FURNACE FACTS, ROI'S & ENERGY USE NUMBERS

The Schaefer Group, Inc

DAVID WHITE
National Sales Manager
THE SCHAEFER GROUP

ARTICLE TAKEAWAYS:

1. Super insulate your furnace linings to reduce energy costs
2. Why Sow pre-heat hearths are a wise investment
3. Understanding "hard energy" use numbers for Gas-fired, Electric Radient-roof, Crucible and Tower Melters

In this article we will give you some basic facts about melting and holding aluminum in everyday furnaces as well as a ranking of ROI on improvements you can make to those furnaces to increase efficiency and energy usage is a number of different types of furnaces.

Ranking of ROI Expenditures

The 'Ranking of ROI' expenditures for aluminum furnaces, in other words, how to get the biggest bang for your bucks from quickest-to-slowest investment recovery.

1. Buying the best furnace designs and most cost effective materials.

a. Central melt furnaces are large – it is difficult to clean furnaces manually that are larger than 50-to-60,000 pounds hold capacity. Mechanized cleaning (fork truck and hoe) does the best job on larger high headroom furnaces. Most large furnaces have single end clean-out doors that are narrower than the interior furnace width. This makes for hidden, right-angled corners that are difficult to clean. Unacceptable oxide build-up leads to premature relines and impaired efficiencies.

1) The solution is having better access to the furnace interior with full width double-end doors. The floors should have gentle transition slopes from door opening hearths-to-the flat portion of the floor (no greater than 35") so that the furnace can be easily cleaned for "sludge" on the floor.

2) It pays to not go cheap on the hot face furnace linings. Modern central melt furnaces have 80-to-90% alumina non-wetting hot face linings. They are easily cleaned (build-up is easily removed), rugged and will not penetrate at the all important belly-band area (molten metal contact area).

a) Premium hot face linings pay. We recommend higher alumina products containing a phos bonding agent. If you do use the cheaper hot face linings, a product like 70-to-85% alumina phos-bonded plastic refractory will hold up better in a melter than the same alumina content non-wetting low cement castables.

2. Spend the money to super insulate the furnace linings. New products, such as micro porous silica insulating materials will save a huge amount of "fixed heat loss" energy. If the lining is properly engineered, the all-important "freeze plane" will still occur in non-wetting lining materials. This is a case of your being able to "have your cake and eat it too." These super insulating products normally add about $18.00/sq. ft. to the cost of the furnace lining, but they normally provide about a 16-to-20 month ROI.

3. Sow pre-heat hearths are a wise investment. If 50% of the aluminum you melt is new metal (typical of a foundry with a 50/50 yield), and 50% is scrap and returns melted in the charge well, the metal pre-heated for about 30 minutes on the hearth and then pushed into the bath will save 12-15% of the normal energy required to melt the metal if it were all cold charged into the bath.

a. This method of preheating and charging normally provides about a 20-to-24 month ROI, based on 5,200 hours of melting per year.

4. Circulation of the molten metal within the furnace bath (from the charge well-to-the-thermal head chamber-and-back) has the advantage of saving another 9-to-12% of the energy that it takes to melt the aluminum, reduces melt loss through enhancing more rapid melting and reduces sludging by convectively maintaining a homogenous bath temperature. In recent years great strides have been made in improving molten metal pump efficiency and drastically reducing their need for maintenance.

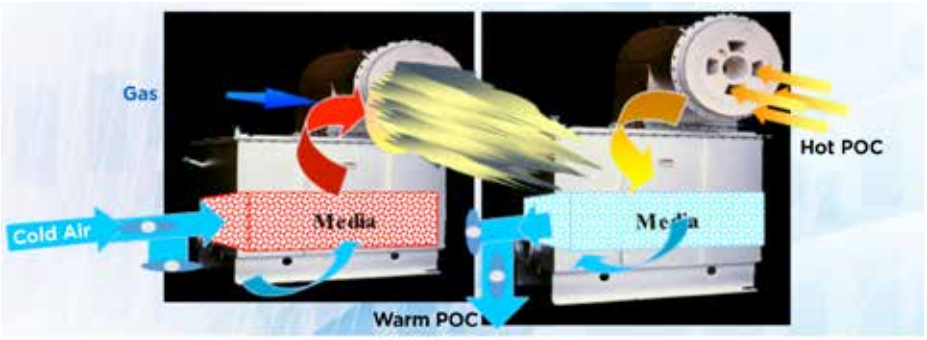
a. Typically, circulation pumps, and the wells into which they are designed, have a 24-to-28 month ROI.

b. Transfer pumps are also a good investment as they transfer metal to the ladle much faster and are safer for the metal handlers. The new overflow pumps available are very efficient and provide a less turbulent transfer into the transfer ladle see movie clip below!

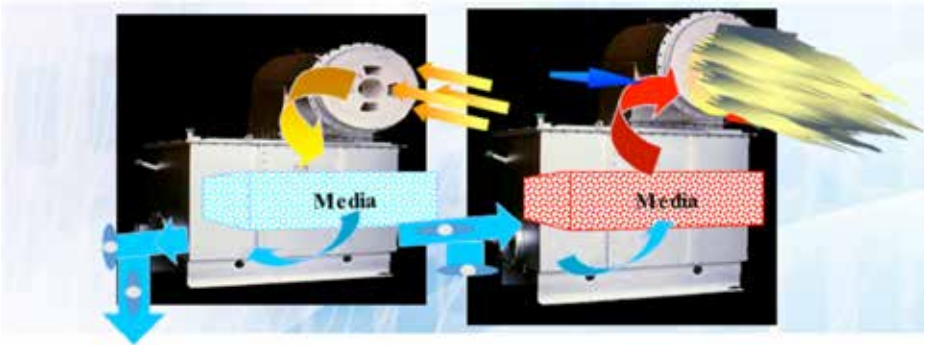
WATCH THE VIDEO

5. Pre-heated combustion air through a regenerative combustion system, added to the features mentioned above, will drive the energy consumption down to 900-to-1050 BTU/pound of aluminum melted in a fully utilized melter Because of the efficiencies of the first four items above, the added cost of the regenerative combustion system takes about 8,400 hours of full capacity operation per year of $3.00/MCF natural gas to yield a 60-month ROI. Escalating energy costs can shorten the ROI drastically. These burners work in pairs and as one burner is firing the other is exhausting the products of combustion into the bed of tabular aluminum balls which heat up to the exhaust temperature then the burners switch and the combustion air is drawn through that heated media to preheat the combustion air significantly.

REGENERATIVE BURNERS "CYCLE A"



REGENERATIVE BURNERS "CYCLE B"



NOTE: If the first four items above are furnished on a furnace, a fully utilized central melter will melt at about 1235 BTU/pound in a SGI radiant roof-fired reverb furnace, and at about 1,590 BTU/pound in a SGI high headroom wall-fired furnace. This is all being accomplished in a wet-bath reverb furnace, which absolutely provides the aluminum foundry the lowest metal melt loss by several percentage points.

***Continued** on page 8*

6. Recuperators for combustion air pre-heat offer the faster return on your investment for pre-heating combustion air. They come in various sizes and are easily retrofitted in any size furnace for you to start saving energy instantly. The BTU's required to heat the combustion air up to 700° F are saved immediately upon installing this heat exchanger. Customers are realizing a 19-25% reduction in fuel usage with these heat exchangers. At today's gas prices ROI's are averaging 20 months.

7. Well Covers should be placed on any open well that will be out of production for more than 30 minutes. At higher temperatures 1400° F you lose approximately 7800 BTU's/square foot/hr of surface area off an open well with some dross on the surface. Since the average charge well on a large reverb is about 30 square feet, that is 234,000 BTU's/hr off that well.

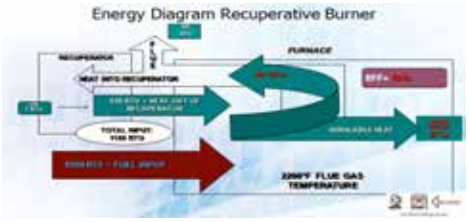
Of course none of these items are free but the cost vs return on investment make most of these worthwhile investments for your furnaces.

HARD USE ENERGY NUMBERS

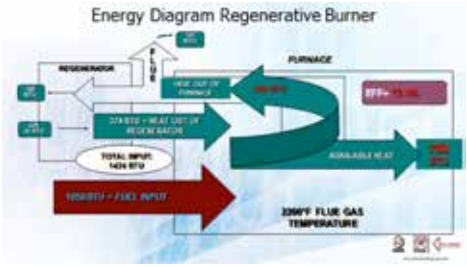
Let's talk some "hard energy" use numbers.

A. Gas-fired

1. A well designed and fully utilized radiant roof-fired melting furnace will melt for 1,500-1600 BTU/lb. (34% effic.): 100% cold metal charging.
2. With the addition of the "easy" energy recovery enhancements of the lining super insulation package, sow pre-heat hearth and molten metal circulation = 1,235BTU/lb. (**41% effic.**).
3. The more expensive energy enhancements start with:
   a. **Recuperation**, in conjunction with 1&2 above, = 1,095 BTU/lb. (**50%** effic.).



   b. **Regenerative burners**, in conjunction with 1&2 above, = 940 BTU/lb. (72% effic.).



B. Electric Radiant-roof .23-.24 kwh/# electric reverb 784 btu/lb. **66.7%**

1. with molten metal circulation 21-22 kwh/# 687btu/lb. **72.8%**
2. immersion element melter 18-19 kwh/# with molten metal circulation 655 btu/lb. **76.3%**

C. Crucible furnaces:

Gas: Connect 3,000BTU"s/# of metal melted uses about 2,300BTU's/# Melted 32% efficient

Electric: Connect .31KW/# of metal melted it uses about .25-.27KW/# of metal melted about 48% efficient.

D. Tower or Stack Melters: Generally connect about 1800BTU's/# of metal melted and use about 1,000BTU's/# of metal melted when the stack is kept full, which puts them (depending on their fixed heat loss) into the 74% efficiency range.

ENERGY VALUES OF THE MOST COMMONLY USED ENERGY SOURCES:

- **Natural gas 1,050 BTU/CF Some countries are less, some are more!**
- **100,000 BTU/therm**
- **1,000,000 BTU/decatherm, or 1,000 CF**
- **Electric-3,412 BTU/KWH**
- **#2 Fuel Oil - 138,000 BTU/U.S. gallon**
- **Propane - 92,000 BTU/ U.S. gallon in liquid**

BOTTOM LINE!

The information in this article is meant to provide you with ways of saving energy which even at today's prices is still one of your most expensive costs to operate a foundry or die cast facility.

Know what your present melting and holding energy uses are now and meter them. A Peter Drucker's truism "If you can't measure it, you can't manage it." This is just a relevant today as it was years ago.

Contact:
DAVID WHITE
david.white@theschaefergroup.com