UNDERSTANDING THE CHALLENGES WITH ELECTRIC CRUCIBLE FURNACES

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ARTICLE TAKEAWAYS:

- Understanding each type of furnace
- Furnace energy usage
- Metal melt loss for each furnace

A lot of companies use electric crucibles for plenty of good reasons (especially space saving). However, sometimes we see foundries using them, because that's all they are accustomed to operating. We believe that if they did a careful evaluation of all of the high energy and labor costs that they would take a harder look at ways to reduce those costs.

Between costly energy losses, maintenance time, crucible bowl, element, and reline costs, and workers compensation/safety costs; these units usually cost more than the dollars for the space they save, metal inventory (3-1 hold to melt ratio) and low up-front costs. If you are melting and casting out of the same crucible, you also need to factor in scrap losses, which are usually quite large. Most manufactures of crucible furnaces still maintain that 3-1 hold to melt ratio. But, unless you charge that crucible no more than ¼ of its hourly melt rate every 15 minutes, you will have a hard time holding metal temperature. The rule of thumb is this – put in whatever you take out every 15 minutes. In fact, if you return your gates, runners, and scrap (while it is still hot), into the furnace, that will help increase its overall efficiency.

It's not unusual for us to see foundries both melting and casting in the same bowl – and *not* using a baffle in between the casting part and the loading part of the crucible. As a result, inclusions and an increase of hydrogen gas in the metal and into your part are likely outcomes. You generally need to hold temperature at a much higher than normal rate in order to overcome the large temperature swings when loading one of these types of furnaces. There is simply not enough stored BTU's in that small amount of metal left in the bowl to help with the melting process. It must draw all the energy from the heat source which can cause huge temperature swings which leads to cold shots, increased dross and separation of the alloy constituents. Wet bath reverbs eliminate most of these issues because of their hold to melt ratio.

In the last two years we converted three foundries from crucible furnace to small gas or electric in cell melters, and virtually eliminated their scrap issues. They are also spending less on energy than with the crucible furnaces, because they were always on 100% output just to try to keep up.

Crucibles have their place, don't get me wrong. If you change alloys a lot, shut furnaces down often for extended periods of time and have extremely limited space, then you really have no choice but to use crucible furnaces.

There are some ways to eliminate some of the headaches involved in crucible melting and holding at the machine. Always inspect the design approach when evaluating these crucibles. In electric furnaces a lot of companies are offering quick change elements. The reason is—you have to change them often! Look for elements that typically last about two years and are easily changed when you must also change a bowl. Also, if you do get a burned-out section you can easily splice in a piece of element to keep it going, which also means you no longer need to keep a complete set of elements in stock.

CRUCIBLE OPERATION TIPS:

- Don't over charge the crucible.
- Use a baffled bowl to keep inclusions out of your parts.
- If your crucible bowls are cracking at the top, then you are allowing them to be drawn down more than 4 inches. After that the temperature differential at the top of the bowl and the middle is so great that the top expands and cracks prematurely.
- Do not allow ingots to be dropped into the bowl. This can cause cracks to occur in the bottom of the unit.
- With a little pre-planning and care you should be getting a year or more of life out of your crucible bowls.

Cleaning the crucible bowl and metal tips:

1. Gently scrape the inside of the bowl to clean it once a day. This should remove any oxide buildup that forms. Right after you do this you must introduce your metallurgical flux into the bath of aluminum and work it towards the bottom of the bowl. The deeper you get the flux the more metal it will clean. Don't forget about the bottom of the bowl to prevent sludge buildup, which will occur if the temperature is allowed to go below the alloy's sludge point.
2. Make sure your metallurgical flux is both temperature and alloy specific.
3. Degassing to the bottom of the bowl with flux injection will float those heavies (iron, manganese and silicon) that have settled to the top where they can be skimmed off.
4. If you use more than the bowl's capacity in an 8-hour shift then you should clean your furnace metal every shift.

5. Talk with your flux manufacture regarding their specific instructions on how long to leave the flux in to clean your dross.

When buying a crucible furnace, look for four things:

1. Closeness of the burner or elements to the bowl – if it is too close the heat (flame impingement particularly) will oxidize the coating on the bowl and cause premature failure.
2. Make sure the casing temperatures are less than 130°F when looking at 1300°F metal or lower.
3. Ability to hold at least 4–5 times what you are melting per hour.
4. If electric .28kw/# of metal melted connected. If gas 3,000 BTU's/# connected.

In summary, the most important reason to purchase any furnace is to help produce higher quality castings at less cost. Understanding the costs and tradeoffs associated with any furnace will help you to make the best decision.

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