THE BUZZ

MT. SAVAGE
SPECIALTY REFRACTORIES

ISSUE 2
SEPTEMBER 2007

Alkali Problems?

Is your refractory coming out in dry flakes like bad dandruff? If so, you may have an alkali problem and not even know it. Alkali problems can be like termite problems in your house, they get you when you least expect them. See **page 2** to know what to do about this pesky situation.

What is 66?

What does the number 66 mean in **IMPACT 66**? This versatile gun mix has been a leading seller for Mt. Savage for almost 30 years, but why was it given the number 66? See **page 3** for the answer.

Q-TEK made Easy!

Mt. Savage now is making its unique two component castable much easier to use. Now customers can purchase our Q-TEK products and receive the binder ready to use, one jug of binder per one bag of castable. Gun versions of these unique phos-bonded products are also available. The picture above shows Q-TEK 32 AL, a product designed for aluminum applications. Note that there is no penetration in this standard cup test using a high magnesium alloy. Contact your local Mt. Savage representative for more information.

Ask Dr. Dirt

Kind of like the Dear Abby of the Refractory world, Dr. Dirt can answer all of your refractory questions. You can decide if the answers are right. See the column on **page 3.**

Mr. Right and Mr. Right Now

Mt. Savage Specialty Refractories (MSSR) got its start 32 years ago with a simple premise, make good, reliable specialty products and get them to the customer when they were needed. Its partner, **Mt. Savage Firebrick** (MSFB), developed a reputation of having the largest brick inventory in the industry often having what was needed with zero lead time. These reputations allowed Mt. Savage to develop a solid niche as customers learned they could get good reliable products with very fast turnarounds.

In 2001, MSSR purchased the Narco facility in **Curwensville, PA** along with sophisticated shotcrete technology from Oak Mountain Industries. The Curwensville facility was set up to consistently produce some of the world's most sophisticated low cement, low moisture castables. Every worker in the plant had years of experience with low moisture castables, understanding the nuances that make these products click. The high capacity and low cost structure of the plant also made it ideal for production of dry specialties for large, sophisticated project jobs. This started MSSR's move to being not only Mr. Right Now, but also Mr. Right.

In 2006, MSSR entered a new partnership with the **Snow Shoe, PA** brick plant. This Snow Shoe Refractories plant produces an established technical line of high alumina products and is a perfect fit with the MSFB Frostburg plant that concentrates on fireclay through standard bauxite based mixes. The shuttle kiln set up at Snow Shoe also allows for a tremendous amount of flexibility and some of the best lead times in the industry.

(continued on page 2)

Alkali Attack

One of the nasty actors that refractories come in contact with is alkali. If you looked at a periodic chart, they would include all the elements below Hydrogen in the very first column. The ones that we have to worry about, however, are the first three after hydrogen which are lithium, sodium, and potassium.

There are a variety of applications where alkali attack can occur. These include cement kiln preheat towers, incinerators, boilers, wood burners, and many others. The form that the alkalies are in will affect their level of reactivity. For instance, sodium carbonate will be more reactive with a refractory than sodium sulphate. Still, any form of alkali can and will attack a refractory under certain conditions.

Alkali attack is something that is highly temperature related. The worst reaction will occur in the temperature range of 1800°F and 2200°F. The reason for this is that this is where alkalies condense from an air stream. The most likely source of alkali is in the fuel. Many coals, for instance, contain a fair amount of sodium and potassium. When burned, these alkali compounds will volatize, then will condense somewhere downstream as they cool. It is where they condense that problems begin.

There is a knee jerk reaction in the refractory industry that when a problem occurs, go to a higher alumina material. In this case, that is exactly the wrong thing to do! That is because an alkali reaction with alumina is much more destructive than one with silica. When alkali reacts with pure alpha alumina, it forms another mineral phase called beta alumina. Put shortly, beta is bad. Beta alumina is a lot less dense than run-of–the-mill alpha alumina, and the reaction from alpha to beta gives a 130% volume expansion. It's like you have 5 pounds of "stuff" in a 5 pound bag then suddenly you have 11.5 pounds of stuff in the same bag. The bag suffers in this scenario, as does the reaction zone of a refractory.

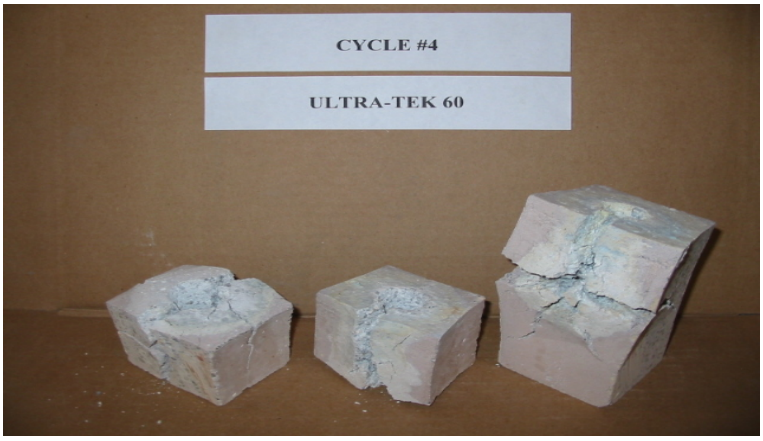
The tell tale sign of alkali attack on alumina is a dry, powdery, friable hot face. The hot face of the refractory in this case, literally self destructs. Typically, one can remove part of the hot face with their fingers under these conditions. The powder tends to be a white or gray color, though not always depending on other conditions in the furnace.

So, when faced with alkali conditions in the temperature range of 1800-2200°F, how does one design around it? Most refractories, after all, contain some amount of alumina so how does one prevent this destructive reaction. Luckily, alkali is selective in the order it reacts with minerals in a refractory. For some reason, alkalies prefer silica compounds over alumina compounds, thus, if there is silica readily available, it will hook up with silica first. This has something to do with relative reaction energies, but that is getting way too complicated. It's sort of like the average Refractory Contractor, he would rather go to the dance with Angelina Jolie, but if she is not available, he would take Cameron Diaz. To an alkali ion condensing on a refractory, silica is like Angelina, alumina like Cameron.

So, what happens when alkali reacts with silica. It forms a sodium silicate phase, which is largely amorphous. This phase has a slight expansion of about 20%. This level of expansion can usually be accommodated by the porosity of the refractory. In fact, this slight expansion has the tendency to fill up the porosity, blocking more alkali from getting into the lining and halting the reaction.

Thus, when designing a refractory for alkali attack, one puts available forms of silica in the matrix to react with the alkali. The best form is zircon. The reason zircon is so good is that it gives up its silica to the alkali, and leaves a zirconia skeleton that keeps the reaction zone strong and resistant to abrasion. This is the theory that led to the design of **ULTRA-TEK 60 ARZ**. In areas that abrasion is not a factor, lower cost silica units are used, which led to the design of **ULTRA-TEK 60 ALK**. Both will be resistant to alkali attack.

Thus, when designing an area that may see alkali attack, don't think higher alumina, think fine additives. Don't let alkali attack ruin your day!



This photo shows a standard sample in an alkali cup test, cycled 4 times at 1800°F. Note the dry, expansive reaction that has bloated the surface. This is typical of alkali attack. Samples with alkali resistant additive show less cracking and reaction.

Mr. Right (continued from page 1)

This partnership of two plants in Pennsylvania and two plants in Maryland put Mt. Savage in an extremely unique position in the refractory industry. These four facilities can now supply a full range of refractory products to contractors that rival the big boys. Still, during our drive to be Mr. Right, we did not forget what got us here, being Mr. Right Now. All of these plants strive for the fastest turnarounds in the industry. The brick plants still carry a wide variety of shapes and qualities in inventory, and both specialty plants carry stocks of finished product and raw material inventory to make any of its many products on a moments notice.

If you haven't talked to Mt. Savage lately, you may be extremely surprised about the wide variety of products we offer. In brick it includes from medium duty fireclay to 99% alumina and alumina chrome. In specialties it includes a wide variety of lightweights, conventional castables, low cement castables, shotcrete, gun mixes, plastics, mortars, silicon carbide containing, one and two component phosphate bonded mixes, and on and on. Combined with an investment in experienced engineers and applications experts, Mt. Savage Specialty feels it can be both your Mr. Right and your Mr. Right Now!

Pumpable Lightweight

Mt. Savage has recently developed a new line of pumpable lightweights for a variety of applications. One of the first major installations was a 390,000 pound installation of an 80 pound mix into a reheat furnace subhearth. The material was pumped an a rate exceeding 5 tons an hour without a hiccup or plugged pump. A 60 pound version has been developed and we are looking for applications to try it! OK, maybe you don't want to try 390,000 pounds, but let us know your application, and as always, Mt. Savage will work with you! Those who work with Mt. Savage know that not only quality, but also major product innovation is a big part of what we do Right!

What is 66?

IMPACT 66 is a popular fireclay gun mix that has had wide acceptance in the refractory industry. We were recently asked, what does the **66** stand for? No one really knows except Jerry Zawatski, our founder and president, and he isn't telling. The theories, however, abound.

We can throw out the alumina content. **IMPACT 66** is a very versatile price competitive product, but not nearly up to 66% alumina.

Another theory floated was that it was to honor the great Mario Lemieux, Pittsburgh's all time great hockey player, if not athlete. The problem is that **IMPACT 66** has been around longer than even Mario has, being installed in power plants, cement kilns and reheat furnaces before Mario knew how to tie his own skates. Thus, this could not be a tribute to the Great One.

Could it be a play on Rolling Rock Beer's "33" on their bottles? Rolling Rock is a local favorite and was brewed down the road in Latrobe, PA. The theory is that **IMPACT 66** is as good as two Rolling Rock Beers put together. Possible, yes, but it is certainly not likely. Now that Budweiser bought Rolling Rock and closed down the Latrobe brewery, we will forget this theory.

How about Rt. 66? This highway from Chicago to Los Angeles, after all, goes across half the country. **IMPACT 66** for many years covered the other half in all kinds of applications. The highway has had songs written about it while the gunning mix has had contractors sing its praise for a number of years. This makes sense to me.

Whatever the "**66**" stands for, it is always a good choice for low to medium duty gunning repairs. A contractor recently remarked he used it for a large job overhead and was amazed how low the rebounds were. It is designed to be user friendly, has a long proven track record, is often in stock and available on a moment's notice, and like the highway, the Latrobe brewery, and the hockey player, is a legend in its industry. Score, with **IMPACT 66!**

Ask Dr. Dirt

Dear Dr. Dirt,
My son is a sophomore in High School and he has decided he wants to be a Refractory Ceramic Engineer just like you. What should he pay most attention to in school to make his dream come true?
Cindy from Alfred, NY

Dear Cindy,
I think your son should pay most attention to psychology classes as he obviously will need years of treatment and self help. Still, if he insists on this ill fated path, I would say to have him really understand pH in chemistry class. Acid-base reactions, you see, govern so many of the things that happen in refractories it is probably the most important property to understand. In furnaces you have acid and basic slags to contend with that behave much like acids and bases do at room temperatures. The alkalinity of ceramic slips largely dictate their viscosity (that is how fluid it is) and the pH will also have a huge affect on cement sets or, for that matter not setting. Finally, when your son goes to college make sure he tells girls that ask him what he is going to be that he is going to be a Rock Scientist, it sounds better than Dirt Doctor.

Dr. Dirt

Dear Dr. Dirt
What is steam spalling? What causes it, and how can it be avoided?
Shell Shocked in WV

Dear Shocked,
If you have ever been to a WVU football game, you know how loud that damn Mountaineer's musket can be. A steam spall gone bad can sound just like that! Steam spalling is caused by steam pressure that builds up inside of a refractory faster than the porosity of the material can release it. When the pressure inside the refractory exceeds the strength of the material, Boom (!) is the typical result. This can occur in any installed refractory with water in it, including castables, gunning mixes, plastics, or trowelling mixes. It is most common, however, in cement bonded materials that are cast.

Two main factors that affect the incidence of steam spalling are heat up rate and permeability of the refractory. As refractory castables set, the cement in them combines with water to form hydrated cement phases. These phases are stable up to about 450°F, where the water starts to be released to the atmosphere. A large percentage of the hydrated water is gone by 600°F (though not all). It is when the refractory is in this temperature range that it is most critical. Think about it, if you contained a certain amount of steam by weight at the boiling point of water, this same amount of water would either take up more volume at higher temperatures or be under more pressure (if I remember my high school chemistry, isn't that Boyle's Law, tell little Johnny to pay attention to that one too). This super heated steam is what causes the problem.

To avoid this, the best way is to increase the permeability of the product. This is most commonly done by adding burn out fibers that are gone by the time the refractory hits these critical temperatures (though called burn out fibers, they actually don't burn, they shrink to allow pores). These are more useful in higher cement products but where fast dry outs are needed, are commonly used in all cement containing refractories. The other approach to avoid steam spalling is to heat the material up slowly through its thickness at these critical temperatures. Boom is not a sound you want to hear when heating up your furnace!

Dr. Dirt