

# MOLTEN METAL MANAGEMENT BACK TO BASICS



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## ARTICLE TAKEAWAYS:

1. Back to basics starts with leadership
2. Control of the metal melting and delivery process
3. Saving metal

In my 37 years of traveling all over the world one thing has become increasingly apparent. Some die casters and foundries have lost the basic understanding of molten metal management. I have been asked to talk to companies about this subject more in the last three years than in all years combined with The Schaefer Group, Inc.

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”! Pretty straight forward isn't it? But amazingly this concept has been pushed aside to increase production, reduce manpower and because of the lack of qualified workers, an acceptance of poorer quality workmanship. Customers are demanding higher and higher quality parts and so rejects are up scrap rates are high and this trend gets worse when our industry is overwhelmed with work like we all have been for the last 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. There is usually a better way. About 40% of my time now is spent training companies on how to clean metal, clean furnaces so the linings last 5-7 years and molten metal management.

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? That last one baffle me the most and it is a simple fix. How can you 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 scenarios cause issues. Melt shop managers need to know how many pounds of aluminum is required for each machine that is running each day. It can vary day to day depending on downtime and part weights being cast that day. You can obtain better utilization of your melters, holders and people with this basic knowledge.



**Figure 1.**  
*High headroom central melter  
with preheat hearth!*

This is my point: 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 (fig. 1), molten metal management is critical to their operation and efficiency. For example if you draw your melters down 6-8” before refilling them then chances are they are not at specified set point temperature anymore. They have to work much harder to get the heat to the aluminum. 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. Stefan-Boltzmann Law of Radiant Heat says “that the total energy radiated per unit surface area of a black body across all wavelengths per unit time (also known as the black-body radiant emittance or radiant existence), is directly proportional to the fourth power of the black body's thermodynamic temperature”. In English it is basically the greater the temperature difference between your heat source and the media (aluminum) when there is a slight oxide film, the faster the transfer of BTU's into that load to the 4th power. Also the closer they are to each other enhances that transfer. So by limiting the draw down to a couple of inches you can make your furnaces run more efficiently and guarantee better temperature control. The best practice is whatever you take out of a furnace in 15-20 minutes you replace with more metal to bring it back up full again.



This is especially true with crucible furnaces. Although it may have less of an effect on efficiencies it will definitely shorten your bowl life. Crucible furnaces have very hot surfaces as heat rises up against the steel plate on top when you remove 5-6" of metal from the bowl it is replaced with air which is an insulator. So you have this buildup of heat at the top and nothing to transfer it into. Now you get a temperature gradient from the middle of the bowl to the top and this cracks the top of the bowl. Simply evenly charging this crucible furnace so as to never let it get lower than a couple of inches, may increase your bowl life substantially!

So establishing a molten metal and scrap and ingot delivery system to the furnaces will help manage furnace tenders time and hopefully show where you need more or less people in the department. In larger casting operations that deliver scrap to the melters by fork lift as well as ingots or sows it is critical to get this schedule right. This should make it clear as to when you have time to clean your metal and your furnace linings.

One of the most expensive budget items in a foundry or die cast operation is the constant relining of furnaces. Some companies are spending hundreds of thousands of dollars on refractory relines but won't hire one more person to clean their furnace every day. Aluminum melting furnaces regardless of the manufacturer need to be cleaned every day. The aluminum may need to be cleaned more often than that depending upon your alloy and ratio of scrap to new metal. The holding furnace should be cleaned every other day unless they are the electric immersion type and those can generally



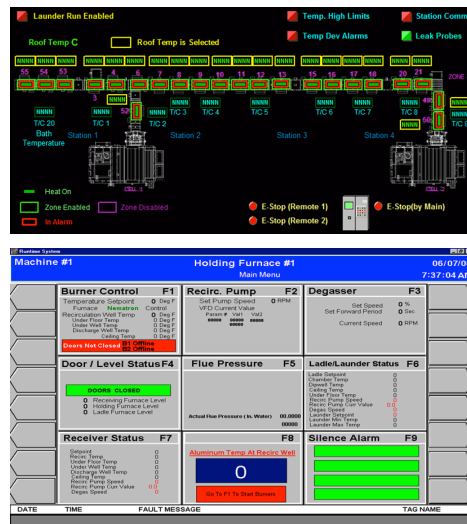
go about 5 days between cleanings. Molten metal launder systems should be skimmed every day and the bottom lining scraped every week.

Pay the melt shop people on an incentive program. I hope you have tracked your refractory costs and dross metal losses (if not you sure should be) give them an incentive that for every dollar they save you off that monthly average you will give them a quarter of it. Run energy audits on all your furnace so you know your casing temperature baselines and can tell when the refractory has been compromised.

Cold clean all furnaces once a year. This means draining them and having a qualified refractory contractor come in and get whatever oxide is present out of 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 cast 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 on earth would you want to have someone else to melt metal that you have already melted and then sells it back to you? I actually had one person tell me they make money off the aluminum then sell in their dross. Even if you don't buy it back from the dross recovery guy you have to replace that metal with new somewhere. That costs you much more money than the scrap guy gives you for your dross and it never saves you money.

Finally the last thing you should consider is a SCADA control system for your production facility. 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 specifications. You can measure various parts of the casting process and record them and if one of them gets out of your designed parameters it will actually stop the cell from producing the casting till the issue is resolved. The whole thing can be placed on a computer screen at the production manager's desk like below:



## CONCLUSION:

1. Get a molten metal management program started with your melt shop foreman. Try it for one month and I guarantee you will see measurable results.
2. Train your employees on the best practices for your specific operation.
3. Clean melters every day and holders as discussed above. Clean your metal as needed.
4. Pay melt shop people on an incentive program!
5. Work towards delivering clean metal on time and at temperature every day.
6. Control refractory costs through energy audits and yearly cold cleans and if you do this buy premium refractories. If they give you one year longer life they have more than paid for themselves!
7. Reduce the amount of aluminum in your dross. Don't pay twice to melt metal ever.
8. "You cannot control what you cannot measure" (from the famous quotes of Peter Drucker) implement a SCADA Control System. He also said "Management is doing things right; leadership is doing the right things".

These few basic simple things will positively affect your bottom line.



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