SAINT-GOBAIN PERFORMANCE CERAMICS & REFRACTORIES

NUCLEAR ENERGY SOLUTIONS

FOR REACTOR SENSING, COOLING AND RODS

SAINT-GOBAIN

Innovative Ceramic and Refractory Technologies

SUPPORTING SAFE & EFFICIENT NUCLEAR APPLICATIONS

REACTOR COOLANT PUMP SEAL FACES

Safe reactor operation depends on efficient cooling.

Saint-Gobain Performance Ceramics and Refractories offer precision-engineered seal faces made from advanced ceramic materials Hexoloy® SA SiC and Noralide® Si_3N_4 for Reactor Coolant Pumps (RCP).

These solutions deliver exceptional durability and thermal stability in the most demanding nuclear environments.

Engineered for **SAFETY AND RELIABILITY IN NUCLEAR REACTOR COOLING SYSTEMS**

Manufactured from advanced ceramics: **HEXOLOY® SA SIC AND NORALIDE® SI_3N_4**

Exceptional **WEAR, CORROSION, AND THERMAL SHOCK RESISTANCE**

BENEFITS

- **Superior chemical and thermal stability**
- **Extended service life, reducing downtime**
- **Trusted by leading Seal & Pump OEMs and nuclear reactor manufacturers**

CRUSHABLE INSULATORS FOR REACTOR TEMPERATURE SENSOR

Precise temperature control is critical in nuclear reactors.

Saint-Gobain's Alundum® crushable insulators—crafted from high-purity alumina—are designed for use in Mineral Insulated Metal Sheathed (MIMS) thermocouples and Mineral Insulated (MI) cables, delivering reliable insulation performance in demanding environments.

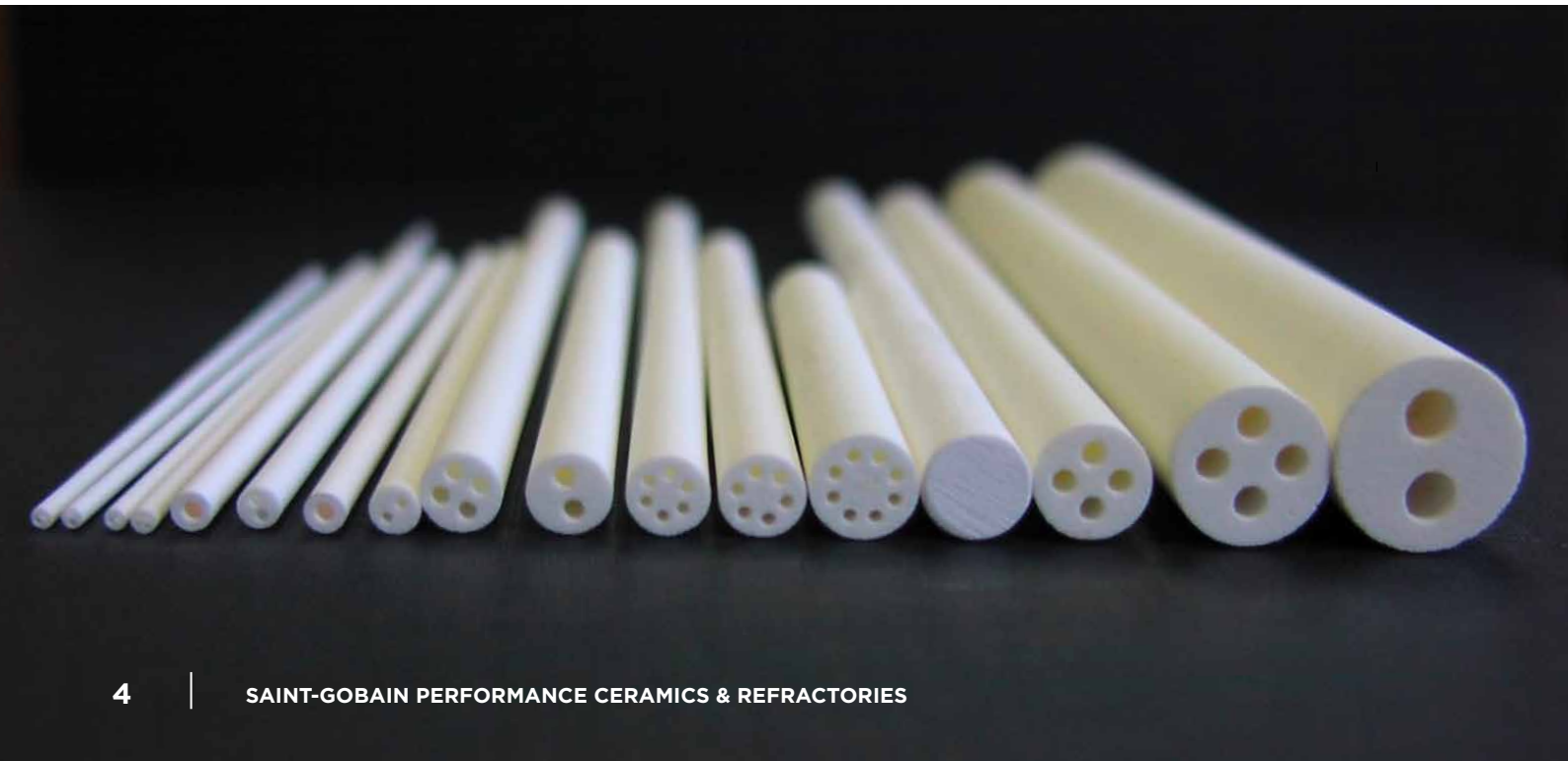
Precision insulation for **REACTOR TEMPERATURE SENSORS**

Made from **HIGH-PURITY ALUNDUM® ALUMINA**

ENSURES **ACCURATE, RELIABLE TEMPERATURE MEASUREMENT**

BENEFITS

- **Maintains sensor accuracy under extreme conditions**
- **High dielectric strength and thermal stability**
- **Customizable for various thermocouple and cable designs**



REFRACTORIES FOR NUCLEAR FUEL SINTERING FURNACES

Saint-Gobain Performance Ceramics and Refractories offers a range of high-purity alumina refractories (Alundum® AH199, AL100, AH199B, Alfrax® 101, AN599B) for lining nuclear fuel sintering furnaces. To ensure optimal performance in atmosphere-controlled sintering furnaces, high-purity, high-alumina refractories are the preferred choice for lining.

These advanced materials withstand extreme temperatures and reducing environments, making them ideal to produce nuclear fuel pellets.

BENEFITS

- **Minimizes contamination and degradation**
- **Reduces maintenance and downtime**
- **Supports stable, efficient furnace operation**

High-purity alumina refractories for **DEMANDING FURNACE ENVIRONMENTS**

Exceptional **CHEMICAL PURITY AND THERMAL STABILITY**

DESIGNED FOR **LONGEVITY AND CONSISTENT PERFORMANCE**

BORON CARBIDE PRODUCTS FOR NEUTRON ABSORPTION

Norbide® boron carbide solutions from Saint-Gobain Performance Ceramics and Refractories are expertly engineered for advanced neutron absorption in nuclear reactors.

As fuel is consumed and excess neutrons are generated, Norbide® B_4C helps maintain safe operating temperatures by effectively controlling neutron levels - ensuring reliable performance and enhanced reactor safety.

Effective
NEUTRON ABSORPTION FOR REACTOR SAFETY AND CONTROL

NORBIDE® BORON CARBIDE IN PELLETS, PLATES, AND CUSTOM SHAPES

Solution for
CONTROL RODS AND REACTOR SHIELDING

BENEFITS

- **High neutron absorption cross-section**
- **Customizable geometries for various reactor designs**
- **Proven performance in demanding nuclear environments**

TYPICAL VALUES

ALUMINA BASED REFRACTORIES for nuclear fuel sintering furnaces

Properties	Unit	ALUNDUM®		AL100	Alfrax®
		AH199B	AN599B		101HF
Alumina	%	99.55	99.8	99.50	98.7
Silica	%	0.07	0.05	0.1	0.1
Max. Service Temperature	°C	1870	1760	1800	1800
Bulk Density	g/cc	3.25	1.6	3.32	3.00
Apparent Porosity	Vol. %	18	56	16	22
Cold Crushing Strength	MPa	113	1,4	95	85
Modulus of Rupture @ RT	MPa	24	4	20	20
Modulus of Rupture @ 1250°C	MPa	17,9	0.31	10 @ 1200°C	3 @ 1350°C
Modulus of Elasticity @ RT	GPa	117	22	75	–
Thermal Conductivity	W/(mK)	4.3 @ 1200°C	1.45 @ 1200°C	3.8 @ 1000°C	2.7 @ 1000°C
Thermal Expansion	10-6/K	8.4	8.7	8.3	0.7

ADVANCED CERAMICS SOLUTIONS for reactor pump seals / neutron absorption

Properties	Unit	Hexoloy®		Norbide®	Noralide®
		SA	SG	HOT PRESSED**	NBD-200
Composition		**SiC**	**SiC**	**B_4C**	**Si_3N_4**
Key Component	%	>99	95	98	95
Max. Service Temperature (inert)*	°C	1950	1950	2000	1600
Bulk Density (typical)	g/cc	3.15	3.0	2.46	3.16
Porosity	Vol. %	2	2	<2	1
Flexural Strength @ RT	MPa	380	311	425	800
Modulus of Elasticity	GPa	430	376	440	320
Thermal Expansion RT to 1000°C	10-6/K	4.02	4.6 @ RT-700°C	5	2.9

* In air, max service temperature is lower. ** Sintered B_4C option is also available.

OXIDE BASED SOLUTIONS for crushable insulators

Properties	Unit	ALUNDUM®	MAGNORITE®
		AN900	MN399A
Al_2O_3	%	99.85	0.08
Fe_2O_3	%	0.06	0.10
SiO_2	%	0.02	0.10
CaO	%	0.02	0.24
MgO	%	0.02	99.47
ZrO_2	%	0.0001	–
Na_2O	%	0.004-0.01	–
C	%	0.003	0.01
S	%	75	0.001

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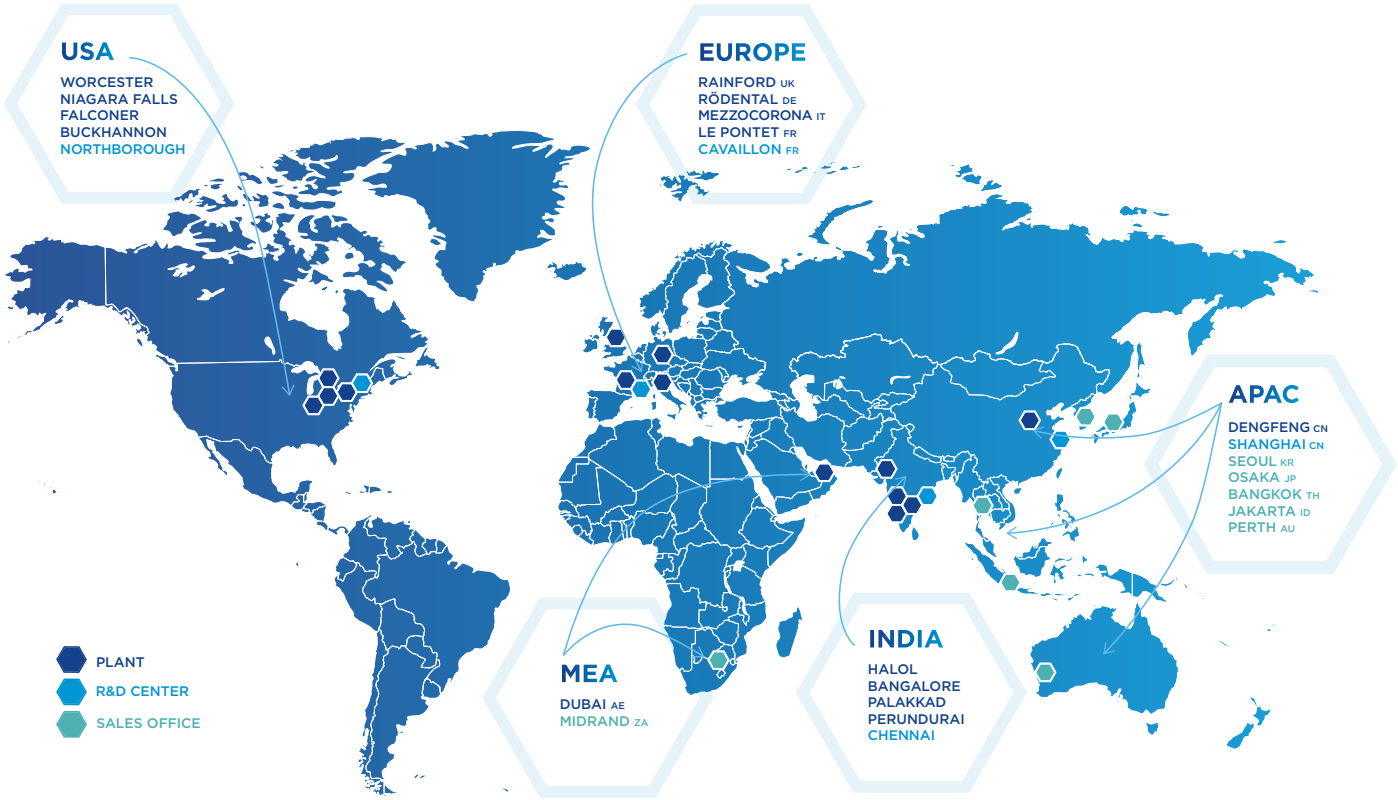
OUR GLOBAL PRESENCE



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