the buzz

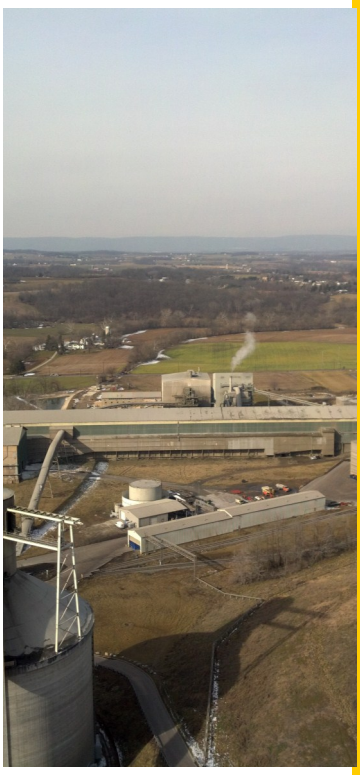
MT. SAVAGE
SPECIALTY REFRACTORIES

Volume 11
July 2012

Quantity and Quality

The first quarter of 2012 was the busiest in Mt. Savage history. How did they get there? To make the quantity needed, the plants stepped up production, added a production line, hired new employees, and increased efficiency. Quantity, however, is nothing without quality. In these tough times, customers cannot afford the high cost of poor or inconsistent products. The plants know this, and as production has increased, quality has followed suit. In February, at a cement customer in Maryland, 300 one ton bags of **ULTRA-TEK 60 ALKZ**, a super alkali resistant low cement shotcrete were installed. At the same time, 350 tons of various materials in 1500# bags were being shot by a cement customer in Ohio. Every bag pumped the same at the same water content. Every bag had the same flow and pump pressure. Not one plug at the pump was recorded, even on start up. This is certainly important when you are pushing material up to 300 feet into the air and applying it in a critical application area.

The industry has come a long way since the early days of shotcrete, where plugging, flash sets and slumping off the wall were common. From the consistency seen in Mt. Savage shotcrete, we have just come a little bit further. It has been years since Mt. Savage has had a serious pumping problem with a single bag of shotcrete material. If you are a customer looking for excellent performance and properties as well as the best quality record in the industry, give Mt. Savage a call!



From the top of a cement preheat tower. Pretty high up there!

Mt. Savage Growth

Mt. Savage Specialty Refractories continues to grow. In April of 2012, **Frank Piluso,** a new salesman for the Northeastern U.S. was hired. He will be calling on industries throughout the territory. Frank has a long history of customer service in related industries and we are sure that he will provide MSSR customers with the high level of service that they have grown to expect.

To make sure Mt. Savage has enough capacity to handle the additional sales, a plant engineer, **John Bertoline** was hired to improve output at existing plants and to help in engineering of refractory design. John has 20 years experience in engineering and will be a valuable asset to the plants. John joined Mt. Savage on July 2 and already has his sights on increasing capacity and product quality at our plants. If you get the chance to run into Frank or John, please take the time to welcome them to the MSSR team!

Inside this issue:

Buzzi says, " Quantity doesn't count without Quality. Get it right not only the first time, but every time!"

BE AFRAID

That is, be afraid if you are trying to pump anyone else's lightweights besides Mt. Savage. It may be counter intuitive, but it is much harder to pump a lightweight castable than a dense castable. As pump pressures go up, the water gets pumped right out of the lightweight aggregate and an ensuing "dry plug" occurs. Getting a lightweight plug out of a hose or pipe is also often harder than getting a dense castable plug out of a pipe.

Mt. Savage, on the other hand, has had tremendous success in pumping light and medium weight products. The key is to keep the water from being pushed out of the lightweight aggregate.

Through the years, research engineers have tried a variety of tricks to make that happen. It turns out that it took a combination of things to assure success and thus made a pumpable lightweight much harder to develop. Now we have a simple test that shows the pumpability of a lightweight. The picture attached shows a normal lightweight product in a large hypodermic needle case. This was placed under maximum hand pressure and except for a small drop of water, no material came out. The second picture shows the same casing with "pumpable" lightweight. With minimum hand pressure the material flows easily out of the end with no separation of water and material.

Like its dense cousins, pumpable lightweights came first and lightweight shotcrete came next. Mt. Savage has developed a 60 lb lightweight shotcrete mix that can be installed with a conventional piston pump and shotcrete rig. Though more expensive than gunite, the material can be installed with nearly zero rebounds and zero dust inside the vessel. This allows lightweight to be installed while other trades work in the vessel welding anchors or making mechanical repairs.

Thus, next time you need a vessel with a lightweight back-up or working lining turned over in a hurry and you need to have multiple trades working at the same time, call Mt. Savage. We can supply the right lightweight shotcrete or pumping mix for your use.

Top picture shows normal lightweight in syringe under pressure. Bottom picture shows pumpable lightweight in syringe under identical pressure. One pumps, one doesn't!

Laminations Can Ruin Your Day!

A lamination in terms of refractories is a void plane in the product. These can occur in almost any refractory product. In some applications, such as heat containment, this may not cause an issue at all. In others, such as metal containment, this can become a very serious issue. In any application, however, the best results will be obtained by avoiding laminations.

Brick laminations can occur because of pressing issues at the factory. Pressing a brick mix that is too wet or pressing too hard can cause a shear plane that leaves a void in the center of the brick. The installer has little control of this except to inspect the brick they purchase and check them for flatness. Brick with laminations will tend to be bowed on the pressed surface and should not be used. This is rarely seen in the field from respectable suppliers, as a good quality system will prevent most of them from occurring or catch them before they get shipped if they do.

Plastics are where laminations tend to be the highest. When one clot is thrown against the next, it takes a lot of pressure to get it to knit them together. Improper ramming techniques, such as putting too many clots down or not roughing surfaces will exasperate this problem. To keep plastic laminations to a minimum, use proper ramming techniques. Gunned plastics are particularly prone to laminations due to the high amount of trapped rebounds that occur. To minimize gunned plastic rebounds, use a dry plastic gunite material such as **Q-TEK (**see *Buzz #10*).

Cement bonded refractory gunite materials are also prone to laminations. These flat voids are often caused by material hardening before additional material is sprayed on it, shooting the material at an awkward angle that prevents knitting, or excessive rebounds that can get trapped between layers. Proper gunning techniques teamed with low rebound gun mixes can minimize all of these affects. The best bet here is to hire an experienced nozzleman who cares about the work they are doing.

Shotcrete materials tend to see a lot less laminations. With a fast setting accelerant, such as **ULTRA-SET**, however, care must be taken to minimize the time between spraying then going over the material again. Thus, the proper technique is to gun a small area to full thickness then move to the next area and repeat. In the rare cases where it is not practical to shotcrete this way, a slower setting activator, such as **ULTRA-GEL** can prevent laminations from occurring if you are shooting over tapered material. When done properly, a good shotcrete material will show no visible laminations in a cut panel.

Regardless of your applications, avoiding laminations will probably increase performance of your installation. It is best to develop a plan to minimize possible laminations by using proper installation techniques for the material being used.

Cement Hydration and De-Hydration

Though there are a number of bonds besides cement in refractory monoliths (see *Buzz #10*), still the most common bond used in refractory castables is calcium aluminate (CA) cement. CA cements offer a lot of advantages over other bonding mechanisms. They offer predictable working and installation times, they generally set very hard in a predictable time allowing stripping of forms, and they are quite refractory, with the higher purity CA cements having melting points in line with many refractory aggregates.

High purity CA cements are made by combining calcined alumina (Al_2O_3) and synthetic calcium carbonate ($CaCO_3$) in a high temperature kiln and firing them until they react to form calcium aluminate phases. When the reactant is ground to a fine powder, these CA phases will react with water to form CA hydrated phases that harden and give a concrete strength. In a refractory material, as the cement is heated, the water in the cement is released as steam causing dehydration. Chemically bonded water does not come off at the normal boiling point of water, and thus is released at higher temperatures as super heated steam.

As a cement bonded material is heated up, allowances must be made for safe escape of the water vapor that is coming off of the cement (keep it from going boom!). The two main phases that occur during cement hydration are C_3AH_6, where the H stands for water, and AH_3. Both of these phases start to dehydrate between 400°F and 500°F. That is why manufacturer's recommended dry out schedules have holds in this temperature range. As the water leaves the castable, the permeability of the product increases, allowing easier passage for water further into the castable. If water is released deeper in the castable before the hot face area starts its dehydration process, steam pressure can build beyond the strength of the castable and dangerous steam spalling can occur. CA cement does not completely dehydrate until temperatures above 950°F, but a majority of the water is out at about 550°F. Because of this, steam spalling incidents tend to occur when the refractory is in the 450°F to 600°F temperature range.

Continued on Page 4

GUNNING FLEXIBILITY

N-Type Gun

Low Cement Gun Mixes, such as **ULTRA-TEK GM** from Mt. Savage, are quickly replacing conventional refractory gun mixes throughout the industry. Not only do they have better properties than their higher cement cousins, they now gun equally well and have become more competitive as the price of refractory cement has soared. Excellent properties have been obtained by gunning without pre-dampening with rotary type gunite machines. Many customers and contractors, however, have dual chamber pressurized guns such as the Allentown N-Type gun (pictured here) and were curious how the low cement gunning mixes worked with them.

The one issue of gunning low cements with this type of gun is that they tend to get hung up between the chambers when they are not pre-dampened. Thus, to get a consistent feed with this material, it is recommended that you pre-dampen a minimum amount so that the material falls cleanly between the chambers. Though there is no issue pre-dampening ULTRA-TEK Gun Mixes, some competitive low cement mixes cannot be pre-dampened, so check with the manufacture before gunning (or just get ULTRA-TEK).

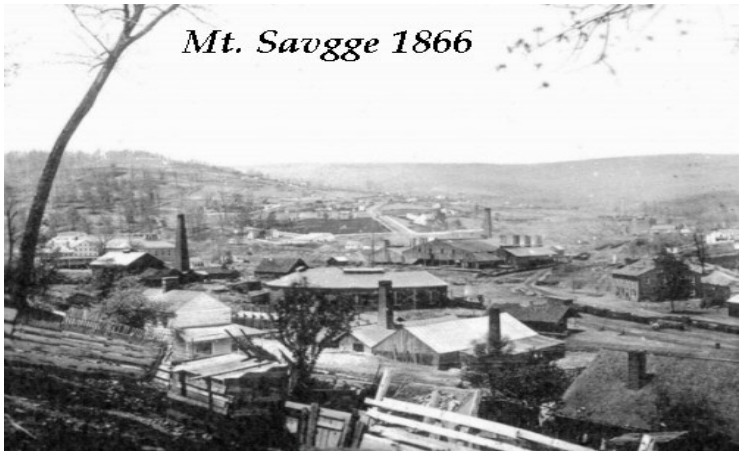
When gunning with pre-dampened material, slightly higher air pressures may be desirable to get proper densification of the material on the wall. As always, good nozzle water pressure is essential to getting low dust and rebounds. The material should go on the wall slightly wetter looking than with conventional gunite, as the additives in the material will quickly stiffen the material and the wetter material will have more tendency to move and densify, maximizing properties.

In the fall of 2010, an installation was placed into an aggregate dam in the Chicago area using a N-Style gun. The material was pre-dampened at about the 2.5% level. The gunning was relatively continuous with the kiln being turned to allow horizontal gunning throughout. After 16 months, this dam showed no significant wear while a competitor's low cement gun mix had to be replaced at that time within a year.

Allentown N-Style Gun

ULTRA-TEK gun mixes got their start through rotary guns without pre-dampening and have consistently outperformed conventional gun mixes in ash hoppers, incinerators, preheat cement towers, and many other applications. Now we know that the gun used doesn't matter, it is the material that goes through the gun that does! This makes ULTRA-TEK Gun Mix the ideal material to be stocked in your warehouse!

ASK DR. DIRT



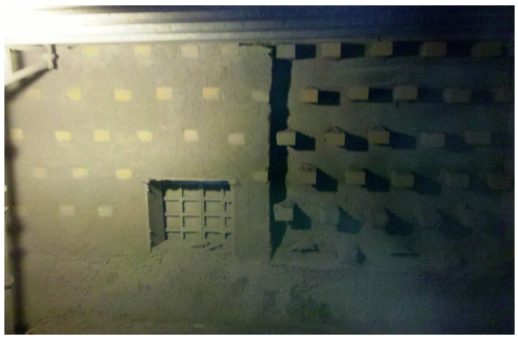
Dear Dr. Dirt; Why has it been so long since we have seen a Buzz Newsletter? We miss you when you are gone. **Andy from Porterfield**

Dear Andy: Absence makes the heart grow fonder. If you had seen any of these newsletters before our proof reader got a hold of them, you would understand just how difficult this is for this poor ceramic engineer! We will try to get them out more regularly, promise. Dr. Dirt

Dear Dr. Dirt: You mentioned Q-TEK Gunning Mixes in the past, have you tried them anywhere new? **Steve in the South.**

Dear Steve; Indeed we have. Q-TEK, as you know, is a dry plastic mix that when installed is virtually identical to phosphate bonded rammed plastics, minus a bunch of the laminations. Last fall we installed Q-TEK 30 GM in place of rammed plastic in a reheat furnace in Huntington WV. This furnace is hard on the rammed plastic, and after 6 months, it is clear that the gunned Q-TEK plastic is holding up better than rammed plastics do. One of the advantages of Q-TEK versus cement containing gun mix is that it will bond better to a used lining than cement does. As it does not have any dehydration phases which affect thermal expansion properties, its expansion curve more closely resembles that of the used refractories that are still in the furnace. Once the proper equipment is obtained, the labor needed to install Q-TEK is a fraction of ramming plastic. For larger installations, Q-TEK is the way to go!

Dr. Dirt

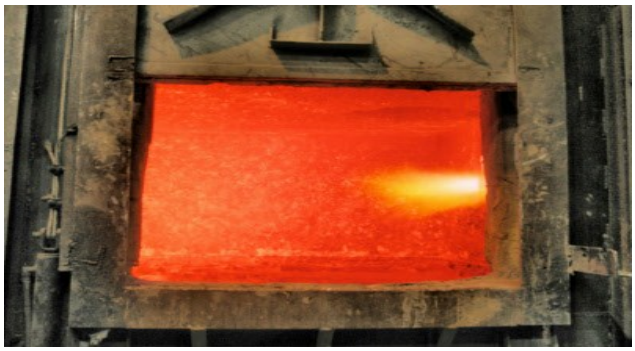


A Q-TEK Plastic Gunned Lining.

Hydration from Page 3

During dry outs, manufacturers will often have holds at different temperatures for dense CA bonded castables. The reason for this is that the temperature is usually coming from one side. A hold at 500°F will mostly dehydrate the hot face, but will not get chemically bonded water out of the castable a couple of inches down. Thus, a second hold around 700°F is often recommended to allow dehydration further down the castable and further open up permeability. For still thicker castings, a third hold at a higher temperature may also be recommended.

Several "tricks" are employed by manufacturers to make it easier for the water to leave the castable without causing dangerous steam spalling. One is the use of burn out fibers. These will shrink away and leave small tunnels for the steam to pass through. Different types of CA cement can also be used that develop phases with less chemically bonded water, making the castable easier to dry out but also having a negative impact on strength. These methods improve the ability to remove steam, but do not eliminate the possibility of steam spalling. The best bet is before drying out a thick lining or shape, contact your local Mt. Savage representative for a recommended dry out schedule.



Aluminum Melting Furnace

See story in next Buzz Newsletter!

Buzzi says "A water booster pump is a great investment. A majority of gunning problems such as dust or high rebounds can be solved with higher water pressure. Most of the rest can be solved by using Mt. Savage products!"