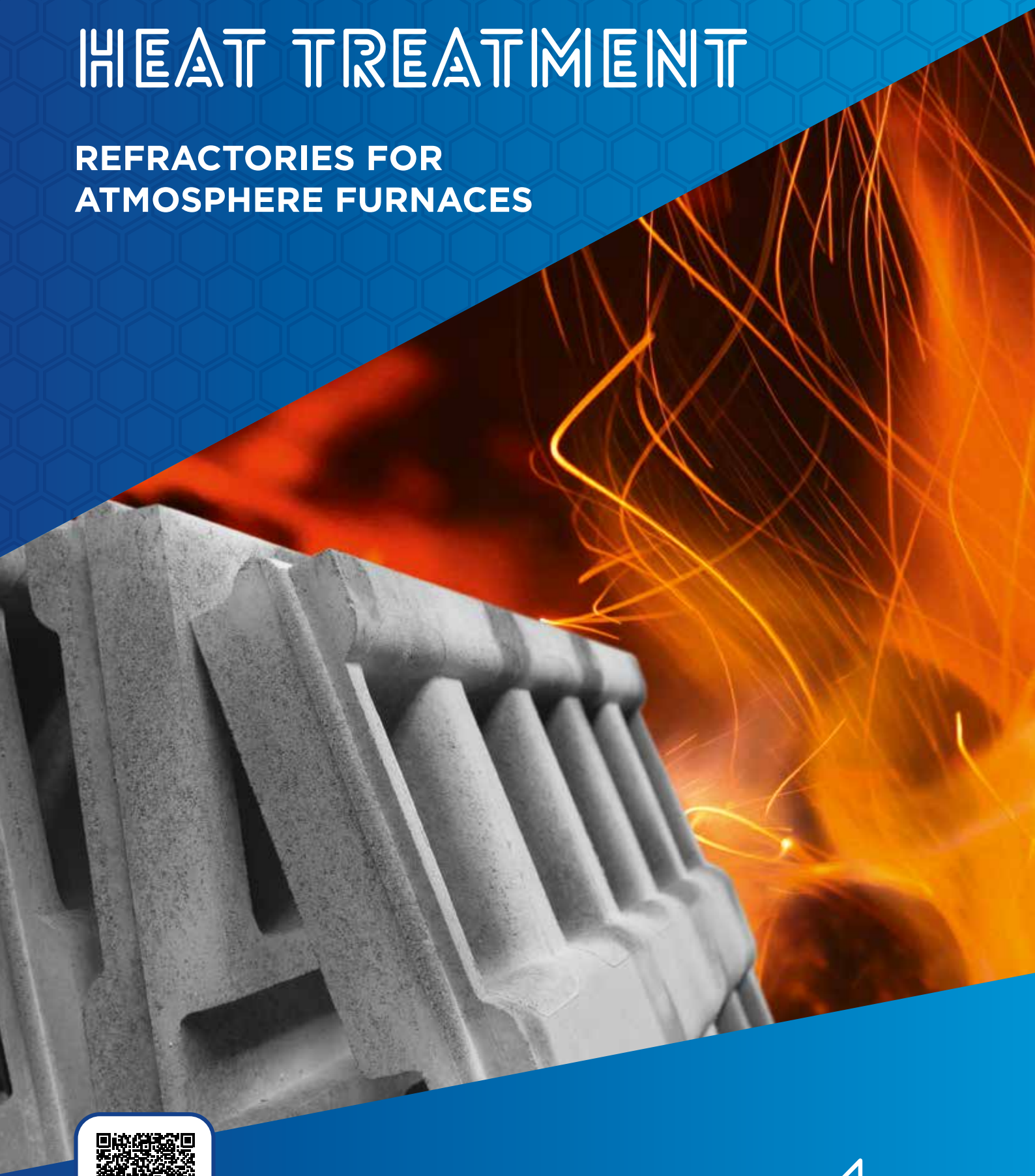
SAINT-GOBAIN PERFORMANCE CERAMICS & REFRACTORIES

HEAT TREATMENT

REFRACTORIES FOR ATMOSPHERE FURNACES



SAINT-GOBAIN

TAILOR-MADE MATERIALS & SOLUTIONS

HIGH PERFORMANCE REFRACTORIES

Saint-Gobain Performance Ceramics & Refractories (PCR) has been designing and manufacturing high performance refractories for demanding atmosphere furnaces for over 70 years. Our team of application engineers, material scientists and design engineers understand the conditions in atmosphere furnaces and can help you choose the correct material for your application.

BENEFIT FROM THESE ADVANTAGES:

- **Tailor-made engineering to customer specifications**
- **Consistently high-quality manufacturing**
- **Extensive worldwide capacity**
- **Robust export compliance**
- **Manufacturing locations on multiple continents**
- **Global R&D resources**

OUR SERVICES

INNOVATION

Research & development team stationed at our leading-edge R&D centers in Europe, North America and Asia; specialize in ceramic & refractory technology and constantly interact with customers & industry experts while using the most progressive and multidisciplinary technologies.

DESIGN & ENGINEERING

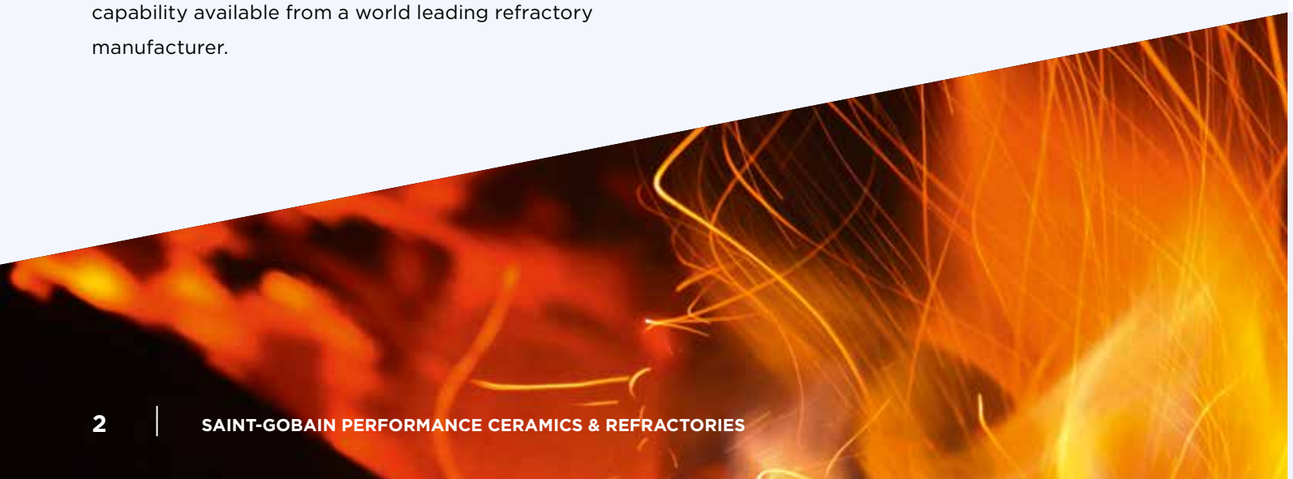
Customized solutions including refractory drawings, adjusted design and modeling capabilities to help minimize maintenance/relining frequency.

PARTNERSHIP

Experienced application teams offer assessments, working in partnership with customers to explore material science and shape capability available from a world leading refractory manufacturer.

CUSTOMER SUPPORT

Experienced, dedicated teams work closely with customers, either in person or remotely via the most advanced digital platforms.

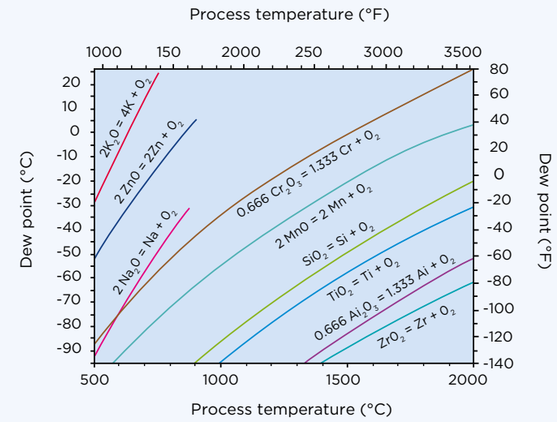


OUR MATERIALS DELIVER VALUE

Many of the metal oxides found in traditional refractories will reduce and reoxidize in cooler areas of the hydrogen atmosphere furnaces. This reaction is especially volatile in furnaces operating with low dew points. As a result it is important to understand this reaction when specifying furnace refractory and kiln furniture* (see oxide equilibria graph to the right). This reaction can lead to premature refractory repairs, inconsistent furnace operation and poor production yields. To avoid these costly and time consuming problems, it is important to select the correct refractories.

*Kiln furniture is synonymous with the refractory plates, batts, boats, setters, saggers, fixtures and specialty shapes used to support/ transport products during firing.

Metal-metal oxide equilibria in H_2-H_2O atmosphere at 1 ATM total pressure



OUR MATERIALS - YOUR BENEFITS

With over 125 years of experience with alumina (Al_2O_3) and silicon carbide (SiC), today we leverage production capability in North America, Europe and Asia to support customers globally.

BENEFITS

- **Increased service-life**
- **Reduced maintenance costs**
- **Lower energy consumption**
- **Optimum efficiency**
- **Excellent creep resistance up to max. application of T = 1.870°C**

We provide ceramic materials designed to meet your needs:

- **QUALITY**
- **EFFICIENCY**
- **CUSTOM DESIGN**

HYDROGEN ATMOSPHERE

Alundum® 99 furnace refractory should be specified in hydrogen atmosphere furnaces that operate from 1205 - 1870°C (2200 - 3400°F). This ultra-low silica content refractory will minimize or eliminate the contamination and degradation that results from the reduction and re-oxidation of silica, soda and potassium found in many refractory shapes.

*AN199 & A299: Less than 0.07% silica and 0.25% soda and potassium
AN599: Less than 0.05% silica, and 0.05% soda and potassium

IMPROVE YOUR YIELD WITH
ALUNDUM®

HIGH PURITY ALUMINA

BENEFITS

- **High strength dense alumina mixes***
- **Minimize contamination & degradation**
- **Provide longlasting, durable, stable linings**

HIGH TEMPERATURE 1205°-1870°C

BRICKS

ALUNDUM® • ALFRAX® 101 • AL100 • RI34

Our oxide solution products can withstand operating temperatures up to 1800°C or even higher if zirconia is used (2200°C).

- **Brick shapes that support heavy loads**
- **Industry standard and specialty shaped brick available**

MUFFLES

ALUNDUM® • ALFRAX® • AL100

High purity alumina muffles are used to control firing conditions and to provide a stable, wear resistant support medium for resistance heated atmosphere pusher furnaces at temperatures up to 1,870°C (3,400°F).

- **Designed to accommodate pusher plates**
- **Customized dimensions available**

HEARTH PLATES

ALUNDUM® 199 • ALUNDUM® 299 • ALFRAX® 101 • AL100

Hearth plates provide a long lasting, wear resistant push surface at temperatures up to 1,870°C (3,400°F).

- **Excellent creep and slag resistance**
- **To maximize their life it is important to ensure they are properly supported**

HYDROGEN-NITROGEN ATMOSPHERE

Most traditional kaolin-based, silica rich, refractory brick and fiber can be used to insulate low temperature (1,120°C, 2,050°F) atmosphere (hydrogen-nitrogen) belt furnaces because these furnaces generally operate in atmospheres and at temperatures and dew points where silica is stable. These furnaces, which are used to sinter, braze and normalize P/M parts, typically incorporate silicon carbide (SiC) based structural furnace refractory.

SILICON CARBIDE

FEATURES & BENEFITS

- Excellent creep resistance
- Outstanding wear resistance
- Superior thermal conductivity

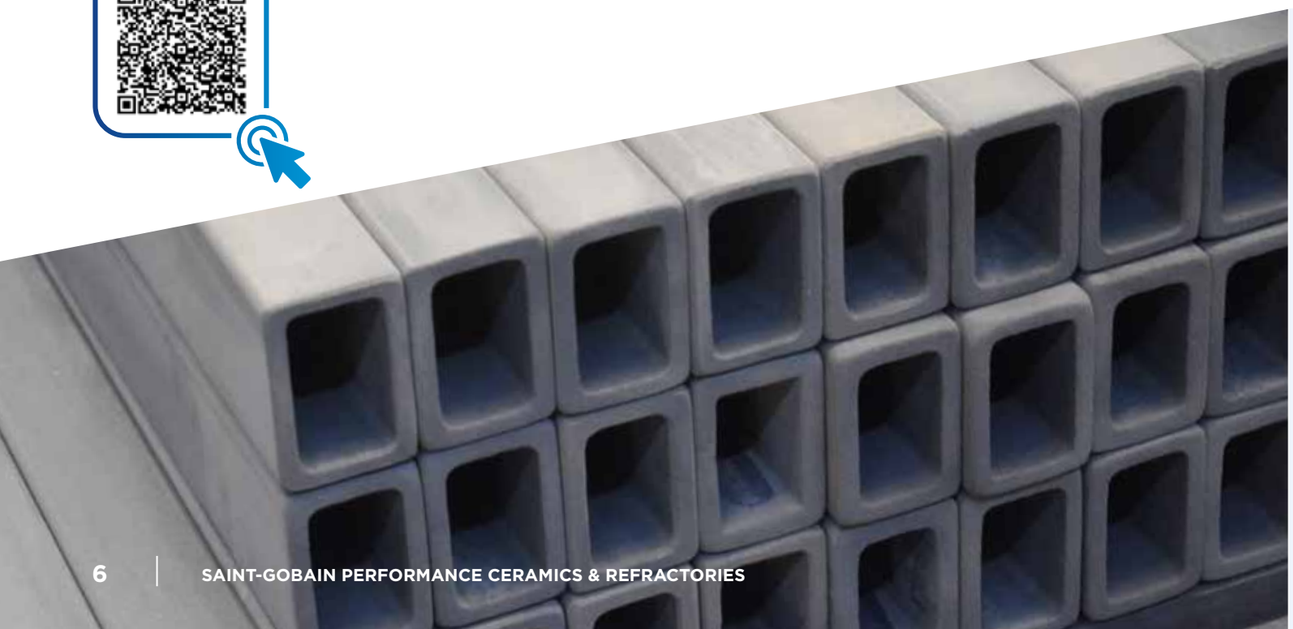
BEAMS

CRYSTAR® • HEXOLOY® • N-DURANCE® • SILIT® SK

SiC beams can be used as structural supports for ceramic and alloy muffles in belt furnaces.

FEATURES & BENEFITS

- Produced in wide range of cross-sections, wall thickness and lengths (up to 4000 mm)
- Low mass
- Very high strenth



- Doubled Fired SiC with higher oxidation resistance

MUFFLES/SKID RAILS

CARBOFRAX® • MULLFRAX® • REFRAX® • ZIRCOFRAX® • AZS

Ceramic muffle sections can reduce the costs associated with the replacement of standard alloy muffles.

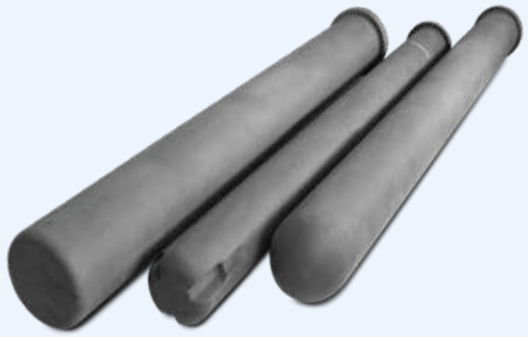
- Produced to accommodate belts
- Used in atmosphere belt furnaces that sinter traditional P/M parts
- Excellent creep and wear resistance

CERAMIC RADIANT TUBES

SILIT® SKD

The silicon carbide radiant tube offers higher productivity at lower energy consumption.

- Withstands application temperatures up to 1.380°C / 2.500°F
- Available for straight and single-ended applications
- Up to 3500 mm length and 300 mm diameter



DISCOVER OUR ENTIRE PRODUCT RANGE

Saint-Gobain Performance Ceramics & Refractories' extensive portfolio of ceramic materials is available in many shapes and sizes.

TYPICAL VALUES

Family	TRADITIONAL SILICON CARBIDE			ADVANCED SILICON CARBIDE			
Brand	REFRAX® PLUS	REFRAX® TOP	CARBOFRAX® A/M	N-DURANCE®	SILIT® SKD	HEXOLOY® SA	CRYSTAR® 2000
SiC (%)	75.0	75.0	86.0	70.0	85.0	> 99.0	> 99.0
Composition (Phases)	Si_3N_4 bonded	Si_3N_4 bonded	SiO_2 bonded	Nitride bonded SiC	Silicon Infiltrated SiC	Sintered SiC	Recrystal-lized SiC
Max. Application Temperature, °C	1550	1550	1450	2642	1380	1900	1600
Density, g/cc	2.7	2.7	2.5	2.75	3.0	3.07	2.7
Apparent Porosity, (%)	14	12	18	<1	0	< 0.6	15

TYPICAL VALUES

Family	HIGH PURITY ALUMINA						
Brand	ALUNDUM® AN199	ALUNDUM® AN299	ALUNDUM® AN599	AL100	ALFRAX® 101	MULLFRAX® 201	ZIRCOFRAX® AZS
Alumina (%) SiO_2 (%) FeO_3 (%) Zirconia (%)	99.5 0.07 0.09 -	99.6 0.07 0.03 -	99.8 0.05 0.06 -	99.5 0.1 0.1 -	98.7 0.1 0.1 -	78 21 0.2 -	52 17 - 30
Composition (Phases)	Alumina	Alumina	Alumina	Fused Alumina	Fused Alumina	Fused Mullite	Zircon/ Mullite
Max. Application Temperature, °C	1870	1870	1760	1800	1800	1750	1700
Density, g/cc	3.2	3.2	1.6	3.3	3.0	2.6	3.0
Apparent Porosity, (%)	20	20	56	16	22	18	18

OUR COMMITMENT

BEING CARBON FREE

BY 2050

OUR AMBITION

To provide solutions to our customers that contribute to de-carbonization and reduce environmental footprint.

SUSTAINABILITY AT THE HEART OF OUR BUSINESS STRATEGY

Sustainability is a key tenet of modern environmental, social, and corporate governance (ESG). At Saint-Gobain Performance Ceramics and Refractories, our business model directly contributes to critical ESG outcomes with a dual approach to sustainable development goals: Minimizing our environmental footprint while maximizing our virtuous impact across the entire value chain.

OUR 2030 OBJECTIVES

WATER

- 50% Industrial water withdrawal
0 water discharge in area with extremely high water risk

CO_2 EMISSIONS

- 33% reduction in scope 1 and scope 2 emissions
- 16% reduction in scope 3 emissions

CIRCULAR ECONOMY

- 80% non valorized production residue
+ 30% avoidance of virgin raw material
100% recyclable packaging with 30% recycled or bio-sourced content

PRODUCT STEWARDSHIP

100% Life Cycle Analysis for all of Group product ranges

PIONEERING CERAMIC SOLUTIONS FOR EXTREME INDUSTRIAL APPLICATIONS AND A GREENER WORLD.

SAINT-GOBAIN 2023

Derwent Top 100 Global Innovator 2023 Clarivate Analytics

top EMPLOYER GLOBAL 2024

1 IN 4
PRODUCTS
did not exist 5 years ago

160,000
EMPLOYEES

47.9 BILLION
SALES IN 2023

REPRESENTED IN **76**
COUNTRIES

-34 %
CARBON EMISSIONS REDUCTION
(vs. 2017 on scope 1+2)

8
MAIN R&D CENTRES

OUR PURPOSE

MAKING THE WORLD A BETTER HOME.

OUR MISSION

Saint-Gobain designs, manufactures and distributes materials and solutions which are key ingredients in the well-being of each of us and the future of all.

WE ARE COMMITTED TO ACHIEVING NET ZERO CARBON EMISSIONS BY 2050

SAINT-GOBAIN

PERFORMANCE CERAMICS & REFRACTORIES

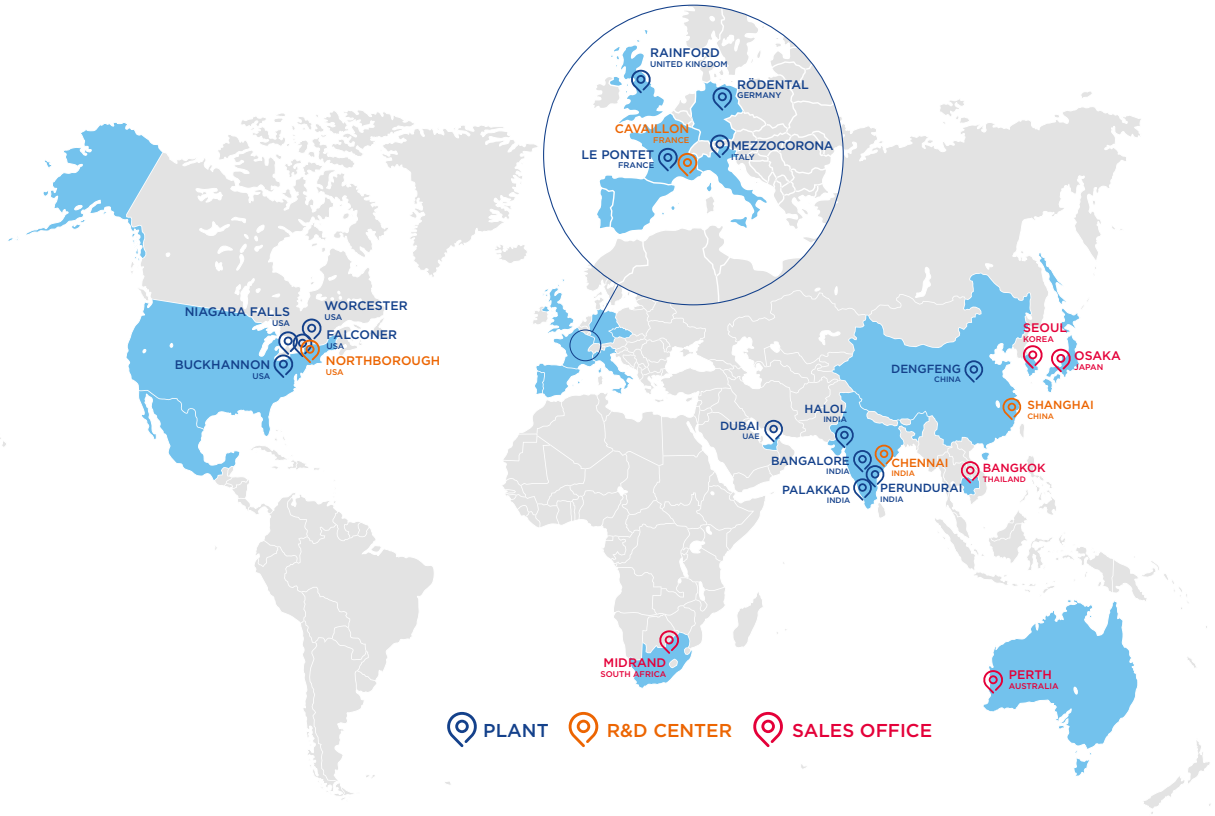
OUR MISSION

To design, develop and **supply solutions** and **services** for **extreme operating industrial conditions.** Our **engineered ceramics** and **refractory** products are manufactured to the **highest industrial standards** and deliver **enhanced performance** while **minimizing environmental impact.**

PIONEERING CERAMIC SOLUTIONS FOR EXTREME INDUSTRIAL APPLICATIONS AND A GREENER WORLD.

SAINT-GOBAIN PERFORMANCE CERAMICS & REFRACTORIES

OUR GLOBAL PRESENCE



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