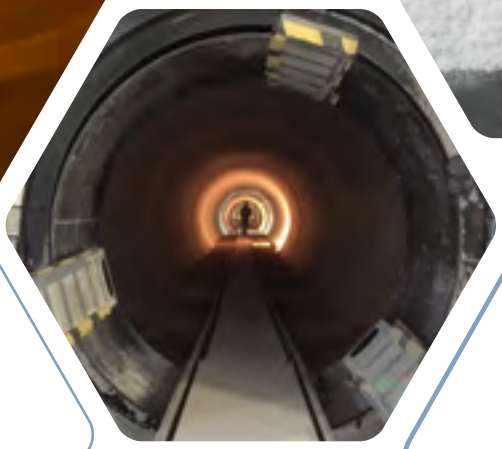
REal

ALUMINA SOLUTIONS
FOR REFRACTORIES



2022-09

SPECIALTY ALUMINAS FOR HIGH PERFORMANCE REFRACTORIES

alteo
SMART ALUMINA//

ALTEO: A WORLD LEADER OF SPECIALTY ALUMINAS FOR HIGH PERFORMANCE REFRACTORIES

Since 1893, and the start-up of its plant in France, Alteo has always looked ahead to the future to develop, manufacture, and deliver specialty aluminas for highly demanding applications.

For more than 30 years, Alteo has been a major supplier of calcined and reactive aluminas for the refractory industry. Alteo has been and is dedicated to improving the knowledge, performance, and behavior of refractory products.

Working with Alteo enables our customers to:

- **Put product stability in the forefront**
  thanks to a century-old expertise in the world of alumina
- **Run a smooth and efficient manufacturing process**
  thanks to our product and service range
- **Improve the performances of their range of products**
  thanks to our dedicated technical team, laboratories and alumina range of solutions
- **Choose a supplier with a vision toward the future**
  thanks to our environmental responsibility

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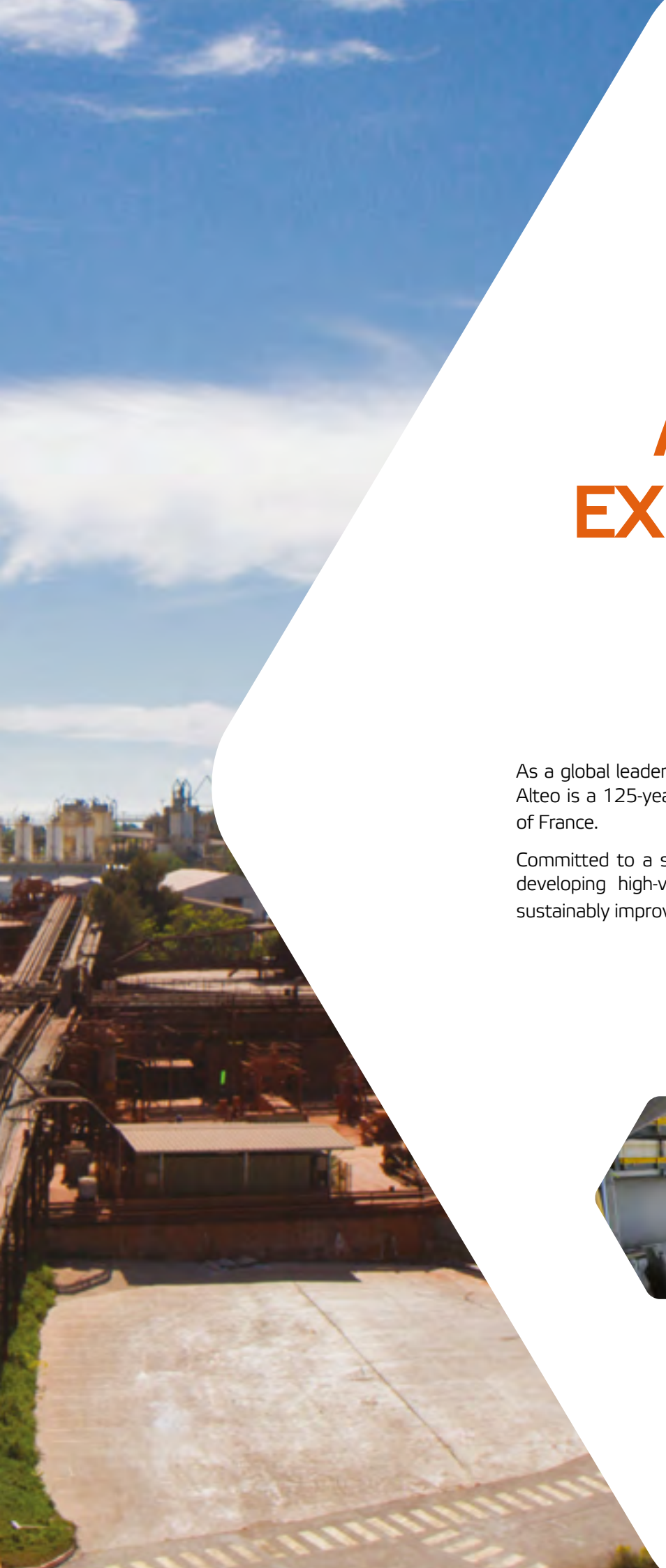


ALTEO EXPERTISE

As a global leader in the production of specialty aluminas, Alteo is a 125-year-old manufacturer located in the south of France.

Committed to a strategy of sustainable growth, Alteo is developing high-value products while continuously and sustainably improving its environmental performance.

ALTEO, YOUR SUSTAINABLE PARTNER

As a global leader in specialty aluminas, our sustainable growth strategy is based on two inseparable components:

- **Customer orientation** to supply high-quality products and services to support your growth
- **Sustainable development** in all of our activities

Thanks to our **production process, we can ensure quality at all stages**. Much more than just a powder manufacturer, our teams also provide the **technical support and services** you need.

KEY FIGURES (2020)

191 M€
Turnover

81 %
of turnover exported

629
Customers

59
Countries

509
Employees

17
Sales offices

1000
Direct local jobs

PROXIMITY & FLEXIBILITY WITH OUR CUSTOMERS

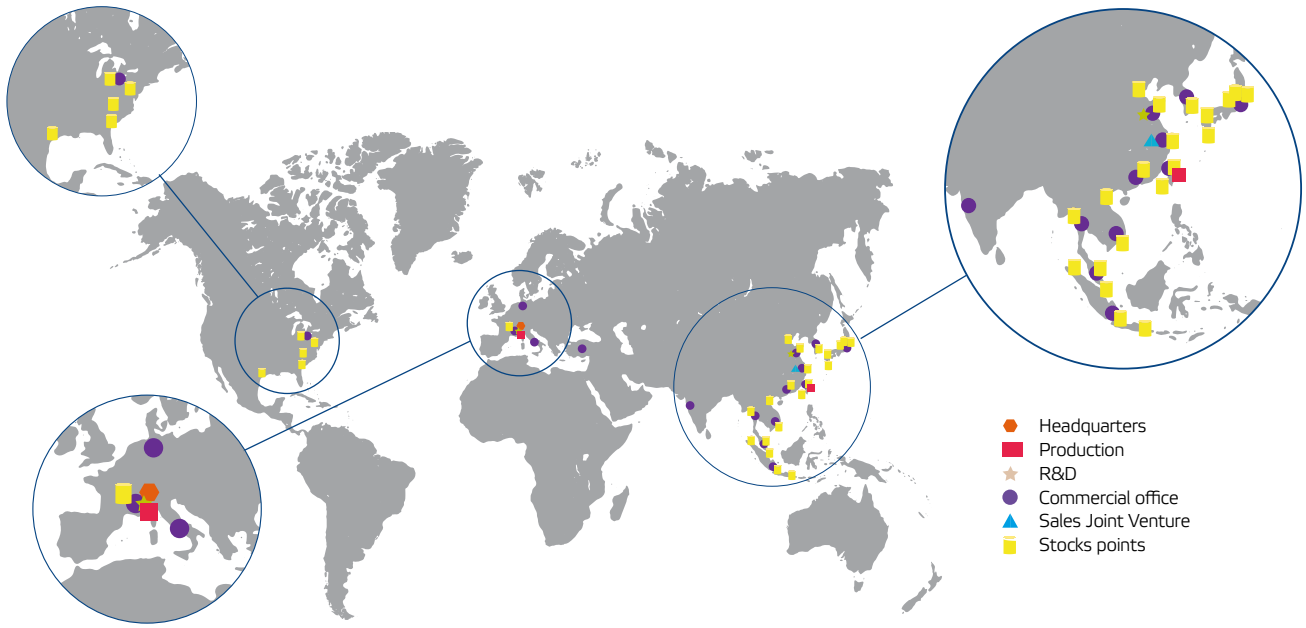
As a major player in the alumina market, our aim is to best serve our customers around the world. With a global network, comprised of **17 offices in Europe, North America, and Asia**, our local sales teams and CSR departments can help you find the best solution, wherever your production sites are located.

Moreover, our technical support department, with dedicated staff and application laboratories (in Europe and Asia), can help you optimize formulations by understanding local constraints and market structure.

To bring **serenity to your daily operations**, we implemented:

- Workshops producing refractory alumina in both Taiwan and France to allow for a **quick delivery time**
- **More than 20 stock points** enabling availability on finished products

Find the nearest Alteo office, workshop, and stock point:



MONITORING PERFORMANCES IN ALL AREAS

Our approach to continuous improvement, operational excellence and the certification of our integrated management system according to the standards ISO 9001, ISO 14001, ISO 45001 and ISO 50001 bears witness to our ambition to achieve excellence.

An integral part of our strategy is to increase our customers' satisfaction and to decrease the negative impacts of our activities.

ENVIRONMENTAL MANAGEMENT

Our Environment & Energy policy is divided into objectives, aiming to:

- Protect the environment and work with our neighbouring communities ;
- Reduce our greenhouse gas emissions and increase our energy performance.

Fully committed to the reduction of the impact of our activities and to the improvement of the quality of water, air and soil, **more than 40% of our investments have been devoted to environmental improvement since 2013.**

ALTEO ALUMINA PROCESS

With more than 125 years of expertise, Alteo is a world leading supplier of specialty aluminas. Managing our production from alumina hydrate to finished product, we can ensure quality and develop the specific product you need.

PRODUCTION

UPSTREAM PROCESS

Different steps enable the manufacturing of alumina hydrate:

1. **Digestion:** Alumina is made soluble in a hot caustic liquor
2. **Precipitation:** Controlled cooling of the liquor and crystallization of alumina hydrate (Al(OH))
3. **Filtration:** Crystallized alumina hydrate is filtered before being sent to calcination

PACKAGING

Before shipment, alumina is packed to ensure its delivery and integrity. In order to be processed smoothly in our customers' processes, different types of packaging are offered by Alteo: paper bags, bulk bags and bulk.

PROCESS

CALCINATION

Alumina hydrate is directed to drying/calcination kilns. Depending on the temperature of calcination, a complete range of alumina (Al_2O_3) can be manufactured from hydrate to "hard" calcined.

GRINDING

Calcined alumina can be milled to adapt the particle size to market needs. Alteo has three milling technologies: continuous milling, batch-ball milling and airjet milling.

LOGISTICS

Our industrial footprint gives our customers the opportunity to have product delivered via road, sea or rail.

SERVICES

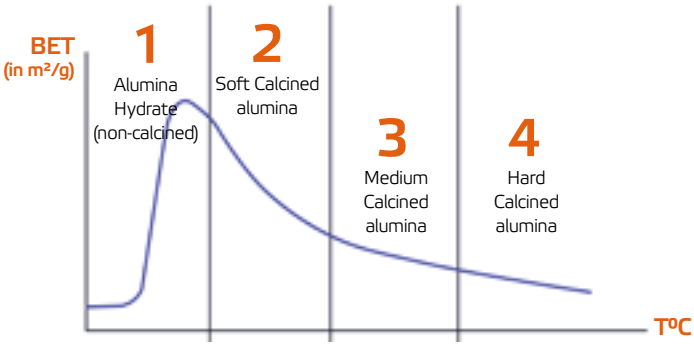
CALCINATION AND GRINDING: key role in shaping alumina performances

In the world of alumina, the calcination step and the grinding step have a big impact on final physical properties (e.g. crystal size, Particle Size Distribution [PSD], BET). Calcination will impact all physical properties (by modifying the crystal size), while grinding will impact PSD and BET.

Thanks to Alteo's expertise in manufacturing specialty aluminas, we are able to manage our calcination and grinding processes to offer s**table and tight specifications** in our **REal®** product range.

Impact of calcination on crystal size and BET

During the calcination process, temperature and loss of water molecules change the structure of the alumina hydrate particle. Step by step alumina hydrate transforms itself into alpha alumina (chemical formula: α-Al_2O_3) and the particle shape changes. Therefore, the calcination process determines the crystal size of Alteo aluminas.



Impact of calcination temperature on BET

Zone 1 : ALUMINA HYDRATE ZONE

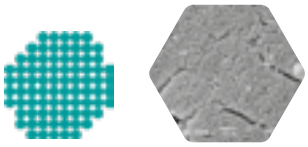
Drying of alumina hydrate occurs. Molecules of water evaporate (free water and linked water). Cracks, resulting from the evaporation of water molecules start to shape the particle surface.

Zone 2 : SOFT CALCINED ALUMINA ZONE

Molecules of water have completely vanished. The particle has now become an alumina particle. Cracks cover the entire surface. Due to the increasing calcination temperature, alumina atoms reorganize to form different crystal structures. Micro porosity of the crystallite decreases and, as a consequence, the BET decreases.

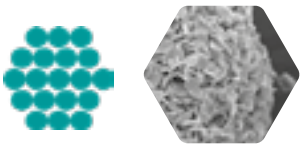
Zone 3 : MEDIUM CALCINED ALUMINA ZONE

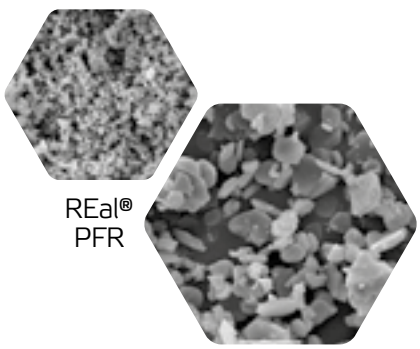
Alumina crystals grow with calcination temperature. Alpha alumina content is around 90-95%.



Zone 4 : HARD CALCINED ALUMINA ZONE

Crystals continue to grow and alumina is fully transformed into alpha alumina (> 97%).





REal® PFR

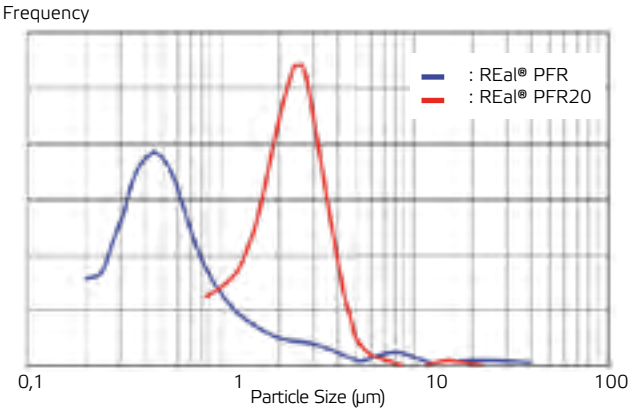
REal® HC-G

IMPACT OF GRINDING ON PARTICLE SIZE DISTRIBUTION (PSD)

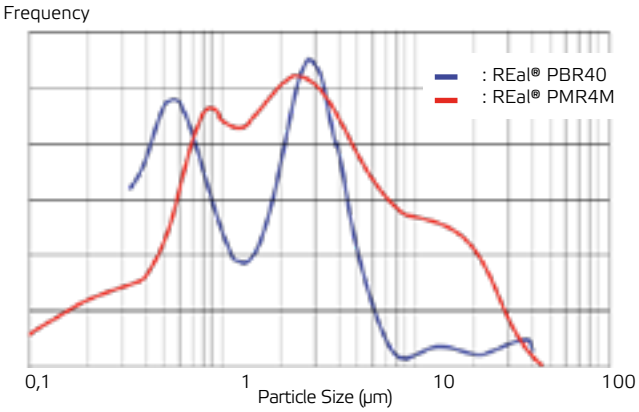
During the grinding process, the bond between alumina crystals is broken due to the high energy released in a grinding mill. To meet refractory formulation requirements, Alteo alumina can be ground or fully ground to primary crystal.

Calcination and grinding determine the Particle Size Distribution (PSD) and average particle size (d_{50}) of Alteo REal® range of alumina.

Typical particle size distribution of Alteo REal® - Reactive alumina



REal® Mono-modal aluminas



REal® Bi and Multi-modal aluminas

TECHNICAL KNOW-HOW IN REFRACTORY APPLICATION

Alteo continues to improve and invest in its technical knowledge of refractory applications. Our technical expertise is due to our:

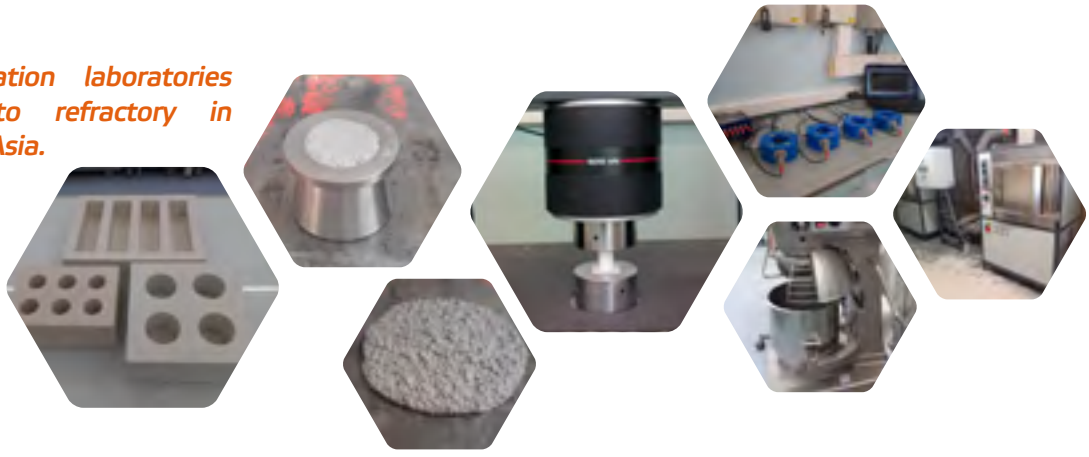
- **Dedicated, multidisciplinary and regularly staffed teams** who have worked over the past 30 years and continue to work on refractory applications (R&D, Development, Marketing);
- Analytical laboratories and application laboratories giving a **quick and reliable answer to any customer requirement** and **developing or co-developing solutions**;
- Tailor-made technical assistance to help our customers **optimize their formulations and improve refractory material performances during operation**;
- Ongoing and future partnership with universities and research centers (e.g., FIRE, GEMM, ICAR,WUST, RWTH Aachen) **to improve refractory material understanding and performance of alumina**.

Alteo technical assistance helps our customers find links between alumina (e.g., PSD, rheology, morphology), refractory material (e.g., flowability, cold and hot properties, wear resistance) and behavior in application (e.g., easy implementation, lifetime, in line with the application requirements).

To assess all these characteristics, Alteo manages and performs various tests and trials:

- Refractory material shaping and firing;
- Slurry/Paste and Castable characterization: flowability, rheology control, setting time, Zeta potential;
- Final properties characterization: density/porosity, microstructure, mechanical strength (CCS, MOR), Refractoriness Under Load (RUL).

Two application laboratories dedicated to refractory in Europe and Asia.



ALUMINA FOR REFRACTORY

Different raw materials with different particle sizes (from sub-micron size to millimeter size) are blended to create a refractory material.

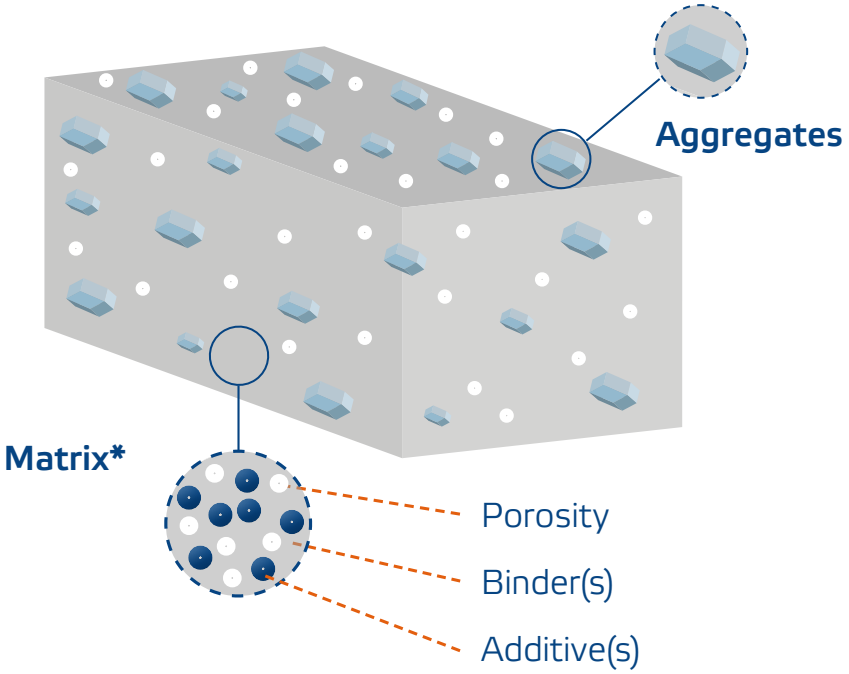
The right formula of raw material and particle size is part of the know-how of a refractory producer.

ALTEO ALUMINA FIELD OF ACTION

REFRACTORY COMPOSITION

Four distinctive phases appear after refractory manufacturing:

- Aggregates: particles from grade <0.2mm to 20mm providing main characteristics;
- Additive(s): Added to reinforce some characteristics;
- Binder(s): Insuring the cohesion of the largest particles;
- Porosity: empty spaces in the material.



Refractory composition when using mixing and assembly of particles

*Binders, additives &porosity altogether are called "matrix".

Alteo REal® calcined and reactive aluminas are designed to complete all the requirements needed for enhancing the matrix performances.

ALTEO ALUMINAS IN REFRACTORY MATERIAL

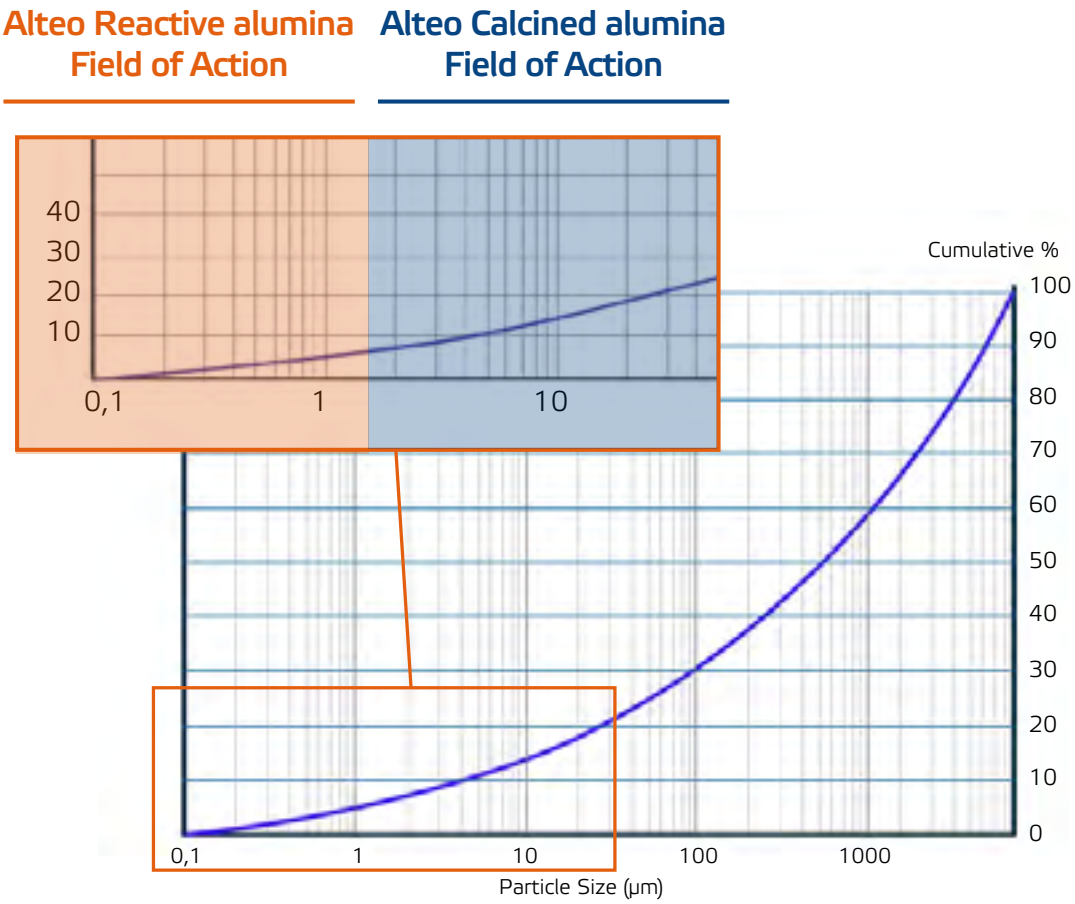
In a refractory formulation, refractory producers usually follow a particle size distribution (PSD) model to have the best packing (less porosity) and flowability (for castability).

The model commonly used are Andreasen's and Andreasen's modified model (modified thanks to Dinger & Funk work). It considers the minimum and maximum diameter of particles, as showed in the following equation:

$$P(d) = \frac{d^q - dmin^q}{dmax^q - dmin^q}$$

P(d) = size cumulative distribution function
d = particle diameter being consider
dmax = largest particle size
dmin = smallest particle size
q = distribution modulus (usually between 0.2 and 0.4)

REal® range of aluminas have an impact on a refractory formulation in a range of PSD between 0.1 µm to 45µm, allowing our customers the best packing.



Alumina-based castable theoretical PSD model (Andreasen's modified)

REFRACTORY END-USERS PROCESSES

Alumina based refractories bring value to various and highly demanding processes.

REal® range of aluminas helps refractory makers share this value downstream.

Iron & Steel industry consumes more refractory than any other industry.

There are two main routes to create crude steel:

- The first route is a two-step process. These plants are called integrated steel mills.

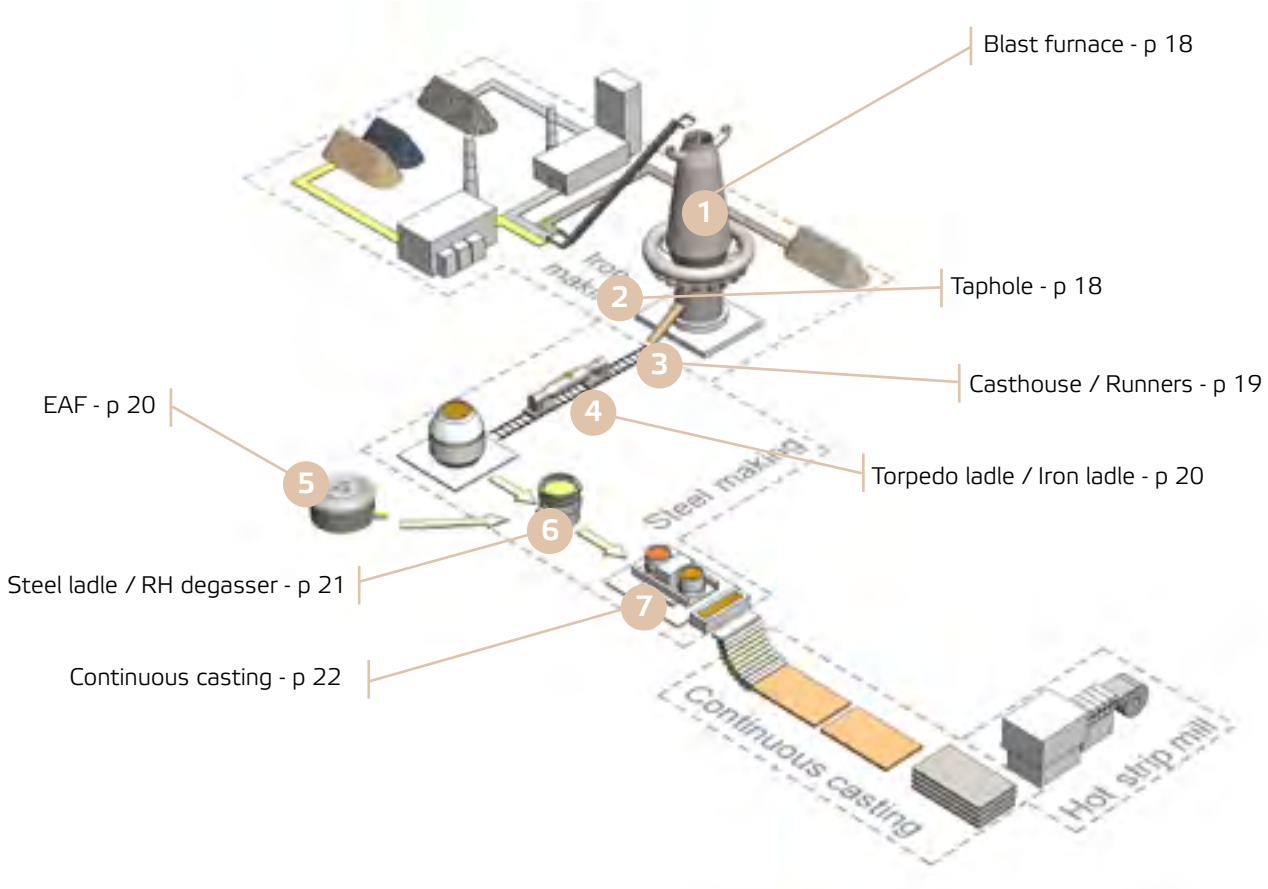
  Step 1 **PRODUCTION OF PIG IRON.** By reducing iron ore into molten iron in a blast furnace.

  Step 2 **REFINING OF PIG IRON.** Pig iron is transferred to a steel mill nearby and transformed into crude steel.

- The second route is by melting steel scraps in an electric arc furnace. Molten steel is created and then transferred to a steel mill to be processed again. These plants usually are called mini-mills.

Refractories formulated with **REal®** range of alumina can be used in most parts of the process. This brochure **focuses only** on applications where **REal® calcined and reactive aluminas are found.**

The main applications are listed below:



Steel plant overview

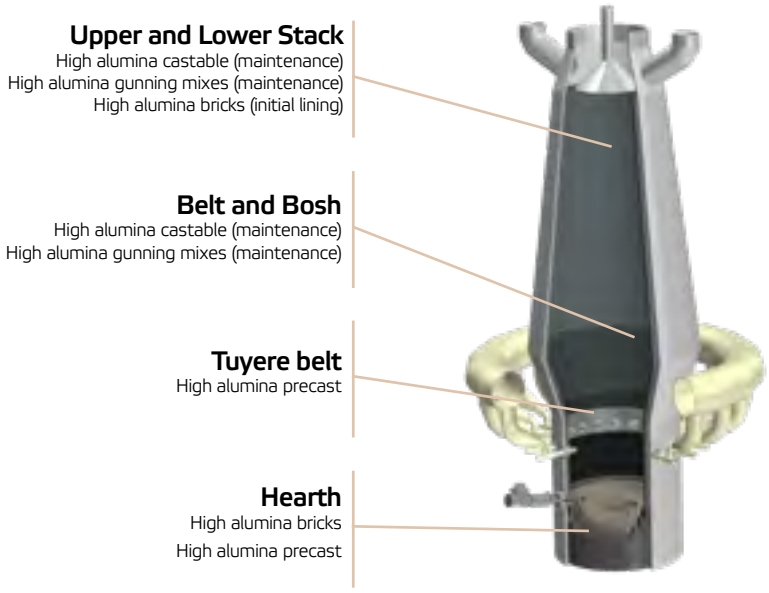
IRON & STEEL

BLAST FURNACE

Reduction of iron ore into pig iron (molten iron) occurs in blast furnaces. Between 1200 T/day to 13000 T/day of pig iron can be produced. Refractories in this area have to withstand a lot of different constraints: abrasion (solid and liquid), corrosion (slag and molten iron), hot gases attack (CO), and Alkali-Zinc penetration.

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:** alumina high refractoriness
- **Improvement of the matrix:**
  - Wear and corrosion resistance enhancement
  - Alkali and gases penetration limitation
- **Precast mechanical strength:** easier use of precast shapes



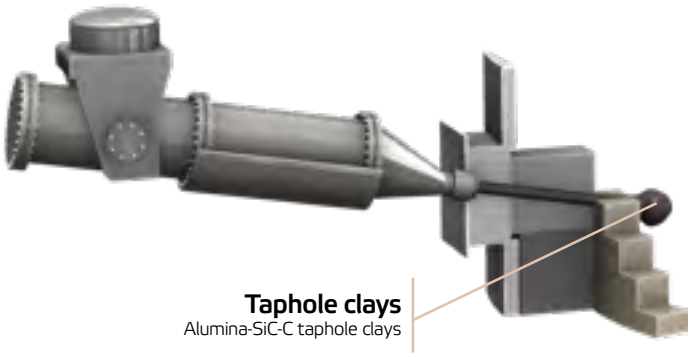
Example of alumina based refractories for blast furnace

TAPHOLE

When blast furnaces need to be emptied, a hole is drilled in the taphole area. Slag and molten iron produced come out from it. Once the blast furnace is "emptied" the hole is closed with a plastic refractory product: taphole clay.

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:** alumina high refractoriness
- **Plastic behavior easier to reach:** complementarity with taphole clays binders



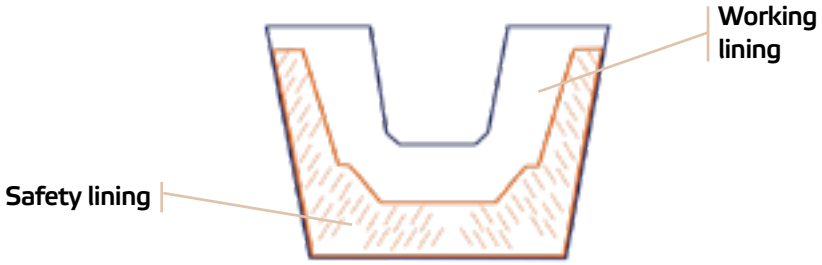
Taphole clays and taphole gun

CASTHOUSE RUNNER SYSTEM

After exiting from the blast furnace taphole, molten iron is directed to torpedo ladle cars through the casthouse area. This area is a combination of different refractory-lined troughs:

- Main trough: comes directly after the taphole. It separates iron from slag by gravity and transfers them to secondary runners (using a skimmer block);
- Slag runner: transfers slag to a slag pit;
- Iron runner: transfers molten iron to tilting trough;
- Tilting trough: transfer moten iron to torpedo ladle cars.

All troughs and runners are made up of different refractory layers: a working lining (in direct contact with molten iron) and a safety-lining (back-up lining in case of working lining breach).

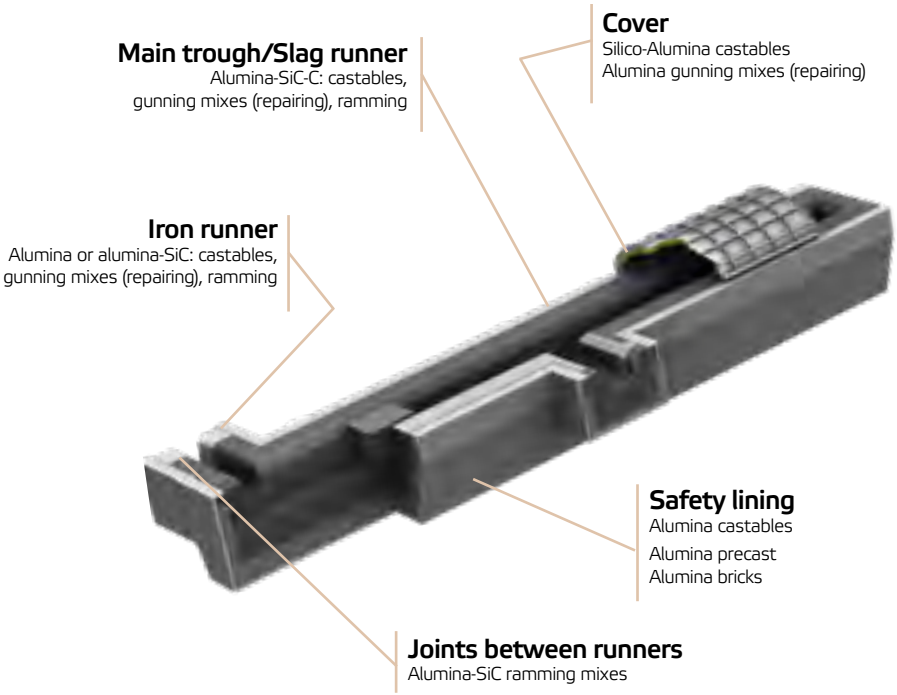


Trough and runner configuration

This area is a highly demanding area in terms of refractoriness, corrosion resistance, oxidization resistance, and abrasion resistance.

REal® ALUMINAS ADVANTAGES:

- **Mullite formation & refractoriness enhancement**
- **Improvement of the matrix:**
  - Wear and corrosion resistance enhancement
  - Decreased porosity for oxidization resistance
  - Thermal shock resistance
- **Precast mechanical strength:** easier use of precast shapes



Example of alumina based refractories for casthouse runner system

IRON & STEEL

TORPEDO LADLE AND IRON LADLE

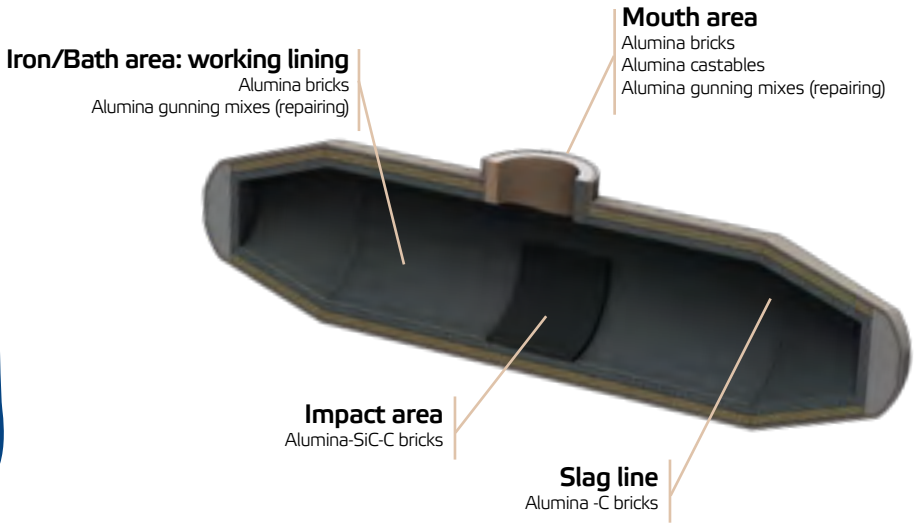
Molten iron is transferred to a steel mill with a torpedo ladle car. This latter is also used to perform early treatment on molten iron, such as desiliconization, desulfurization and dephosphorization, to remove first impurities.

After treatment, molten iron is poured into an iron ladle, before entering the steel making process.

This is a demanding area in terms of corrosion resistance, abrasion resistance and thermal shock resistance.

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:** alumina high refractoriness
- **Improvement of the matrix:** Wear and corrosion resistance enhancement



Example of alumina based refractories for torpedo ladle cars

ELECTRIC ARC FURNACE (EAF)

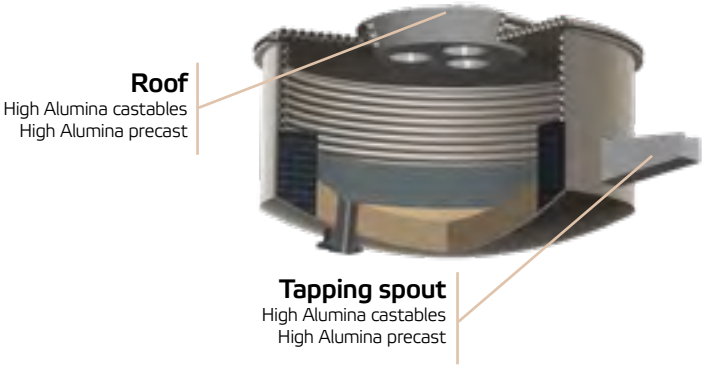
An EAF's main function is to melt scrap steel and/or direct reduced iron (DRI) with an electric arc. Molten steel will then be processed downstream in the steel mill.

This area is confronted with temperature, thermal shock, corrosion by slag, erosion by liquid steel and scrap.

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:** alumina high refractoriness
- **Wear resistance enhancement** by improving the matrix
- **Precast mechanical strength:** easier use of precast shapes

EAFs also are used in Foundry



Example of alumina-based refractories for EAF

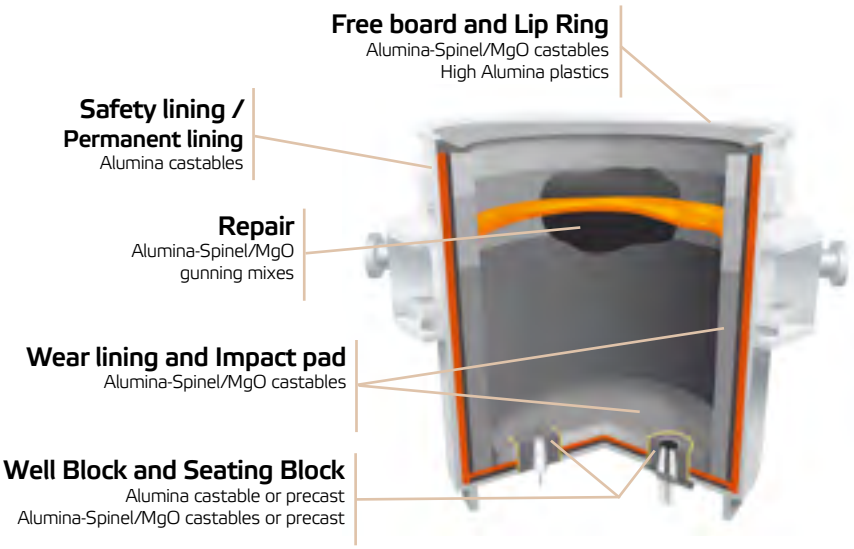
STEEL LADLE

The steel ladle is a transport vessel and a refining vessel for molten steel. The steel ladle is critical equipment for a steel mill because steel's final performance, purity, and composition are partially determined during this step. Refractory lining choice is clearly a hot topic as it has an impact on steel's final performance (low carbon content).

This area is confronted with high temperature, corrosion by slag, and erosion by liquid steel.

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:**
  - Alumina high refractoriness
  - Decreased silica fume/clay use
- **Improvement of the matrix:**
  - Wear and corrosion resistance enhancement
  - Thermal shock resistance
- **Precast flowability control** to decrease open porosity
- **Plasticity management:** complementarity with binders



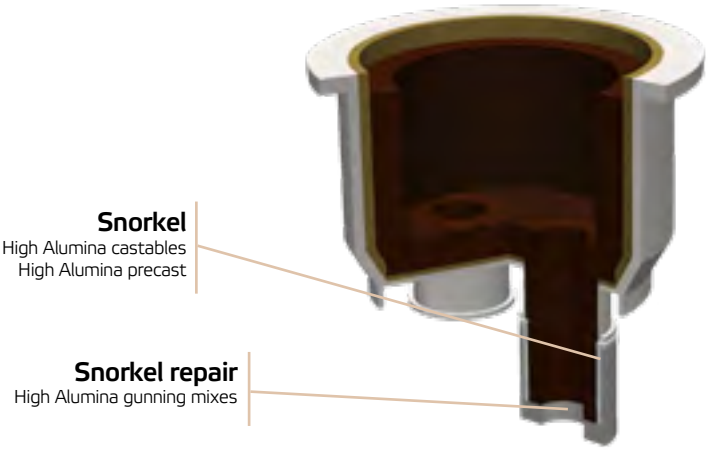
Example of alumina based refractories for steel ladle

RH DEGASSER

An RH degasser main function is to refine molten steel by removing dissolved gases. This area is confronted with thermal shock, corrosion by slag, and erosion by liquid steel.

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:**
  - Alumina high refractoriness
  - Decreased silica fume/clay use
- **Improvement of the matrix:**
  - Wear and corrosion resistance enhancement
  - Thermal shock resistance



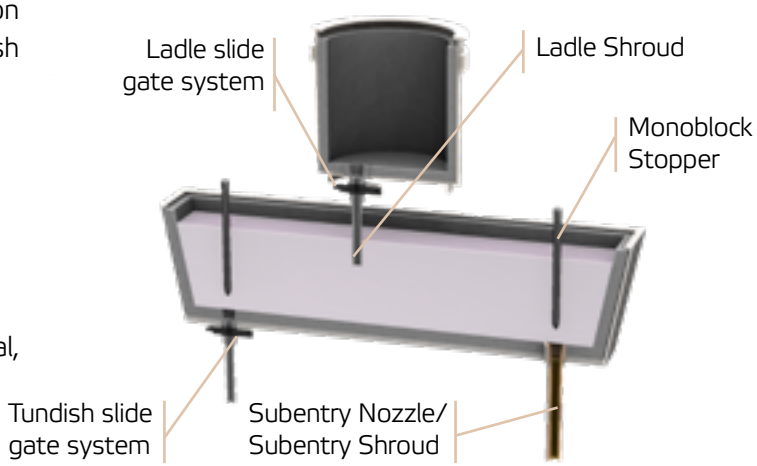
Example of alumina-based refractories for RH Degasser

CONTINUOUS CASTING: FUNCTIONAL PRODUCTS

In the Continuous Casting unit, molten steel flow must be regulated to ensure a smooth run of the process. Various refractory elements are designed to fulfill this vital role. These elements are called functional products.

- **Flow control elements:** allow the smooth introduction of molten steel from steel ladle to and from tundish to mold;
- **Gas purging elements:** inject an inert gas that will stir/treat molten steel directly in the vessel;
- **Tundish:** acts as a reservoir of steel to ensure a continuous casting of molten steel.

These elements are subjected to extreme chemical, thermal and mechanical stresses.



Continuous casting functional products

FLOW CONTROL ELEMENTS

- **Isostatic Pressed Products**

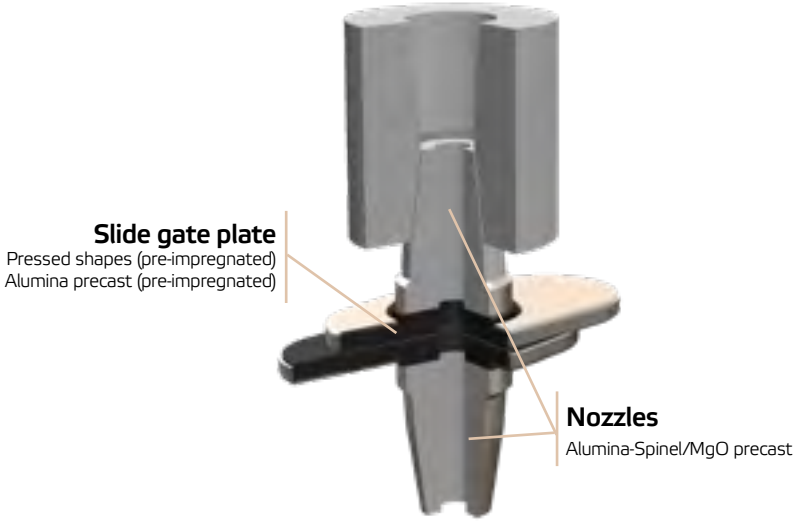
  The main Isostatic Pressed Products are: Ladle Shroud (LS), Monoblock Stopper (MBS), Subentry Nozzle (SEN) and Subentry Shroud (SES). They are appropriate solutions thanks to the important length-to-diameter ratio.

- **Ceramic material for emptying vessels**

  Their function is to regulate and control the emptying of vessels containing melts (e.g., steel ladle, Tundish). When a vessel has to be cleared out, molten steel is directed to the slide-gate system.
  It consists of different components: nozzles and slide-gate plates. The plates slide on each other to control the flow. The upper nozzle (upper part) is inserted in the steel ladle wellblock.

REal® ALUMINAS ADVANTAGES:

- **Enhanced refractoriness:** Alumina high refractoriness
- **Precast mechanical strength:** easier use of precast shapes



Slide gate system

GAS PURGING ELEMENTS

Many treatments occur in a steel ladle (e.g., desulfurization, reduction of inclusions, steal cleanliness). Moreover steel temperature needs to be uniform in every part of the ladle. Therefore, gas purging elements are critical to ensure treatment. Purging plugs are the best example of gas purging elements.

REal® ALUMINAS ADVANTAGES:

- **Enhanced refractoriness:** Alumina high refractoriness
- **Improvement of the matrix:** Corrosion resistance enhancement
- **Precast high flowability** when casted

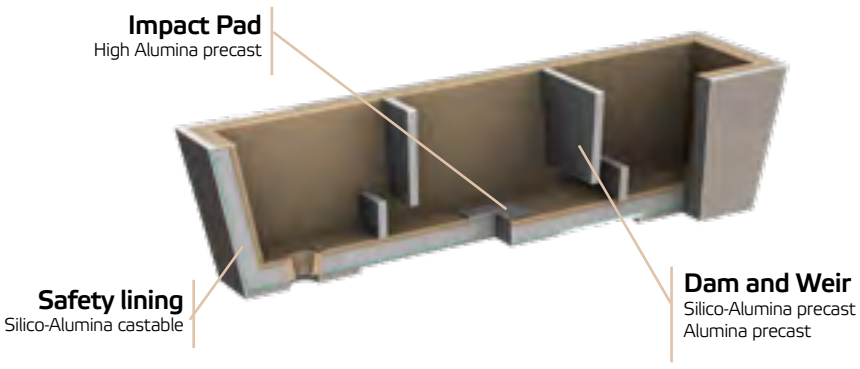
Purging plug in its seating block

TUNDISH

Tundish acts as a tank of molten steel to ensure a continuous flow of steel into the casting machine. Tundish is made up of different refractory layers: a wear lining and a safety lining.

REal® ALUMINAS ADVANTAGES:

- **Enhanced refractoriness:** Alumina high refractoriness
- **Precast mechanical strength:** easier use of precast shapes



Example of alumina-based refractories for Tundish

REHEATING FURNACE

Through the casting machine, different shapes of finished steel (i.e., billet, bloom or slab) can be created. These shapes are then stored before sales or further processing.
One type of additional processing is the production of Hot Rolled Steel. In a Hot Rolling mill, steel stock (i.e., billet, bloom or slab) is heated at high temperature to enable a plastic deformation for rolling in the mill. Reheating furnaces are used to do this.

Reheating Furnaces can be divided into the following categories:

- **Pusher type**
- **Walking beam / Walking hearth**
- **Rotary hearth**

In every category, alumina-based plastics are well designed to protect side wall and roof. For Walking beam / Walking hearth, and Rotary hearth categories, alumina castables are used.

REAL® ALUMINAS ADVANTAGES:

- **Improvement of the matrix:**
  - Wear and corrosion resistance enhancement
  - Thermal shock resistance

Foundry is an industry in which metals are melted and cast into molds to produce finish pieces (for automotive, machinery, household Appliances, etc.).

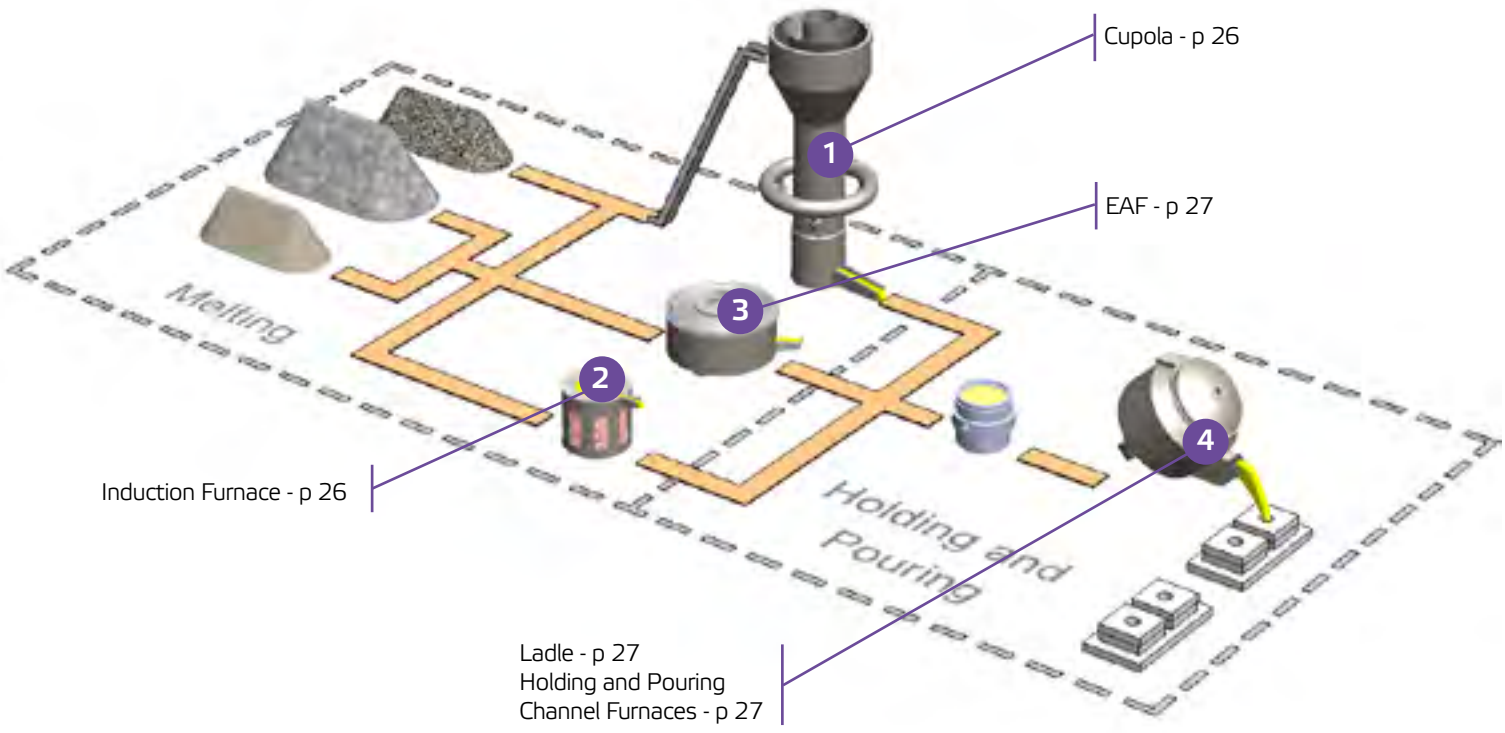
The Foundry industry (Iron, Steel and Aluminum mainly) is asking for alumina-based refractories.
Refractories are mandatory in two main parts of the process:

N°1 **MELTING OF METALS**
different processes exist.

N°2 **CASTING OF LIQUID METALS IN A MOLD**
melting is then followed by cooling and finishing step.

Refractories formulated with **REal®** range of alumina can be used in most parts of the process. This brochure **focuses only** on applications where **REal® calcined and reactive aluminas are found.**

The main applications are listed below:



FOUNDRY

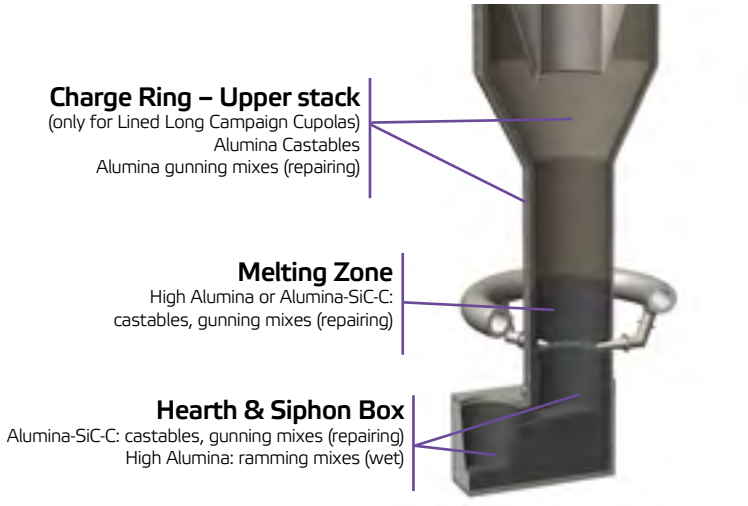
CUPOLA (Iron Foundry)

Cupola is a melting method used in iron foundries. Unlike blast furnaces, the main source of iron comes from iron scraps or pig iron. Between 20 t/day to 1500 t/day of cast iron can be produced.

Refractories in this area have to withstand a lot of different constraints: thermal shock, abrasion (solid and liquid), corrosion (slag and cast iron), and hot gases attack (CO).

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:** alumina high refractoriness
- **Improvement of the matrix:**
  - Wear resistance Enhancement
  - Decreased porosity for oxidization and corrosion resistance



Example of alumina-based refractories for cupola

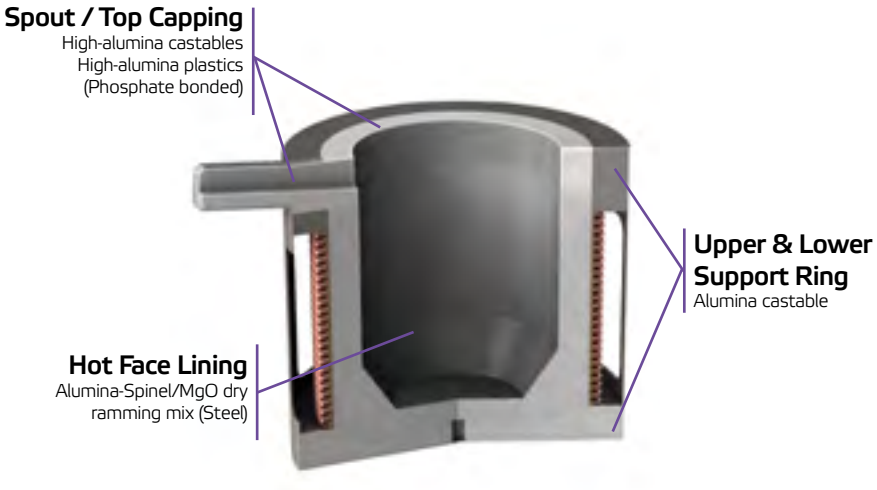
INDUCTION FURNACES (Iron Foundry / Steel Foundry / Other Alloys Foundry)

The main purpose of an Induction furnace main purpose is to melt metal by induction heating. It offers an energy-efficient and well-controllable melting process. The main source of metal comes from scraps (e.g., iron, steel, copper, aluminum, precious metal). Induction furnace capacities range from a few kilograms to 100 tons.

Refractories in this equipment have to withstand mainly thermal shock and erosion by molten metals and scraps.

REAL® ALUMINAS ADVANTAGES:

- **Better shelf life and improved refractoriness**
- **Improvement of the matrix:**
  - Wear resistance enhancement
  - Thermal shock resistance
- **Increased performances:**
  - Volume stability enhancement
  - Higher mechanical strength



Example of alumina-based refractories for induction furnace

ELECTRIC ARC FURNACE (EAF)

Same solutions as the Iron and Steel part (page 20).

LADLES

In foundries, ladles can have different tasks:

- **Casting ladle:** used to pour molten metal into molds to produce the casting;
- **Transfer ladle:** used to transfer of molten metal from one process to another. Typically, to transfer molten metal from a primary melting furnace (e.g., cupola, EAF, Induction furnace) to a holding furnace or an auto-pour unit;
- **Treatment ladle:** a treatment occurs within the ladle to change molten metal characteristics.

This area has to withstand mainly thermal shock, erosion, abrasion (by molten metals), and corrosion (by slag).

REal® ALUMINAS ADVANTAGES:

- **Improved refractoriness:** alumina high refractoriness
- **Improvement of the matrix:**
  - Wear resistance enhancement
  - Thermal shock resistance

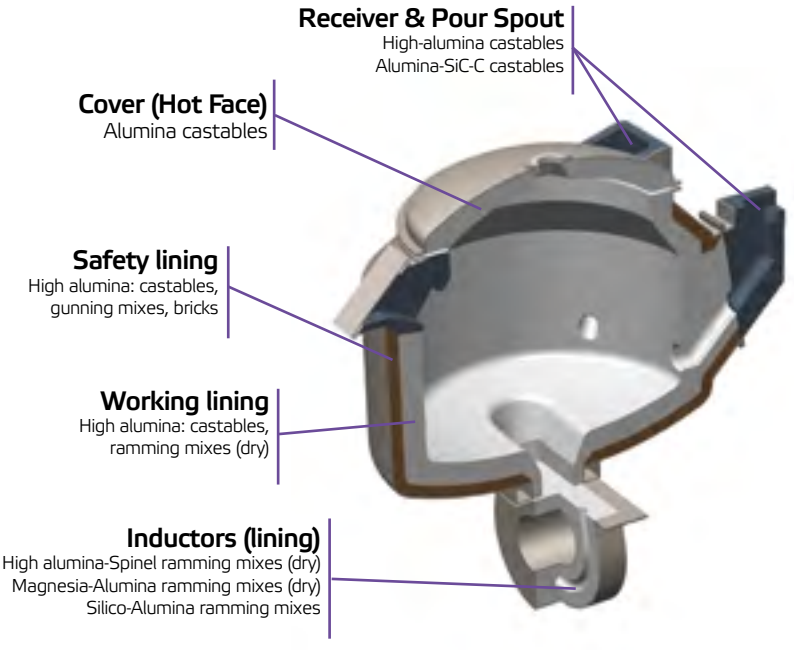
HOLDING AND POURING CHANNEL FURNACES (Iron Foundry)

Channel-type induction furnaces are commonly used for melting lower melting-point alloys and/or as a holding and superheating unit for higher melting-point alloys such as cast iron. The furnace consists of a refractory-lined steel shell connected to an induction unit, in the form of a loop/ring. Molten metal is heated within the loop/ring, which allows the metal to circulate and causes a useful stirring action in the melt.

Refractories, in this equipment, have to withstand thermal shock, erosion and abrasion (by molten metals) as well as overheating.

REAL® ALUMINAS ADVANTAGES:

- **Improved refractoriness:**
  - Better packing density
  - Sinterability enhancement
- **Improvement of the matrix:**
  - Wear and corrosion resistance enhancement
  - Decreased porosity for oxidization and corrosion resistance
  - Thermal shock resistance
- **Air-tight increase**
  - Less cracks formation



Example of alumina-based refractories for channel furnaces

CEMENT

The Cement industry is a key industry for housing and construction. Cement is an essential raw material in concrete (along with sand, aggregates, and water). Typically, cement represents 10% - 15% of a concrete mix and acts as a binder.

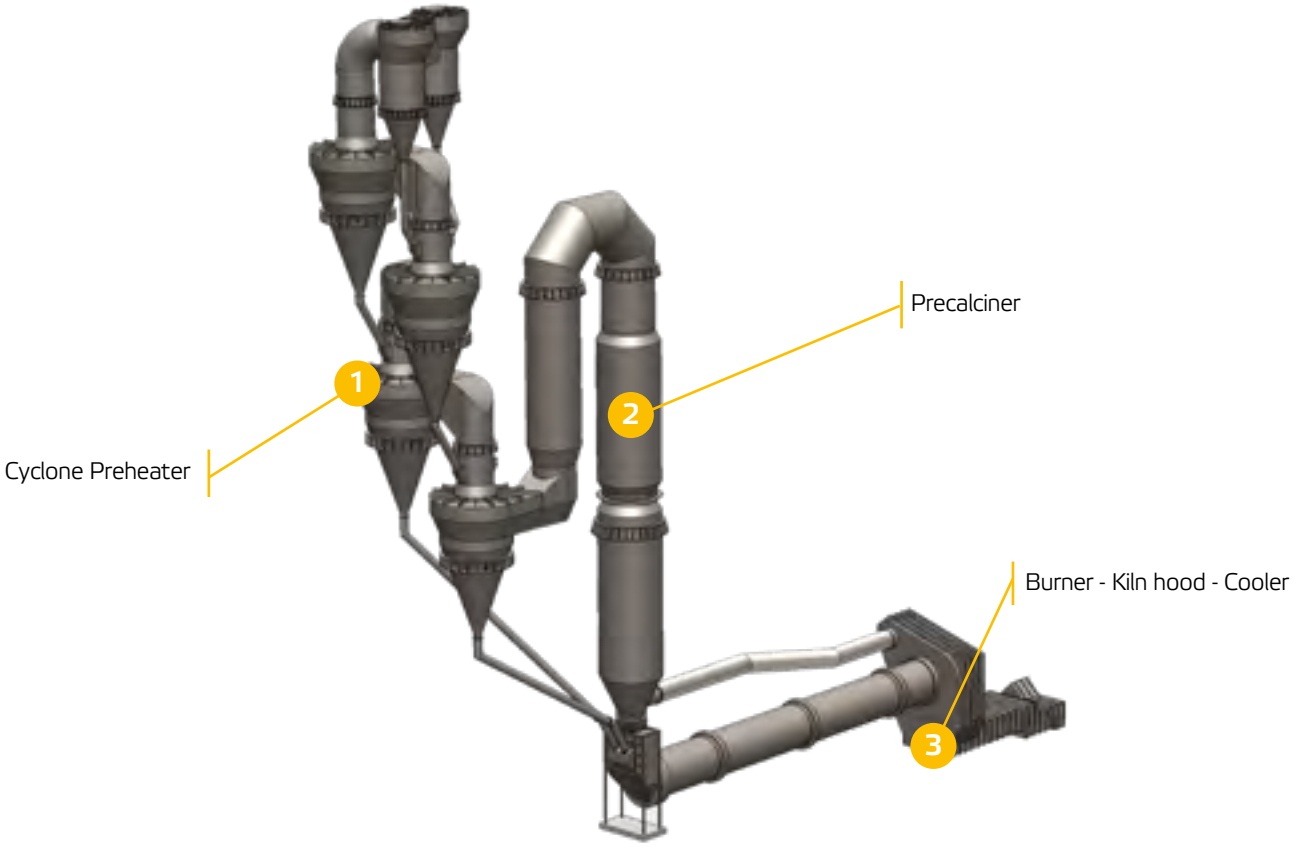
Cement-making process can be divided in two steps:

Nº1 **CLINKER PRODUCTION.**
Clinker is an intermediate product in cement manufacturing and is the main substance in cement. Clinker is made in a rotary kiln at high temperature (1450ºC)

Nº2 **GRINDING.**
Clinker is ground with other minerals to produce cement

Refractories formulated with **REal®** range of alumina are used only in the clinker production part of the process. This brochure **focuses only** on applications where **REal® calcined and reactive aluminas are found.**

The main applications are listed below:



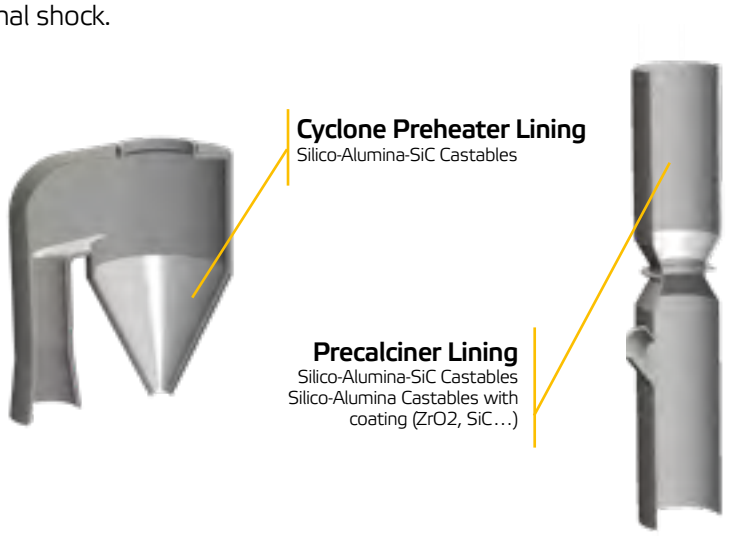
CYCLONE PREHEATER AND PRECALCINER

REal® ALUMINAS ADVANTAGES:

- **Mullite formation and refractoriness enhancement**
- **Improvement of the matrix:**
  - Wear and abrasion resistance enhancement
  - Alkali and gases penetration limitation
  - Thermal shock resistance

Before entering in the rotary kiln, raw materials used for clinker making (e.g., limestone, clays) are mixed and preheated in a preheater unit.

Refractories in this area have to withstand a lot of different constraints: abrasion (solid), hot gases attack (i.e., Alkali, Sulphate, Chloride) and thermal shock.



Example of alumina-based refractories for cyclone preheater and precalciner

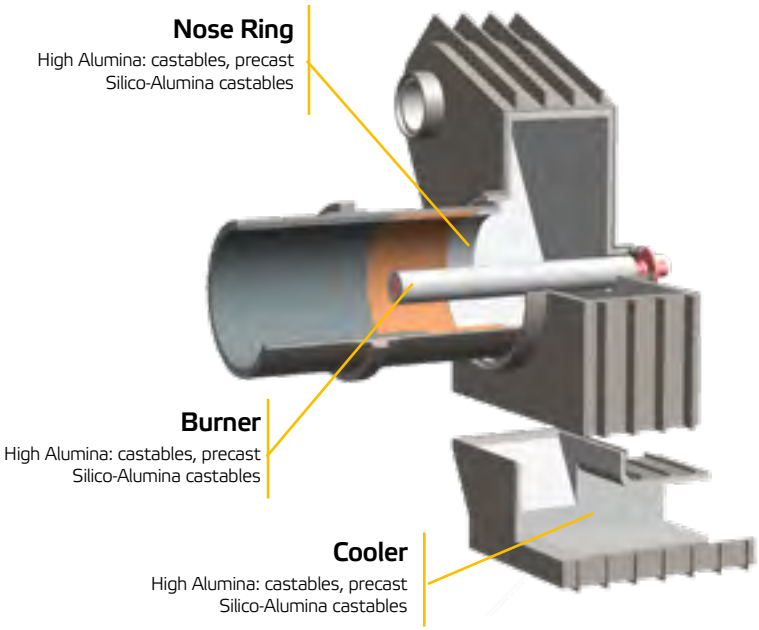
BURNER - KILN HOOD - COOLER

At the bottom of the rotary kiln, a burner produces a flame that will allow the kiln to reach the expected calcination temperature. Right after the burner, the kiln hood connects the hot area with the clinker cooler.

Refractories in this area have to withstand a lot of different constraints: hot gases attack (especially kiln hood area), abrasion (by solid), and thermal shock.

REal® ALUMINAS ADVANTAGES:

- **Enhanced refractoriness:** Alumina high refractoriness
- **Improvement of the matrix:**
  - Wear and abrasion resistance enhancement
  - Gases penetration limitation
  - Thermal shock resistance
- **Precast mechanical strength:** easier use of precast shapes



Example of alumina-based refractories for Burner – Kiln Hood – Cooler

ALTEO REal® ALUMINA OFFERING

With recognized technical know-how and manufacturing management, Alteo offers its high quality and dedicated range of aluminas for refractory applications: REal®.

ALTEO DEDICATED RANGE FOR REFRACTORIES

REal® range of alumina is structured around three types of products: calcined, special calcined and reactive aluminas.

REal® - CALCINED ALUMINAS

Our controlled calcination and grinding process ensures the production of highly stable calcined aluminas with tight specifications on chemistry, crystal size, surface area/BET, and PSD.

REal®- calcined aluminas are:

- Classified as hard-calcined aluminas: absence of under-calcined aluminas (α-alumina content > 97%), providing very high temperature resistance;
- Unground or ground (<45 µm).

REal® - CALCINED ALUMINA		Hard Calcined - Normal Soda			Hard Calcined - Low Soda
		REal® HC-UG	REal® HC-G(1)	REal® HC-FG(2)	REal® HC-GLS
Physical properties	**Unit**				
Grinding		Unground	Ground	Ground	Ground
Particle size Id_{50} (Cilas) *Typical value*	µm	90	5.5	4.0	4.6
Surface Area		Low	Low	Low	Low
Chemical properties					
Na_2O *Maximum value*	%	0.45	0.45	0.45	0.06

(1): better top cut is available on demand
(2): lower Id_{50} is available on demand

REal® - « SPECIAL » CALCINED ALUMINAS

REal®- "Special" calcined aluminas provide a higher BET for more reactivity in application.

REal® - « SPECIAL » CALCINED ALUMINA		Soft Calcined
		REal® MC-G
Physical properties	**Unit**	
Grinding		Ground
Particle size Id_{50} (Cilas) *Typical value*	µm	5.0
Surface Area		Medium
Specific Surface Area / BET *Typical value*	m^2/g	14.0
Chemical properties		
Na_2O *Maximum value*	%	0.45

REal® - REACTIVE ALUMINAS

High performance refractories need superior **cold and hot properties,** as well as **higher particle-packing control** and **rheology.** To attain these properties, refractory producers ask for finer and more reactive raw materials.

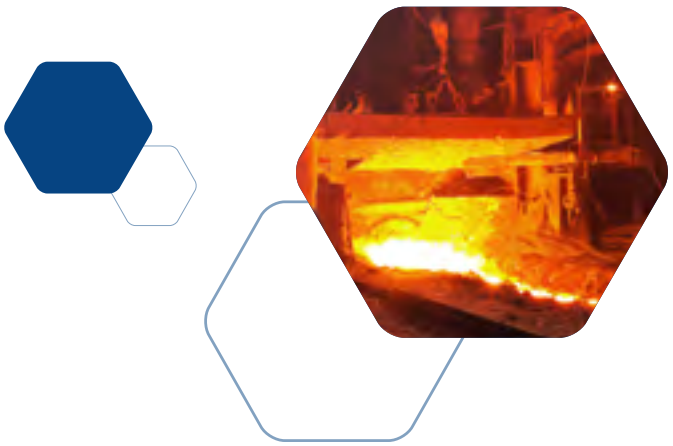
To fulfill the requirements for high performance refractories, Alteo offers fully ground reactive aluminas, ground down close to primary crystal.

REal® - reactive aluminas are classified as follow:

- **Mono-modal reactive aluminas:** Enable full flexibility in the design of refractory matrix PSD. They are used in association with ground calcined aluminas and very fine aggregates to give a continuous and broad PSD;
- **Bi-modal reactive aluminas:** Their content of fine particles enable refractory matrices to reach a high-packing density and high refractoriness. Furthermore, they enhance refractory material placement by increasing flowability. They also are used in association with ground calcined aluminas and particles to give a continuous and very broad PSD;
- **Multi-modal reactive aluminas:** Thanks to its optimized and broad particle size range, REal® M4R brings simplicity to a normally time-consuming formulation design process. These properties also help to achieve expected performances (e.g., reach high thermal and mechanical properties).

REal® - REACTIVE ALUMINA RANGE		Mono-Modal		Bi-Modal		Multi-Modal
		REal® PFR[3]	REal® PFR20[4]	REal® PBR40	REal® PBR	REal® PMR4M
Physical properties	**Unit**					
Particle size sd_{50} (Sedigraph) *Typical value*	µm	0.5	2.0	1.3	2.1	2.4*
Specific Surface Area / BET	m^2/g	6.3	2.1	4.0	2.9	3.5
Chemical properties						
Na_2O *Maximum value*	%	0.08	0.08	0.08	0.08	0.22

[3]: lower sd_{50} is available on demand
[4]: lower sd_{50} is available on demand
**: Cilas measurement (ld_{50})*



FIND THE BEST REal® ALUMINA FOR YOUR APPLICATION

REAL® ALUMINA RANGE OVERVIEW

Based on our expertise in the refractory field, you can select a REal® alumina for your application:

		Calcined					Reactive				
							Mono-Modal		Bi-Modal		Multi-Modal
		REal® HC-UG	REal® HC-G	REal® HC-FG	REal® HC-GLS	REal® MC-G	REal® PFR	REal® PFR20	REal® PBR40	REal® PBR	REal® PMR4M
Refractory type											
Monolithics	Castables :										
	Dense Regular		⬢	⬢							
	Deflocculated (MCC/LCC/ULCC/NCC)		⬢	⬢			⬢	⬢	⬢	⬢	⬢
	Gunning		⬢			⬢					
	Dry vibratable mix		⬢	⬢	⬢						
	Plastics & Ramming mixes		⬢	⬢		⬢					
	Taphole clays		⬢								
	Mortars	⬢	⬢		⬢						
Bricks & Special shapes	Gas purging elements Casted Nozzles		⬢	⬢					⬢	⬢	
	Slide gate plate		⬢	⬢			⬢		⬢	⬢	
	Bricks	⬢	⬢						⬢	⬢	
	Kiln Furniture		⬢	⬢	⬢				⬢	⬢	

REal® ALUMINAS : LEVEL OF PERFORMANCES IN APPLICATION

To share our expertise on alumina in refractory materials and to contribute to the best choice of alumina in applications are something that moves Alteo forward.

To better advise you on which alumina to select for your highly demanding applications, we selected **4 application formulations*** on which we performed trials in our R&D laboratories.

For each application we highlighted which are the **best combinations of REal®** calcined and reactive aluminas to help drive the formulation performances upwards.

**Chosen formulations are designed for the application they target, however other formulations exist on the market*

OUR RECOMMENDATION FOR YOUR SPECIFIC NEEDS

To help you choose the right REal® aluminas to fit your refractory application requirements, we recommend:

N°1 IN MONOLITHICS FORMULATIONS

FOR	Self-flow castables	Dry vibratable mix	Dry Gunning	Tight PSD control	Easy packing density	Simplicity in formulation
CHOOSE	REal® HC-FG	REal® HC-G REal® HC-GLS	REal® MC-G	REal® PFR REal® PFR20	REal® PBR40 REal® PBR	REal® PMR4M

N°2 IN BRICKS AND SPECIAL SHAPES FORMULATIONS

FOR	Bricks (depending on formulation)	Gas purging elements / nozzles flowability	Slide gate plates High sinterability	Easy packing density (gas purging elements, nozzle, kiln furniture)
CHOOSE	REal® HC-G REal® HC-UG	REal® HC-FG	REal® PFR REal® PBR40	REal® PBR REal® PBR40

2 or 3 levels of performances emerge from these trials:

ESSENTIAL MATRIX:
alumina combination that suits application requirements

SUPERIOR MATRIX:
alumina combination that allows a higher quality in application

SUPREME MATRIX:
alumina combination that has outstanding performances on all criteria

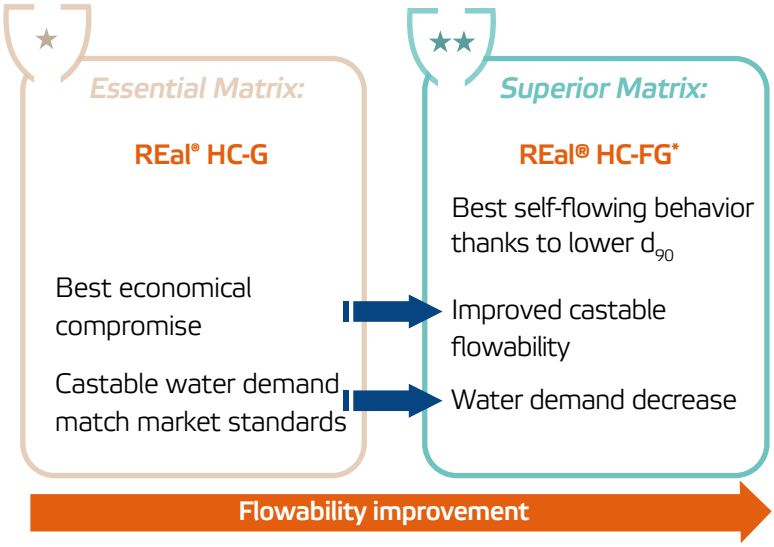
SELF-FLOW CASTABLE

The choice of REal® calcined alumina has a big impact on self-flow castable flowability.

The formulation we worked on is the following:

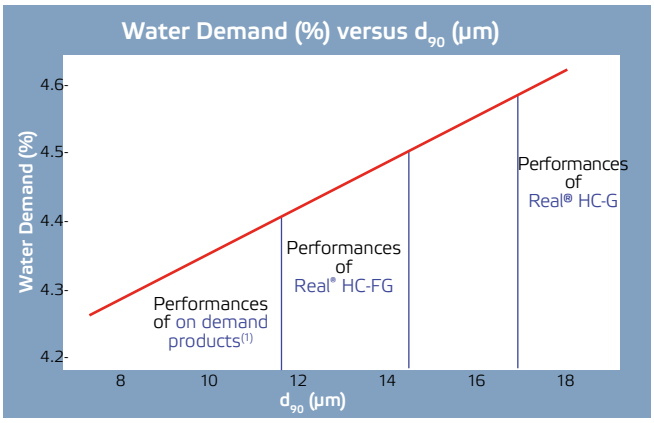
Refractory type	Castable type	Skeleton	Cement content	Alumina content	Other Fines
Deflocculated castable	Self-flow LCC	Tabular alumina	5%	REal® calcined alumina: 9% REal® PFR: 5%	No silica fume

REal® solutions:



**The lower the d_{90}, the lower the water demand (%).*

Impact of Real® calcined alumina d_{90} on water demand of a self-flow LCC



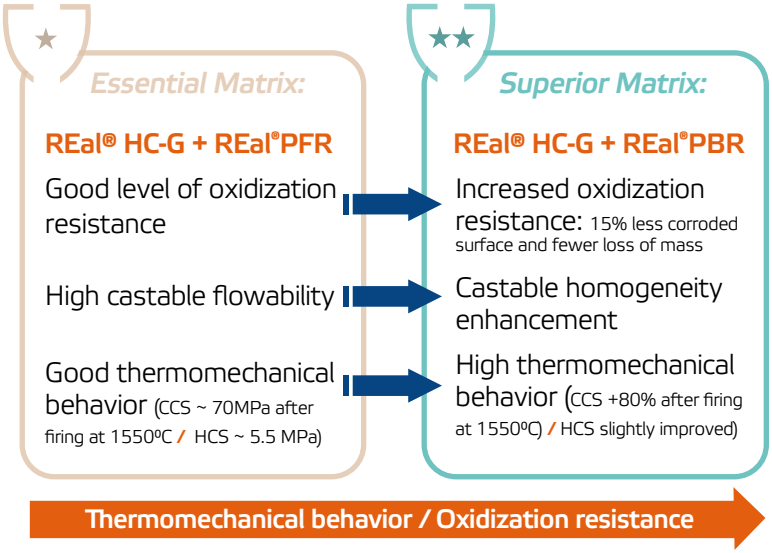
(1)Other REal® products with lower d_{90} available on demand

RUNNER – MAIN TROUGH CASTABLE: improved mechanical and oxidization resistance

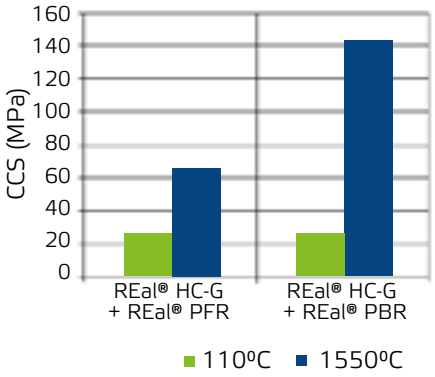
Specific REal® calcined alumina and REal® reactive alumina combination can drive up the wear resistance of main trough castable. The formulation we worked on is the following:

Refractory type	Castable type	Skeleton	Cement content	Alumina content	Other Fines
Deflocculated castable	Vibrate ULCC	Brown Fused Alumina + SiC	1.5%	REal® calcined alumina and reactive alumina: 13%	Silica fume Carbon Silicon metal

REal® solutions:

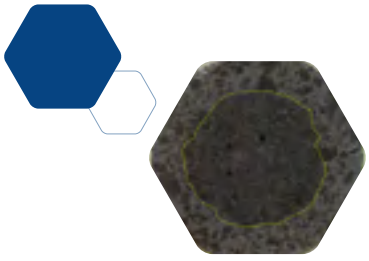


CCS at 110ºC and after firing at 1550ºC (in a reducing atmosphere)



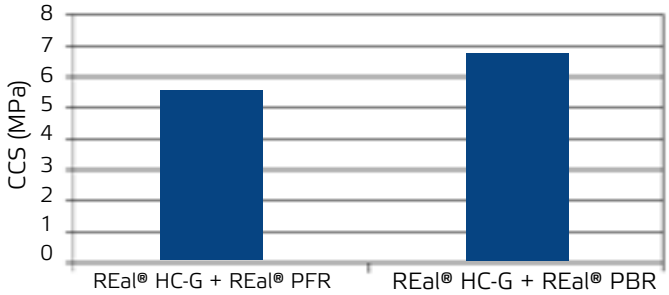
Oxidization test at 800ºC (for 2 hours) after pre-firing at 1550ºC (for 5 hours)

	% loss of mass	% corroded surface	Oxidization speed (mm/min)
REal® HC-G + REal® PFR	1.60	≈ 60	≈ 4.6
REal® HC-G + REal® PBR	1.30	≈ 45	≈ 3.3



Sample after oxidization test (REal® HC-G + REal® PBR)

HCS at 1500ºC (after firing at 1550ºC)



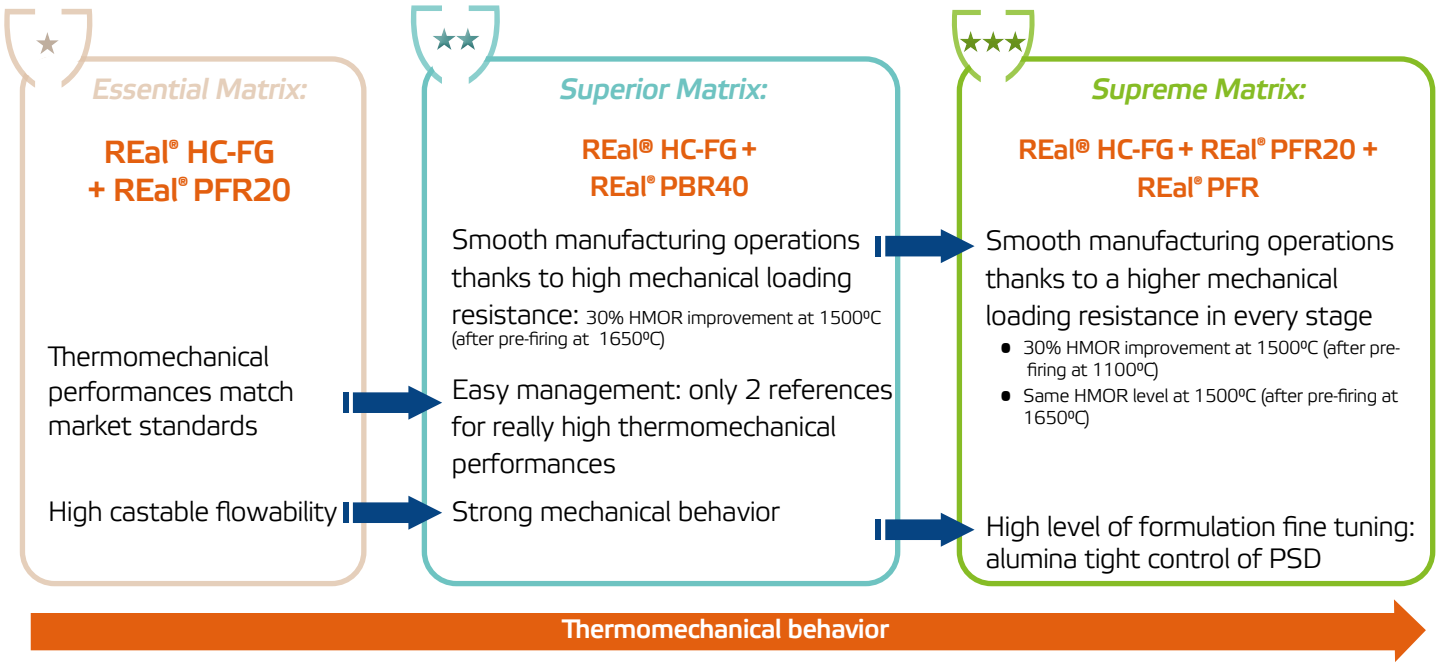
STEEL LADLE CASTABLE

As specific REal® calcined alumina and REal® reactive alumina combination highlights different cold and hot mechanical properties in steel ladle castables.

The formulation we worked on is the following:

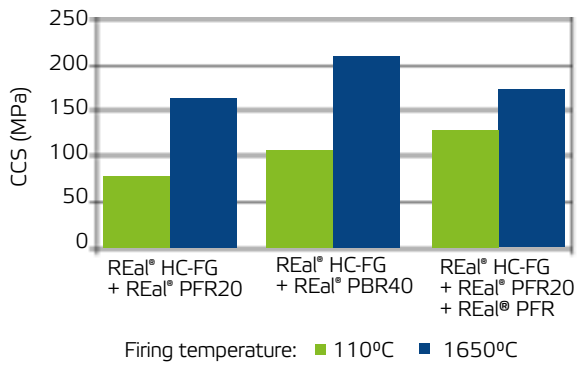
Refractory type	Castable type	Skeleton	Cement content	Alumina content	Other Fines
Deflocculated castable	Self-flow LCC	Tabular alumina + Spinel	6%	REal® calcined alumina and reactive alumina: 15%	No silica fume

REal® solutions:

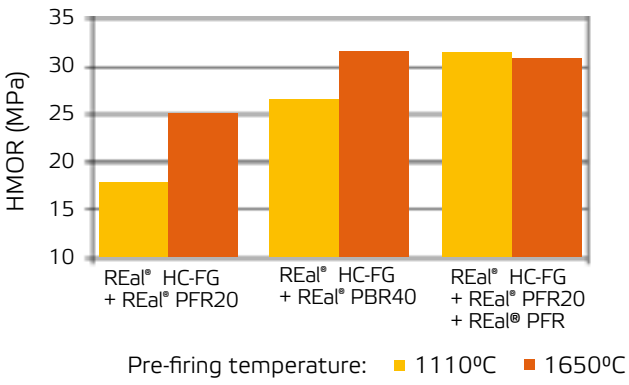


Trials results:

CCS after curing at 110ºC and firing at 1650ºC



HMOR at 1500ºC after pre-firing at 1100ºC and 1650ºC



DRY GUNNING

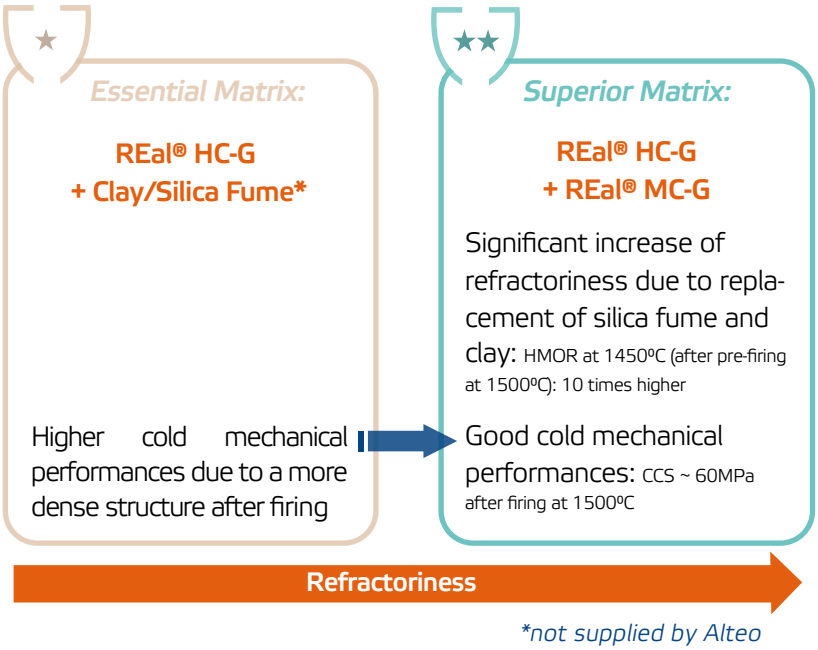
Dry gunning technique can be used either as a quick repair of a refractory lining or initial lining when a castable cannot be casted properly.

REal® calcined alumina choice has a big impact on refractoriness.

The formulation we worked on is the following:

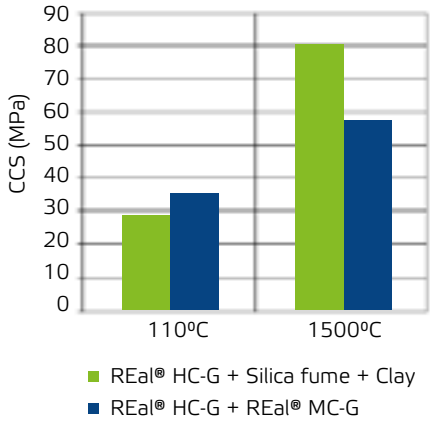
Refractory type	Castable type	Skeleton	Cement content	Alumina content	Other Fines
Dry Gunning	Self-flow MCC	Tabular alumina	10%	REal® hard calcined alumina: 12% REal® "Special" calcined alumina: 5% (when used)	Silica fume Clay

REal® solutions:

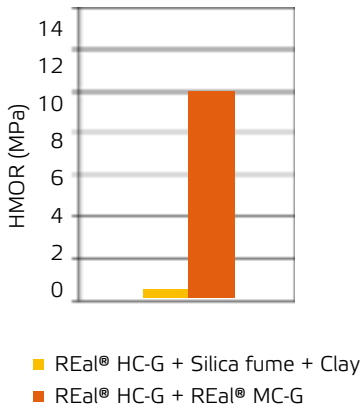


Trials results:

CCS after curing at 110ºC and firing at 1500ºC



HMOR at 1450ºC after pre-firing at 1500ºC

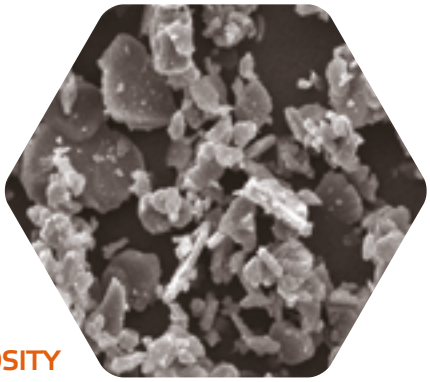


Discover ALTEO dedicated range in details

REal
ALUMINA SOLUTIONS FOR REFRACTORIES

GROUND CALCINED ALUMINA

REal® HC-FG



THE HARD CALCINED ALUMINA TO ACHIEVE THE BEST FLOWABILITY

YOU ASK FOR:

1 **AN IMPROVED CASTABLE FLOWABILITY**
for an easy implementation

2 **A DECREASED OPEN POROSITY**
allowing higher thermo-mechanical performances

FOR THESE APPLICATIONS:


Castable


Slide gate


Plastics


Gas purging


DVM


Kiln Furniture

ALTEO OFFERS:

REal® HC-FG, a **hard calcined alumina**, with a normal soda content, grounded to a Id_{50} of 4 µm.

Its lower Id_{90} provides a **better flowing behavior** to castables, pre-casts, gas purging elements and casted nozzles.

REal® HC-FG is produced and controlled within a **certified quality management system** (ISO 9001).

REal® HC-FG ADVANTAGES:

- **Best self- flowing behavior: lower Id_{90}**
- **Wear resistance behavior of Steel Ladle lining: high HMOR (in combination with REal® Reactive alumina)**
- **Gas purging / casted nozzle flowability: best choice for casted elements**

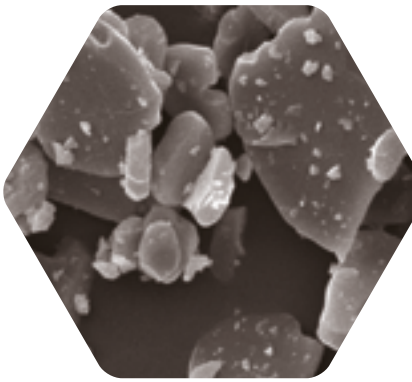
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Cilas):				
Id_{10}	µm	-	-	1.7
Id_{50}	µm	3.0	4.5	4.0
Id_{90}	µm	-	-	11.5
Screen residue > 45 µm (325 mesh)	%	-	0.5	0.2
BET / Specific Surface Area	m^2/g	0.7	1.5	-

CHEMICAL PROPERTIES

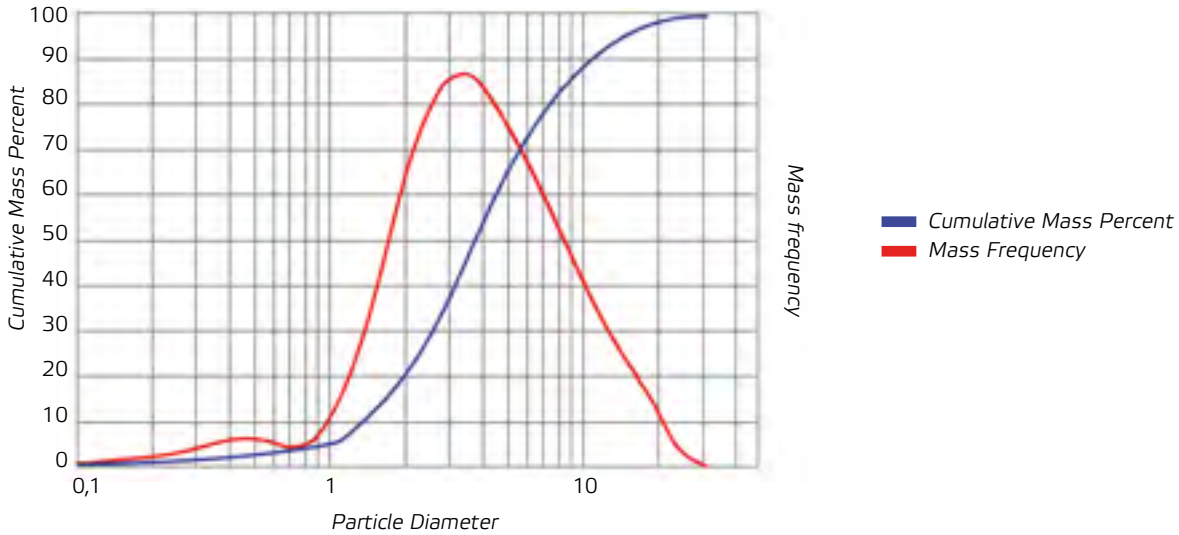
	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	99.40	-	99.60
Na_2O	%	-	0.45	0.36
CaO	%	-	0.04	0.02
SiO_2	%	-	0.04	0.01
Fe_2O_3	%	-	0.04	0.02

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

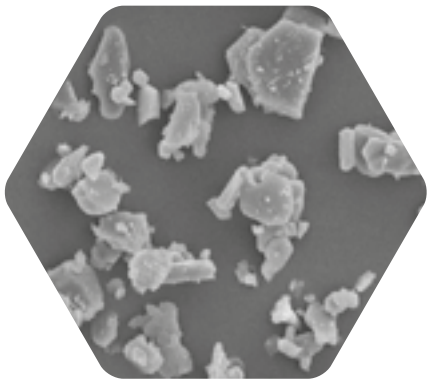
Laser measurement - Cilas



REal
ALUMINA SOLUTIONS FOR REFRACTORIES

GROUND CALCINED ALUMINA

REal® HC-G



THE MULTI-PURPOSE HARD CALCINED ALUMINA

YOU ASK FOR:

1 **EASY MANAGEMENT**
of your stocks and production planning

2 **MATRIX**
with high level of performances

FOR THESE APPLICATIONS:


Castables


Gunning


DVM


Plastics


Mortars


Taphole Clays


Bricks


Gas purging


Kiln furniture


Slide gate

ALTEO OFFERS:

REal® HC-G, a **hard-calcined alumina**, with a normal soda content, grounded to a Id_{50} of 5.5 µm.

REal® HC-G adaptability and stability helps to **easily create formulations** of vibrating castables, dry vibratable mix, taphole clays, plastics & ramming mixes, gunning mixes and bricks.

REal® HC-G is produced and controlled within a **certified quality management system** (ISO 9001).

REal® HC-G ADVANTAGES:

- **Multipurpose use: achieve high performances level in many different refractory applications**
- **Thermomechanical behavior of main trough castables: CCS improvement (in combination with REal® Reactive alumina)**
- **Stability and easy management in production: tight PSD specifications**

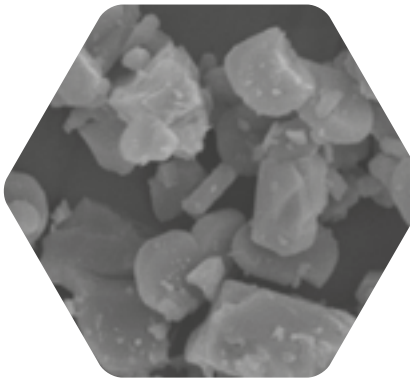
PHYSICAL PROPERTIES

		REal® HC-G		
	Unit	Min.(1)	Max.(1)	Typical(2)
Particle Size Distribution (Cilas):				
Id_{10}	µm	-	-	2.2
Id_{50}	µm	4.5	6.5	5.5
Id_{90}	µm	-	-	15.0
Screen residue > 45 µm (325 mesh)	%	-	4.0	2.2
BET / Specific Surface Area	m²/g	0.6	2.2	-

CHEMICAL PROPERTIES

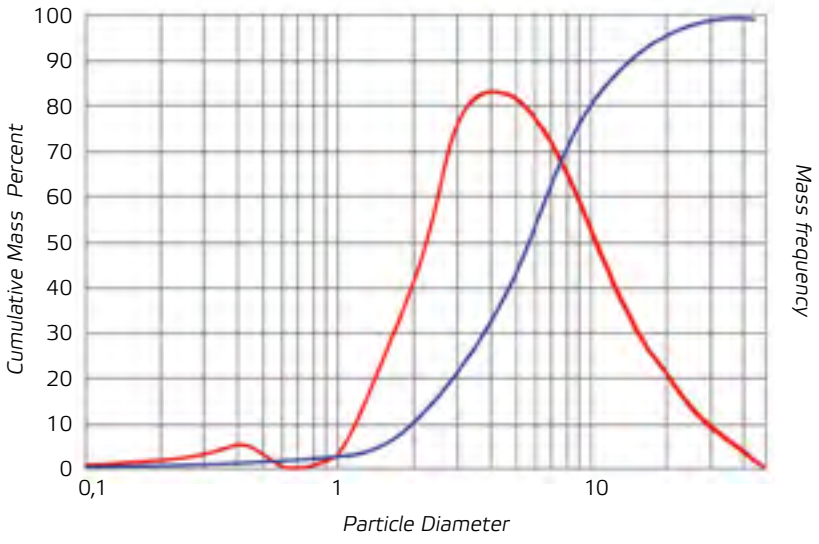
	Unit	Min.(1)	Max.(1)	Typical(2)
Al_2O_3 (on dry basis)	%	99.40	-	99.60
Na_2O	%	-	0.45	0.36
CaO	%	-	0.04	0.02
SiO_2	%	-	0.04	0.01
Fe_2O_3	%	-	0.04	0.02

(1) Min. & Max. values are our standard product specifications for these products.
(2) Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

Laser measurement - Cilas

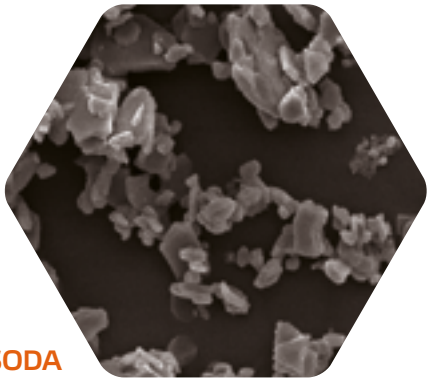


Cumulative Mass Percent REal® HC-G
Mass Frequency REal® HC-G

REal
ALUMINA SOLUTIONS FOR REFRACTORIES

GROUND CALCINED ALUMINA

REal® HC-GLS



THE HARD CALCINED ALUMINA TO MINIMIZE SODA CONTENT IN FORMULATIONS

YOU ASK FOR:

1 **A DECREASE OF LIQUID PHASES**
when firing a dry vibratable mix on jobsite

2 **A LIMITATION OF SOLUBLE SODA**
in mortar formulations

FOR THESE APPLICATIONS:

DVM

Mortars

Kiln furniture

ALTEO OFFERS:

REal® HC-GLS, a **hard calcined alumina**, with a low soda content, grounded to a Id_{50} of 4.6 µm.

Its low soda content provides a **low level** of "soluble" soda in mortar formulations and **fewer liquid phase** in the case of dry vibratable mixes.

REal® HC-GLS is produced and controlled within a **certified quality management system** (ISO 9001).

REal® HC-GLS ADVANTAGES:

- Low soluble soda content
- Decrease of liquid phase during DVM sintering
- Tight PSD control thanks to a better top cut

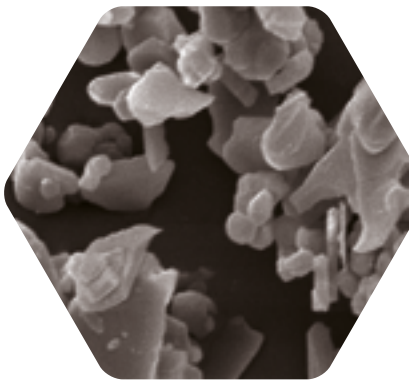
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Cilas):				
Id_{10}	µm	-	-	1.8
Id_{50}	µm	3.5	7.5	4.6
Id_{90}	µm	-	17	11.5
Screen residue > 45 µm (325 mesh)	%	-	2.0	0.7
BET / Specific Surface Area	m²/g	0.7	1.5	1.0

CHEMICAL PROPERTIES

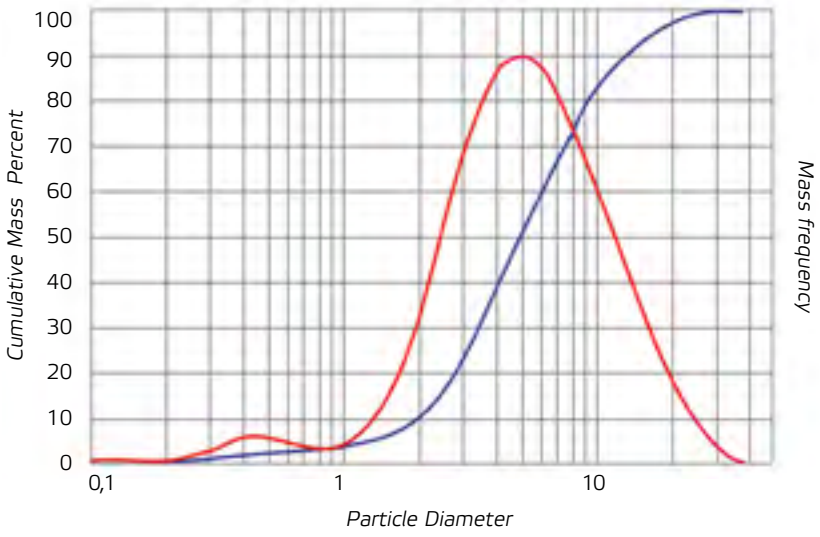
	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	-	-	99.85
Na_2O	%	-	0.06	0.03
CaO	%	-	0.03	0.02
SiO_2	%	-	0.12	0.07
Fe_2O_3	%	-	0.05	0.02

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

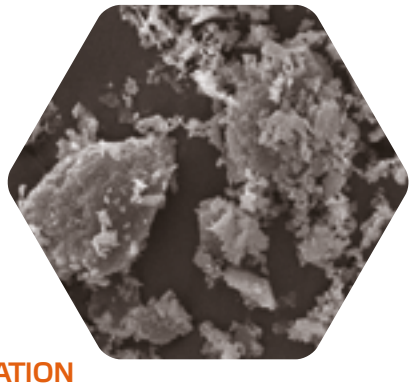
Laser measurement - Cilas



REal
ALUMINA SOLUTIONS FOR REFRACTORIES

SPECIAL CALCINED ALUMINA

REal® MC-G



THE CALCINED ALUMINA TO ENHANCE REFRACTORINESS IN DRY GUNNING

YOU ASK FOR:

1 **A LONGER SERVICE LIFE** of refractory linings used in severe conditions

2 **A GOOD REPAIRING** pattern

3 **A SMOOTH INSTALLATION** of refractory materials

FOR THESE APPLICATIONS:

Gunning

Plastics

ALTEO OFFERS:

REal® MC-G, a **special calcined alumina**, with a normal soda content, high BET and grounded to a Id_{50} of 5.0 µm.

Its high specific surface area provides an **alternative to clays and silica fume** in dry gunning mixes and plastics. REal® MC-G is produced and controlled within a **certified quality management system** (ISO 9001).

REal® MC-G ADVANTAGES:

- **High BET: alternative to clays and silica fume in dry gunning mixes**
- **Significant increase of refractoriness in gunning mixes: higher HMOR** (in combination with REal® HC-G)
- **Good sticking behavior in formulation**

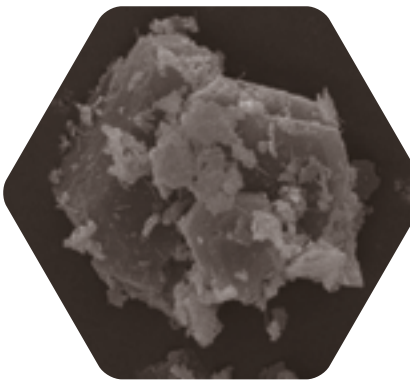
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle size Distribution (Cilas):				
Id_{10}	µm	-	-	1.3
Id_{50}	µm	3.5	6.0	5.0
Id_{90}	µm	-	-	15.0
Screen residue > 45 µm (325 mesh)	%	-	0.5	0.1
BET / Specific Surface Area	m²/g	10.0	16.0	14.0

CHEMICAL PROPERTIES

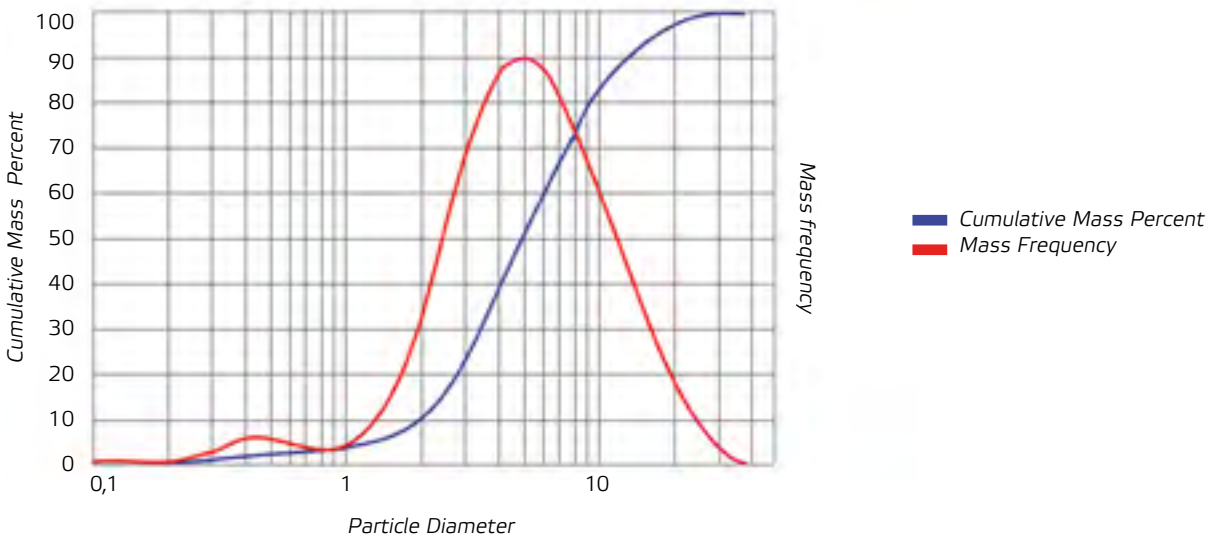
	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	99.40	-	99.60
Na_2O	%	-	0.45	0.36
CaO	%	-	0.04	0.02
SiO_2	%	-	0.04	0.01
Fe_2O_3	%	-	0.04	0.02

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

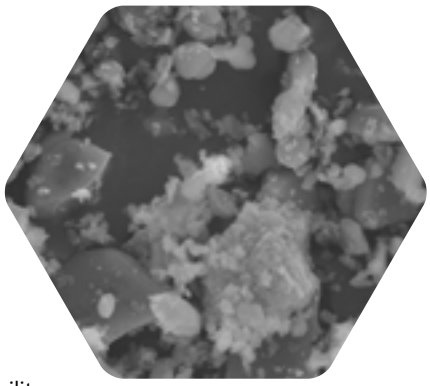
Laser measurement - Cilas



REal
ALUMINA SOLUTIONS FOR REFRACTORIES

BI-MODAL REACTIVE ALUMINA

REal® PBR
REal® PBR40



THE BI-MODAL REACTIVE ALUMINAS FOR AN EASY PACKING DENSITY

YOU ASK FOR:

1 AN EXTENDED SERVICE LIFE
thanks to an increase in wear resistance of your highly demanding application

2 A BETTER CONTROL
on castable/precast flowability and mechanical strengh

FOR THESE APPLICATIONS:


Castables


Gas purging


Slide gate


Bricks


Kiln Furniture

ALTEO OFFERS:

REal® PBR/PBR40, a **bi-modal reactive alumin**a, with a low soda content, super grounded to a sd_{50} of 1. or 2.1 µm.

REal® PBR/PBR40 fine particles content and co-milling manufacturing help to **optimize the packing density** of castables, pre-casts, gas purging elements, casted nozzles, slide gate plates, kiln furniture and bricks formulations.

REal® PBR/PBR40 are produced and controlled within a **certified quality management system** (ISO 9001).

REal® PBR/PBR40 ADVANTAGES:

- **Easy management: high packing density and thermomechanical performances with only one product**
- **Thermomechanical behavior of main trough castables: Higher CCS and oxidization resistance** (REal® PBR in combination with REal® HC-G)
- **High mechanical loading resistance of Steel Ladle lining: high HMOR** (REal® PBR40 in combination with REal® HC-FG)

PHYSICAL PROPERTIES

	Unit	REal® PBR			REal® PBR40		
		Min.[1]	Max.[1]	Typical[2]	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Sedigraph):							
sd_{10}	µm	-	-	0.4	-	-	0.3
sd_{50}	µm	1.5	3.0	2.1	0.9	1.7	1.3
sd_{90}	µm	-	7.0	4.2	3.5	6.0	4.2
BET / Specific Surface Area	m²/g	2.0	4.0	2.9	3.5	5.0	4.0
Crystal Size sd_{50} (Sedigraph)	%	-	-	0.4/2.0	-	-	0.4/2.0

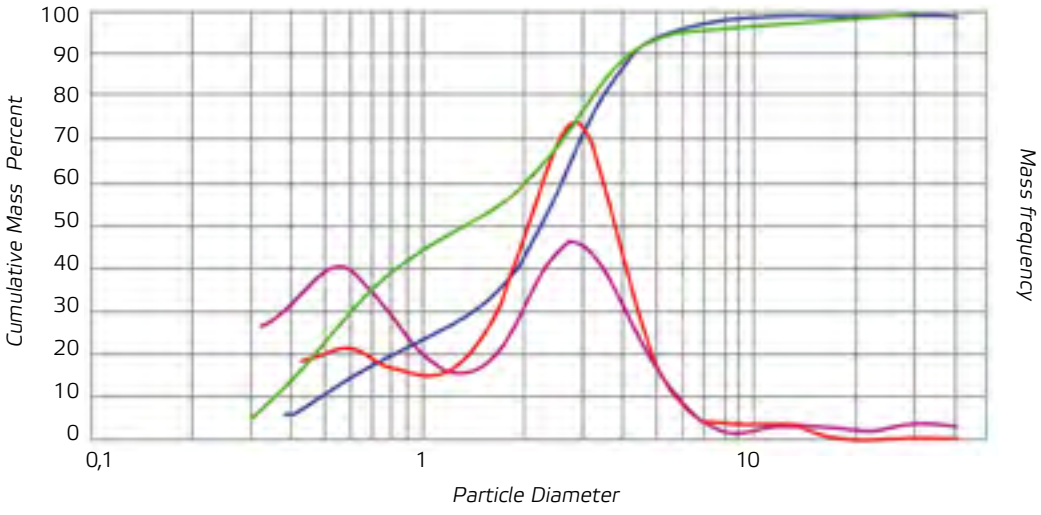
CHEMICAL PROPERTIES

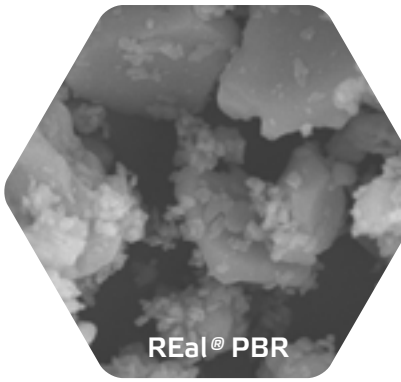
	Unit	REal® PBR			REal® PBR40		
		Min.[1]	Max.[1]	Typical[2]	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	-	-	99.85	-	-	99.85
Na_2O	%	-	0.08	0.03	-	0.08	0.03
CaO	%	-	0.05	0.02	-	0.04	0.02
SiO_2	%	-	0.12	0.06	-	0.11	0.05
Fe_2O_3	%	-	0.04	0.02	-	0.04	0.02

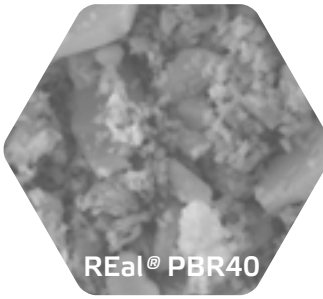
[1] Min. & Max. values are our standard product specifications for these products.
[2] Typical values are taken from production averages.

PARTICLE SIZE DISTRIBUTION

Sedimentation measurement - Sedigraph



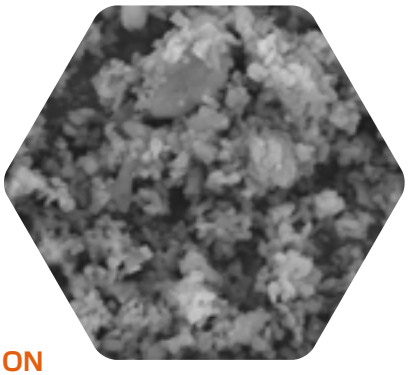




REal
ALUMINA SOLUTIONS FOR REFRACTORIES

MONO-MODAL REACTIVE ALUMINA

REal® PFR



THE ULTRAFINE MONO-MODAL REACTIVE ALUMINA FOR STATE-OF-THE ART CASTABLES

YOU ASK FOR:

1 **AN STRONG IMPROVEMENT** of your matrix in terms of thermomechanical stability

2 **A HIGH LEVEL OF FORMULATION** fine tuning

FOR THESE APPLICATIONS:

Castables

Slide gate

ALTEO OFFERS:

REal® PFR, a **mono-modal reactive alumina**, with a low soda content, super grounded to a sd_{50} of 0.5 µm.

Its extremely low sd_{50} and high BET provide a **high thermomechanical stability** to castables and **enhenced sinterability** for slide gate plates.

REal® PFR is produced and controlled within a **certified quality management system** (ISO 9001).

REal® PFR ADVANTAGES:

- **Mechanical properties enhancement in formulation with a reduced cement content**
- **Wear resistance of main trough castables: Good level CCS and oxidization resistance** (REal® PFR in combination with REal® HC-G)
- **High mechanical loading resistance of Steel Ladle lining: HMOR improvement** (REal® PFR in combination with REal® HC-FG and REal® PFR20)

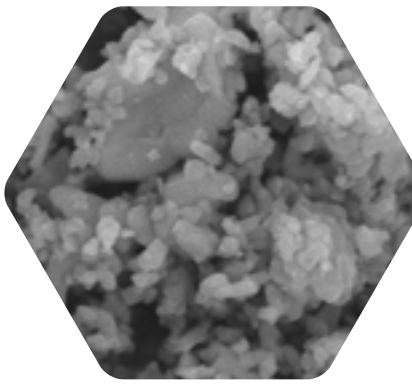
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Sedigraph):				
sd_{10}	µm	-	-	0.2
sd_{50}	µm	0.4	0.7	0.5
sd_{90}	µm	-	5.0	1.8
BET / Specific Surface Area	m²/g	5.0	7.5	6.3
Crystal size sd_{50} (Sedigraph)	µm	-	-	0.4

CHEMICAL PROPERTIES

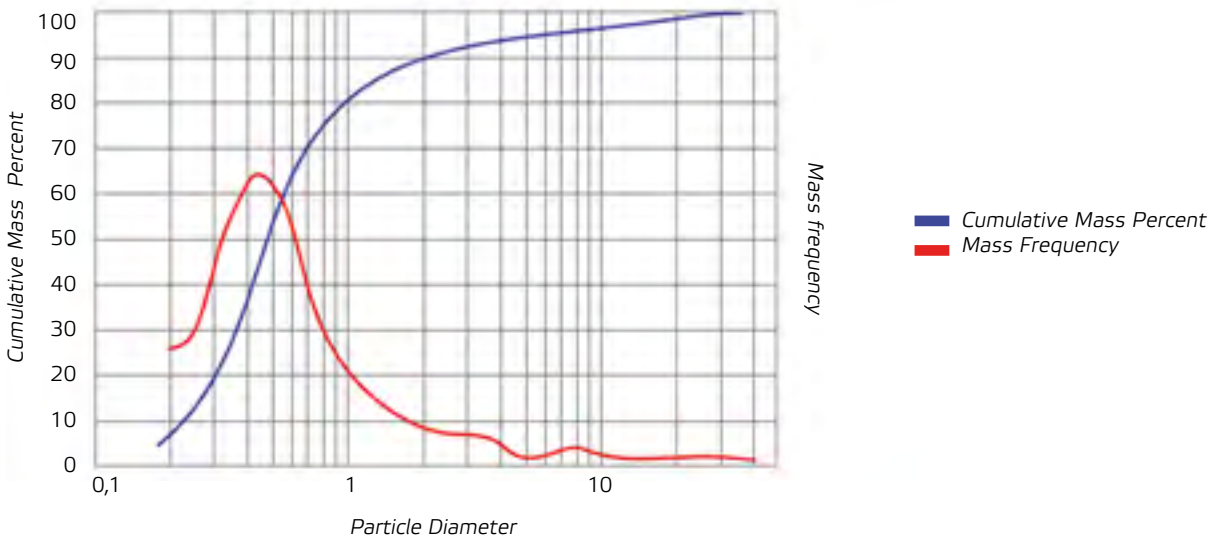
	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	-	-	99.85
Na_2O	%	-	0.08	0.04
CaO	%	-	0.04	0.02
SiO_2	%	-	0.11	0.03
Fe_2O_3	%	-	0.04	0.02

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

Sedimentation measurement - Sedigraph

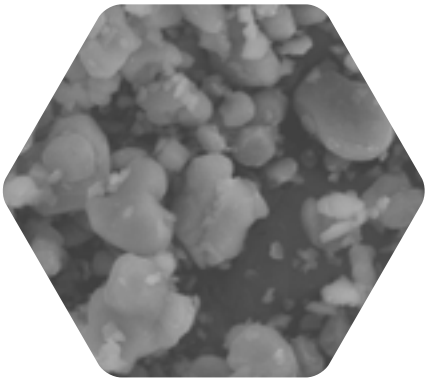


REal
ALUMINA SOLUTIONS FOR REFRACTORIES

MONO-MODAL REACTIVE ALUMINA

REal® PFR20

THE MULTIPURPOSE FINE MONO-MODAL REACTIVE ALUMINA FOR CASTABLE TIGHT PSD CONTROL



YOU ASK FOR:

1 **AN OPTIMIZED CASTABLE**
particle size distribution to achieve higher performances

2 **A FLEXIBILITY**
in formulation fine tuning

FOR THIS APPLICATION:

Castables

ALTEO OFFERS:

REal® PFR20, a **mono-modal reactive alumina**, with a low soda content, super grounded to a sd_{50} of 2 µm.

Its low BET combined with a low sd_{90} provide a **better particle packing behavior** to castables.

REal® PFR20 is produced and controlled within a **certified quality management system** (ISO 9001).

REal® PFR20 ADVANTAGES:

- **Flexibility in formulation: optimization in combination with CAC and silica fume**
- **Enhance refractoriness and flowability: fine alumina particles**
- **Thermomechanical behavior of Steel Ladle lining: good CCS and HMOR**
  (REal® PFR20 in combination with REal® HC-FG)

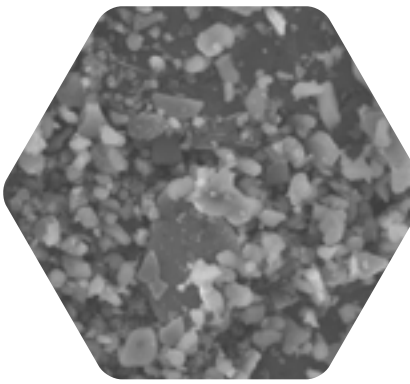
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Sedigraph):				
sd_{10}	µm	-	-	0.9
sd_{50}	µm	1.5	2.5	2.0
sd_{90}	µm	-	6.0	3.4
BET / Specific Surface Area	m²/g	1.5	2.6	2.1
Crystal size sd_{50} (Sedigraph)	µm	-	-	1.5

CHEMICAL PROPERTIES

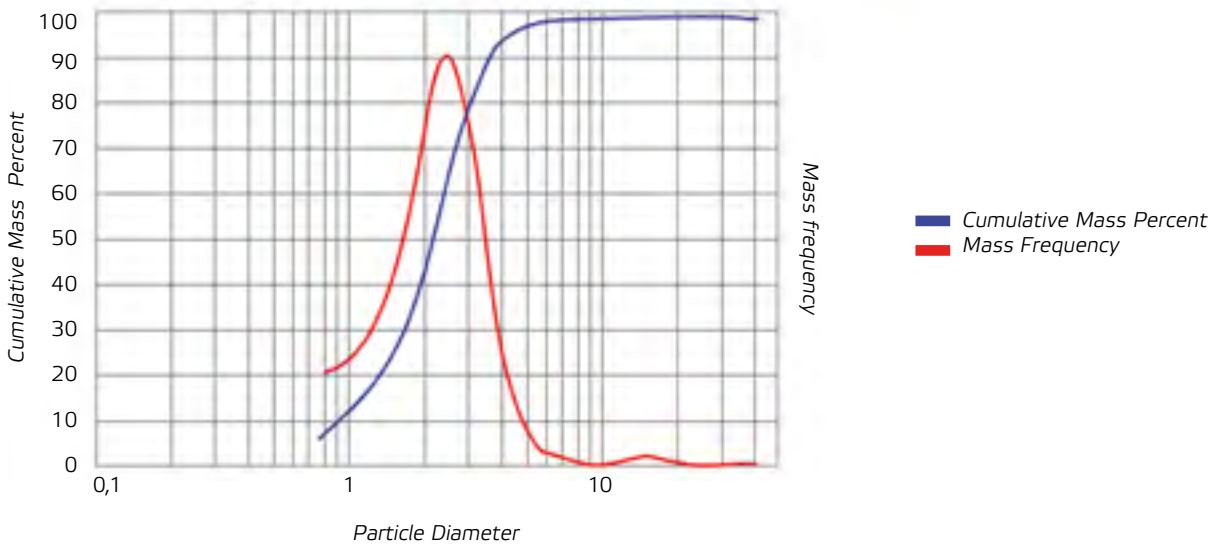
	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	-	-	99.85
Na_2O	%	-	0.08	0.03
CaO	%	-	0.08	0.03
SiO_2	%	-	0.15	0.10
Fe_2O_3	%	-	0.03	0.02

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

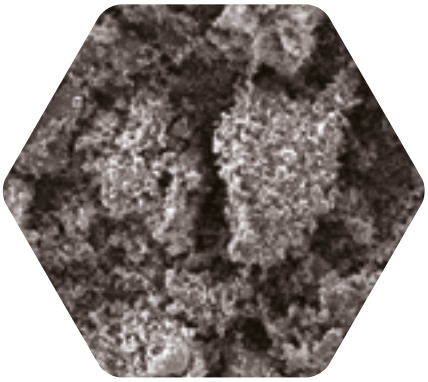
Sedimentation measurement - Sedigraph



REal
ALUMINA SOLUTIONS FOR REFRACTORIES

MULTI-MODAL REACTIVE ALUMINA

REal® PMR4M



THE MULTI-MODAL REACTIVE ALUMINA THAT BRINGS SIMPLICITY IN FORMULATION AND PRODUCTION

YOU ASK FOR:

1 **SPENDING LESS TIME**
in designing formulation while achieving high performances

2 **EASY MANAGEMENT**
of your stocks and production planning

FOR THIS APPLICATION:

Castables

ALTEO OFFERS:

REal® PMR4M, a **multi-modal reactive alumina**, with a medium soda content, grounded to a Id_{50} of 2.5 µm.

Its broad and optimized particle size range (from submicron to 45 µm) **help in designing** high performances castables formulation **more easily.**

REal® PMR4M is produced and controlled within a **certified quality management system** (ISO 9001).

REal® PMR4M ADVANTAGES:

- **Easy storage management: less raw material to store**
- **High mechanical performances** (high alumina self-flow castable) **: CCS after firing at 1 600ºC > 200 MPa**
- **High rheological performances of castables thanks to its fine particle content**

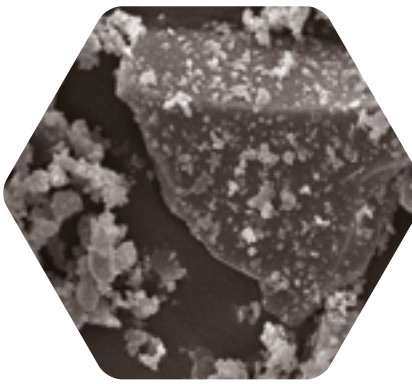
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Cilas):				
Id_{10}	µm	-	-	0.4
Id_{50}	µm	1.5	4.0	2.4
Id_{90}	µm	-	20	13.5
BET / Specific Surface Area	m²/g	2.5	5.0	3.6

CHEMICAL PROPERTIES

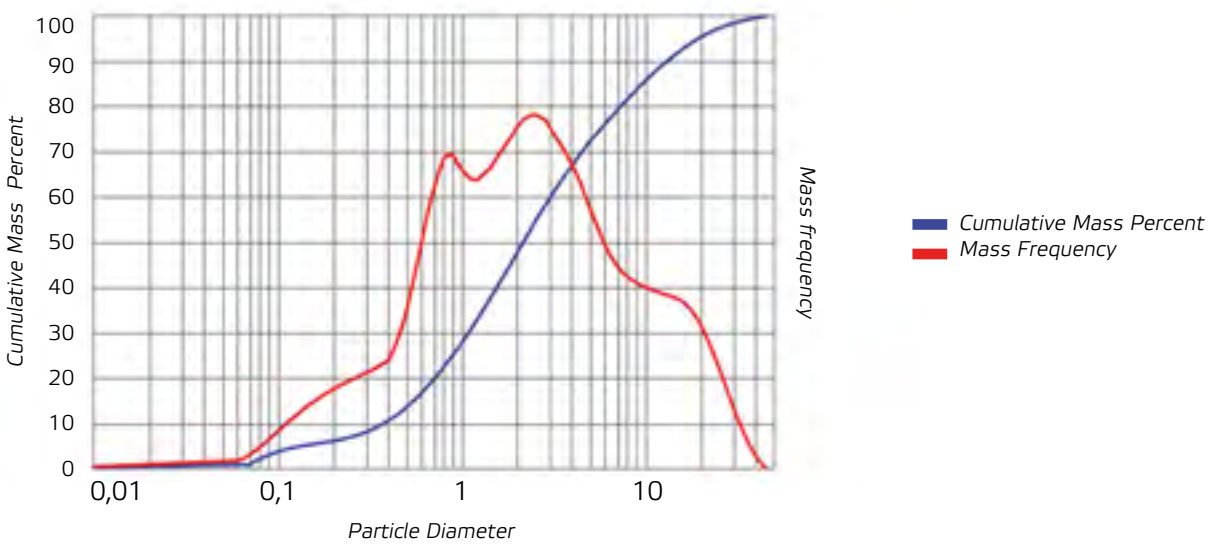
	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	99.50	-	99.70
Na_2O	%	-	0.22	0.15
CaO	%	-	0.06	0.04
SiO_2	%	-	0.09	0.04
Fe_2O_3	%	-	0.04	0.03

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



PARTICLE SIZE DISTRIBUTION

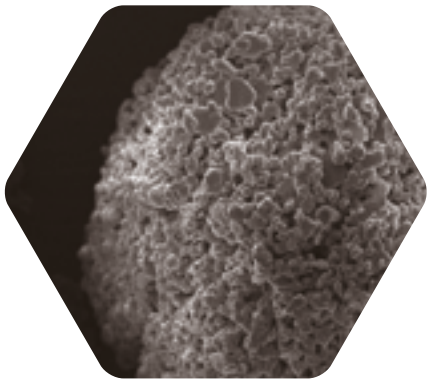
Laser measurement - Cilas



REal
ALUMINA SOLUTIONS FOR REFRACTORIES

UNGROUND CALCINED ALUMINA

REal® HC-UG



THE UNGROUND HARD CALCINED ALUMINA DESIGNED FOR REFRACTORY BRICKS

YOU ASK FOR:

1 **A LONGER SERVICE LIFE**
of bricks in severe environment

2 **A HIGHER REFRACTORINESS**
of brick formulations

3 **A GOOD DIMENSIONAL**
stability during firing

FOR THESE APPLICATIONS:


Bricks


Mortars

ALTEO OFFERS:

REal® HC-UG, a **hard calcined alumina**, with a normal soda content and ungrounded.

Its high degree of calcination and stability provide a **better refractoriness** to refractory bricks and mortars.

REal® HC-UG is produced and controlled within a **certified quality management system** (ISO 9001).

REal® HC-UG ADVANTAGES:

- High refractoriness
- Dimensional stability
- Tight specifications allowing a serene use in production

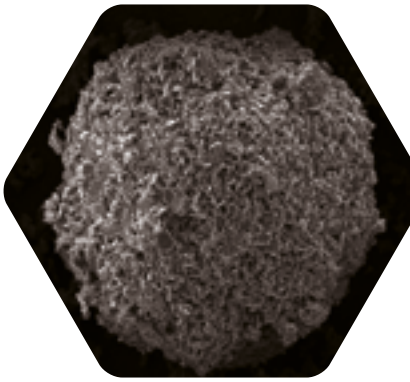
PHYSICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Particle Size Distribution (Cilas): Id_{50} <15 µm	 µm %	 60 -	 120 20	 90 -
Angle of Repose	º	-	-	45-48
BET / Specific Surface Area	m²/g	0.40	0.80	-
Loss On Ignition 20ºC to 1000ºC	%	-	0.30	0.1

CHEMICAL PROPERTIES

	Unit	Min.[1]	Max.[1]	Typical[2]
Al_2O_3 (on dry basis)	%	99.40	-	99.60
Na_2O	%	-	0.45	0.36
CaO	%	-	0.04	0.02
SiO_2	%	-	0.04	0.01
Fe_2O_3	%	-	0.04	0.02

[1] Min. & Max. values are our standard product specifications for this product.
[2] Typical values are taken from production averages.



ALTEO PACKAGING & LOGISTICS SOLUTIONS

PACKAGING

To ensure you a **smooth manufacturing process**, we offer different **types of packaging and minimum logistic units,** which will suit all **your production requirements**.

We offer 3 different types of packaging depending on your production needs:

- Paper bags
- Bulk bags
- Bulk

Our basic offer is:

Type of packaging	Bulk	Bags	Bulk bags
Products	REal® HC-UG	All REal® range	All REal® range
Packaging characteristics	/	Valve bags Thermo sealable valve bags	Outer sleeve bottom(1)
Location Availability	Gardanne workshop area only	All workshops and stock points	All workshops and stock points
Minimum logistic units*	Silo truck	Pallet	Pallet
Tons per logistic unit	25 29 (France only)	1.0 0.9 (REal® MC-G only)	1.0 0.75 (REal® MC-G only)
Article per logistic unit	1	40	1

(1): flat bottom available on demand
** the smallest item established for transport and/or storage*

LOGISTICS

To match your requirements in terms of deliveries, we offer **different logistics solutions.**

Our basic offer in terms of DELIVERY is:

Type of Transportation	Road transportation	Sea shipping
Point of delivery(2)	At Customers' plant Ex works - Gardanne plant Ex works – stock point	At Port of Destination

(2) Other type of delivery on demand

Our basic offer in terms of MINIMUM ORDER QUANTITY (MOQ) is:

Type of Packaging	Bulk	Bags / Bulk bags
MOQ	**Full silo truck**	Road transportation: **full truck** Sea shipping: **Full Container Load (FCL)**

We can offer you **flexibility** on MOQ, when it is needed. A **lower MOQ** is available on demand, however **additional transportation costs** will be charged. For more information, please reach out to your local Alteo sales representative.

SAFETY

When it comes to sea shipping, containers can be delivered everywhere. Weather and swell can give containers a hard time during transportation. To avoid any overthrow of pallets when containers are unloaded in your plants, we **secure** our containers with **safety sheets and straps**.

ALTEO
Route de Biver - 13120 Gardanne - France

www.alteo-alumina.com

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