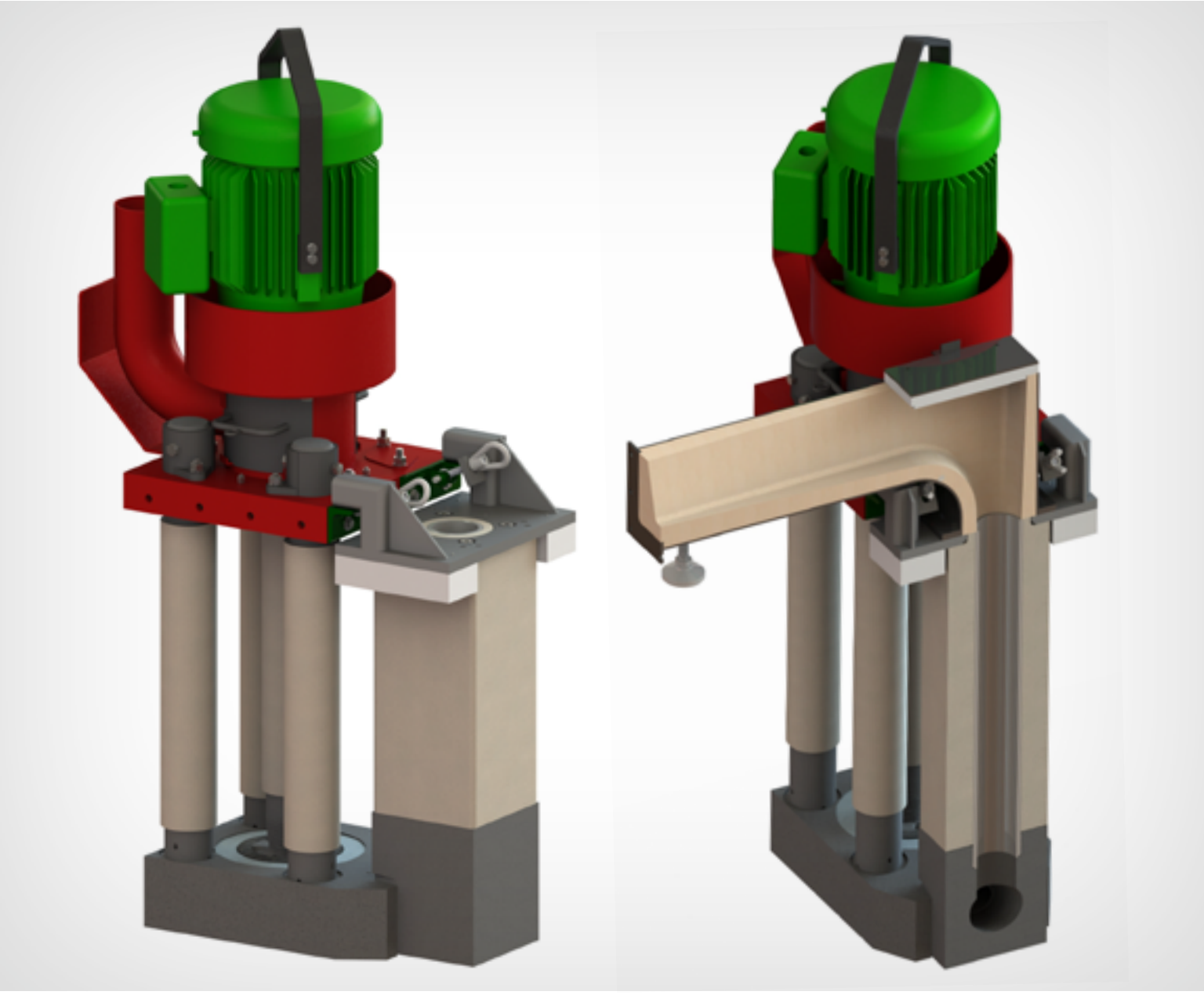
As aluminum is the most widely used nonferrous metal, let's focus on it. A bath of molten aluminum is a pretty hostile work environment. It's bloody hot, almost always north of 700 degrees centigrade, it can be really dirty with all kinds of impurities present, even rocks, and it's almost always fluctuating as metal is used and added. There are relatively few materials that can survive in this environment and almost anything put into molten aluminum will degrade over time. Three of the most widely used materials for these applications are graphite, refractories and ceramics. All can handle the heat and they all can deal with the impurities and the fluctuating metal levels though not equally well and there are lots of variables that will determine how they do. At Molten Metal Equipment Innovations (MMEI) we have been working with these materials since our beginning more than 30 years ago, and with the help of many great customers in the industry, we have developed products that can meet the stringent requirements and over time improve the metal transfer process. Step one was to utilize the mechanical pump technology used to circulate metal in a new way that would allow a pump to push metal "uphill" through a riser and then into a pipe that would direct the metal to the next point of use.

Continued on next page

Common applications would be to transfer metal between a melting furnace and a holding furnace or to fill a ladle that would then be taken to the die casting press. This was a major step forward in overcoming the limitations of gravity and was significant for the industry as it allowed metal to be transferred safely across longer distances and with a much higher degree of control. Step two was to realize that while piping molten metal works, there are benefits to using an open trough or a launder and hence, the launder transfer pump was launched. The primary benefit to this method was to further eliminate turbulence and thus oxidation and maximize the value and the quality of the metal being transferred.

PUTTING THE RIGHT STUFF IN THE RIGHT PLACE

More recently, we've shifted our focus back to the construction of the pumps and combining the benefits of graphite, refractory and ceramic materials in a new way that brings new benefits to the pump and the process. We call it the Hydra Pump. Essentially, we've replaced the riser tube with a sealed



riser assembly that combines both graphite and refractory materials in the construction. The benefits of this are multiple. It is stronger as the riser assembly design fits into the pump base in a way that adds structural integrity to the riser that is not possible when using a tube design. This interface is made of graphite and thus ensures that the riser assembly doesn't leak as can sometimes be a problem with a ceramic riser tube fit into a graphite base. The like materials behave the same way in the environment and thus it's both stronger and tighter. The refractory riser design is square vs. round where it mates up with the graphite below it, again adding to the strength of the assembly. This design keeps the graphite submerged in the aluminum where it is not exposed to air and thus does not oxidize. Higher up in the assembly where it is made of refractory material the metal level fluctuates and that material handles this much better than graphite. This extends the life of the pump and the riser assembly, adding value to the user. Another benefit to the user is that the assembly of this riser assembly design is easier and takes less time again adding value to the user in the form of lower maintenance cost. As it is a self-contained unit and doesn't need to mate up with the inlet in a dividing wall, it's much easier to put in and take out than a design that incorporates a dividing wall. The outlet assembly at the top of the riser can accommodate any direction of desired travel for the molten metal. This simplifies things as there is no longer a need for either a right hand or a left hand outlet depending on which way the metal is to travel after being pumped up through the riser assembly. The outlet will mate up with either a launder or piping as the application requires which is yet another improvement. We have also enhanced our launder designs over time to specialize in both high flow and low flow applications with a general accuracy for dosing requirements of 1% of shot size.

NEW OPTIONS THAT WORK BETTER

This history of mechanical pumps is one of iteration and continuous improvement. In the early days back in the 1980's the learning curve was steep and failure common. As we made light of earlier, it really is a challenging environment with so many variables. In time the pumps became more reliable and circulating molten aluminum produced very significant benefits both in improved metal quality and reduced operating cost. The same trajectory followed with molten aluminum transfer. There are still applications where using a traditional riser pipe will be necessary and the best choice, especially when trying to get as far "uphill" as possible. The benefits of the open launder transfer process were another milestone in terms of quality and volume of metal and when used together with lasers and SMART technology can dose metal very accurately. The Hydra Pump is now yet another new option that will expand the benefits of using a mechanical pump to transfer molten metal even more. Strength, improved life, lower maintenance costs and ease of operation are all things that provide the end user an enhanced value proposition and this is something we are all looking for as we work to continuously improve our businesses. I am a firm believer in the old adage "the perfect is the enemy of the good", especially in the foundry/casting space where nothing is ever perfect and the demands are so great. Better is something we are all striving for, and that is always the right focus!

Contact:
JEFF KELLER
jeff.keller@mmei-inc.com