



# THE BUZZ

MT. SAVAGE  
SPECIALTY REFRACTORIES

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Page 5: Q-TEK is reborn. Learn how to use phosphate bonded gunning mixes in a cost effective manner

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## CEMENT FREE TECHNOLOGY ISSUE

Cement free monolithics have been with us for a long time. Clay bonded and phosphate bonded plastics would be examples of cement free monolithics that have been here longer than Dr. Dirt. During the 90's, cement free castables based on hydratable aluminas and colloidal silica were introduced to the market. Today, the choices for the refractory consumer are wider than ever. This newsletter is largely dedicated to explaining some of those technologies.

On Page 2 an exciting, brand new technology is discussed. This is a cement free gunning mix that has some remarkable properties. Mt. Savage feels

this new technology may be the biggest refractory breakthrough since low cement castables.

On Page 5, a technology that has been used for years as a patching mix is given new life as a product used in new construction.

Two other ways to "get the lime out", colloidal silica monoliths and old fashioned plastics, are discussed on Pages 3 and 4. Alumina Gel bonding is described on Page 4. Thus, if a buyer has an application where cement doesn't work, the options are here.

## LIGHTWEIGHT SHOTCRETE

In July of 2010, Mt. Savage ran their first successful trial of a 60 pcf lightweight shotcrete mix. As Mt. Savage prides itself on its pumping mixes actually being easy to pump, we had not been promoting our lightweights in pumping applications. Previously, the lightest easy to pump mix that Mt. Savage sold had a density of 80 pcf, which is a medium density material. With the development of a new technology, MSSR was able to reduce that density by 25% and the mix can also be shotcreted.

The largest advantage of lightweight shotcrete vs. gunite is the total lack of dust at the nozzle. With the activator being added at the nozzle, the lightweight will set quickly, allowing the dense material to be installed immediately after the lightweight is finished. Rebounds are near zero and the density is more

predictable as lower air pressures are used to install it.

Unlike some competitive lightweight "pumpables" this 60 pcf mix is designed to be shot through a conventional piston pump which is widely available throughout the industry.

Where would someone use this mix? The principle use would be in vessels where dust is an issue and multiple trades want to work in the same unit at the same time. The lack of dust and rebounds make it possible for people to be working both above and below the sprayed material. Time will also be saved as volumes will likely be higher than gunite and less time for rebound removal will be needed. Contact your MSSR representative for more information.

## Cement Free Gunning Mix

Breakthroughs in monolithic bonding systems seem to occur about once every decade. In the 1960's, gunning mixes were adjusted to allow for much higher production and became their own refractory category. In the 70's, low cement castables stumbled out of the lab and have since taken over large segments of the market. In the 80's, this technology was pushed to ultra low cement mixes. The 90's led us to cement free bonded mixes based on colloidal silica and alumina gels. No significant new bonding technology was developed in the first decade of the new century, but the second decade is starting out with a bang with the introduction of PDQ gun mixes from Mt. Savage.

The PDQ bonding system develops a strong gel at room temperature with no hydrate phases being formed. This means that the product can be fired immediately after installation and at a faster rate than cement bonded products can safely be heated. The bonding phase, like colloidal silica, continues to get stronger through intermediate temperature ranges and shows excellent hot strength.

The initial developed gunning mix is a 60% alumina product. Other mixes, including fused silica, silicon carbide, and high purity alumina versions are in development and will be available soon. Regardless of what the aggregate is, this new binder system will give many advantages over even low cement bonded gunning mixes.

One of the tests that we have run on the standard 60% alumina system is an alkali test. We suspected that the PDQ bond would be highly resistant to alkali, but the test far exceeded our expectations. After 4 cycles of alkali loading, a standard low cement 60% alumina gun mix breaks apart; the 60% PDQ mix was virtually unaffected. The cup in the sample quickly sealed itself off from the alkali and the test material boiled out of the cup and onto the top in each cycle, leading to no expansive reactions or cracking.

The PDQ bonding system is developed as a gunning mix system. The closest thing to it in a castable or shotcrete would be a colloidal silica bonded product. Meanwhile, PDQ would be an excellent choice the next time you need fast turnaround or dry out, excellent refractoriness, ease of installation, or have a serious alkali problem. Contact your local Mt. Savage representative for more information, pricing, and availability.



This picture shows a standard 60% alumina low cement gunning mix with the cement free PDQ version after 4 cycles in the alkali cup test. Note the expansive cracking in the 60% alumina system, and just a pool of alkali sitting on the PDQ sample.

## Types of Cement Free Bonds

In the previous article, an exciting new cement free bonding system was introduced. Though exciting, it was hardly the first cement free bonding system for monolithics introduced in the refractory world. Other cement free bonding systems have been used for decades and others are relatively new. As of now, there are 5 different cement free systems commercially available that this author is aware of; they are:

1. Clay bonded – can be Plastics, Gunning Mixes, or Castables.
2. Phosphate Bonded – Plastics, Castables, and Gunning Mixes.
3. Colloidal Silica – Castables, Shotcrete, Gunning Mixes.
4. Alumina Gel – Castables, Shotcrete, and Gunning Mixes.
5. PDQ Gun Mixes

Each of the bonding systems have applications that they are best suited for. By reading the articles in this newsletter, we hope you can get a feel for which cement free technology might fit your individual application. Contact your Mt. Savage representative for more information.

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## Old Dog Plastics

They say that you can't teach an old dog new tricks, but don't tell that to Ed Swanson of Curwensville, Pennsylvania. A little over a year ago, Mt. Savage introduced their new plastic line at the Curwensville operation. Since that time, the improvements made by Ed and his crews have been remarkable. The plastic was pretty good at first, but improvements were made based on feedback from our customers. Based on their input, following are some of the improvements that have been made.

The clots are now placed in the box vertically instead of horizontally, making it easier to separate the clots when opening the box. The shelf life of both the air set plastics and phosphate bonded plastics have been dramatically increased, both are in excess of 6 months when properly stored. The cohesiveness has also been improved, with customers indicating that Mt. Savage plastics are the easiest to ram overhead, staying where you try to put them. The workability on the standard mixes has been made to a softer range, right where most customers like it for jobs being done with plastics today. Mt. Savage also offers a 70% alumina blue plastic, **SAVAGE RAM 70 BLUE**, which brings back memories of the glory days of easy to use mullite based plastics. Boxes have been right sized for each plastic, making them easier for installers to handle. Many of these improvements have been transferred to the Mt. Savage, Maryland facility and customers will not see a difference in quality between the plastics at either plant.

The improved shelf life coupled with higher business activity has allowed Mt. Savage to stock **SAVAGE RAM 70 BLUE** and **SAVAGE SUPER RAM AS** at both plant locations. This allows us to offer volume pricing for these products even when buying single pallets. **SAVAGE RAM 85** is also made in full truckload quantities. Thus, customers can expect quality, consistency, and value when buying plastics from Mt. Savage.

All of these changes have led to higher demand, so Curwensville made some changes to the production line recently to increase capacity. The production area is now heated and heated storage was added to prevent freezing of finished product in the winter. Largely because of the increased plastic volume, a second crushing line was installed recently to keep up with aggregate demand. A larger surge bin eliminates down time between batching and extrusion. Mt. Savage will continue to make the investments needed to better serve our customers



This shows Curwensville Plastic Line during production last winter. Improvements will make it even busier this coming winter.

## Ask Dr. Dirt

**Dear Dr. Dirt:** Mt. Savage has had a remarkable run of new products lately, how do you guys do it? **Tim in Denver, CO**

**Dear Tim,** Creativity is like football talent, you take what you are given then you work hard at it. In our case, we have a naturally creative individual as technical director, Craig Felton. Starting at Mt. Savage when the research budget would not buy a round of drinks for a gunite crew, Craig learned to work with what he had to compare the laboratory with real life situations. During that time, Craig developed a series of tests that we have found to be remarkably predictive of field results which we affectionately call the West Virginia Tests. They include tests on gunning, pumpability, flow, and setting. A wide variety of very successful products were developed on a shoe string budget. Now that the research budget is a little larger, Craig is coming into his own with an impressive number of mix developments in the past couple of years that have led to widely successful products. Some may call Craig a tad eccentric, but to be creative, you need to dare to be a little different.

**Dr. Dirt**



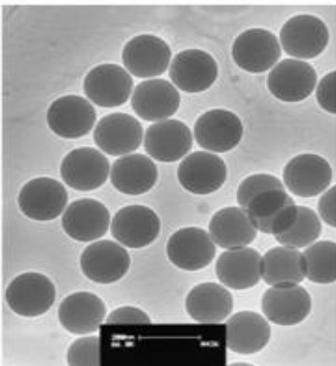
**Buzzi says**  
"Refractory  
Plastics are the  
original cement  
free monolithic  
products."

## Colloidal Silica Bonds

A colloid is a particle that is half way between a dissolved particle and a solid particle. Dissolved particles, like salt stirred into water, are broken down to the atomic level and will not settle out due to gravity. Solid particles, like the fine grains in a dipping consistency mortar, will eventually settle due to gravity per Stokes's Law, with bigger particles settling faster than smaller ones. A colloid is a very, very small particle that exhibits some of the characteristics of solutions and some of the behavior of solid particles. The particles are so small, for instance, that something called Brownian Motion keeps them from settling due to gravity, making them act like a solution. In other words, the particles moving around bounce off each other and keep them from going to the bottom of the beaker. This combination of properties can be and is used in refractories to form a bonding system that exhibits some very interesting properties.

A colloid can be almost any metal oxide, but the most common one used in refractories is colloidal silica. The particles in colloidal silica are about a half micron in diameter, a thousand times smaller than the diameter of a human hair. With the right additive, these very fine particles can be made to gel, and when used as a binder in a refractory, form some green strength. The strength continues to develop as the material is dried then fired. Because of their size, colloids tend to be very reactive and start to form a very strong bond at fairly low temperatures.

Mt. Savage has developed several castable/shotcrete mixes using colloidal silica as a bond. These products exhibit excellent strength at intermediate to high temperatures, excellent hot load properties, good alkali resistance, and an ability to be dried out quickly as there are no hydratable phases present in the colloidal silica.



Pictured here is a SEM photograph of spherical colloidal silica particles. The bar at the bottom is 1000 nanometers, which is pretty darn small.



Buzzi says, "Not all cement free products can be dried out quickly, make sure that the proper dry out is used for the material being installed."

## Alumina Gel Bonds

Another lime free bonding system that has been used for a number of years is the alumina gel bond. This is based on an activated rho alumina material that when mixed with water forms an alumina gel. This then turns into an alumina hydrate that bonds the castable much like a lime bearing cement without the lime. The advantage of this system is its extremely high refractoriness as there is no lime or silica present to flux the castable at high temperatures. The disadvantage of this system is that the alumina hydrate, like a cement hydrate, will contain water well above the boiling point, meaning that a controlled dry out will be necessary.

Mt. Savage has several products that contain an alumina gel bond. These products are designated with the NC suffix. Thus, an ULTRA-TEK 70 NC represents a 70% alumina low moisture castable that is bonded with an alumina gel bond. These products tend to have excellent resistance where gas streams would attack either lime and/or silica and in reducing applications where phosphate bonded materials like Q-TEK would not be advisable. In reheat furnaces, they can also prevent sticking of scale that may attach itself to lime and silica bonded castables.

For applications such as hydrofluoric acid, ULTRA-TEK 100 represents a virtually lime and silica free product with excellent acid resistance. The melting point of this refractory would be in excess of 2100°C, though the rho alumina would cause some shrinkage of the castable above 1600°C.

These castables act much like low or ultra low cement bonded materials and can be pumped and/or shotcreted. The process of doing this is the same as it is with low cement materials. Though they are more limited in use than the silica gel bonded materials (PDQ) and require a controlled dry out, there are a number of applications where the NC brand is the product of choice.

## **Gunned Plastic in a Bag**

Mt. Savage offers several phosphate bonded specialty products in the market. One of them is a two component gunning system under the brand name **Q-TEK**, the Q being for quick. This system has been used for years as a patching material where fast turnaround is required. More recently, several customers have discovered the advantages of this unique phosphate bonded system for larger initial installations with a great deal of success. The characteristics of the materials make Q-TEKs the right choice for many applications over cement bonded or other phosphate bonded gunning mixes or even rammed plastics.

Compared to cement bonded mixes, the Q-TEK system offers some significant advantages. This bond attaches itself better to used refractory than cement bonded materials, making it a better patching material. The lack of a hydratable phase means it can be fired as soon as installation is complete and at a faster rate since no hydratable phases are present. It is highly successful in areas where the furnace air stream is corrosive to lime and cement, making it an excellent cement free alternative.

There are also several advantages of the two-component Q-TEK system versus gunned plastics or single component phosphate bonded gunning materials. Compared to gunned plastics, Q-TEK guns much more like a standard gun mix, having lower rebounds and much lower inclination to clog the hose. This allows much higher production rates and a higher degree of safety for the operator, as clogged hoses can be dangerous for nozzle men on scaffolding. Compared to single component phosphate mixes, Q-TEK gives the same basic properties at a much lower cost, thus providing a much higher value. Once the Q-TEK is on the wall, the chemistry and properties are practically identical to a phosphate bonded rammed plastic lining.

This makes Q-TEK an excellent choice anywhere you would use a phosphate bonded ramming mix and you don't have forty people to ram the wall.

Like all Mt. Savage gunning products, Q-TEK gunning mixes are designed to be user friendly. The proper mix design and pre-dampening levels keep rebounds and dust to a minimum. The result is the equivalent to a rammed plastic lining in a quarter of the time. A recent construction job in a zinc recovery furnace demonstrated a 9% loss counting both trim and rebounds over a 220 ton installation. Whether it is a patch of old refractory, or new construction in an air stream not friendly to cement bonded materials, Q-TEK could be the answer to your situation.

To see how smoothly this material goes on, cut and paste this link to your computer and see for yourself:

<http://www.youtube.com/watch?v=QKRD2e49bAo>



**A wall recently shot with Q-TEK 32 GM. Overall appearance was of a wall rammed with plastic. The result was also the same with a strong, phosphate bonded monolithic lining.**