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A high-headroom central melter with a preheated hearth.

MELT/POUR

Get Back to the Basics of Melting

For aluminum foundries and diecasters, establishing the right processes will achieve high-quality metal consistently, improving results and reducing waste

David White | Jan 01, 2018

If you ask 10 different melt-shop managers what molten metal management is you may get 10 different answers. Molten metal

management is “managing the workers ability to deliver clean, hydrogen-free, inclusion-free aluminum to the casting equipment on-time and at temperature.” It seems straightforward, but amazingly this concept has been set aside due to lack of qualified workers and an acceptance of poorer quality workmanship. Customers demand higher and higher quality parts. Poor molten metal management increases scrap rates and this trend gets only worse when our industry is overwhelmed with work, like it has been for the past three years.

It all starts with leadership: Someone in the company has to take ownership of the aluminum. There are people being put in melt shop management positions with little or no experience and being told to do it ‘the way we always have done it’. About 30% of my time is spent training companies on proper molten-metal management to produce higher quality parts, and how to clean furnaces so that the linings last 5-7 years.

What is the most important aspect of casting aluminum parts? Is it not the metal quality, metal temperature and on-time delivery to the holding furnaces? How can anyone expect molten metal handlers to deliver metal on time if no one knows how much metal is needed per hour per machine? When there is no daily plan then metal gets delivered too often or not often enough, and both outcomes cause issues. Melt shop managers need to know how many pounds of aluminum is required for each machine that is running each day. This can vary by day, depending on downtime and part weights being cast.

If you have radiant burners in the roof or electric elements in the roof of a holder, or even a high-headroom, side-fired melter, molten metal management is critical to operation and efficiency. For example, if you draw your melters down 6 to 8 in. before refilling them, then chances are they are not at the specified set point temperature anymore. They have to work much harder to get the heat to the aluminum. This same thing applies to radiant roof holders. If you draw them down 5-6” before refilling

them chances are they will start to lose temperature.

The greater the temperature difference between the heat source and the media (aluminum) when there is a slight oxide film, the faster will be the transfer of BTUs into that load, to the fourth power. Also, keeping the heat source and the media closer to each other enhances transfer efficiency. Limiting the draw-down to a couple of inches makes furnaces run more efficiently and guarantees better temperature control. The best practice is, whatever comes out of a furnace in 15-20 minutes is replaced with more metal, to fill it up again.

This is especially true with crucible furnaces. Although it may have less of an effect on efficiencies, it will definitely shorten the bowl life. Crucible furnaces have very hot surfaces as heat rises up against the steel plate on top; when 5-6 in. of metal is drawn from the bowl it is replaced with air, which is an insulator. So, heat builds up at the top and there is no place to transfer it. Now, a temperature gradient will build from the middle of the bowl to the top and crack the top of the bowl. Simply charging this crucible furnace evenly, so that the melt never falls lower than a couple of inches, may increase bowl life substantially!

Establishing a molten metal and scrap and ingot delivery system to the furnaces will help manage furnace tenders' time, and may reveal where more or fewer people are needed. In larger casting operations use forklifts to deliver scrap, ingots, or sows for melting, it is critical to get this schedule right. And, it should identify the best time to clean the metal and furnace linings.

One of the most expensive budget items in a foundry or diecasting operation is constant furnace relining. Some companies spend hundreds of thousands of dollars on refractory relines, but will not hire one more person to clean the furnace daily. Aluminum melting furnaces need to be cleaned every day; some may need to be cleaned more often, depending

upon alloys and ratios of scrap to new metal. A holding furnace should be cleaned every other day, though the electric immersion type can generally wait about five days between cleanings. Molten metal launder systems should be skimmed every day and the bottom lining scraped every week.

Track refractory costs and dross metal losses to provide an incentive program to melt-shop personnel. Reward them with 25% of every dollar saved off that monthly average. Run energy audits on furnaces to understand casing temperature baselines, to determine when the refractory has been compromised.

“Cold clean” all furnaces once a year. This means draining them and having a qualified refractory contractor eliminate oxide in the furnace, and patch it. Gunning over bad refractory is the worst type of repair, and hot gunning is even more of a risk. Gunning any refractory produces a final product that does not have the same properties as a case lining. It is sometimes much lower properties than is desired.

I am always amazed at how much aluminum is sent out with the dross. Why earth would you want someone else melt metal that you have already melted, and sell it back to you? Even if you don't buy it back from a dross processor, you have to replace that metal with new metal somewhere. That costs much more money than a scrap person processor pays for dross, and it never saves money.

Finally, consider installing a SCADA control system. This allows you to collect data from every casting cell and can even control that cell so that it cannot make a part out of specification. You can measure and record various details of the casting process, and if one exceeds designed parameters the controller will prevent the cell from producing the casting until the issue is resolved. Everything can be placed on a computer screen at the production manager's desk like figure below.

In short, lead by example. Do the right things to have consistent high-quality metal, and this will improve melting performance and results, and reduce waste.

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