



EBOOK

Oxidation: How To Beat The Biggest Foundry Cost Issue

Airgas[®]
an Air Liquide company

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Intro

Foundry work is delicate at the best of times. But one problem makes it so much harder – the same problem that’s been around since the dawn of industrial melting and casting.

It’s not about management, or logistics, or using an old energy source.

Instead, it’s part of nature. Something too many foundry bosses have just accepted or overlooked because it seems as inevitable as a spark cooling on the floor.

This is the specter of **high-temperature oxidation**.

You may have dismissed it as a fact of life too. Oxide formation is fundamental to melting metals. Yet you aren’t just wasting metal every single day, you’re also wasting money on more labor, energy and materials to deal with the negative effects of oxidation.

And while you may treat those effects eventually, near the end of your production line, you don’t have to. Your foundry deserves something more cost-effective ...

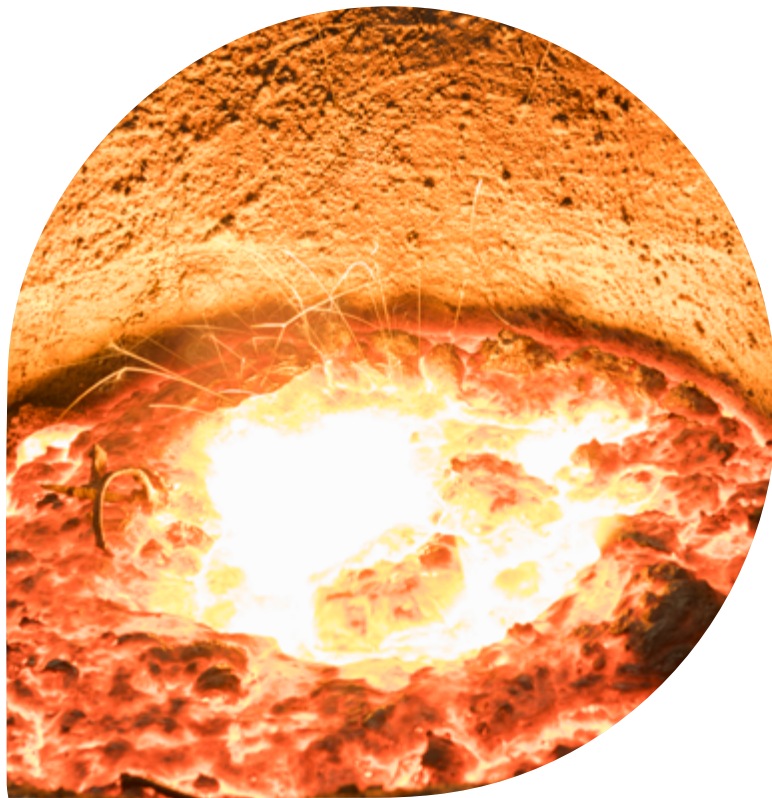
Like a solution that can **protect your materials as melting is taking place**.

It’s real. We’ve come up with a way to beat the biggest foundry cost issue.



Why does oxidation matter?

Traditionally, alloys for open-air induction melting furnaces are exposed to a huge amount of oxygen in the air. Oxidation, quite simply, describes how metal changes as it encounters oxygen. All metals – apart from certain precious subsets – do this. Whether you're losing precious alloying metals to oxidation or producing refractory inclusions in the molten alloy when oxides from oxidation start the erosion process of the refractory in your furnace lining or crucible, oxidation is costing you time, money and materials.



But instead of stopping oxidation at conception, foundries are used to dealing with it later, after oxides have formed. That's a huge mistake. Here's why:



Oxidation robs you of the energy needed for melting metal, lowering furnace efficiency and foundry productivity.



An astonishing **10–30%** of additional, billable castings are lost per day due to oxidation. You'll scrap and rework more castings because you aren't protecting them early enough.



Quality suffers all around. By sticking to the typical foundry practice, you'll use more alloys and create more quality problems.

Furthermore, there are three main effects on your foundry: **wasted materials, labor** and **energy**.

Wasted materials

Expensive deoxidizers and alloying elements are your best shot at treating oxidation after it's had a chance to take hold and spread.

However, you must account for the waste this generates.

Depending on the alloy melted, high-temperature oxidation strips 1–8% of the potential alloy yield for each furnace melt cycle. It also shortens the melt furnace and ladle refractory life by 40–66%.

That's a significant amount of materials consigned to the junk heap. Such costs add up and domino into others affecting your business.

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By preventing oxidation during the melt cycle, you'll have a much more efficient melting process. Which means you can produce more castings without increasing labor, energy and overhead.”





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Whether you're repairing the quality defects or scrapping the castings all together, the added labor cost to fix these oxide-induced defects is preventable.”

Additional labor

Downstream processing like welding and grinding repairs are often necessary to make sure that your metal castings are ready for market. It's a labor-intensive last step to assure that your foundry's castings are functionally and cosmetically fit for purchase.

These quality welding and grinding repairs can be very manual processes, which means more hands on deck and added labor cost to make the repairs. Additionally, it creates delays and bottlenecks in your process as castings undergo these additional steps and inspections before shipping.

Whether you're repairing the quality defects or scrapping the castings all together, the added labor cost to fix these oxide-induced defects is preventable. Melt and pour oxide-free metal from the beginning and your foundry will not have to spend the time, money and labor to fix quality issues later.

The energy thief

It's hardly a secret that melting metal alloys in an induction furnace relies on an enormous amount of energy. In fact, the process that melts ingots, scrap and alloys is probably the largest energy consumer in your plant.

That can be as much – or more – of what you spend on personnel.

Unfortunately, energy is sapped to form oxides. This means you're diverting energy (and dollars) to form oxides instead of melting metal. That's why high-temperature oxidation adds 10–50% more time to the alloy melt cycle.

By letting oxidation occur and treating it later, you're increasing overhead on a massive scale. Every furnace in your foundry is taking longer to melt and do its job, weighing the cost/benefit ratio even further against you.

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Where famous solutions fall short

You've probably tried to fight oxidation already. Its harmful effects on your process never cease.

Until recently though, nothing has quite proven itself as the great countermeasure. Why?

Well, some methods are effective, but not cost-effective. Many innovators in the gas industry don't understand foundries. When it comes to affordable, easily replicable solutions, they often fall short.



Two popular methods exemplify this:

1

Porous plug bubbling

Most foundries in the U.S. use induction melting furnaces to make critical alloy castings. Porous plug bubbling of inert gas works efficiently only in a quiet non-stirring bath of molten metal, but it's very inefficient in the stirring molten bath of an induction melting furnace. Over the past 20 years, the staff of most induction melting foundries have discovered the inefficiency of porous plug bubbling and the resultant low benefit-to-cost ratio.

2

Inert gas blanketing

Inert cover gases like argon and nitrogen are not effective over induction furnaces due to the gas buoyancy created by the furnace's heat. In fact, the inert gas buoyancy will act to entrain more air into the process versus not using inert gas.

EGAL™ – the only answer you need

To eliminate waste and countless hours of inefficiency, and save energy and money, we knew the industry required a game changer. So we started from that perspective – wearing the shoes of a foundry owner and seeing what they see.

Our patented EGAL technology has been developed **for** foundry professionals **by** a former foundry metallurgist. He had raw experience with oxidation, witnessing the effects on his own throughput. And he wanted to make a difference. That's exactly what EGAL represents: a simple way to stop oxidation in its tracks, before it ever occurs.

With this solution you can:



Minimize foundry, energy, material and labor costs with a super cost-effective gas application.



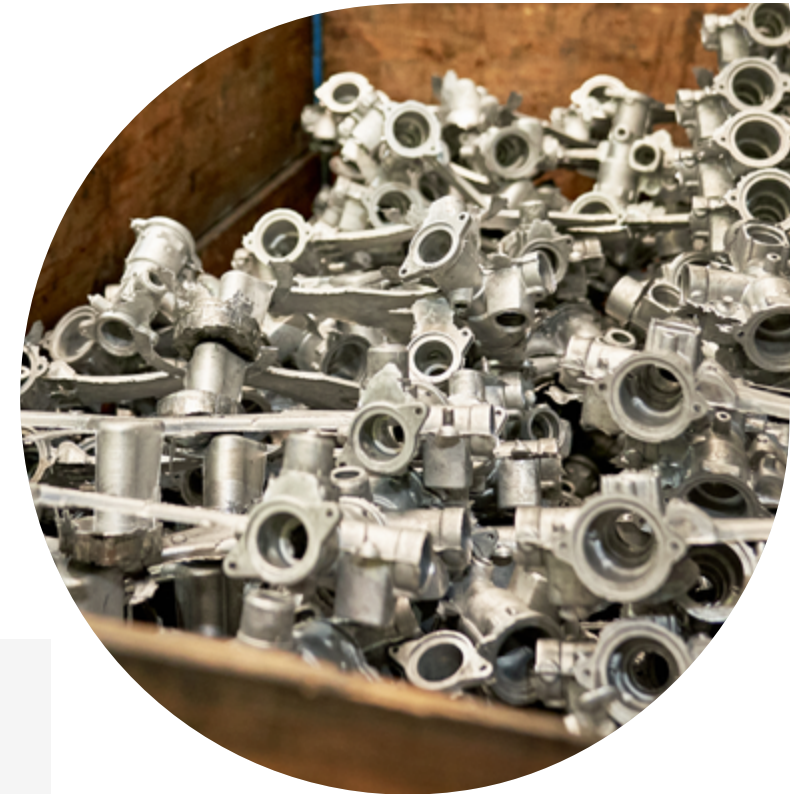
Raise productivity as better castings and alloys move more quickly through your plant.



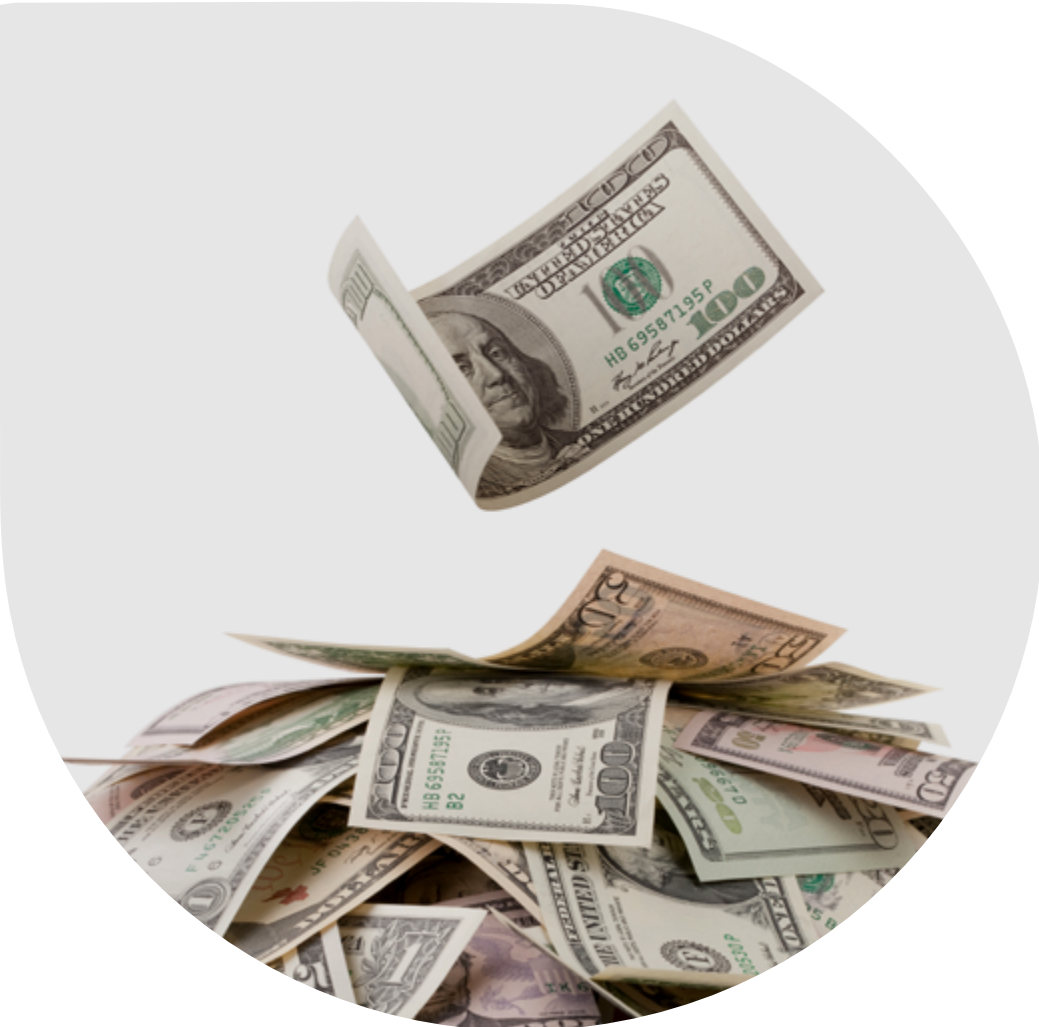
Effectively reduce emissions of carbon and heavy metal oxide fumes into the atmosphere during the melt cycle, measured directly by spectrometer analysis during the cycle or after via a molten alloy sample.



Tap into our EGAL experts for installation and training, then run with the technology yourself, adding it to any site.



Both the equipment and process have a patent; our innovation is incredibly unique. But don't take our word for it.



Typical return on investment for EGAL™ ranges from **47% to 319%.**”

How we've revolutionized minimizing oxidation

EGAL effectively applies a different phase of argon or nitrogen during casting. It lays a dense, non-turbulent inert blanket over the molten alloy. The expanding gas is vaporized, using 60–80% less gas than older gas inerting methods. We call this a **hybrid inert blanket**, able to separate molten metal from the atmosphere to a much greater degree.

The ultimate result is **you're protecting metal inside the furnace**, instead of leaving it naked to air exposure as it melts and when it comes out. No gas is wasted displacing the atmosphere away from the furnace's interior volume. The real beauty is that inert atmospheres are very consistent across these furnaces. All you require is the EGAL lance system and our assistance to shape the EGAL process to your own practice workload and capabilities.

We'll provide on-site training to get you started. EGAL quickly pays for itself too.

EGAL™ in action

Right now, over 179 U.S. melting operations are applying the patented EGAL process. Around 100 of these are foundry accounts who have been kind enough to share their results over the years.



20–73%
reduced scrap

25–84%
reduced rework +
weld repair

1.1–3.2%*
improved alloy yield +
oxide reduction

20–100%
increase in revert use

25–130%**
improved refractory
life span

10–33%
reduced melt
cycle time

60–100%
reduced de-ox + de-gas

1.6–6.0%
reduced pour
temperature

22–100%
reduced alloy additions

*A 2–6% yield improvement for copper alloys **Reported melt crucibles range increased 45–300%

EGAL can be applied to induction furnaces melting 20 to 100,000 lbs. per cycle. With Airgas' supply modes – such as bulk, MicroBulk and liquid cylinders – supporting the EGAL integration, you have the best response for fighting oxides in your facility.

Ready to count the difference?

We can get to work today. Every day counts for your bottom line.

While the cost of adopting EGAL™ is tailored to every foundry, our specialists will assess furnace size, cycle time and optional melt deck equipment. Then we'll establish a list of best practices during an installation and testing phase. From there, we'll teach your melt staff how to manage and maintain the process. And finally, we'll explain how to tap into EGAL's full potential for clean metal alloy production.

Our invention is melting down false assumptions about foundry work forever. If you don't take EGAL into your own foundries, you'll hear about it elsewhere soon enough.

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EGAL, backed by over 40 years of experience in the foundry industry, can help you beat oxidation and oxides once and for all.”

Email askAES@airgas.com or call ALTEC Engineering Solutions at Airgas at 800.282.1524.



Terry LaSorda

EGAL Program Manager
ALTEC Engineering Solutions



CONTACT US

800.282.1524 | askAES@airgas.com | Airgas.com
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Fill Your Potential.™