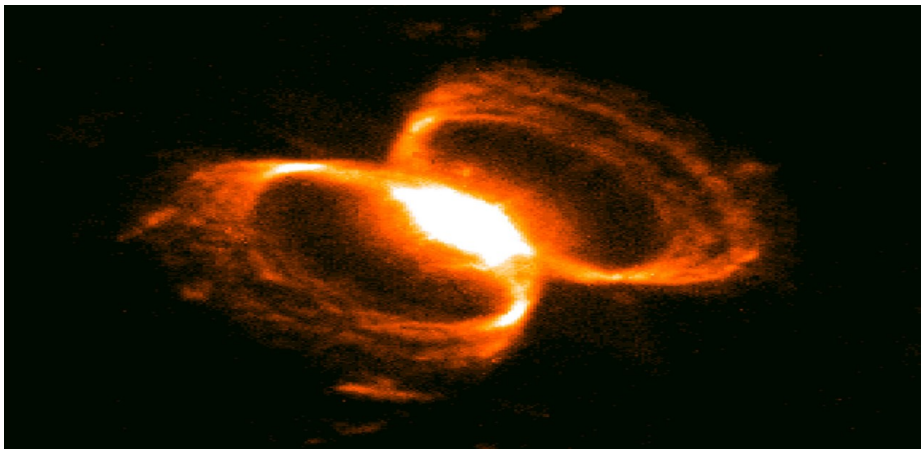
THE BUZZ

Issue #13 May, 2014

X BOND MARKS THE SPOT



Colloidal Silica is dead! Long live the heir, **X-BOND** is here!

Colloidal silica shotcrete and gunite showed the world that a strong, refractory bond can be formed which gives the ability for a rapid cure, rapid dry out, and superior resistance to alkali and acid attack. The two component system, however, is messy and difficult to coordinate. **SAVAGE X™** shotcrete and gun mixes gives all the advantages of colloidal silica with the added advantage of being a single component system. With a special bonding system we have dubbed, **X-BOND,** all the advantages of colloidal silica with fewer disadvantages can be achieved. High hot strengths, alkali resistance, acid resistance, and fast dry out can all be realized with the **X-BOND** system. This special edition of *"The Buzz"* is dedicated to this innovative new system, introducing perhaps the biggest refractory breakthrough since low cement castables were first developed in the 1970's, with a tip of the hat to the phosphate bonded **Q-TEK™** products that continue to excel in a number of applications.

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SAVAGE X™ Marks The Spot!

ON
X-BOND

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Colloidal Silica Obsolete?

During the 70's and 80's, several ceramic departments around the world developed new ceramic bonds called Sol Gel Technology. This bond was developed from extremely small particles known as colloids. Silica and titania were the first of these colloids that were used successfully in a bond. A colloid is a discrete particle that is so fine that it doesn't settle like a suspension, but Brownian motion (particle's natural vibration) is enough to keep it in a permanent suspension in a liquid to make it look like a solution.

These very small particles have reactive sites that ceramic scientists learned to use to get them to bond together. The first phase of this bond is usually a gel formation, like a thick paste. During the early 90's, refractory engineers learned to use colloidal silica as a bonding phase, developing first a gel bond then a strong silica to silica chemical bond as it was dried and fired. Refractory concretes made with this bond tended to have excellent hot strengths, excellent chemical resistance to both acids and alkalis, and were very easy to dry out as there were no hydraulic phases that would lead to the formation of superheated steam like you see in cement bonded concretes.

This past year, Mt. Savage Specialty Refractories has taken this technology one step further. The methods for manipulating colloidal silica to form a bond can be tweaked to form a silica gel bond without the use of a colloidal silica suspension. This allows for the development of single component refractory concretes and shotcrete mixes that have all of the chemical and physical properties of colloidal silica without the expense and mess of it. These new refractory concretes are the same as normal refractory concretes, just add water and place. Green strengths, water removal, high temperature strengths, chemical resistance, and abrasion resistance of these products are nearly identical to those of a colloidal silica bonded product.

Based on this new technology, MSSR has introduced new **SAVAGE X™** shotcrete and gunning mixes. The aggregate systems that are used mirror low cement offerings, ranging from fireclay to high purity alumina, zirconia containing for the cement industry, silicon carbide, and fused silica.

Cement free shotcrete being installed onto a blast furnace stack.

X-BOND Trials

SAVAGE X™ products come in two forms, gun mixes and shotcrete/castables. The gun mixes were initially introduced as ULTRA-TEK PDQ gun mixes, and the shotcrete products were a variation of this. As we sold the gunning mixes, we began to see a pattern, they work everywhere! Initial trials in cement plants and incinerators showed easy installation, excellent chemical resistance, and very good strength and abrasion resistance. When the shotcrete version came out, the initial properties in the lab were overwhelming. A research engineer at a steel customer actually called up and asked if the hot strength numbers could be right. They just seemed too high for a 60% alumina castable and he thought his furnace must have been broken.

Shotcrete trials have been run in reheat furnaces and cement kilns. They show an ability to pump and install like the best of the refractory shotcretes. More trials are scheduled in different reheat furnace zones, iron runners, and cement preheat towers. The gunning versions have been used in a number of applications, and the rave reviews start with the nozzlemen, who say it guns as well as any gunning mix they ever used! Using any kind of gunning equipment, coke oven repairs, hot metal car mouths, aggregate kiln dams, drop out boxes, incinerators, reheat furnaces and boilers have all been installed and looking great!

Q-TEK Update

Where X-BOND is making waves replacing low and ultra-low cement shotcrete and gunning mixes in a broad range of industries, Q-TEK™ has been doing the same to plastics for a couple years now. Q-TEK™ is a phosphate bonded system that is fed into a gun, pneumatically moved to a nozzle where water is added and is shot onto the wall. The results of a Q-TEK™ wall is nearly identical to a wall rammed with phosphate bonded plastic. With the introduction of Q-TEK™ Super, the plastic is pre-tempered and placed right into the gun from the bag, creating a nearly dust free environment both at the gun and at the nozzle.

Many customers are leery of the term gunnable plastic, and rightly so. The old fully tempered plastics that were shredded or shipped as wet ramming mixes were extremely difficult to install, and created high amounts of rebound. Q-TEK™ is nothing like that! The pre-tempering acts as a perfect pre-dampening amount, giving a good even feed into a gun, and the moisture level is controlled at the nozzle like a normal gunning mix.

Areas that Q-TEK™ has excelled include aluminum furnaces, reheat furnace sidewalls, cement preheat towers, and drop out boxes/dust collectors. Generally, it can be used anywhere that a rammed plastic would be used. Compared to hard concretes, Q-TEK™ will be more resistant to thermal cracking caused by furnace cycles. Compared to cement containing specialties, Q-TEK™ will bond much better with used refractories.

Q-TEK™ Super is available in 50, 60, 70, 85, and 95% alumina contents. Aluminum resistant additives can be added to all versions. Shelf life is at least six months, and may be longer if properly stored. Being available in 50 lb. bags, it can make an excellent shop repair mix, available for small to major repairs.

Q-TEK™ SUPER is now available in 50 lb. bags

Strength At and After

When looking at hot modulus of rupture values of the new SAVAGE X™ products, they indeed look quite remarkable. Modulus of Rupture (MOR), which is flexing strength test at temperatures of 2700°F in the thousands of psi are enough to make a ceramic engineer cry with joy. To the layman, they should tell you that the product is extremely strong at high temperatures, meaning little to no liquid formation (i.e. no melting) to weaken the product.

A typical data sheet will have MOR numbers for specialty products after drying, after some reheats, and sometimes at given temperatures. MOR after 1500°F is common for refractory castables and gunning mixes, because this is hot enough for them to completely dehydrate the cement but cool enough to not form glassy phases that would increase the strength after heating. This temperature was chosen as giving a minimum strength in conventional, high cement castables; and in these products, was always less than dried strength. With the advent of low cement, ultra-low cement, and no cement castables, however, this strength was often higher at this temperature than dried because of other bonds that were forming.

Typical Hot Modulus of Rupture Testing Apparatus

Sometimes on a data sheet you will find MOR after a higher reheat temperature, such as 2910°F. This becomes buyer beware, as it is a natural reaction to think that the higher the better. If the product is tested AT temperature, then higher is better. If something is heated to a high temperature, partially melts due to low melting phases forming a pool of liquid, then cools, this product will have a very high cold MOR, which is bad! If an MOR is given for a product AFTER a reheat, the number you want is consistent with MOR after lower temperature reheats. If it is very high, that should set off warning bells that the product is partially melting at that temperature.

Ask Dr. Dirt

Dear Dr. Dirt: How is it that Q-TEK™ and X-BOND products can be dried out so quickly while cement bonded products take so much time with holds or very slow ramp rates? **Impatient in Nebraska**

Dear Impatient: When you boil a pot of water on the stove, the steam comes up in lazy, wispy clouds. If the water is boiling harder, there may be more, but it is still lazy. Now, put that same water in a tea pot that has a whistle. It lets the steam build under pressure for a while until the pressure is enough to escape through the whistle and let you know your water is boiling. Cement containing castables are like the tea pot, X-BOND and Q-TEK™ like the open pot.

Cement reacts with water to form hydrated phases. The cement phases hold onto their water until elevated temperatures ranging from 450°F to 1100°F. As steam comes off at these higher temperatures, it wants to take up more space; and being confined in the pores of the castable, build up more pressure. The Q-TEK™ and X-BOND have no hydrated phases; so all the water comes off at the boiling point around 212°F, just like the lazy steam of the open pot. Thus, you really can dry out these non-hydrated specialties a lot faster without risking a loud booming noise called a steam spall.

Dear Dr. Dirt: Why is some refractory plastic blue? **Stained hands in Hoosier Country.**

Dear Hosier: Many years ago before Chinese bauxite became the norm for 80% plus plastic, the mullite and the bauxite based plastic rammed pretty much the same. When manufacturers started using Chinese bauxite, that all changed. Ramming characteristics of bauxite plastics were radically compromised. Installers soon learned that mullite plastic was easier to install. One smart manufacturer started putting blue dye in the mullite plastic so workers knew it wasn't the bauxite problem material.

HOT OR COLD?

SAVAGE™ X gun mixes have been shot in a number of applications. Some of the applications have been hot gunned and include coke oven batteries, rotary kiln dams, reheat furnace repairs and iron tilting spouts. The material is a natural hot gunning mix. The bond develops as the material dries, the fast drying that occurs during hot gunning appears to have no negative affect on the performance. It is very easy to build material up, and rebounds are extremely low. Combined with outstanding properties, SAVAGE™ X might be the best hot gunning mix in the world!

Q-TEK in Aluminum

Phosphate bonded plastics have performed very well in aluminum furnaces for many years. The alumina-phosphate bond is resistant to aluminum penetration and also to fluxes that are often used in aluminum. The issue has always been that the ramming of plastics is time consuming and costly. Q-TEK™ offers the operator a choice of a fast installation and all the benefits that a phosphate bonded plastic gives them.

Several furnace repairs have been installed using Q-TEK™ 31 or 32 SUPER AL GM. This is a product that is simply added to a pneumatic gun, water is added at the nozzle (don't forget the water booster pump) and shot onto the wall. This product has been used successfully in both lower sidewalls and upper sidewalls.

The installation outlined in the video below included a repair of both the upper and lower sidewalls. Rebounds and dust during the installation were minimal. No controlled dry out was necessary. The furnace was brought up to operating temperature in just a few hours. Currently this furnace is still in service and appears to be performing at least as well as a rammed plastic repair.

Q-TEK™ has proven to be an extremely versatile product that has a long list of uses. Follow the link below to see an actual aluminum furnace installation:

http://www.youtube.com/watch?v=brSEiI3lgBs

Pictured above is a recent gunning installation of Q-TEK™ 31 AL Gun Mix. The material replaced rammed plastic, cut days from the installation time and is performing so far just like a rammed plastic lining. Why ever ram again?