

USA

High-Purity Alumina Kiln Furniture for Industrial High-Temperature Applications

Sunrock Ceramics is a US-based supplier of high-performance alumina kiln furniture for advanced ceramics component manufacturers and alumina pusher plates for powder metallurgy parts producers. Sunrock Ceramics specializes in pressing alumina tiles, alumina saggers and setters, alumina pusher plates and alumina bricks, as well as casting shapes that are more complicated.

Doug Thurman (DT), President at Sunrock Ceramics Co, gave us some insights to the company's business at Ceramics Expo 2015 in Cleveland/US.

cfi: *What does high-performance kiln furniture from Sunrock Ceramics offer with regard to temperature range, atmosphere, and corrosion resistance?*

DT: We have a wide selection of products in our portfolio, with materials ranging from 70 % to over 99,6 % alumina content and accordingly with operating temperatures up to max. 1870 °C.

We fire our products at high temperatures, to avoid free silica content, which is particularly important in hydrogen atmosphere applications. In the alumina-silicate products, used for higher thermal shock resistance, the SiO_2 has undergone mullite formation and is therefore not in the form of free silica. In technical ceramics firing applications, our products are designed for air atmosphere and fast cycle times.

In powder metallurgy, with reducing hydrogen atmospheres, free silica is both a contaminant problem and an operational

concern. Of course, avoiding contaminants is a concern in most applications. In some specific cases this means the use of pure alumina rather than an alumina-silicate, such the processing of high purity alumina powders, piezoceramics, and some powder metal applications.

cfi: *Which shaping technologies are utilized at Sunrock Ceramics?*

DT: For alumina-based ceramic components, we offer clay-free products formed by either pressing or thixotropic casting.

We use thixotropic casting for complex shapes such as saggers or crucibles, or for lower volume production. We have an extensive library of existing tooling solutions for both pressing and casting, and we can offer very reasonable tooling costs for new designs because of the unique design of our press tooling.

If the tools are available, we have a lead time of 4 – 6 weeks, which enables our customers to run their inventories at low levels.

cfi: *What are the challenges for R&D work at Sunrock Ceramics?*

DT: An ongoing focus is improving hot strength without compromising on excellent thermal shock resistance. High hot strength provides many operation benefits



Fig. 1 Doug Thurman, President at Sunrock Ceramics Co

to users of our products including a reduction in the thermal mass in the kiln.

Relatedly we are working on the optimization of microstructure with tailoring additives and the particle size distribution of our raw materials. Another topic is high-temper-



Fig. 2 Sunrock products for ceramics and PM

ature chemical inertness in harsh working environments. Also in addition to product development we focus on process development, such as our ERP system, which has the flexibility for us to produce products tailored to each specific application.

As such, we strive to have a deep understanding of the needs of each customer application so we can approach the manufacturing of our products in the manner that maximizes the benefit for the customer.

cfi: *What can kiln furniture contribute to energy efficiency in firing processes?*

DT: In many thermal processing situations the mass of the kiln furniture can greatly exceed the mass of the ware being fired. That is where improving hot strength, as previously discussed, can help with mass reduc-

tion. But more broadly we try to work with customers to optimize the entire system.

There are many trade-offs between operational efficiency, product quality, scrap rates, life of the kiln furniture and other economic considerations.

Every application is different and we seek to work with our customers to optimize the system in the face of these competing objectives. Experimentation is often a key part of this process.

cfi: *What are the strongest customer segments for Sunrock Ceramics?*

DT: A primary market is kiln furniture for advanced ceramics (air atmosphere, fast cycles) which includes CIM products.

In powder metallurgy, also a large market for us, we are enjoying success with a new

range of pusher plates for fast-firing cycles as these can withstand high mechanical stresses and extended inertness in highly reducing atmospheres.

Also for the PM market we produce 99,6 % alumina furnace infrastructure refractory such as hot face bricks, hearths, muffles, etc, and we have recently introduced a 99,6 % insulating brick. For powder calcination, we offer special saggars, and for melting corrosive glass, crucibles tailored for this application.

cfi: *What is the export rate?*

DT: We have been holding at a level of about 25 %, even with fluctuations of exchange rates.

cfi: *Thank you for talking to us.*

KS

Case Study

Sunrock has recently developed a cast 91 % alumina formulation with higher hot strength than traditional 90 % or 91 % alumina cast kiln furniture, due in large measure to the elimination of clay, which is traditionally needed in at least small amounts for the forming process. While clay is beneficial in the production of the saggars, the impurities in even a small amount of clay can introduce glassy phases in the ceramic matrix compromising hot strength. An example of the benefit of this new non-clay product formulation for casting saggars and other complex shapes is described.

A customer of Sunrock's recently received a large new parts order and they needed to attain a certain kiln loading requirement to achieve the targeted economics. For a variety of reasons it was determined that saggars were the preferred kiln furniture system for this application.

The firing temperature was well over 1650 °C. To achieve the needed kiln loading the saggars had to have a relatively thin base, but unfortunately with typical 91 % alumina saggars the base would warp with the needed base thickness given the heavy



Fig. 3 Saggars on tunnel kiln

weight loading and temperature. Maintaining flatness was also a key criteria, adding to the challenge.

The thermal cycle in the existing tunnel kiln was too rapid to use a higher alumina material without excessive cracking of the saggars. After initial testing it was determined

that the additional hot strength of the non-clay cast sagger formulation in 91 % alumina was sufficient and the saggars could be made with the thinner base, allowing the additional saggars to fit on the kiln cars as required to achieve the target product loading.