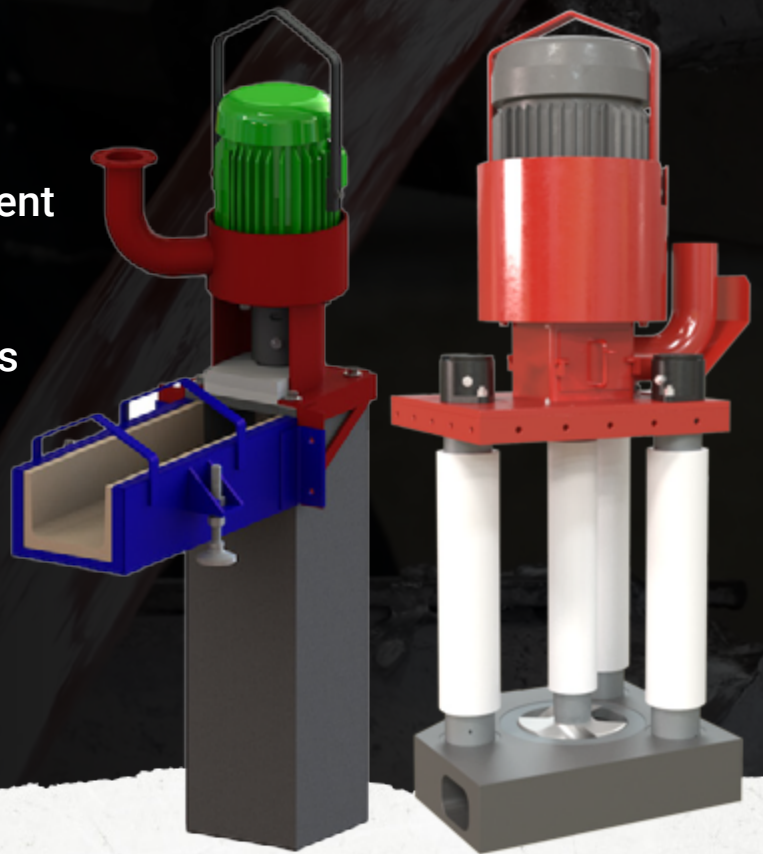


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TRANSFORMATIONAL TECHNOLOGY: MECHANICAL MOLTEN ALUMINUM PUMPS

**JEFF KELLER**

CEO

Molten Metal Equipment Innovations

**ARTICLE TAKEAWAYS:**

- Mechanical Pumps improve heat transfer with reduced energy consumption
- Mechanical Pumps provide better metal quality and reduce dross creation

My dad often says that we don't celebrate enough in life. I think he's right and so I'd like to take a minute to celebrate one of the great advancements in foundry operations, the mechanical pump! Self serving I realize as someone who is part of a mechanical pump company, but it truly is a transformational technology that has radically changed how foundries operate for the better. Like all great advancements, there is someone that is central to the story, and so (because he would never toot his own horn), I'd also like to celebrate Paul Cooper who did so much to lead this revolution.

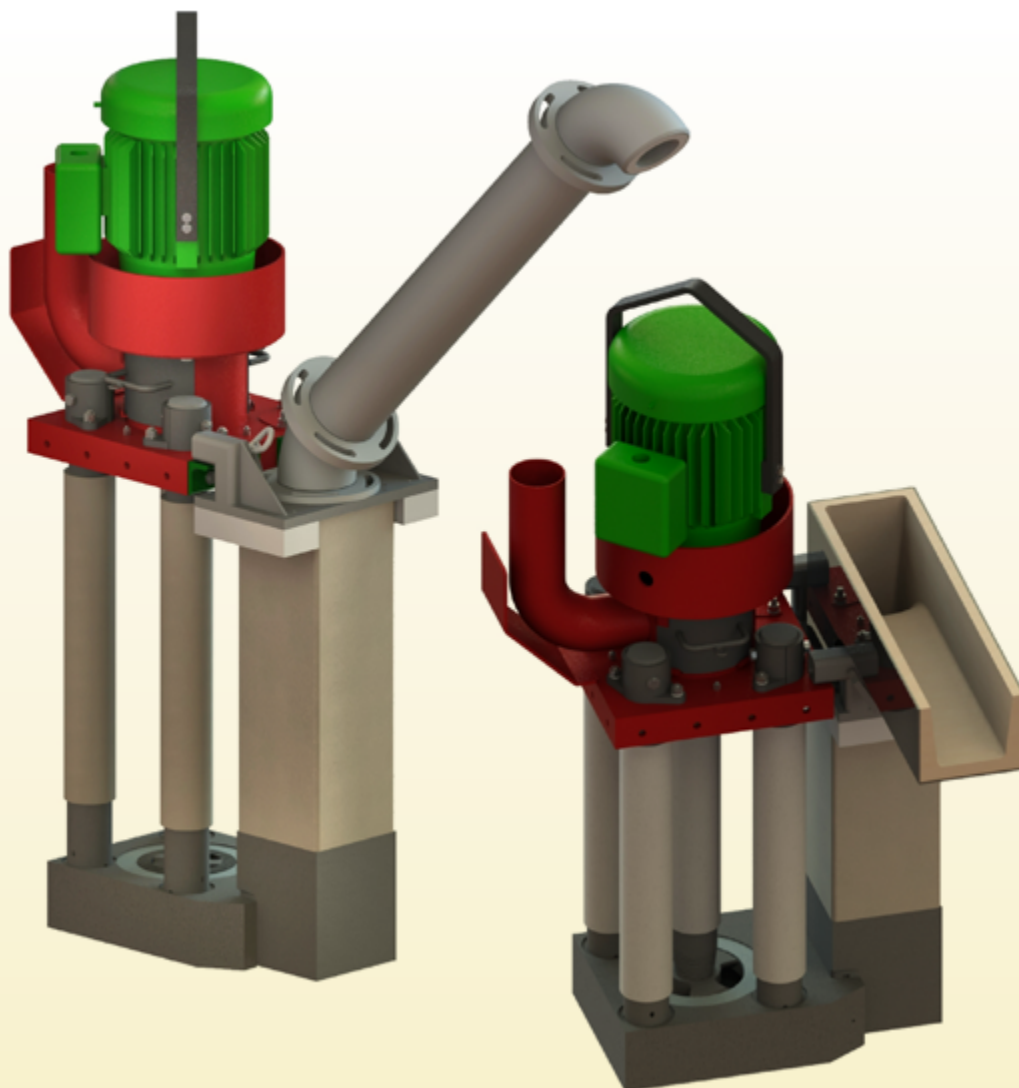
The mechanical pump is born out of physics and fluid dynamics. Some may argue impellers are only so sexy and far from cutting edge, but I will suggest that spinning things on a shaft has led to many of the great innovations of the modern age! Think Kitty Hawk, and then Cleveland. In Cleveland a young engineer was modeling a new impeller design (using wood at first) to create flow while dealing with the realities of pumping a liquid that is very hot and full of submerged solids that clog pumps and break things. To say that mechanical pumps in the foundry industry got off to a rocky start is entirely accurate. When one of the first designs was shared with a trusted professor at his graduate school, the assessment was blunt; "that won't work." Like all great innovators, he was undeterred and continue to pursue his design improvement to open up the pump base aperture to allow solids to pass while creating strong flow. Thirty years later, the impact pumps have had on the foundry industry is indisputable and the continued drive to innovate now allows pumps to circulate, transfer and dose molten metal all to the benefit of industry performance.

The first mechanical pump application in the foundry was to circulate furnaces. In a modern reverberatory furnace all the heat is applied to the metal bath from the top and so absent circulation, you have very hot metal at the top and much cooler metal at the bottom. This impedes heat transfer and leads to inefficiency that can impact the energy cost of heating the furnace very substantially. By circulating the furnace, we greatly reduce the temperature stratification in the bath and improve the heat transfer, often in the range of 20-40%. As energy is the 2nd biggest input cost behind aluminum in the foundry process, this cost reduction is truly transformational to foundry operations. Additionally, the circulation process ensures better alloy homogeneity and thus better metal quality. Foundries that melt their own ingot, sow or scrap will also see substantial improvement in melt rate as the circulated metal will produce the same benefit as stirring ice in a cup of coffee. So, with mechanical pump circulation you get major energy cost savings, better metal quality and improved melt rate. Not so bad.

Continued on next page

SIMPLE SOLUTIONS **THAT WORK!**

The next innovation was to apply mechanical pump technology to the task of moving molten aluminum out of the furnace to the point of next use. Prior to this application the accepted technology was gravity and tap out plugs. While gravity is free, the use of tap out plugs and a trough with a downward slope makes it very challenging to control the flow of metal. If the flow is too slow, you freeze the metal, too fast and you create turbulence which has the effect of exposing more aluminum to the air than necessary or desired, increasing dross creation and reducing the amount of metal available for sale. It also can place a foundry associate in harm's way and increase the possibility of an accident. Importantly it is very limiting in foundry layout design, as metal always must go downhill. Enter the transfer pump transformation! Using a traditional transfer pump with a pipe, there is a greater ability to control the flow of the metal by using the variable speed drive that controls the pump motor. Depending on how high the metal needs to be lifted to get it out of the furnace, the speed of the pump, and thus velocity of the metal can be controlled. The use of piping, however, restricts the flow of the metal and can result in turbulence as the metal exits the piping, given that the metal is forced out of the piping at a higher velocity due to the need to satisfy the lift requirements. So, let's get rid of the pipe. The launder transfer pump best addresses the velocity issue by using a "chimney" in which the metal rises up without the restriction of a pipe and with the significant



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Circulation Pump System

benefit of limiting the amount of air the aluminum comes in contact with, thus creating a skin that protects all the metal beneath it from oxidizing. As the metal exits the chimney and enters the launder it flows quiescently to the next point of use, with no added dross creation. It has been our experience that this method of metal transfer can reduce dross creation by more than 50%.

The most recent innovation is to use mechanical pumps to provide liquid metal directly to the mold. The dosing pump application allows for very accurate metal delivery, generally within 1%-3% of overall shot weight. The use of mechanical dosing pumps can often simplify the metal delivery system eliminating more costly components and saving space as it can be a very compact system. For foundries that are manually ladling metal, it is a significant safety and cost improvement.

So let's celebrate! The transformational impact of mechanical pumps has been only a small part of the innovation that continues to lead our industry forward. The levels of production and gains in productivity continue to move forward as we meet ever increasing demands that will see more exciting development in the years ahead. So, some acknowledgement of what we have accomplished is appropriate, but our focus needs to stay on the future and leveraging these gains to set the bar yet again higher. New materials, less industrial water usage, competing technologies to power the next generation and lots more ensure that there will be no shortage of opportunities for all of us to find new things that "won't work" and see them become the new way.



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