Mt. Savage Specialty Refractories

the buzz

MT. SAVAGE
SPECIALTY REFRACTORIES

Issue #4
September 2008

Are you seeing long lead times for your refractory brick or even specialties? The refractory industry is going through a mini boom and for the first time in many years demand is pushing supply. Will this trend continue? See page 4 for Dr. Dirt's take on this.

Constant temperature changes have your furnace lining in a bad state? Maybe fused silica is the answer, see page 2.

Back by Popular Demand, Ask Dr. Dirt, the Dr. Phil of the Refractory Industry, for answers to your refractory questions! See page 4.

The rising price of refractories got you down? A big part of the reason is the price of raw materials from China, like calcined bauxite. Mt. Savage has always depended more on domestic sources than many of our competitors. The picture above is showing high quality bauxitic kaolins being mined by CE Minerals in Georgia, USA. See the story of "Cut Bauxite" on page 3.

Mt. Savage Specialty Refractories

736 West Ingomar Rd.
Ingomar, PA 15127

Phone: 412-367-9100
Fax: 412-367-2228
www.mtsavage.com

Fused Silica

If you go to a white sand beach for vacation this year, you will be laying your blanket on almost pure silica. In the refractory business, we often hear how dangerous breathing in silica dust is, and it can indeed be deadly, then we go vacation in a breezy area laying on almost pure silica. The silica found on the beach, and the form mostly found in nature is quartz, a crystalline form of silica. Quartz as found in nature is an excellent refractory raw material and at one time was the predominant raw material used in refractories, from coke ovens, open hearth roofs, glass tank crowns, and many acid practice furnaces. The main problem with crystalline silica, however, is that it goes through large phase transformations as temperature changes. These changes cause large degrees of expansion or contraction (depending on temperature direction) that if done too quickly will tear the refractory apart. For this reason, crystalline silica based refractories are not good in thermal shock applications.

Let's consider another form of silica, or at least mostly silica, that the average contractor is familiar with, the beer bottle. The beer bottle is made from mostly sand with other minerals added to lower the melting point of the sand. The result is glass, which has no crystalline structure and thus does not go through a phase transformation with temperature. Because of the other minerals present, however, glass still has an expansion curve which makes it prone to thermal shock, which can be seen if a hot bottle is put into a freezer, it can break or crack (with a resulting alcohol abuse if the bottle was full).

Fused silica is simply sand that has been turned into glass without the other minerals present. As pure silica is very refractory, this takes a significant amount of energy to convert to a glass. The main strength of fused silica is its very, very low thermal expansion. Fused silica has extremely low thermal expansion over a wide temperature range, giving it excellent thermal shock resistance.

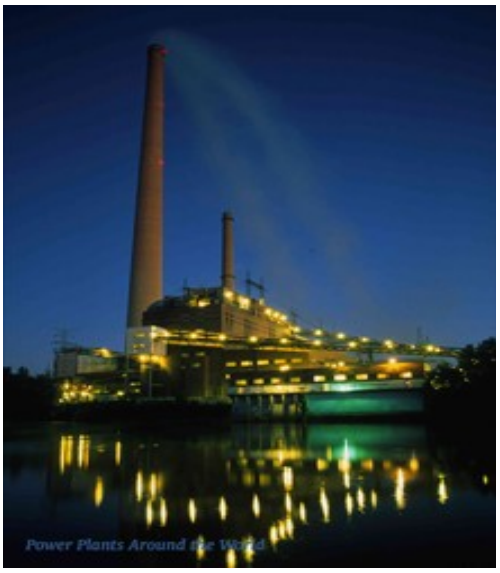
Unfortunately, the fused phase of silica is not really the stable phase in nature. If you heat fused silica enough, those pesky atoms want to arrange themselves in a nice orderly fashion, i.e. turning back to a crystalline phase. This starts to occur around 2200°F or so, though is somewhat dependant on time as well as temperature. This limits the use of a fused silica refractory in a thermal shock application to about 2200°F.

With that limitation in mind, where does fused silica work? Any application that sees high temperature cycling where the temperature does not exceed 2200°F is where. This would include quenching applications in lime or cement, aluminum launders and runners, ash hoppers with intermittent water, and many others. In any application where thermal shock takes a furnace down below 2200°F, fused silica should be considered.

Buzzie says, "to minimize cracking from thermal shock, choose refractories with very low thermal expansion. Fused silica has lower thermal expansion than any other common refractory aggregate."

Mt. Savage offers a wide variety of fused silica products. ULTRA-TEK FS and ULTRA-TEK FS AL are fused silica low cement castables. ULTRA-TEK FS Gun Mix has gotten rave reviews in high thermal shock areas of waste to energy ash hoppers. Conventional castables, gun mixes, and plastics are also available. So, next time you have some shocking refractory applications, call your Mt. Savage Representative and ask them if fused silica may be right for you. *

*Side effects might include extended periods between work stoppages, followed by repeat business and end use customers buying you a dinner for a change. Contact your Dr. Dirt if these symptoms continue.



Power Plant ash hoppers are an area that can see severe thermal shock, particularly if cooling water is interrupted often. Fused silica gun mixes or shotcretes are often good alternatives in this application.

Project Time

Mt. Savage Specialty Refractories has often been thought of as a small nimble company that can get small orders out in a short amount of time. Though MSSR is still a nimble company that prides itself in addressing emergency orders, they have expanded production to be able to address large project assignments. This includes plant capacity and service capabilities. In the fourth quarter of 2008 through the first quarter of 2009, MSSR is working on large projects supplying material to the steel, cement, and incineration markets. These follow earlier projects that included a drop out box in a steel mill and a full reheat furnace at an integrated steel mill. With partners, MSSR is now able to supply most all refractory products needed for a whole variety of applications. A vast majority of these products are American made, lowering lead times and increasing reliability.

Cut Bauxite

Alumina content, as well as many other chemical components, is a very important property in a refractory. To the new refractory student, you will hear that the higher the alumina content, the better the refractory. That is a general rule that is not always true for all applications, but it has generally been true that the higher the alumina content the more expensive the refractory. Then along came Chinese bauxite.

For many years, Chinese bauxite, which has an alumina content of 88 to 90%, flooded the North American refractory market at extremely low prices. This bauxite was landing in New Orleans for a lower cost than it took to mine and fire the excellent bauxitic kaolins found in central Alabama and Georgia. These kaolin based products had formed the back bone of the 50 to 70% alumina refractories in the U. S. for many years. This low cost Chinese material fundamentally changed the way many high alumina refractories were made. Seventy percent alumina products were thus made with a combination of bauxite and 60% alumina aggregates. Sixty percent alumina products were made with combinations of bauxite, and I kid not, calcined fireclay aggregate. Thus, they saved millions of dollars over the years making these combinations instead of using the straight aggregates. They probably also cost their customers millions of dollars in increased wear by making the switch!

Mt. Savage, and a few other companies, largely resisted this trend. They believed that the strength of a refractory was determined mostly by its weakest link. By using a combination of aggregate, the lower quality aggregate lowers the overall properties, with a more homogenous system giving better overall properties. In the past, Mt. Savage had a difficult time being competitive in 70% alumina products because Mt. Savage used 70% alumina aggregate while the competition used lower cost bauxite and 60% alumina aggregate. Our product was better, but more expensive to make, costing us many sales opportunities.

Times, however, have changed. The price of Chinese bauxite has risen so much the last two years, it is no longer competitive to use blends of products. While our competitors are scrambling to relearn how to use straight 60 and 70% alumina aggregate again, you will be getting the same products you have always gotten from Mt. Savage. The difference is, now we will be very competitive. So, you will have a choice in the market, buy a reliable Mt. Savage product made the same way it has been for years or buy someone else's product that may or may not have been reformulated in the last couple of months, hopefully not by some Marketing guy.

Buzzie says, "its better to buy products based on American based raw materials, as they are much more stable in price and quality!"

CO Resistance

Carbon Monoxide (CO) can be deadly. It can be deadly to people and is a common cause of injury and death in both industrial applications and home environments. A CO detector at both work and home is an excellent idea. Like with people, CO can also play havoc on refractories. It can take what appears to be a very strong brick or castable and turn it into powder in an alarmingly short period of time. Knowing where CO can occur and how to fight it can save a company a lot of money!

When one thinks of CO environments, the first thought is often a blast furnace. After all, the job of the blast furnace is to create CO to react with iron ore and turn it into iron. All of the refractories inside a blast furnace and the connecting flues and stoves must be able to resist CO to survive. There are many other applications, however, where CO may attack refractories and being aware of this possibility is important to refractory life. These applications could include almost anywhere that a carbon source is being burned without an abundant amount of oxygen available.

CO reacts with free iron and iron oxide in a refractory. The resultant reaction is so highly expansive it literally explodes the refractory turning it into dust. A tell tale sign of CO attack is grayish powder that is lying around. CO will attack available iron in a relatively wide temperature range from about 1600^{o}F to 2200^{o}F.

One way to make a refractory that is not susceptible to CO attack is to not have any iron in it. If there is no iron to attack, no attack will occur. Thus, engineering companies often specify low iron refractories for applications that are highly reducing, which means that some CO may be present.

Another way to prevent CO attack is to fire the refractory at a very high temperature so that the iron gets tied up in a glass and the CO cannot get to it. SAVAGE HF, with the HF meaning high fired, is burned at a much higher temperature than standard SAVAGE SD, and thus can survive quite nicely in a CO atmosphere. Many of the aggregates that are used in modern refractories have been burned hard enough to tie up the iron, but one must be careful not to mill these products with steel milling media as this will cause them to pick up enough iron to again be susceptible to CO attack.

Besides SAVAGE HF, Mt. Savage offers a wide range of specialty products that will resist CO attack. This includes several low cement castables, shotcretes, and gun mixes in the ULTRA-TEK family of products. If you suspect CO attack or highly reducing conditions, ask your Mt. Savage representative for a product recommendation to prevent this from ruining your day. Also, get a CO detector at home, better safe than sorry!

Dear Dr. Dirt:
Why do people use steel needles in refractory castables? Does it make the castable stronger?
Cracked Up, Hickman, KY

Dear Cracked,
Most people don't know this, but perfectly formed ceramic bodies are inherently stronger than steel. So, no, steel fibers do not generally make a castable stronger. What causes the problems with ceramics, and thus refractories, are a combination of their brittleness and surface flaws that weaken the ceramic body. These surface flaws allow a crack to start and the inherent brittleness allows the crack to go about its merry way. The technical term for going about its merry way is propagate. Steel, however, is much more flexible than ceramics, so when this crack that is propagating hits a steel fiber, the fiber bends a little, absorbing the crack's energy and either slowing it down or stopping it. Therefore, fibers are added to prevent cracks from propagating. Now, fibers that oxidize form iron oxide, or rust, which is a ceramic. Thus, fibers begin to lose their usefulness when they begin to oxidize. Stainless fibers will tend to oxidize at higher temperatures than carbon steel fibers, so they stay effective at higher temperatures. If cracking is not a wear mechanism for failure, don't use fibers as they are very expensive, much more expensive than most any refractory.

Dr. Dirt

Dear Dr. Dirt:
Why do I need to mix these ULTRA-TEK Castables for 4 minutes or more? **Impatient, Stoney Creek, Ont.**

Dear Impatient,
Low Cement Castables such as ULTRA-TEK have soluble additives in them that reduce the required water and these take time to dissolve in the low water additions that are used in these materials. These additives are like detergents that cause particles of dirt to float away by pushing them away from other materials. When you first add water, these are still in the solid form and the material will look and appear dry. The soluble additive package is also there to control the setting behavior and working time of these high tech materials. Even after the material begins to look wet enough, continued mixing action may be needed to totally dissolve the additives that control working time and set. Uncle Ed and cousin Donny at our Curwensville plant work very hard to get these additives perfect in each bag so that the castable will behave in an easy to use and predictable manner. If the additive is not totally dissolved, all this work could go for naught. One trick to use to get these materials dissolved a little faster is to put half of the material in the mixer, all of the water, mix for a minute, then put the rest of the dry material in.

Dr. Dirt

Dr. Dirt out doing a little pumping.

Refractory Industry Overview

Does it seem a little hectic when you call your favorite refractory customer service representative? If the economy is down, why are refractory sales up most everywhere? There are several reasons for that, and the good news for the refractory industry is that these reasons shouldn't change anytime soon.

The first is the strength of the steel industry. The steel industry, thanks largely to consolidation, is as healthy as it has been in many decades. All of the major players are now in a position to ride out slumping conditions by cutting capacity instead of price, preventing the large inventory swings seen in the 80's and 90's. The weakness of the dollar has also made the domestic industry very competitive. Imports of steel are down and exports are up. This has had the entire industry at near full capacity and making record profits. As much of the equipment in the industry has been in disrepair for many years, the industry continues to develop projects at a fast clip, with new reheat furnaces, a giant rotary hearth furnace, coke ovens, and reportedly even a new blast furnace are being built in the next year or so. All big consumers of refractories.

The cement industry is obviously down, as housing starts slump, but commercial building and infra structure repair keep it limping along. The long term trend for the cement industry, however, is very bright and many new projects from Pennsylvania to Missouri are being built, again consuming a significant amount of refractories.

The foundry industry is down from 10 years ago, but even they are seeing a leveling off as the price of foreign castings and transportation have increased, giving the U.S. foundries at least somewhat of a respite in an otherwise gloomy market.

The Power industry is relatively recession proof and continues to move along at a good clip. Foreign money is flooding into the U.S. as with the value of the dollar down, it has become a cheap place to invest. All in all, the refractory industry looks pretty strong for the next year or so, certainly compared to the rest of the economy.