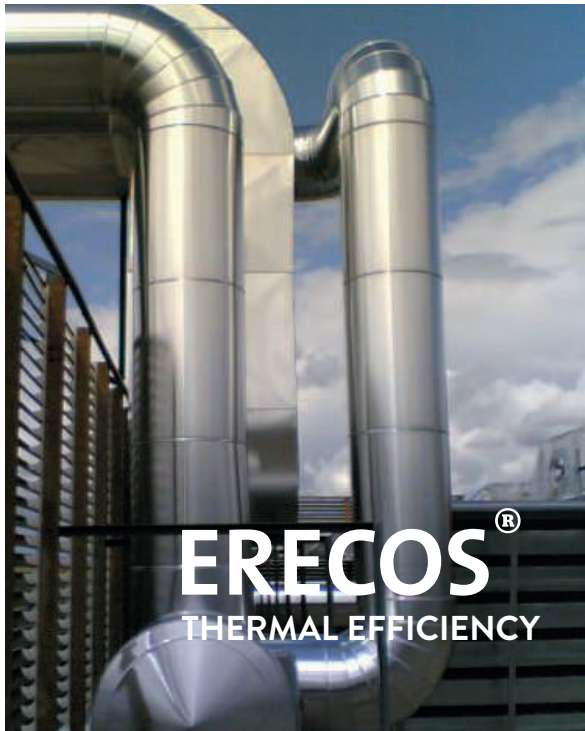
REFRACTORY PRODUCTS



ERECOS®
THERMAL EFFICIENCY

Electroporcelana GAMMA S.A. is a Colombian company with a track record of over 60 years in the market, that is the owner of the ERECOS® brand. We are part of the CORONA Group, a Latin-American industrial conglomerate with more than 140 years of experience in manufacturing processes, which employs more than 18,000 people and has 25 production facilities. The CORONA Group is recognized for its huge environmental and social commitment.

GAMMA|ERECOS® manufactures and markets the following refractory products: bricks, castable, mortars, ramming mixes, plastics and thermal insulation. Our refractory materials solutions are offered to a wide range of industries in Latin America. We have two refractory production plants (in Sogamoso-Boyacá and Itagüí-Antioquia) and four commercial offices, all located in Colombia.

Our facilities in Colombia allow us to offer a broad portfolio, adapted to the specific needs of each client. Some of the industries we serve include: cement and lime, ceramic, chemical and petrochemical, ferronickel, metal-mechanic, non-ferrous, environmental services and, iron and steel.

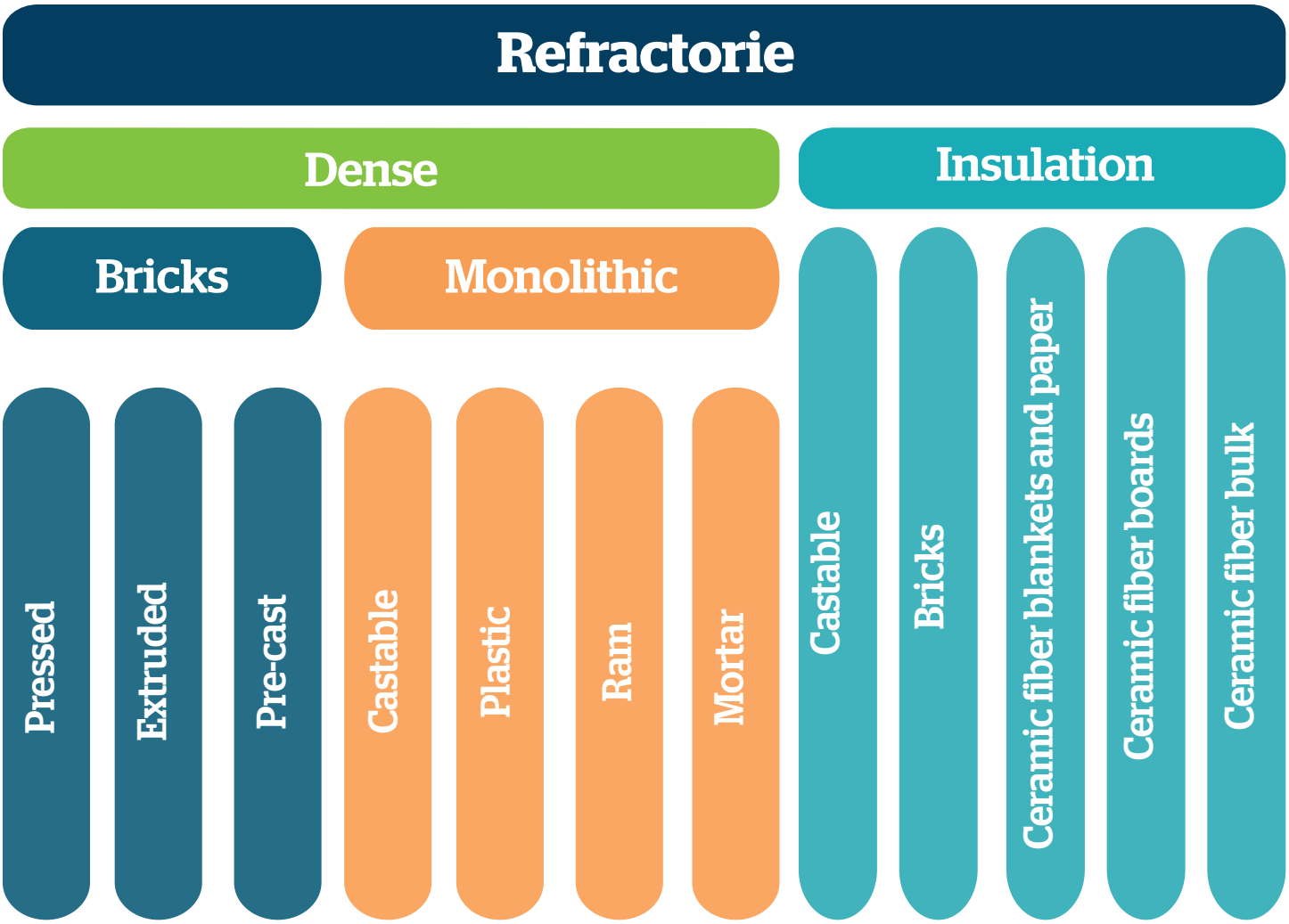
For quotation and development of these special pieces, we have qualified teams that are selected according to product and technology requirements, ensuring compliance with the specifications defined by furnace designers, refractory manufacturers, and the requirements of the facility.

ERECOS®
THERMAL EFFICIENCY

REFRACTORY PRODUCTS

REFRACTORY PRODUCTS

We offer an extensive portfolio of products that can be classified into groups and subgroups depending on their physical form, as shown in the following image.



Each of these subgroups comprises a number of different products as explained below, taking into account other classification criteria such as density, chemical composition, physical appearance, and installation.

Preformed

PRESSED BRICKS

Pressed bricks are pieces that have undergone a pressing process to give the resulting products the desired shape. They can be bricks of standardized shapes (ISO formats) or special geometries, where shapes and dimensions are established by agreement between manufacturer and consumer.

Our portfolio includes three groups of pressed bricks: alumina-silica (fireclay), high-alumina and acid proof bricks. The first two are classified in compliance with the guidelines of the ASTM C27 international standard. Manufacture of acid-proof bricks complies with International Standard ASTM C279.

The following chart shows the classification criteria for each group:

- **Alumina-silica (fireclay) bricks:**

Bricks with a content of less than 50% Al_2O_3 . They are manufactured from selected clays, consisting essentially of hydrated silico-aluminates with small amounts of other oxides.

International Standard ASTM C27 classifies them into four groups:

Table 1.Classification of alumina-silica (fireclay) bricks according to standard

Clasification	General description
Low Duty	Used as back up bricks in linings with higher refractoriness and for applications where the operation conditions and temperatures are moderates.
Medium Duty	Used in equipment where the operating conditions are not very severe.
High Duty	Bricks with good resistance to thermal shock and abrasive wear at relatively high temperatures.
Super Duty	Bricks very stable at high temperatures and resistant to the action of acid slag.

- **High-alumina bricks:**

This type of product contains between 50% and 99% Al_2O_3 in its composition. Its manufacture includes alumina-rich raw materials, such as high-alumina chamottes, bauxites, corundum, tabular alumina, and others. According to the ASTM C27 standard, they are classified into the following subgroups:

Table 2.High-alumina bricks classification in accordance with ASTM C27.

Classification	Al_2O_3 content (%)
50%	50 ± 2.5
60%	60 ± 2.5
70%	70 ± 2.5
80%	80 ± 2.5
85%	85 ± 2.0
90%	90 ± 2.0
99%	minimum 97

- **Acid-proof bricks:**

Acid-proof bricks are products that are chemically resistant to acid attack. They are made from specially selected raw materials to achieve very low water absorption rates and low acid solubility (except hydrofluoric acid).

Depending on their intended application, they can be classified into three large groups in accordance with ASTM C279, as shown below:

Table 3.Acid-proof brick classification in accordance with ASTM C279

Designation	Minimum modulus of rupture (MPa)	Maximum water absorption (%)	Solubility in H_2SO_4 maximum (% weight)
Type I	8.6	6.0	20
Type II	8.6	4.0	12
Type III	8.6	1.0	8

Preformed

Pressed bricks: Alumina-silica

Pressed bricks: Alumina-silica	Properties	ERCLAY LT	TP	U 32	U 33
	Classification ASTM C-27	Medium Duty	High Duty	High Duty	Super Duty
	Chemical composition (%)				
	Al_2O_3	44.8	43.5	44.6	46.3
	SiO_2	51.0	50.4	51.3	49.3
	Bulk density (g/cm³)	1.90-2.00	1.90-2.00	2.03-2.13	2.13-2.23
	Apparent porosity (%)	24.0-28.0	28.0-32.0	24.0-28.0	20.0-24.0
	Permanent linear change (%)		-		
	1300°C	0.5C-1.2C			
	1400°C	-	-	0.5C-1.5C	-
	1600°C				0.5C-2.0C

Pressed bricks: Alumina-silica	Properties	ER 40	AQ 45M	AQ 45K	ERMULCOR	ABRASiC 50
	Classification ASTM C-27	Super Duty	Super Duty	Super Duty	High Duty * Mullite-cordierite	Super Duty *with SiC
	Chemical composition (%)					
	Al_2O_3	45.2	45.7	49.2	46.8	44.0
	SiO_2	50.5	50.0	47.0	45.6	42.0
	Other oxides	-	-	-	-	10
	Bulk density (g/cm³)	2.16-2.26	2.23-2.33	2.32-2.38	1.95-2.10	2.20-2.30
	Apparent porosity (%)	16.0-20.0	12.0-16.0	12.0-16.0	20.0-25.0	18.0-22.0
	Permanent linear change (%)					
	1600°C	0.5C-1.5C	0.0 - 0.5C	0.5C - 0.8C	-	0.5C - 0.5E

Pressed bricks: High-alumina

Pressed bricks: High-alumina	Properties	AQ 50	AQ 60	ALUM 50	BAUXAL 60
	Classification ASTM C-27	50% Al_2O_3	60% Al_2O_3	50% Al_2O_3	60% Al_2O_3
	Chemical composition (%)				
	Al_2O_3	50.5	61.8	51.8	61.1
	SiO_2	45.1	33.7	43.6	34.1
	Bulk density (g/cm³)	2.30-2.35	2.45-2.55	2.16-2.26	2.31-2.41
	Apparent porosity (%)	12.0-16.0	12.0-16.0	20.0-24.0	20.0-24.0
	Permanent linear change (%)- 1600°C (%)	0.0 - 0.1E	0.0-0.4E	1.0C-0.5E	2.0E-4.0E

Preformed

Pressed bricks: High-alumina	Properties	BAUXAL 70	BAUXAL 80	BAUXAL 85	CORINBRICK	ANDALUBRICK
	Classification ASTM C-27	70% Al_2O_3	80% Al_2O_3	85% Al_2O_3	90% Al_2O_3	60% Al_2O_3 *With andalusite
	Chemical composition (%)					
	Al_2O_3	69.8	80.0	83.5	93.0	57.0
	SiO_2	24.8	14.5	8.9	4.5	40.2
	Other oxides	-	-	2.8	2.2	-
	Bulk density (g/cm³)	2.46 - 2.56	2.68 - 2.78	2.72 - 2.82	2.95 - 3.15	2.45 - 2.50
	Apparent porosity (%)	19.5 - 23.5	18.0 - 21.0	17.0 - 21.0	16.0 - 18.0	11.0 - 15.0
	Permanent linear change (%)					
	1600°C	3.5E - 6.0E	0.5E - 1.5E	0.0 - 0.1E	1.0C - 3.0C	0.0 - 0.5E

Acid-proof bricks

Acid-proof bricks	Properties	ANTAC II	ANTAC III
	Classification ASTM C-279	Type II	Type III
	Chemical composition (%)		
	Al_2O_3	29.3	22.0
	SiO_2	70.3	72.0
	Bulk density (g/cm³)	5.0-9.0	1.0-3.0
	Apparent porosity (%)	2.14 - 2.24	2.14 - 2.24
	Water Absorption (%)	2.0 - 4.0	0.5 - 1.0

EXTRUDED BRICKS

Our technology enables us to manufacture symmetrical bricks, with or without horizontal perforations. These products are also classified under ASTM C27, as shown in Table 1.

Our portfolio includes two products manufactured by extrusion: CTE and ERCLAY SM.

The CTE brick was specially designed for the pottery industry due to its high resistance to thermal shock. CTE are perforated bricks used in the construction of tunnel kiln cars. ERCLAY SM bricks are compact types of bricks (similar to a paving stone) used in industries such as the coke industry and wood-burning stoves.

Preformed

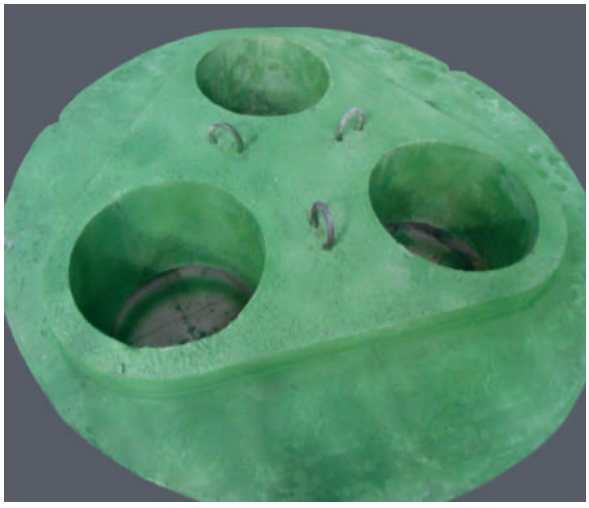
Extruded: Alumina-silica	Properties	CTE	ERCLAY SM
	Classification ASTM C-27	Cordierite	Medium Duty
	Chemical composition (%)		
	Al_2O_3	40.8	42.2
	SiO_2	23.9	52.6
	Bulk density (g/cm³)	<2.20	1.80-1.95
	Apparent porosity (%)	>18.0	28.0-34.0
	Permanent linear change (%)		
	1000°C	-	0.0-0.5C

PRE-CASTED BRICKS

We have the appropriate technology to perform the mixing and casting of refractory castable in special molds, enabling the production of pre-cast pieces, also known as casted bricks. Unlike pressed and extruded bricks, the shape of casted bricks is usually irregular and is made according to specific customer needs or requests.

Our products can be delivered dried or fired. Dried bricks are refractories that have been subjected to a thermal treatment to ensure the absence of free or chemically bound water in the microstructure. Fired products have been fired at high temperatures, allowing development of the ceramic bond that improves refractory properties. The selection between a dried and a fired product should be made taking into account process conditions and also, the properties of the materials.

The selection between a dried or fired piece should be based on the expected conditions in which it will be used, as well as the intrinsic properties of the castable selected for production. We are able to produce any of the types of castables described in the following section.



CASTABLES

Refractory castables are heterogeneous mixtures of ground materials with the appropriate granulometry and the presence of a binder (hydraulic, chemical or sol-gel) that allows adhesion between the particles of the material. The binder will give the material the desired cold strength and will develop the ceramic bond as the temperature is increased. This bond provides the finished product with high resistance when put into service. To ensure the performance of the castable, it is essential to control the quantity and quality of water addition, the application method, the setting and curing time, and the initial warming up of the piece.

According to ASTM C401, refractory castable are classified into groups depending on the calcium oxide (CaO) content included in their formulation, as shown in Table 4. In addition, dense castables can be sub-classified into categories depending on the temperature at which they exhibit a permanent linear change not exceeding 1.5%, as shown in the following table.

Table 4. Classification of dense castable refractories

Classification	Lime (CaO) as contributed by cement (%)
Conventional castable	≥ 2.5
Low cement castable	> 1.0 y ≤ 2.5
Ultra low cement castable	> 0.2 y ≤ 1.0
No-cement castable	≤ 0.2

Table 5. Conventional castable refractories

Class	Permanent linear change of no more than 1,5% when burned for 5 hours to:
A	1095
B	1260
C	1370
D	1480
E	1595
F	1705
G	1760

Our portfolio includes conventional, low cement and no-cement castables, and a group that we call specialties because they refer to products that are used for very specific applications.

All castables can be subjected to fast dry out (SR) technology, which was developed for industrial applications requiring fast kiln start-ups without compromising refractory performance. In addition, they can be reinforced with stainless steel fibers (A) to improve thermal shock and abrasion resistance.

The products we offer are listed below, including a brief description of their properties and the class to which they belong.

Monolithic

Castables: Conventional

Conventional castables are materials containing ≥ 2.5% calcium oxide (CaO). They are further sub-classified based on their alumina content.

Conventional - alumina-silica

Properties	CONCRAX UG	CONCRAX 1300	CONCRAX 1500
Classification ASTM C-401	Class B	Class B	Class D
Chemical composition (%)			
Al_2O_3	44.2	43.4	50.8
SiO_2	42.2	42.8	38.4
Maximum service temperature (°C)	1300	1300	1480
Bulk density (g/cm³)			
110°C	2.00 - 2.15	2.05 - 2.20	2.00 - 2.10
1260°C	1.90 - 2.00	2.00 - 2.10	-
1480°C	-	-	1.95 - 2.00
Cold Crushing Strength (MPa)			
110°C	25.0 - 50.0	25.0 - 50.0	25.0 - 40.0
1260°C	20.0 - 30.0	20.0 - 30.0	-
1480°C	-	-	50.0 - 54.0
Modulus of rupture (MPa)			
110°C	5.0 - 8.0	5.0 - 8.0	5.0 - 8.0
1260°C	7.0 - 10.0	5.0 - 8.0	-
1480°C	-	-	14.0 - 15.0

Conventional - high-alumina

Properties	CMC 55 RA	CRX 55 RA	CONCRAX 1650	CONCRAX 1700	CORINDAL 1900 B
Classification ASTM C-401	Clase D	Clase B	Clase E	Clase C	Clase G
Chemical composition (%)					
Al_2O_3	56.4	56.0	68.7	84.1	93.7
SiO_2	35.1	33.4	21.3	5.1	0.3
Maximum service temperature (°C)	1550	1300	1650	1650	1800
Bulk density (g/cm³)					
110°C	2.25 - 2.35	2.25 - 2.35	2.20 - 2.30	2.50 - 2.60	2.85 - 2.95
1260°C	-	2.10 - 2.15	-	-	-
1480°C	2.10 - 2.15	-	-	-	-
1600°C	-	-	2.10 - 2.15	2.85 - 2.95	2.90 - 3.00
Cold Crushing Strength (MPa)					
110°C	50.0 - 80.0	80.0-100.0	20.0 - 30.0	25.0 - 45.0	20.0 - 40.0
1260°C	-	50.0 - 80.0	-	-	-
1480°C	50.0 - 80.0	-	-	-	-
1600°C	-	-	30.0 - 40.0	140.0 - 160.0	60.0 - 80.0
Modulus of rupture (MPa)					
110°C	8.0 - 12.0	9.0 - 15.0	4.5 - 6.5	6.0 - 9.0	7.0 - 10.0
1260°C	-	6.0 - 10.0	-	-	-
1480°C	8.0 - 12.0	-	-	-	-
1600°C	-	-	8.0 - 12.0	50.0 - 60.0	25.0 - 30.0

Castables: Low cement castables

Low cement castables are materials with calcium oxide (CaO) content between 1.0% and 2.5%. Their preparation requires less water consumption than conventional castables. In addition, they show excellent performance at room temperature and service temperatures. They are then further subclassified into low cement - high-alumina and low cement - special applications.

Low cement castable

Properties	CBC 50	CBC 60	CBC 70	CBC 85
Classification ASTM C-401	Class D	Class D	Class D	Class E
Chemical composition (%)				
Al_2O_3	53.9	62.5	69.3	82.7
SiO_2	41.4	32.9	25.1	12.2
Maximum service temperature (°C)	1600	1600	1600	1600
Bulk density (g/cm³)				
110°C	2.15-2.15	2.46-2.53	2.50-2.60	2.67-2.80
1095°C	-	-	-	-
1600°C	2.05-2.10	2.24-2.25	2.40-2.50	2.90 - 3.05
Cold Crushing Strength (MPa)				
110°C	40.0-70.0	40.0-70.0	45.0-70.0	50.0-70.0
1095°C	-	-	-	-
1600°C	80.0-110.0	90.0-120.0	90. 0-130.0	100.0-130.0
Modulus of rupture (MPa)				
110°C	8.0-10.0	8.0-11.0	9.0-12.0	8.5-12.0
1095°C	-	-	-	-
1600°C	16.0-20.0	18.0-23.0	18.0-23.0	20.0-54.0

Low cement castable - high-alumina

Properties	CANBC 60	CANBC 80	CORINCAST 94
Classification ASTM C-401	Class D	Class F	Class F
Chemical composition (%)			
Al_2O_3	62.5	77.7	93.6
SiO_2	32.4	16.5	5.1
Maximum service temperature (°C)	1600	1700	1800
Bulk density (g/cm³)			
110°C	2.15-2.25	2.50-2.60	2.80-2.90
1600°C	2.55-2.65	2.65-2.75	2.85-2.95
Cold Crushing Strength (MPa)			
110°C	80.0-110.0	80.0-110.0	25.0-50.0
1600°C	100.0-130.0	100.0-130.0	90.0-130.0
Modulus of rupture (MPa)			
110°C	8.0-10.0	11.0-17.0	8.0-12.0
1600°C	14.0-18.0	17.0-21.0	15.0-25.0

Low cement castables - high-alumina	Properties	CORINCROM	CASTAB	CASTAB C
	Classification ASTM C-401	Class F	Class F	Class F
	Chemical composition (%)			
	Al_2O_3	90.9	93.9	89.2
	SiO_2	4.7	4.8	4.5
	Maximum service temperature (°C)	1800	1700	1700
	Bulk density (g/cm³)			
	110°C	2.80-2.90	2.80-2.90	2.80-2.90
	1600°C	2.85-2.95	3.00-3.10	2.94-3.02
	Cold Crushing Strength (MPa)			
	110°C	25.0-50.0	30.0-50.0	25.0-50.0
	1600°C	90.0-130.0	80.0-160.0	90.0-110.0
	Modulus of rupture (MPa)			
	110°C	8.0-12.0	6.0-10.0	6.0-8.0
	1600°C	15.0-25.0	40.0-60.0	30.0-40.0

Castable: No-cement castables

These castable types use alternative binders, different from calcium aluminate cement, and the CaO content in the formulation is usually less than or equal to 0.2%. These castables are used as silica-colloidal binders.

No-cement castable	Properties	CSC 50	CSC 60	CSC 85	CSC 95
	Classification ASTM C-401	Class D	Class E	Class F	Class F
	Chemical composition (%)				
	Al_2O_3	51.2	62.0	82.9	95.8
	SiO_2	45.5	34.2	12.2	2.8
	Maximum service temperature (°C)	1600	1650	1700	1700
	Bulk density (g/cm³)				
	110°C	2.19-2.24	2.30-2.40	2.80-2.90	2.80-2.95
	1600°C	2.30-2.40	2.30-2.40	2.50-2.60	3.05-3.15
	Cold Crushing Strength (MPa)				
	110°C	35.0-45.0	30.0-45.0	35.0-50.0	20.0-30.0
	1600°C	80.0-100.0	90.0-110.0	80.0-120.0	90.0-120.0
	Modulus of rupture (MPa)				
	110°C	4.5-6.0	3.5-4.5	6.5-8.0	3.5-4.5
	1600°C	11.0-18.0	9.0-12.0	12.0-20.0	10.0-15.0

Castable: Special

This category includes products designed for specific applications. It includes concretes formulated with andalusite, zirconium oxide and silicon carbide, and is available in low cement and cement-free formulations.

	Properties	ANDALUCRAX	CBC AND	CANBC AND	SCAND 65
With andalusite	Classification ASTM C-401	Class E *Conventional	Class E * Low cement	Class E * Low cement self-leveling	Class E * Without cement
	Maximum continuous use temperature (°C)	1600	1600	1600	1650
	Chemical composition (%)				
	Al_2O_3	56.7	63.9	64.2	65.0
	SiO_2	34.4	32.6	32.6	32.0
	Bulk density (g/cm³)				
	110°C	2.10-2.25	2.45-2.55	2.50-2.60	2.43-2.57
	1600°C	2.10-2.20	2.40-2.50	2.40-2.50	2.40-2.50
	Cold Crushing Strength (MPa)				
	110°C	20.0-35.0	40.0-60.0	40.0-60.0	25.0-35.0
	1600°C	70.0-100.0	80.0-120.0	100.0-140.0	65.0-80.0
	Modulus of rupture (MPa)				
	110°C	5.0-8.0	7.0-10.0	7.0-10.0	4.5-6.0
	1600°C	10.0-13.0	12.0-20.0	13.0-20.0	90.0-13.0

	Properties	CBC ZIRCAST	CANBC ZIRCAST	CSC ZIRCAST
With zirconium oxide	Classification ASTM C-401	Under cement with zirconia	Under self cement - leveling with zirconia	Cementless with zirconia
	Maximum continuous use temperature (°C)	1700	1700	1700
	Chemical composition (%)			
	Al_2O_3	51.9	52.5	49.7
	SiO_2	19.8	20.1	22.3
	Other oxides	26.2	25.8	27.4
	Bulk density (g/cm³)			
	110°C	2.70-2.80	2.70-2.80	2.80-2.90
	1370°C	2.75-2.85	2.70-2.80	2.75-2.85
	Cold Crushing Strength (MPa)			
	110°C	50.0-80.0	30.0-50.0	25.0-40.0
	1370°C	80.0-120.0	50.0-80.0	45.0-70.0
	Modulus of rupture (MPa)			
	110°C	8.5-12.0	7.0-10.0	6.0-8.0
	1370°C	12.0-18.0	12.0-18.0	10.0-14.0

Monolithic

Alkali and abrasion resistant

Properties	CBC ANTIPEGA	CBC 10 SiC	CBC 30 SiC	CBC 40 SiC	CORINSiC 40
Classification ASTM C-401	Class D	Class E	Class D	Class D	Class C
Maximum continuous use temperature (°C)	1200	1500	1500	1400	1500
Chemical composition (%)					
Al_2O_3	42.0	31.1	31.2	28.7	41.6
SiO_2	52.4	55.3	36.9	29.2	16.8
Other oxides	-	11.0	28.6	39.6	40.2
Bulk density (g/cm³)					
110°C	2.75-2.85	2.10-2.25	2.15-2.25	2.55-2.65	2.60-2.70
1095°C	2.15-2.25	-	2.15-2.25	-	-
1370°C	-	2.10-2.20	-	2.55-2.65	2.50-2.60
Cold Crushing Strength (MPa)					
110°C	40.0-70.0	40.0-60.0	40.0-60.0	40.0-60.0	40.0-60.0
1095°C	70.0-90.0	-	40.0-60.0	-	-
1370°C	-	70.0-100.0	-	70.0-100.0	70.0-100.0
Modulus of rupture (MPa)					
110°C	14.0-20.0	6.0-8.0	7.0-10.0	9.0-13.0	7.0-10.0
1095°C	14.0-18.0	-	9.0-13.0	-	-
1370°C	-	8.0-12.0	-	7.0-10.0	8.0-12.0

No cement castable

Properties	CSC 10 SiC	CSC 20 SiC	CSC 30 SiC
Classification ASTM C-401	Class E	Class E	Class D
Maximum continuous use temperature (°C)	1500	1450	1450
Chemical composition (%)			
Al_2O_3	44.2	39.9	34.8
SiO_2	42.1	37.2	32.3
Other oxides	10.0	20.0	30.0
Bulk density (g/cm³)			
110°C	2.20-2.30	2.25-2.35	2.30-2.40
1480°C	2.20-2.30	2.25-2.35	2.30-2.40
Cold Crushing Strength (MPa)			
110°C	25.0-35.0	25.0-35.0	25.0-35.0
1480°C	65.0-80.0	65.0-80.0	65.0-80.0
Modulus of rupture (MPa)			
110°C	3.5-4.5	3.5-4.5	3.5-4.5
1480°C	9.0-13.0	6.0-8.0	7.0-11.0

Monolithic

Special castables*

Properties	CONCRAX 1300 RAL	CONCRAX 1500 RAL	CONCRAX 1700 RAL
Classification ASTM C-401	Class B	Class D	Class C
Maximum continuous use temperature (°C)	1300	1480	1650
Chemical composition (%)			
Al_2O_3	40.7	48.4	81.4
SiO_2	37.9	35.3	6.0
Other oxides	9.0	7.2	2.9
Bulk density (g/cm³)			
110°C	2.05-2.20	2.00-2.10	2.50-2.60
1260°C	2.00-2.10	-	-
1480°C	-	1.95-2.00	-
1600°C	-	-	2.85-2.95
Cold Crushing Strength (MPa)			
110°C	25.0-50.0	25.0-40.0	25.0-45.0
1260°C	20.0-30.0	-	-
1480°C	-	50.0-54.0	-
1600°C	-	-	140.0-160.0
Modulus of rupture (MPa)			
110°C	5.0-8.0	5.0-8.0	6.0-9.0
1260°C	5.0-8.0	-	-
1480°C	-	14.0-15.0	-
1600°C	-	-	50.0-60.0

*The RAL product line was specially designed for contact with molten metals such as aluminum and lead. Its composition includes oxides that reduce the wettability of the refractory, thus making it more resistant to the penetration of this type of metals.

Monolithic

For non-ferrous industry*

Properties	CBC 50 RAL	CBC 60 RAL	CBC 70 RAL	CBC 85 RAL	CANBC 80 RAL
Classification ASTM C-401	Class D	Class D	Class D	Class E	Class F
Maximum continuous use temperature (°C)	1400	1600	1600	1600	1600
Chemical composition (%)					
Al_2O_3	52.1	61.8	67.8	82.4	77.5
SiO_2	38.5	30.6	23.7	10.3	13.7
Other oxides	5.0	2.9	3.1	2.9	2.9
Bulk density (g/cm³)					
110°C	2.20-2.25	2.46-2.53	2.50-2.60	2.67-2.80	2.75-2.85
1095°C	2.10-2.20	-	-	2.67-2.80	-
1600°C	-	2.24-2.30	2.40-2.50	-	2.65-2.75
Cold Crushing Strength (MPa)					
110°C	40.0-60.0	40.0-70.0	45.0-70.0	50.0-70.0	80.0-110.0
1095°C	60.0-80.0	-	-	70.0-100.0	-
1600°C	-	90.0-120.0	90.0-130.0	-	100.0-130.0
Modulus of rupture (MPa)					
110°C	8.0-10.0	8.0-11.0	9.0-12.0	8.5-12.0	14.0-20.0
1095°C	10.0-13.0	-	-	12.0-30.0	-
1600°C	-	18.0-23.0	18.0-23.0	-	17.0-21.0

*The RAL product line was specially designed for contact with molten metals such as aluminum and lead. Its composition includes oxides that reduce the wettability of the refractory, thus making it more resistant to the penetration of this type of metals.

PLASTICS

Plastics are extruded refractories formulated from a mixture of aggregates and cohesive clays. They are wet products, packing container, and do not require any additional preparation. They are used as refractory linings in floors, walls, and ceilings of industrial furnaces. Their most common use is in repairs and in manufacture of monolithic parts. They are generally applied by mechanical ramming.

Plastics and ramming compounds are classified according to ASTM C673, as shown in Table 6.

Table 6. Classification of fireclay and high-alumina plastic refractories and ramming mixes

Class	PCE, min	AL_2O_3, %
High Duty	31	Not required
Super Duty	32 ½	Not required
60% Alumina	35	57.6 - 62.5
65% Alumina	35 – 36	62.6 - 67.5
70% Alumina	36	67.6 - 72.5
80% Alumina	37	77.6 - 82.5
85% Alumina	Not required	82.6 - 87.5
90% Alumina	Not required	87.6 - 92.5
95% Alumina	Not required	92.6 - 97.5
100% Alumina	Not required	> 97.5

The following plastics are available as part of our portfolio:

	Properties	ERPLAX 45 P	ERPLAX 45 PLA	ERPLAX 45 PLA GR	RAMPLAX 45 PLA GR
Plastic -alumina-silica	Classification NTC -1008, ASTM C-673	High Duty	Super Duty	Super Duty *With graphite	Super Duty *With graphite
	Classes of setting	Heat setting	Air setting	Air setting	Air setting
	Maximum continuous use temperature (°C)	1600	1600	1600	1600
	Chemical composition (%)				
	Al_2O_3	43. 7	47.8	44.5	43.9
	SiO_2	47.3	47.5	49.3	50.0
	Workability (%)	25- 35	-	40-50	45-55
	Bulk density (g/cm³)				
	1370°C	-	-	-	1.80-1.90
	1480°C	-	-	1.80-1.90	-
	1600°C	2.00- 2.10	1.90- 2.00	-	-
	Cold Crushing Strength (MPa)				
	1370°C	-	-	-	14.0-16.0
	1480°C	-	-	14.0-16.0	-
	1600°C	30.0- 35.0	19.0- 21.0	-	-
	Modulus of rupture (MPa)				
	1370°C	-	-	-	-
	1480°C	-	-	6.0-10.0	6.0-10.0
	1600°C	9.0- 12.0	8.0- 10.0	-	-

Plastic - high alumina

Properties	ERPLAX 60 P	ERPLAX 80 PLF	ERPLAX 80 PLF RAL
Classification NTC-1008, ASTM C-673	60% Alumina	80% Alumina * Phosphate-Bonded	80% Alumina * Phosphate-Bonded
Classes of setting	Heat-setting	Chemical bonded and heat-setting	Chemical bonded and heat-setting
Maximum continuous use temperature (°C)	1650	1650	1370
Chemical composition (%)			
Al_2O_3	62.3	78.3	78.6
SiO_2	32.6	10.9	9.7
Other oxides	-	5.5	6.4
Workability (%)	Min 45	45-55	-
Bulk density (g/cm³)			
1095°C	-		2.60-2.70
1600°C	2.00-2.05	2.59-2.64	-
Cold Crushing Strength (MPa)			
1095°C	-	-	70.0-100.0
1600°C	7.0-7.5	40.0-50.0	-
Modulus of rupture (MPa)			
1095°C	-	-	10.0-13.0
1600°C	2.0-2.5	9.0-10.0	-

RAM

These materials are very similar to plastics, but they have a lower humidity. They can be installed using pneumatic hammers. The resulting refractory tends to be denser and more resistant than plastics.

The classification of this type of products is also explained in ASTM C673, as shown in Table 6.

	Properties	ERPLAX 40	ERPLAX 45	ERPLAX 60	ERPLAX 80
Ram	Classification NTC -1008, ASTM C-673	High Duty	High Duty	60% Alumina	80% Alumina
	Classes of setting	Heat-setting	Heat-setting	Heat-setting	Heat-setting
	Maximum continuous use temperature (°C)	1550	1600	1650	1700
	Chemical composition (%)				
	Al_2O_3	45.9	47.3	59.8	77.5
	SiO_2	49.1	47.3	35.0	16.0
	Bulk density (g/cm³)				
	Workability (%)	15-25	15-20	16-24	12-18
	1480°C	2.05-2.10	-	-	-
	1600°C	-	2.00-2.10	2.00-2.0	2.25-2.35
	Cold Crushing Strength (MPa)				
	1480°C	13.0-13.5	-	-	-
	1600°C	-	30.0-35.0	7.0-7.5	15.0-22.0
	Modulus of rupture (MPa)				
	1480°C	4.0-4.5	-	-	-
	1600°C	-	9.0-12.0	2.0-2.5	5.0-5.6

MORTARS

Refractory mortars are used to bond bricks together. They are responsible for providing stability to the masonry, in addition to preventing penetration and being resistant to attack by slag, liquids and corrosive gases. These materials are made up of a mixture of finely ground refractory aggregates, plastic clays, additives, and special binders. They must be selected in accordance with the brick to which they will be applied, to ensure compatibility.

Depending on the type of setting, they can be classified as follows:

- Dry - heat setting
- Dry - air setting.
- Wet - air setting.
- Wet - chemical bonded.

Silico-alumina and high alumina mortars can be classified according to ASTM C1655, using the classification criteria shown in Table 7.

Table 7. Classification of fireclay and high-alumina mortars

Class of brick	Class of mortar	No flow from joins in pier test (Test method C199) when fired to:	Minimum alumina content (%)
Medium Duty	Medium Duty	1400	-
High Duty	High Duty	1500	-
Super Duty	Super Duty	1600	-
High alumina up to 70%	High alumina	1705	-
High alumina 80%	High alumina 80%	1705	77.5
High alumina 85%	High alumina 85%	1705	83.0
High alumina 90%	High alumina 90%	1705	88.0
High alumina 99%	High alumina 99%	1705	97.0

MORTAR: DRY HEAT SETTING MORTAR

This type of mortar requires a thermal treatment to develop the desired properties. It is delivered dry and requires onsite addition of water at the time of bonding.

Dry - air setting

Properties	UNIVERSAL
Classification NTC-765, NTC-851	Super Duty
Class	Dry - heat setting
Chemical composition (%)	
Al_2O_3	48.4
SiO_2	47.0

MORTARS: DRY - AIR SETTING

Setting in this type of mortar occurs when the material is exposed to air. It is delivered dry and requires the addition of sodium silicate on site.

Wet - air setting

Properties	SUPERAEROSEC	BAUSEC	ALUSEC
Classification NTC-765, NTC-851	Super Duty	High Alumina	High Alumina
Chemical composition (%)			
Al_2O_3	46.1	62.8	76.1
SiO_2	49.4	30.7	19.2

MORTARS: WET - AIR SETTING

These mortars do not require the addition of water or sodium silicate at the time of application, since their formulation is ready to use and only requires initial homogenization.

Wet - air setting

Properties	SUPERAEROFRAX	MT BLUEBOND	BAUFRAX	ALUFRAX-68	ALUFRAX-75
Classification NTC-765, NTC-851	Super Duty	Super Duty	High Alumina	High Alumina	High Alumina
Chemical composition (%)					
Al_2O_3	44.7	44.5	60.8	66.0	73.5
SiO_2	49.1	49.6	33.0	26.5	19.5

MORTARS: WET-CHEMICAL BONDED MORTARS

These mortars do not require the addition of water or sodium silicate at the time of application since their formulation is ready to use and only requires initial homogenization.

Setting occurs by a chemical process.

	Properties	ANTAC
Wet - chemical bonded	Classification NTC-765, NTC-851	Chemically resistant silica
	Working time to 20°C (min)	Up 30
	Cold Crushing Strength (MPa)	14.0-20.0

COMPATIBILITY TABLES

Below is a table of the compatibility of bricks with the different mortars we offer.

Brick/Mortar	UNIVERSAL	SUPERAEROSEC	SUPERAEROFRAX	MT BLUEBOND	BAUSEC	BAUFRAX	ALUSEC	ALUFRAX 68	ALUFRAX 75	ANTAC
ERCLAY LT										
TP										
U 32										
U 33										
ER 40										
AQ 45M										
AQ 45K										
ERMULCOR										
ABRASiC 50										
AQ-50										
AQ-60										
ALUM 50										
BAUXAL 60										
BAUXAL 70										
BAUXAL 80										
BAUXAL 85										
CORINBRICK										
ANDALUBRICK										
CTE										
ERCLAY SM										
ER IFB 2300										
ER IFB 2600										
ER-IFB 2800										
ER IFB 3000										
ANTAC II										
ANTAC III										

INSULATING CASTABLES

This type of castables characterized by its low density, less than 1.68 g/cm3 after drying at 110°C. It is generally used as backing material, although it can also be used on the working surface when service conditions allow it.

According to ASTM C401, insulating concretes as well as dense mixes, can be classified into categories, as shown in Table 8 below.

Table 8. Insulating castable refractories

Class	Permanent linear change of no more than 1.5% when burned for 5 hours to:	Maximum bulk density after dry at 105 -110°C (g/cm³)
N	925	0.88
O	1040	1.04
P	1150	1.20
Q	1260	1.44
R	1370	1.52
S	1480	1.52
T	1595	1.50
U	1650	1.68
V	1760	1.68

The insulating castables available in our portfolio are shown below:

	Properties	CORAL 25	CORAL 40V	CORAL 50 X	CORAL 50 V
Insulating castable	Classification ASTM C-401	Class N	Class O	Class P	Class P
	Maximum continuous use temperature (°C)	950	1000	1100	1000
	Chemical composition (%)				
	Al_2O_3	33.2	37.1	38.7	46.0
	SiO_2	28.3	41.6	35.5	29.2
	Bulk density (g/cm³)				
	110°C	0.40-0.50	0.54-0.68	0.70-0.85	0.70-0.85
	815°C	0.35-0.45	-	-	-
	930°C	-	0.52-0.56	0.61-0.67	0.55-0.65
	Cold Crushing Strength (MPa)				
	110°C	> 0.5	0.2-0.3	1.0-1.5	1.8-3.0
	815°C	> 0.1	-	-	-
	930°C	-	0.3-0.4	0.8-1.2	1. 5-2.5
	Modulus of rupture (MPa)				
	110°C	> 0.4	0.2-0.5	0.5-1.0	0.5-1.0
	815°C	> 0.1	-	-	-
	930°C	-	0.2-0.3	0.2-0.5	1.5-2.5

Insulating castable	Properties	CORAL 65	CORAL 80	GREENLITE 45 L GR ON LINE
	Classification ASTM C-401	Class Q	Class Q	-
	Maximum continuous use temperature (°C)	1260	1260	1370
	Chemical composition (%)			
	Al_2O_3	46.9	51.1	45.4
	SiO_2	28.4	34.2	39.1
	Bulk density (g/cm³)			
	110°C	1.05-1.15	1.25-1.40	1.36
	815°C	-	-	1.23
	1260°C	0.90-1.05	1.15-1.25	-
	Cold Crushing Strength (MPa)			
	110°C	4.0-6.0	3.0-8.0	23.4
	815°C	-	-	138.8
	1260°C	3.0-5.0	5.0-9.0	-
	Modulus of rupture (MPa)			
	110°C	2.0-4.0	1.2-3.0	5.5
	815°C	-	-	2.8
	1260°C	1.0-2.0	3.0-4.0	-

INSULATING FIRE BRICKS

The low density of insulating refractory bricks provides them with low thermal conductivity. This property makes them optimal for use in industrial furnaces where energy saving is an important design condition. They are manufactured with special raw materials and processes to obtain high porosity, low density, and high refractoriness.

According to ASTM C155, insulating bricks are classified by groups according to the permanent linear change of the material and its density, as shown below:

Table 9. Classification of insulating bricks according to ASTM C155.

Group	Permanent linear change not greater than 2% when tested at (°C)	Apparent density not greater (g/cm³)
16	845	0.54
20	1065	0.64
23	1230	0.77
26	1400	0.86
28	1510	0.96
30	1620	1.09
32	1730	1.52
33	1790	1.52

Insulating Products

The following insulating concretes are available from our portfolio:

Insulating fire bricks

Properties	ER IFB 2300	ER IFB 2600	ER IFB 2800	ER IFB 3000
Classification ASTM C-155	Group 23	Group 26	Group 28	Group 30
Maximum temperature of use (°C)	1260	1400	1510	1620
Chemical composition (%)				
Al_2O_3	48.0	52.0	65.0	72.0
SiO_2	49.0	45.0	32.0	25.0
Bulk density (g/cm³)	0.60	0.80	0.90	1.03
Permanent linear change (%)				
1230°C	0.2C	-	-	-
1400°C	-	0.6C	-	-
1510°C	-	-	0.6C	-
1620°C	-	-	-	0.8C
Thermal conductivity (W/m.K)				
200°C	0.15	0.23	0.26	-
600°C	0.20	0.30	0.31	0.42
1000°C	0.26	0.36	0.37	0.44

CERAMIC FIBERS - BLANKETS AND CERAMIC PAPER

Ceramic blankets are an interwoven network of flexible ceramic fibers. The ceramic fibers conduct heat lengthwise, allowing for thermal insulation or energy concentration where required. It can be used as material for backings or for expansion joints. Ceramic paper can be used for the narrower joints.

The products available from our portfolio are shown below:

Ceramic fiber blankets and paper

Properties	1260	1400	PAPEL CERÁMICO
Chemical composition (%)			
Al_2O_3	45-50	32-37	46.2
SiO_2	50-57	47-52	0.4
ZrO_2	-	13-19	-
Bulk density (g/cm³)	64, 96, 128	64, 96, 128	200
Continuous use temperature (°C)	1200	1340	1260
Classification temperature (°C)	1260	1400	1200
Permanent linear change (%)	< 3 (1200°C)	< 2.5 (1300°C)	-
Thermal conductivity - 1000°C (W/m.K)	0.325-0.490	0.325-0.490	-

CERAMIC FIBER - BOARDS

Low density (LD) ceramic boards are rigid materials manufactured from fibers and binders. Their main components are alumina and silica. Their most characteristic properties include low thermal conductivity, uniform density, and high resistance to thermal shock.

Ceramic fiber boards	Properties	LD-2300	LD-2600	Excelfrax 1800
	Bulk density (g/cm³)	240-320	224-320	230
	Maximum use temperature (°C)	1260	1425	1000
	Permanent linear change (%)			
	1000°C	-	-	0.5C
	1200°C	2.0C–4.0C	3.0C-4.0C	-
	Thermal conductivity (W/m.K)			
	400°C	-	-	0.03
	538°C	0.09	0.10	-
	600°C	-	-	0.03
	760°C	0.12	0.17	-
	800°C	-	-	0.04
	1094°C	0.17	0.20	-

Ceramic Fiber bulk

They are produced from the spun process using high purity alumina and silica as raw materials. They are usually used in applications requiring low thermal conductivity, low heat storage and excellent thermal shock resistance, such as expansion joints, furnace base sealing, filling for burner blocks, and furnace repairs in general.

Ceramic fiber bulk	Properties	Copo 1200	Copo 1400
	Maximum use temperature (°C)	1260	1425
	Continuous use temperature (°C)	1175	1345
	Chemical composition (%)		
	Al_2O_3	44 - 52	33 - 37
	SiO_2	48 - 56	52 - 56
	ZrO_2	-	13 - 19

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