NOLTINA CRUCIBLE

MorganMMS
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Molten Metal Systems

MORGANMMS INTRODUCES NEW SYNCARB Z2 e² CRUCIBLE

MEASUREABLE SAVINGS THROUGH ENERGY EFFICIENCY AND DURABILITY

In every test, performance that meets or exceeds the competition

Background

The metal casting industry is one of the most energy-intensive manufacturing sectors, with the melting process accounting for over half (55%) of its energy consumption. Although high energy expenses have been a significant concern of metal casters, the industry continues to use melting technologies offering poor energy efficiency, often sacrificing energy efficiency for product longevity. In this manufacturing environment, where energy costs are driving innovation and productivity, crucible thermal performance is being tested every day.

With a goal of generating longer service life and increased energy savings, Morgan Molten Metal Systems (MorganMMS) conducted extensive lab and field testing on its new line of Syncarb Z2 crucibles. Through this research, MorganMMS is proud to present the newest member of the Syncarb Z2 family, the Syncarb Z2 e² (Energy Efficiency) designed specifically for aluminum melting and holding applications. The results show an operational performance that meets and often surpasses its competitors "energy" crucibles in both reduced energy consumption and durability.

To summarize:

- **The Syncarb Z2 line is composed of iso-statically pressed, hybrid ceramic bonded crucibles with a high silicon carbide and graphite content.**
- **The Syncarb Z2 line displays a higher breaking strength due to an improved granulation process. This means they are more resistant to damage and higher stresses during operation and handling.**
- **The Syncarb Z2 e² displays higher thermal conductivity at all working temperatures, thereby offering increased energy savings for customers.**

Description

MorganMMS uses a proprietary processing technology that results in a Syncarb Z2 product with a very homogenous and high density structure. The ceramic-bonded Syncarb Z2 e² crucible was designed specifically to provide good chemical resistance against fluxes and excellent thermal conductivity in aluminum melting and holding applications. The inherent high mechanical strength allows the production of much larger crucibles. Other properties include outstanding oxidation resistance, high refractoriness and good thermal shock resistance. Other types of Syncarb Z2 crucibles are especially designed for use in zinc distillation applications as well as for melting and holding of copper and copper alloys.

Crucible Characteristics: A Direct Comparison of the Syncarb Z2 e² vs. Competitive "Energy" Crucibles.

Mechanical Properties

The Syncarb Z2 e² offers a 56% higher transverse breaking strength than the competitor's "energy" crucible as shown in Figure 1. The Syncarb Z2 e² crucible maintained integrity at relatively higher values, most likely due to the granulation of the mix, processing parameters and advanced materials. The raw materials used in the Z2 mix along with the subsequent milling process by MorganMMS yields finer particles, which in turn means higher mechanical strength and increased durability for everyday foundry use.

Results show that the Syncarb Z2 e² is mechanically more tolerant to stresses and damage, a significant benefit to customers regarding operation, handling and higher energy transfer (energy savings)

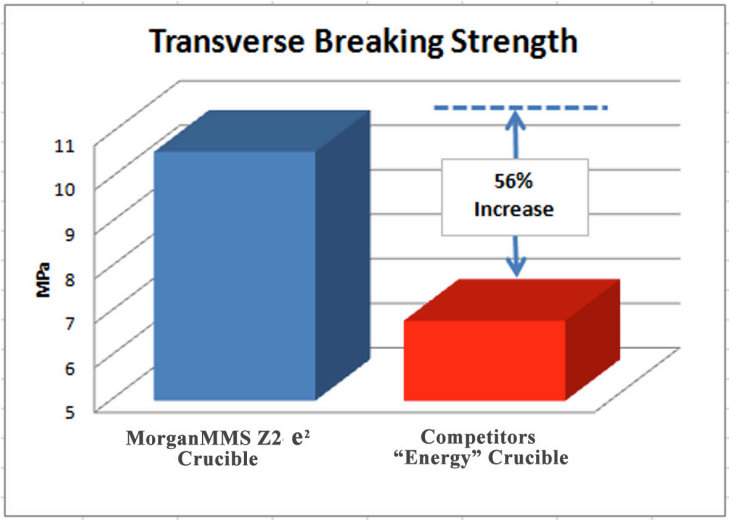

Figure 1: Showing the dramatic 56% difference in transverse breaking strength of MorganMMS' Syncarb Z2 e² crucible verses the competitor's "energy" crucible.

Oxidation Resistance

In any crucible, one of the leading cause of failure is the oxidation of its elements. In particular, as shown in Equation 1, the breakdown of carbon into CO and CO_2 create voids, reduce its mechanical strength and lead to poor thermal conductivity.

Equation 1 *Oxidation of Carbon at High Temperatures:* $3C+2O_2 \rightarrow 2CO+CO_2$

Both the Syncarb Z2 e² and the competitor's crucible showed promising results in terms of oxidation resistance. However, through its advanced glaze technology, Syncarb Z2 e² showed an average 10% increase in oxidation resistance in both five and ten day Loss On Ignition (LOI) tests as shown in Figure 2.

The results are consistent: an average increase in oxidation resistance of 10% over time for the MorganMMS Syncarb Z2 e² crucible verses the competitor's "energy" crucible.

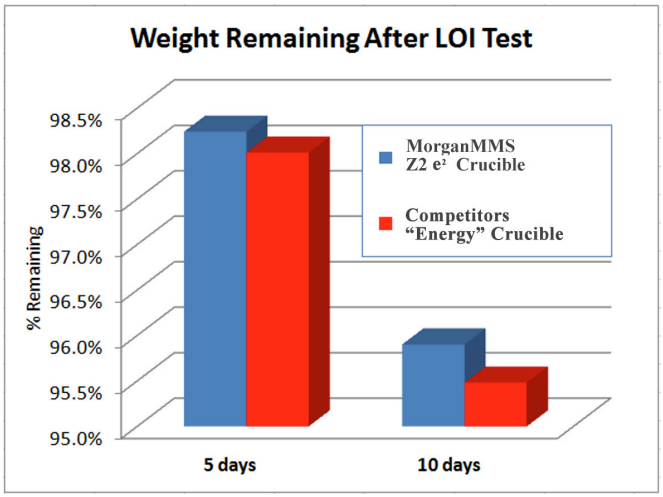

Figure 2: A comparison of MorganMMS Syncarb Z2 e² and a competitor's "energy" crucible in a standard Loss of Ignition (LOI) test performed at 750C for 5 and 10 days.

Thermal Conductivity

The transfer of energy through a crucible wall is dependent upon the thickness of the crucible and its thermal conductivity. Through advanced research, MorganMMS have been able to develop a crucible that has been scientifically proven by an independent lab to achieve superior thermal conductivity while maintaining a standard wall thickness. This achievement directly correlates to increased energy efficiency and savings to the customer in aluminum holding and melting applications. A graph comparing thermal conductivity and operating temperatures of the Syncarb Z2 e² vs. the competition is shown in Figure 3.

It is important to note that thermal conductivity will degrade over time as the crucible oxidizes. As shown in Figure 2, this oxidation occurs slower in the MorganMMS Syncarb Z2 e² crucibles. This reduced degradation combined with a higher thermal conductivity results in energy savings over the competitors not only when the crucible is new, but throughout its lifetime.

The result is a better transfer of heat energy into the metal by the Syncarb Z2 e² throughout the lifecycle of the crucible. This translates into higher energy savings for the customer.

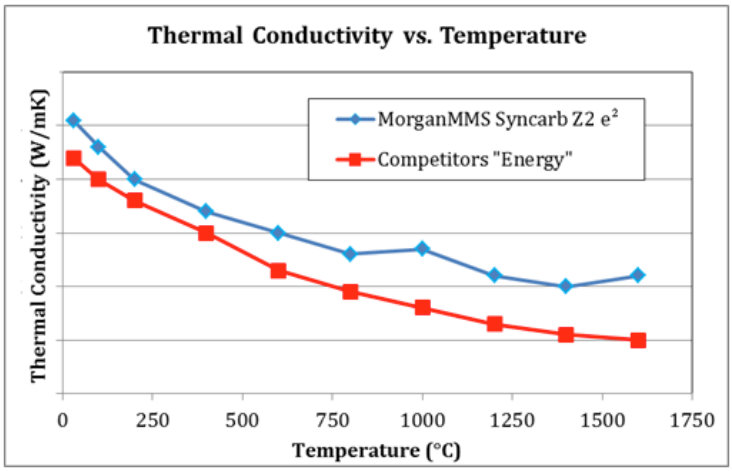

Figure 3: A thermal conductivity comparison over the entire working range of MorganMMS's Syncarb Z2 e² and the Competitors "Energy" crucible.

Microscopic Analysis

As a standard quality control procedure, MorganMMS routinely cross-sections its crucibles to check for proper structure in a way very similar to how customers check for proper metal quality. This type of analysis was conducted on the new Syncarb Z2 e² and the competitor's "energy" crucible and proved very helpful in understanding the physical strength and thermal conductivity differences. As shown in Figure 4, the MorganMMS crucible has a finer particle size distribution, which has an impact on its ability to resist mechanical stresses (Figure 1) during operation and, as shown in practice (see Figure 5), higher erosion resistance. Besides these mechanical advantages, the dense structure also allows for more energy to be transferred per unit area; thus, a higher thermal conductivity.

All this translates to longer run times, more heats, less energy usage and an overall solution advantage to MorganMMS customers.

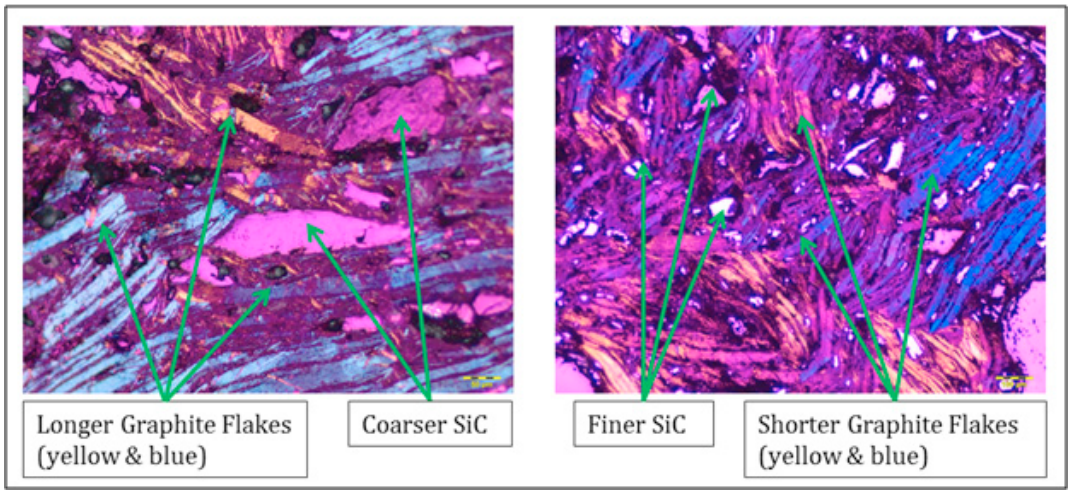

Figure 4: Showing a polished and etched cross-section of a competitor's "energy crucible (left) and a new MorganMMS' Syncarb Z2 e² crucible.

Lab Results vs. Reality

MorganMMS line of Syncarb Z2 crucibles have not only proven themselves in the lab, but have done so in many customer operations throughout the world. This has lead to significant cost savings through their ability to survive in the harsh environments of copper melting and refining, as shown in Figure 5.

In fact: "We've experienced a very dramatic improvement in average crucible life with Z2 crucibles versus other products used in the past – two times the life in fact," said MorganMMS customer, Carl Bednark of MetalTek International. "We expect the Syncarb Z2 crucible to have a major impact on our operations."

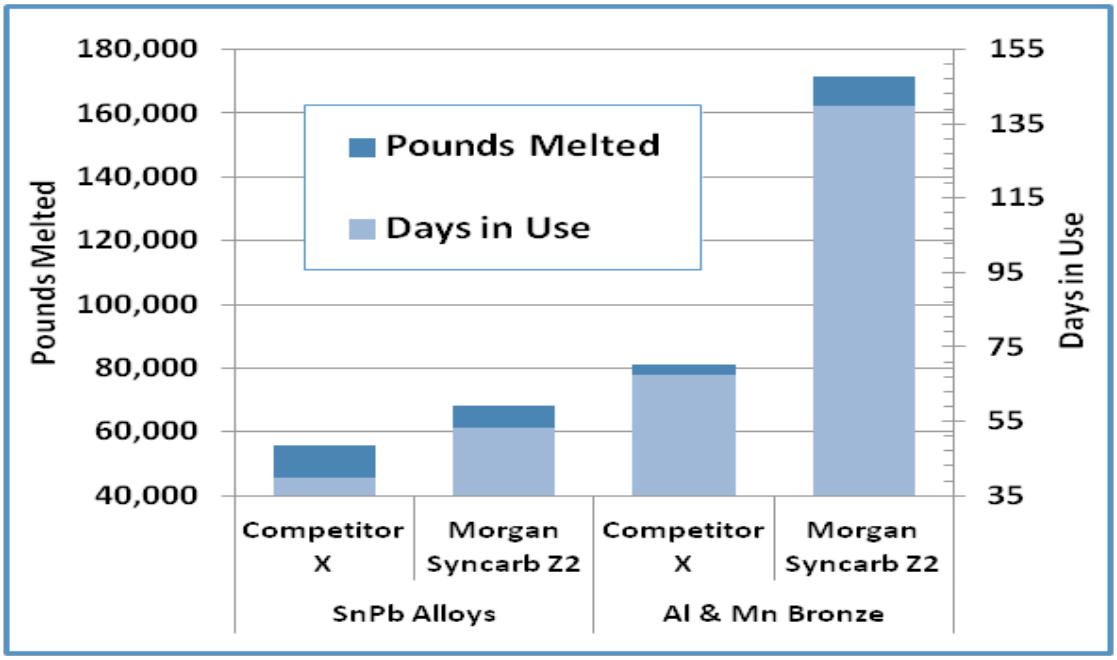

Figure 5: Performance comparison of the new MorganMMS Syncarb Z2 Crucibles compared to MetalTek's previous crucible in three 2000 pound 180Hz, 250KW induction furnaces for SnPb alloys (Furnace 1) and Al & Mn Bronzes (Furnace 2 and 3) (Data provided by MetalTek International)

The MMMS Technology Team, with its development of the Syncarb Z2 e^2, has created a crucible designed specifically for optimum energy savings and efficiency in aluminum melting and holding applications. Field test results show an operational performance that meets and often surpasses its competitors. The Syncarb Z2 e^2 promises to have a positive impact on foundry performance and the customer's bottom line.

Furthermore, MorganMMS is continuing to document energy and production savings at customers around the globe. These results and their next breakthrough in crucible technology will be shared as they become available to further prove that **MorganMMS is delivering tomorrow solutions…. Today!**

SYNCARB Z2 e^2 crucibles are manufactured from premium grade raw materials under an ISO 9001:2008 quality management system.

For additional information on MorganMMS' products & services or to find a location nearest to you, please visit:
www.morganmms.com

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