Designing Your Destiny Through Technological Advances

David Magnuson, Director of Business Development
Modern Equipment Co. Inc.
Port Washington, Wisconsin

Introduction

In my 18 years of working within the manufacturing sector, it has never ceased to amaze me how often the obvious gets overlooked. From contract manufacturers to pharmaceutical producers, I have consulted with numerous organizations that simply viewed certain areas of their operation to be nothing more than "the cost of doing business," without fully evaluating how they can improve those areas and reduce their costs effectively. Many times throughout my career I have heard, "I don't think spending money on capital will make us more money, what we have works fine," or, "You're suggesting for us to buy something new when what we have is paid for?" Fact of the matter is, in most cases, those companies were spending more on their inefficiencies, maintenance, and unnecessary labor on an annual basis than what a new piece of equipment would cost. In addition, the majority of "cheaper" solutions ultimately cost much more in the long run.

Having personally been in hundreds of various manufacturing facilities, I've learned that among the most successful, there are several common denominators. There isn't necessarily a problem with global competition, but more with how we elect to do things as manufacturers. We can't compete on labor costs, so why do we try? Isn't it better to invest in more cost-effective systems that make offshore purchasing options pale by comparison? The way to win is by reducing operating costs, focusing on core competencies, and eliminating certain labor factors through capital improvements. We have the technology to defeat foreign markets right here, right now. It's all a part of the philosophy that these companies share, which allows them to remain prosperous in a turbulent global economy and fierce marketplace.

This is the first in a series of articles addressing different areas of our operations that can lead to health, wealth, and prosperity in your organization. There are good reasons why some companies can compete in an ever-changing business climate, and why the threat of offshore manufacturing, or regional competition is not as great of a concern to them. Embrace the enemy, discover their deficiencies. Work smarter, not harder. Invest in your company wisely, not cheaply. Satisfy customers with integrity, quality products, and unparalleled customer service. Pretty simple really... or is it?

For this segment, we will be addressing the melting department for no reason other than it provides the most immediate cost savings and fastest payback. The cash savings generated will allow for other longer-term improvements. Typically, 55 percent of process energy usage is in the melt department (U.S. Department of Energy). By attacking this area first and reducing these costs, companies can benefit from the hundreds of thousands, or even millions of dollars recouped annually, depending on the size of the operation.

The majority of die casters (90 percent) are still not utilizing best practices when producing their castings (see DCE November 2005's article *Energy Trends*). Too often, organizations fall into the old standby mode, "This has worked for us for 60 years, why change?" Well, why not ride a horse instead of driving a car? Because there are better modes of transportation available! If a horse could run at 70 miles per hour and get us where we needed to go without resting, I for one, would be all for it. However, this is not a reality. The same mentality should apply to the equipment we use to make our products. The better the equipment, the more efficiently we can produce.

Save Tens, or even Hundreds of Thousands of Dollars Monthly!

Let's discuss how to effectively reduce operating costs — through the use of newer technology — in a continuous melting operation. This area can provide instant energy cost relief, drastically reduce melt loss (dross), increase metal quality, and pave the way for additional capital improvements through the massive savings that will be realized.

The Incumbents

Though gas fired reverberatory furnaces are still the most widely used furnaces in the aluminum market, primarily due to price and familiarity; they are far from the most cost effective. Concerns range from their low operating efficiencies (between 12-39 percent), high melt loss (4-12 percent), and hazardous operation (explosion risks, hot metal splash), all of which make them more costly to operate. Typical gas consumption ranges prove to be between 1500-3000 BTUs per pound melted. To achieve the lower percentages in this range typically requires significant upgrades to the furnace. These upgrades could include oxy-fuel burners, circulation pumps and recuperative air handling systems (regenerative burners). In adding these features to a new or existing furnace, you will not only spend substantial amounts of money for the modifications, but also increase annual maintenance requirements for a modest gain in efficiency. This cre-

ates a minimal return on investment when compared to alternative methods of melting and holding. Dry hearth reverbs, though somewhat safer to operate than wet baths, don't take full advantage of the BTUs generated, as the furnace does not channel all of the energy to the charge material; much is lost in other areas of the furnace and exhaust. Dry hearth reverbs are also prone to higher melt losses as they promote more surface exposure to oxidation during the melt process.

The Path to Increased Profitability

Jet Melters® (also known as a stack or tower melter) can dramatically lower gas costs and metal loss while providing better metal quality. They are also much safer to operate due to the full pre-heating of charge material in the stack and through the use of automated charging systems. Though not necessarily a new concept, there have been major strides made in the last decade. Additionally, it is important to note that just because something is called a "stack melter" doesn't mean that it is of good or optimum design. Though fairly simplistic in their operation and principle, the complexity of designing a good stack melter has left many manufacturers in the dark. Like anything else, not all furnaces are created equally. It is of utmost importance to perform due diligence when making a decision on your investment. Many furnace promises come without guarantees and there are significant variations in performance regardless of manufacturer's claims. In fact, Modern was recently informed by one its customers (a major automotive OEM), that its recently purchased Jet Melter uses only 66 percent of the gas versus their previous manufacturer's stack melter. This can't be emphasized enough.

Efficiency Evaluation

A side-by-side comparison of a customer's Jet Melter to a wet bath gas reverb was performed in a parallel operation at a major automotive casting supplier in Michigan. This study outlined both the operating efficiencies and metal quality of a 3000#/hr melting operation using A356 alloy on both furnaces over the course of a day. It was discovered that the stack melter inarguably, showed tremendous savings in gas consumption and melt loss as shown in Table 1.

This is primarily due to the use of flue gases to preheat the charge material to a near melting point before the melting burner provides the required heat input on the already "mushy" charge, causing it to melt near instantaneously. The molten metal then immediately enters the bath and is only in the presence of combustion gases for a very short time. Subsequently, the difference in bath sizes (35,000# reverb vs. 7,500# stack) means that you are also exposing less aluminum to oxidation and hydrogen pick-up in the holding chamber, thus increasing metal quality while reducing dross. Note the tapping temperature variations. This directly contributes to the quality and consistency of castings. The test was evaluated with the company operating in its usual fashion, however there was careful attention paid to the amount of new alloy fed to each furnace and the weights of all returns (gates, risers, scrap parts). Furthermore, all returns were fed to the furnace from which they originated. During the completion of the testing period, both furnaces were fully cleaned and the precise measurement of the dross and sludge removed was subtracted from the total sum of metal that had been consumed. It is expected that the sludge measurements in the reverb would increase, as most companies do not perform a full cleaning daily. This would further reduce the efficiency of the reverb as the sludge promotes higher BTU usage from build-up (requires more energy to maintain temperature) and higher dross formation based on a lower ratio of usable metal to the oxidized surface area. These factors were not taken into consideration in the study.

Melt Quality

Melt quality tests were also performed using K-Mold values and the Reduced Pressure Test (RPT).

The results again, proved the stack melter to be inherently better than those of the reverb as shown in Table 2. By maintaining better values on the Specific Gravity and K-molds, you are typically producing better parts and reducing your degassing needs.

Table 2

Melt Quality of a Reverb vs. Stack Melter		
Melting Characteristics	**Reverb**	**Stack**
K-mold Values	0.1 and 0.1	0.0 and 0.0
Specific Gravity	2.1 and 2.1	2.16 and 2.26

Table 1

Efficiency Comparison of a Reverb vs. Stack Melter		
Melting Characteristics	**Reverb**	**Stack**
Melt Loss	5.50%	0.90%
Energy Consumption (1350˚F)	1975 BTU/lb	955 BTU/lb
Makeup Alloy Additions:		
Strontium		64% less than reverb.
Magnesium		43% less than reverb.
Tap Temperature Ranges	±32˚F	±5˚F

Table 3

Reverb vs. Stack Melter Cost Analysis			
Melting Costs	**Units**	**Reverb**	**Stack**
Melt Loss	Percent	5.5%	0.9%
Aluminum Cost	$ per pound	$0.90	$0.90
Energy cost	$ per therm	$1.20	$1.20
Energy usage	BTUs per pound melted	1,975	955
Aluminum usage	Pounds melted per month	960,000	960,000
COST TO MELT PER POUND		$0.073	$0.02
	Energy Cost Per Month:	$22,752	$11,002
	Melt Loss Cost Per Month:	$47,520	$7,776
	Total Melt Cost Per Month:	$70,272.00	$18,777.60
Melting Monthly Savings:			$51,494.40
Holding Costs	**Units**	**Reverb**	**Stack**
Energy Cost	$ per therm	$1.20	$1.20
Energy Usage	BTUs per pound held	150*	150
Amount Held	Pounds held hourly	35,000	7,500
Holding Period	Hours held monthly	366	366
COST TO HOLD PER MONTH		$23,058.00	$4,941.00
Holding Monthly Savings:			**$18,117.00**
Total Monthly Savings:			**$69,611.40**

** Holding comparison based on bath size only! No usage variables applied!*
Assumptions: Melting 3000#/hr x 16 hr/day x 5, Holding Vol. 8 hr/day x 5 + 48 hr/wknd x 4

The Bottom Line

When performing a cost analysis on the differentiating factors by today's energy and metal costs, this scenario realized monthly savings of nearly $70,000! (see Table 3).

Imagine the possibilities of what an additional $840k in annual profit would do for your company! Understandably, not all die casters have operations of this magnitude, however relative savings can be achieved on operations from 500#/hr to 20,000#/hr. Whether you are a job shop or a major supplier, you have a lot to gain by re-evaluating your method. Progressive companies in the foundry, permanent mold, and die casting industries are well aware of the benefits and increased profitability these furnaces bring. They sit silently waiting as other companies who haven't employed these concepts are overheard asking themselves, "What happened to all of my customers?" and, "Why can't I compete?" Modern Equipment Company alone has over 75 Jet Melters installed in the United States. Have you fully evaluated what stack melting technology could do for you? Hmmm… You may have already been caught sleeping in the lions den…

About the Author

David Magnuson is the Director of Business Development for Modern Equipment Company in Port Washington, WI. He has served the manufacturing industry for over 18 years in positions varying from production supervisor to independent consultant and capital equipment sales. Any questions regarding this technology can be directed to David, at telephone number (262) 284-9431.