

GREENFREE™ 92

GREENFREE™ 92 remains one of the more useful and cost effective, basic brick available to the cement and lime industries. Developed several years ago by the engineers at A.P. Green, this product came to Resco in the acquisitions of March 2000.



Classified as a 1st generation spinel refractory, the spinel ($MgO \cdot Al_2O_3$) in GREENFREE™ 92 forms by reaction of alumina with magnesia in the brick matrix during burning. This spinel type is termed *in-situ*. While this technology has been practiced longer than 2nd generation technology (where the spinel component is pre-reacted), 1st generation technology is not necessarily inferior.

The features of GREENFREE™ 92 are:

- Chemical compatibility with the cement and lime process,
- Higher strengths,
- Reasonably good thermal conductivity, and
- Lower cost.

A high magnesia content and a silicate phase balanced to dicalcium silicate afford GREENFREE™ 92 good compatibility with cement and lime production. The limited spinel content imparts good mechanical strength. As measured by ASTM C-76, GREENFREE™ 92 has a cold crushing strength over 5000 psi, and yet it retains very good thermal shock resistance.

Primary applications for GREENFREE™ 92 include standard service in rotary cement kiln upper transition zones, burning zones of cement kilns with precalciners, and rotary lime kiln burning zones for both pebble lime and lime recovery kilns.

	GREENFREE™ 92	GREENFREE™ KF
Type	1st Generation Magnesite-spinel	Hybrid Magnesite-spinel
Bulk Density, pcf	176 pcf	176 pcf
Apparent Porosity	20%	18
Modulus of Rupture (ASTM C-76)	780 psi	700 psi
Cold Crushing Strength (ASTM C-76)	5400 psi	4900 psi
Thermal Conductivity (K-factor) at 1500°F (816°C)	25.5	19.5
Approximate Chemical Analysis:		
MgO	91.8%	84.5%
Al ₂ O ₃	4.8	12.2
CaO	1.8	1.8
SiO ₂	1.1	1.1
Fe ₂ O ₃	0.5	0.4

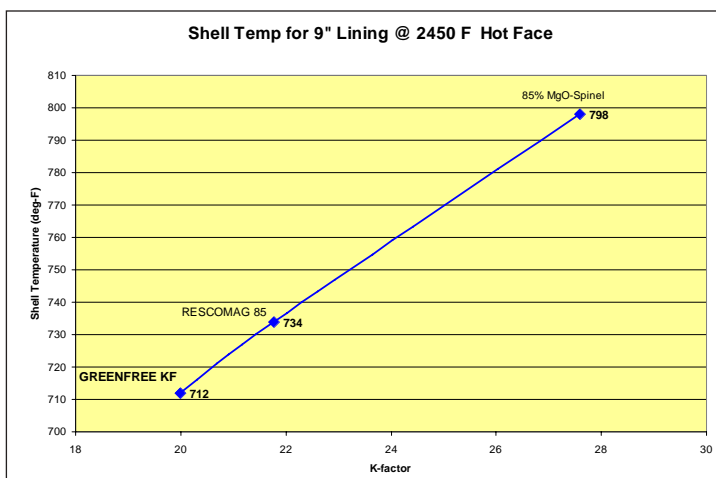
New Magnesite-Spinel Brick with Improved Insulating Value for Rotary Kilns

Kiln shell temperatures are influenced generally by four factors: refractory hot face temperatures, thermal conductivity ("K-factor"), the refractory thickness, and the presence or absence of a coating. In many cement kiln upper transition zones and rotary lime kiln burning zones, coatings do not form well, so the thermal conductivity of a basic brick is a key factor in controlling shell temperatures.

Responding to the need especially in the lime industry for better insulating value, our engineers proceeded with a plan to enhance the insulating value in our magnesia-spinel product offerings. The result is GREENFREE™ KF. Using a hybrid technology based on GREENFREE™ 92 and RESCOMAG® 85, GREENFREE™ KF features high strength, good thermal spalling resistance, and improved shell temperatures.

When measured by ASTM C-201, GREENFREE™ KF has a K-factor of 19.5 BTU/ft²-hr-°F/in at a mean temperature of 1500°F (800°C). This is 24% lower than GREENFREE™ 92 and 29% lower than typical second generation 85% magnesia-spinel brick.

Using a hot face temperature of 2450°F (1343°C), a 9" (228-mm) thick lining and no coating, the estimated shell temperature for GREENFREE™ KF is approximately 712°F (378° C). This is approximately 86°F (54°C) lower than a typical second generation 85% MgO spinel brick. (See Graph) The reduction in heat flow is approximately 1125 BTU/sq ft-hr. For a 10' length of GREENFREE™ KF in a



16' diameter kiln, the reduction is over a half-million BTU/hour. In a year's time and at a cost of \$2 per million BTU, the savings is estimated at \$9,830.00.

GREENFREE™ KF can be a Key Factor in reducing your burning zone shell temperatures.

GREENFREE™ KF is made at Resco's basic brick plant in Marelau, Quebec.



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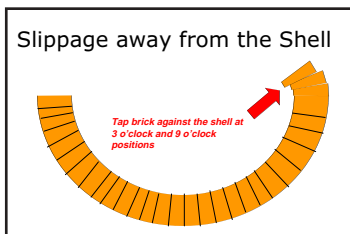
Brick Installation Tune-up

While many cement and lime plants contract their brick installation to professional installation contractors, some plants continue to perform their own installation. Refractory linings are generally lasting longer, and many plants do major brick jobs only once per year. With less practice, it is difficult to maintain a high skill level among plant workers for brick installation.

Proper brick installation is critical to the performance of the kiln refractory. Here are a few conditions that are important to prevent during installation.

Slippage of Brick above the Spring Line

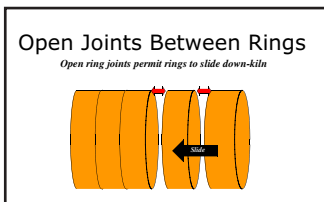
One common error that bricklayers make is to install brick too far above the 3 o'clock and 9 o'clock positions. Above these positions, the brick have a tendency to slip away from the kiln shell. This can lead to brick slipping out of the rings.



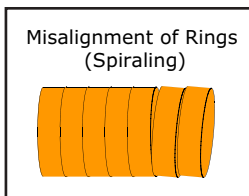
After the kiln rig is placed on the brickwork in the bottom of the kiln, construction of the overhead portion of the ring begins. Drive the brick back against the shell at and above the 3 o'clock and 9 o'clock positions. While tightening the ring during the keying process, the brickwork should again be tapped against the shell at these positions.

Open Joints between the Rings and Ring Misalignment

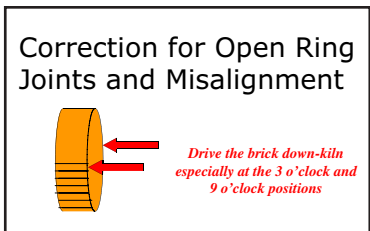
Properly installed brickwork should remain in place during its entire service life without any shifting or movement. Any looseness in the ring joints can lead to movement of the rings, and damage due to crushing and shifting.



In addition, misalignment of the rings can occur as a result of open ring joints. As construction of the bottom kiln lining progresses toward the 3 o'clock and 9 o'clock positions, there is a tendency for the ring joints to open. When the overhead portion of the lining is installed, the keying process causes the ring joints to close up again. Ring misalignment results and doglegs can form.



The remedy for this condition is to grab the hammers and drive the brickwork **down-kiln**, expending particular effort at the 3 o'clock and 9 o'clock positions. Tightening the ring joints prevents doglegs and keeps the rings in alignment. Properly aligned brick rings allow for more even distribution of the stresses that eventually form within the lining as a result of thermal expansion. Good alignment helps prevent movement down-kiln that causes crushing and shifting.



NEW QUIKTURN™ for Preheater Riser Ducts

QUIKTURN™ 60G and QUIKTURN™ 60PC have become one of Resco's fastest selling product families. Designed to use process heat for initial dry-out, these materials have seen increased application in cement kiln lines when it is difficult to implement a scheduled dry-out.

The QUIKTURN™ 60G (Gunning) and QUIKTURN™ 60PC (Pump Cast) family has now been augmented with two specialized products designed for build-up management in the cement kiln preheater: QUIKTURN™ 56SCG and QUIKTURN™ 56SCPC. Formulated as a gunning mix, QUIKTURN™ 56SCG features excellent strength, and alkali and abrasion resistance, along with high silicon carbide content. QUIKTURN™ 56SCPC can be pump cast or applied as a wet shotcrete.

	QUIKTURN™ 56SCG	QUIKTURN™ 56SCPC**
Maximum Service Temp.	2700°F	2700°F
Bulk Density *	147 pcf	155 pcf
Cold Crushing Strength *	14,500 psi	11,000 to 15,000 psi
Modulus of Rupture *	3300 psi	2,000 to 3,000 psi
Erosion Loss * (Typical, ASTM C-704 test)	7 to 9 cc	<12 cc
Typical Chemical Analysis (%)		
SiC	54.9%	55.9
Al ₂ O ₃	27.5	28.1
SiO ₂	15.3	14.3
Fe ₂ O ₃	0.3	0.3
TiO ₂	0.5	0.5
CaO	0.9	0.9
Alkalies	0.2	--
* After Heating to 1500°F (815°C)		** Preliminary Data

Editor's Corner

Resco for the Long Run

I can't remember where the summer went. Somehow the end of September got here. September's last weekend brings Pittsburgh's The Great Race (10K). At 51, I'm hardly built for speed anymore, but I enter The Great Race just because it's fun. My goal each year is just to finish. This year with so much going on (more on that later), my distance training became the last pallet off the flatbed, so TGR will indeed be a very Long Run for me.



Since 1946, innovative products like AA-22® and the semi-universal ladle brick made Resco successful for the long run. A new management team came to Resco in 1998, led by Bill Brown, president, and positioned the company for future opportunity. By 2000, the team made acquisitions that doubled the size of the company and placed it into several markets new to Resco. With the acquisitions came a group of refractory industry specialists who brought a wealth of experience for the long run.

Although the face of Resco has literally changed over the past 5 years, its goal remains success for the long run based on credible and innovative products. Resco's established and new products are directed to helping your operation achieve the Long Run. This letter highlighted some of those. Now if I were only as well prepared for my Long Run....

If you're interested in seeing a short seminar on our products for the Long Run, send me a note on e-mail.

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