



RENO
REFRACTORIES, INC.



MONOLITHIC REFRACTORIES FOR TODAY'S CEMENT PLANTS

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About Reno Refractories, Inc.

Reno Refractories, Inc. began making its monolithic refractories in the mid 1980's under the guidance of Mr. Sid Reno.

Reno Refractories has been, and to this day is, a leader in the development of the nano-bond or No-Cement technology concept.

Reno continues to lead the way with the development of ElectroCast™ a revolutionary bonding system that offers major improvements over cement and NC bonded products.

Reno Refractories is committed to developing new advancements in monolithic refractories to bring cost savings to their customers.

WHAT WE DO:

"INNOVATION" is the driving force for the Reno Refractories team. We service multiple industries and have the ability to offer high quality new product developments that meet the changing operational needs of our customers and lower their overall operating cost.

RESEARCH AND DEVELOPMENT:

Reno Refractories R&D Department boasts extensive research capabilities and tools including scanning electron microscopy, x-ray diffraction, mercury porosimetry, thermo-gravimetric analysis, thermal expansion, optical microscopy, thermal conductivity and laser/optical analysis of particle sizing.

PRECAST:

Our precast division has the ability to cast anything ranging from 5 lbs. in weight to 25,000 lbs. We have three dry-out ovens with a maximum temperature of 1093°C (2,000°F). With refractory production and lab facilities in-house, the precast facility has an enormous advantage, over others, to meet and exceed the goals of our customers. We pride ourselves in quality and promptness to satisfy the needs of our customers.

QUALITY CONTROL:

Reno Refractories quality control department has physical testing and analytical capabilities which are supported by high quality equipment operated by qualified technical personnel. A full range of analysis instrumentation is available for activities such as process control, verification of incoming raw materials and investigative activities.

SERVICE:

Reno Refractories has highly trained salesmen and installation field team members with many years of experience that you can rely on to provide you with the optimum refractory products for Cement Plant Refractories.

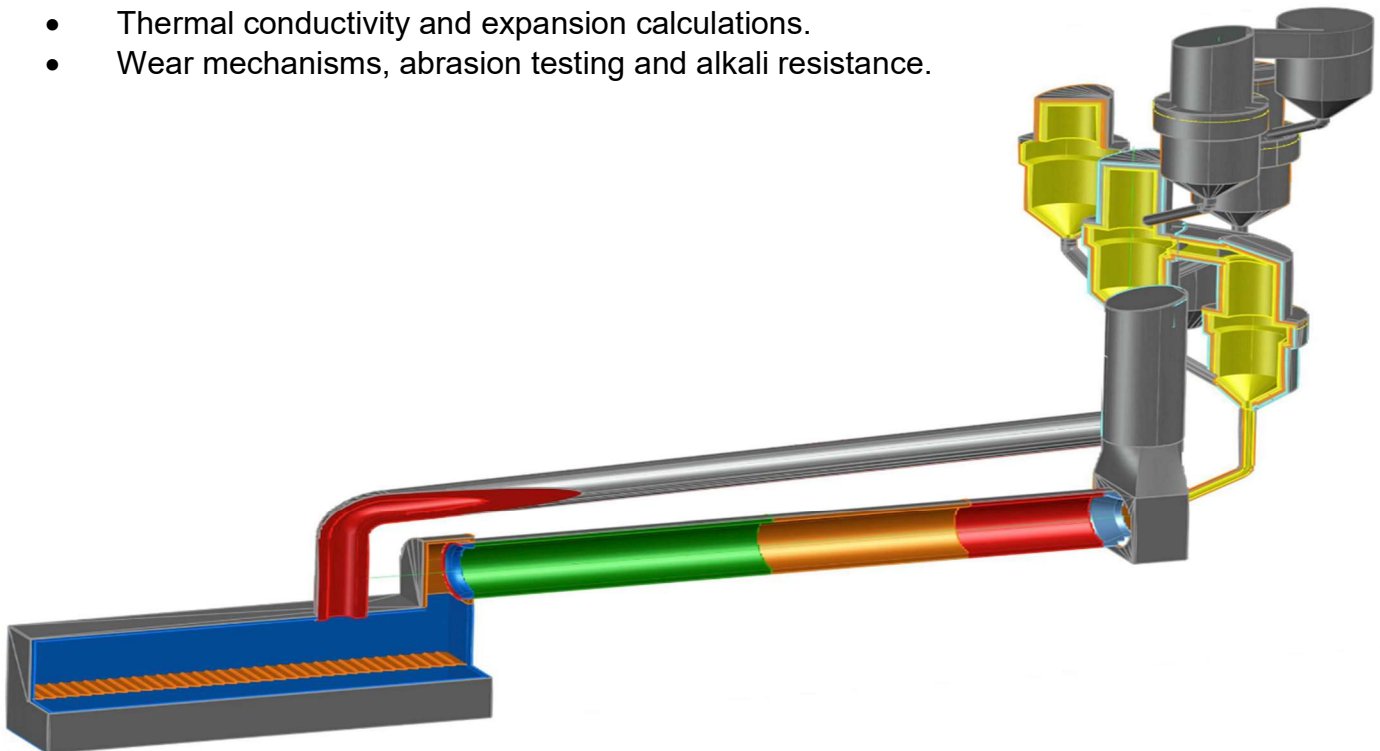
PRODUCT CONSIDERATIONS

There are many factors when considering the optimum refractory to use in a cement plant application. These can range from simple issues to more complex factors, like the following:

- Fuel types used - coal, pet coke, alternative fuels.
- Atmosphere - reducing or oxidizing.
- Installation methods - gunning, casting, shotcreting.
- Dry-out - method to use, independent or during startup.
- Wear Mechanisms - Alkali attack, abrasion, thermal shock, etc.
- Thermal analysis - assists in determining the anticipated shell temperatures to minimize shell corrosion by dew point corrosion from alkali/chloride condensation. Also addresses expansion allowance requirements.
- Location to be installed - upper stages, cooler, riser, etc.
- Turnaround time - how much time is practical for the installation method chosen and material to install.
- Time of the year - hot or cold temperatures affect the final properties.
- Cost - must be cost effective.

Fortunately, there are tools available to assist in addressing the refractory choice(s) based on the above.

- Recommended dry-out schedules.
- Installation guidelines, including cold/hot weather installations.
- Thermal conductivity and expansion calculations.
- Wear mechanisms, abrasion testing and alkali resistance.



A common test for alkali resistance or “AR” is the FLSmidt Alkali test. This is a very aggressive test that provides a starting point on whether a product meets satisfactory alkali resistance. There is no pass or fail, it is rated as satisfactory or unsatisfactory.

This test procedure incorporates a standard cup test of the selected material by inserting a specific amount of anhydrous potassium carbonate (K_2CO_3) into the cup and heating the sample to 1100°C (2012°F) for 5 hours. The sample is then cooled and cut with the depth of penetration measured. To meet satisfactory test results, the penetration must be <3mm (0.12") and not exhibit any expansion or cracking, i.e. alkali bursting.

Reno Refractories has conducted extensive alkali testing of our product line. One of the product lines that has obtained excellent results in cement plant operations is our NC products. The No Cement bond does not contain calcium compounds (calcium silicate, calcium aluminate) which expand and cause cracking after reacting with sodium or potassium vapors. This bond is based upon amorphous silica and is much more resistant to reaction with alkali vapors in the 1100-2000°F temperature range of interest.

Common to all of Reno's NC castables which incorporate nano particles into the bond, the pore size openings are considerably smaller. Typically, the majority of pores in the bond phase are one to two microns in size, versus 10-30 microns for low cement castables of equal mineralogy. With smaller pores, the ability of vapors to enter the matrix and react with the refractory is reduced. This essentially makes the material "non-wetting" and less reactive to alkali attack.

Reno's NC, or No-Cement, castables incorporate a mullite forming, high temperature, ceramic bond. Due to this bond, improvements of hot strengths are seen in these products as exhibited by 100 to 300% increase in HMOR or hot modulus of rupture values at 1370°C (2500°F) when compared to low cement castables of equal density and mineralogy. Greater hot strengths provide less erosion by dust laden air streams at high temperatures.

Another key advantage of No Cement castables is that they retain more than 40% of their original strength when tested using the ASTM C-1171 thermal shock procedure. These values are usually 50 to 100% greater than competitive cement bonded materials. This improvement is due to the non-crystalline nature of the gel bond which is more flexible and resists damage due to expansion/contraction.

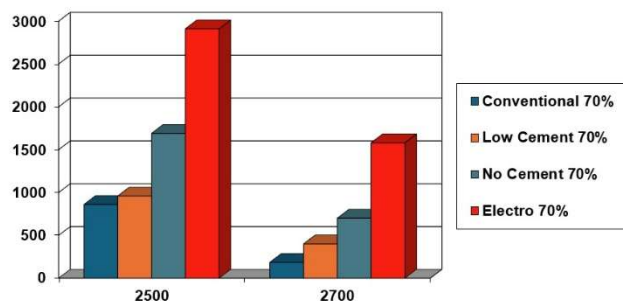
Reno's ElectroCast™ technology is a totally new advancement over other bonding systems. This is achieved by employing an electro-chemical bond which yields properties far superior to other competitive NC and conventional cement bonded products.

Some of the advantages of the ElectroCast™ bonding system are:

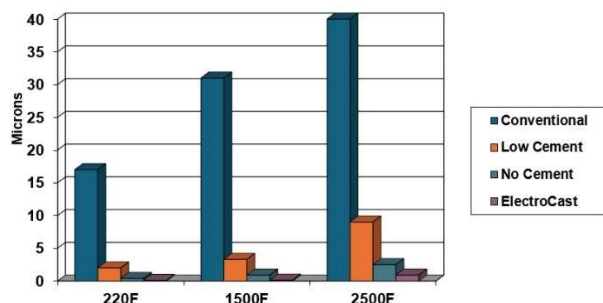
- Lower porosity and reduced pore sizes provides better alkali and vapor resistance. High hot strength that imparts higher load capacity with less cracking.
- Lower water demand - 25-35%.
- Better corrosion resistance due to the higher purity bond. Lower abrasion.
- Lower permeability.

Improvements in the hot properties (HMOR) and apparent porosity (%) are dramatically better than was previously attained due to synthetic mineralization driven by the Electro-Chemical bonding as shown in the comparison graphs below.

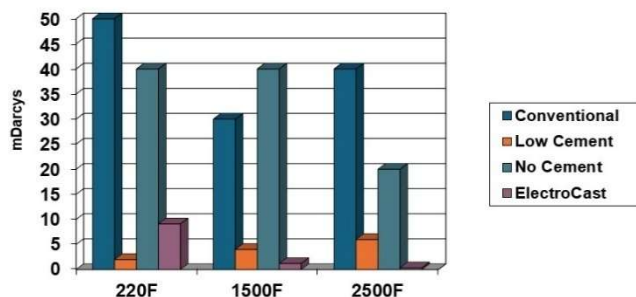
**Bond Comparison
Hot MOR**



**Pore Size Comparison
Median**



**Bond Comparison
Permeability**



The chart to the left provides a comparison of the permeability obtained with the ElectroCast™ technology.

Consult with your Reno representative for additional information on the ElectroCast™ product line, support on thermal analysis, dryout, precast shapes, installation guidelines and other product or services.

Summary of Reno Products by Use Area and Install Method

AREA	CASTABLE	SHOTCRETE	GUN MIX
Stage 1 (Top) & 2	Cast 26 - PC	Cast 26 - PC	Gun 28
Stage 3	Cast 40 AR ASAP Cast 52 AR LC	Cast 40 AR ASAP Cast 52 AR LC	Gun 28
Stage 4	Electropump™ 1152 AR ASAP Cast 52 AR LC	Electropump™ 1152 AR ASAP Cast 52 AR LC	NC Gun 18 Z NC Gun 52 AR
Calcliner	Electropump™ 1152 AR NC 52 AR ASAP Cast 52 AR LC	Electropump™ 1152 AR NC 52 AR ASAP Cast 52 AR LC	NC Gun 18 Z NC Gun 52 AR
Riser	ASAP Clean 33 Z Electropump™ 1125 SiC	ASAP Clean 33 Z Electropump™ 1125 SiC	NC Gun 18 Z NC Gun 52 AR (patching only)
Feed Shelf	ASAP Clean 33 Z	ASAP Clean 33 Z	NC Gun 18 Z
Feed Hood	Electropump™ 1152 AR NC 52 AR ASAP Cast 52 AR LC	Electropump™ 1152 AR Jet Cast NC 52 AR ASAP Cast 52 AR LC	NC Gun 52 AR
Tail Ring	ASAP Clean 25 SIC ASAP Clean 18 Z	ASAP Clean 25 SIC ASAP Clean 18 Z	NC Gun 18 Z NC Gun 52 AR
Firing Hood	Electropump™ 1152 AR NC 52 AR ASAP Cast 52 AR LC ASAP Pump 60 AZR LC	Electropump™ 1152 AR Jet Cast NC 52 AR ASAP Cast 52 AR LC ASAP Pump 60 AZR LC	NC Gun 52 AR NC Gun 60 AZS
TA Duct	Electropump™ 1152 AR NC 52 AR ASAP Cast 52 AR LC	Electropump™ 1152 AR Jet Cast NC 52 AR ASAP Cast 52 AR LC	NC Gun 52 AR Super Abrade AZS-GR ASAP Gun 60 Z
Nose Ring	ASAP 75 ABR ASAP Clean 25 SIC Electropump™ 1125 SIC	ASAP 75 ABR ASAP Clean 25 SIC Electropump™ 1125 SIC	NC Gun 18Z
Cooler Drop Walls & Hot Curbs	ASAP 75 ABR Jet Cast NC 6059	ASAP 75 ABR Jet Cast NC 6059	NC Gun 6059
Cooler Walls	ASAP Cast 60 LC ASAP Cast 70 LC	ASAP Cast 60 LC ASAP Cast 70 LC	NC Gun 52 AR
Cooler Curbs	ASAP Cast 60 LC	ASAP Cast 60 LC	ASAP Gun 80 ABR
Cooler Bullnose	ASAP Clean 25 SIC Jet Cast NC 6059	ASAP Clean 25 SIC Jet Cast NC 6059	NC Gun 6059
Cooler Roof	Jet Cast NC 6059	Jet Cast NC 6059	NC Gun 6059
Cooler Cold Zone	ASAP Cast 60 LC	ASAP Cast 60 LC	ASAP Gun 80 ABR
Cooler Vent Duct	ASAP Cast 52 AR LC	ASAP Cast 52 AR LC	ASAP Gun 80 ABR
Burner Pipe	Reno Cast 70 KH		
Burner Pipe Tip	NC 6059 NC 90 AR NC 52 AR		
Backup Insulation	Lite Cast 22	Pump 80 LW FF	Lite Gun 40
Hot Repairs			Mach Gun 60 P ASAP Gun 80 P
Kiln Brick Patch			NC Mag Gun
Hot Gas Generator	NC Pump 50 FS		NC Gun FS
Cooler Cyclones	Super Abrade RT-GR		Super Abrade RT-GR
Raw Mill/Finish Mill	Super Abrade RT-GR		Super Abrade RT-GR

The above is not an all-inclusive listing of all the products Reno manufactures for cement applications or that can be used in any area. Please consult with your Reno Representative if you have any questions, have a particular need or require additional information.



***MAKE RENO YOUR FIRST CALL FOR ALL OF YOUR
MONOLITHIC NEEDS!***

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It is the mission of Reno Refractories, Inc. to investigate, develop, communicate and deliver valuable refractory products and services to our customers in North America. We have a responsibility to supply the best value in refractory technology by optimizing the profits and safety of our customers. We take pride in our reputation as a leader in these endeavors.
