REFRACTORIES FOR PRIMARY COPPER

ALLIED MINERAL PRODUCTS

Global Refractory Solutions

Corporate Headquarters: Columbus, Ohio, USA | +1-614-876-0244 | alliedmineral.com

ABOUT ALLIED

Allied Mineral Products is a world leader in the design and manufacture of monolithic refractories and precast shapes. With strong sales and service teams in the foundry, aluminum, steel, heat treat/forge and industrial markets, our success is based on our dedication to *Being There Worldwide with Refractory Solutions.*

Producing quality, consistent products is top priority at Allied and we have the products to meet your refractory needs. Our extensive product line includes innovative refractory technology and longstanding refractory alternatives.

Allied's focus on quality at every stage in the production process is unparalleled. A stringent raw material standard and global quality control testing before and after each batch is produced, provides customers with consistent products. We provide quick response times to any urgent request through flexible manufacturing systems at all our manufacturing facilities.

Global **Refractory** Solutions

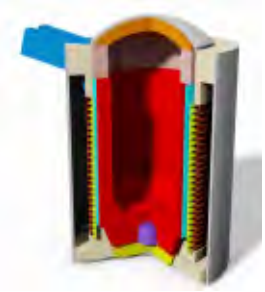
RESEARCH & ENGINEERING

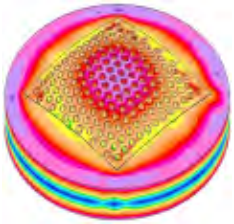
After gaining a detailed understanding of your specific needs, our team evaluates operating criteria and physical design parameters to create a detailed engineered design encompassing:

- Patented technologies
- Optimized product zoning
- Thermal models to optimize and validate designs
- Proven safety lining system designs
- Unique installation properties and techniques
- Leading edge refractory system designs

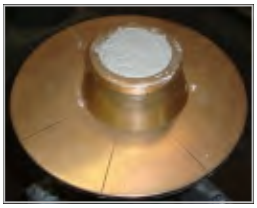
We're focused on developing new products, improving existing products and perfecting installation techniques. Our product development and testing is conducted in our state of the art research and technology center. We have an on-site gunning and shotcreting lab allowing extensive testing of installation properties.

As an innovative, technology-driven supplier we're devoted to providing customized refractory solutions for various industry operations. We offer a wide variety of high performance refractory products with superior raw material quality.



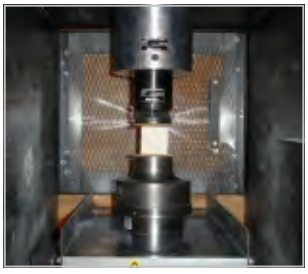


FEA Thermal Analysis



Flow Testing

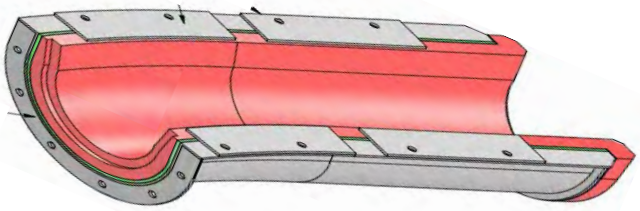
Contact Tests



Strength Tests

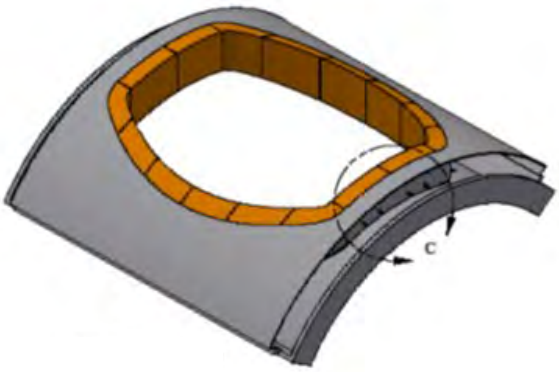
MELTING

Area	Application	Products	Description
FLASH SMELTER	Ductwork/gas offtake	REZIST ABRADE 50 G	Fireclay based, low cement gunning, strength and abrasion resistance
		REZIST ABRADE 65 G	Mullite based, low cement, high strength and abrasion resistance
		TUFF-FLO 50	Fireclay based, low cement castable
		NANO-TEK® 80C	Two component, no cement castable with coarse top grain size
	Side Walls	DURAGUN® 90 CR	High alumina, low cement gunning mix with chromic oxide
		NANO-TEK® 90-10 CR	Two component, no cement castable with chromic oxide
ISASMELT™	Roof	DURACON® 35 LS	Low cement castable, low silica and iron
	Taphole	ALPHA PASTE 1133	Anhydrous plugging paste, longer usage time than traditional plastics
		RAM MAX® 45 AS	Alkali resistant, air set plastic
NORANDA REACTOR	Gas outlet/Mouth	ARMORMAX® ZT 80 10 CR	One component, no cement castable, chromic oxide addition, SS fibers
		Z-TEK 90-10 CR	One component, no cement castable, chromic oxide addition, SS fibers
		ARMORMAX 70 SR	Thermal shock resistant, low cement, high metal fiber content castable
		METAL-ROK®	High metal fiber content based, low cement refractory shape
MATTE AND SLAG LAUNDERS		NANO-TEK® 90-10 CR	Two component, no cement castable with chromic oxide
		Z-TEK 90-10 CR	One component, no cement castable with chromic oxide
		ARMORMAX® ZT 80 10 CR	One component, no cement castable, chromic oxide addition, SS fibers
		TUFF-FLO 85-10 CR	Low cement castable with chromic oxide
		STEEL PAK CR	Phosbonded plastic with chromic oxide
		T-COAT® 692M	Insulative, magnesia based coating
REPAIRS		DURAGUN® 90 CR	High alumina, low cement gunning mix with chromic oxide



Precast Matte Launder insert design (right)

Precast Matte Launder insert

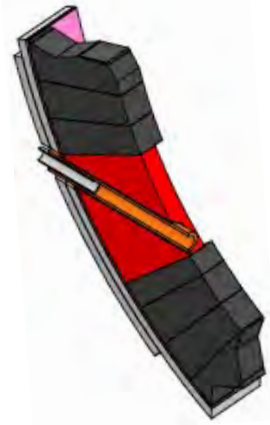


Precast shape concept for Noranda Reactor

Matte Launders cast in place

CONVERTERS

Area	Application	Products	Description
FLASH CONVERTER	Matte and Slag Tapholes	ALPHA PASTE 1133	Anhydrous plugging paste, longer usage time than traditional plastics
		RAM MAX® 45 AS	Air set plastic, long shelf life, natural alkali resistance
PEIRCE-SMITH CONVERTER	Mouth	Z-TEK 90-10 CR	One component, no cement castable with chromic oxide
		ARMORMAX® 70 SR	Thermal shock resistant, low cement castable, high metal fiber content
		METAL-ROK®	High metal fiber content, low cement refractory shape
	Tuyere Blocks & Tuyeres	ARMORMAX® ZT 80 10 CR	One component, no cement castable, chromic oxide addition, SS fibers
		Z-TEK® 90-10 CR	One component, no cement castable with chromic oxide
		NANO-TEK® 90-10 CR	Two component, no cement castable with chromic oxide
		BLASCH SiC TUYERES	Abrasion resistant precast shape
LAUNDERS	Blister Launders	ARMORMAX® 28 SiC	Metal fiber containing low cement castable with silicon carbide
		NANO-TEK® 418A	Two component, no cement castable with silicon carbide
		TUFFCRETE® 60 SiC	Silicon carbide based, low cement, high thermal conductivity castable
		TUFFCRETE® 80 SiC	Silicon carbide based, low cement, abrasion resistant castable
		ARMORMAX® 608	Chemical resistant, low cement, high metal fiber content castable
REPAIRS		DURAGUN® 90 CR	High alumina, low cement gunning mix with chromic oxide



Precast Tuyere Block and Tuyere concept

Precast Tuyere Block and Tuyere

Tuyere System installed with Peirce-Smith Converter

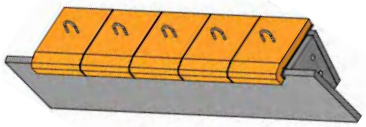
Hot gunning DURAGUN® 90 CR

METAL-ROK® Precast Shape for Peirce-Smith Converter

Installed METAL-ROK® Precast

REFINING AREA

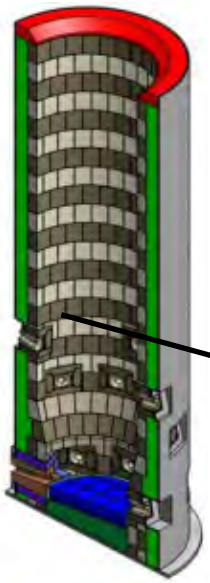
Area	Application	Products	Description
ANODE FURNACE	Mouth	ARMORMAX® 70 SR	Thermal shock resistant, low cement castable, high metal fiber content
		ARMORMAX® 608	Chemical resistant, low cement , high metal fiber content castable
		NANO-TEK® 418A	Two component, no cement castable, silicon carbide addition
		NANO-TEK® 28 SiC Z	Two component, no cement castable, silicon carbide and zircon addition
	Taphole	RAM MAX® 45 AS	Alkali resistant, air set plastic
	Burner Blocks	Z-TEK 91	One component, high alumina, no cement castable
	Cover	NANO-TEK® 70 ABR	Abrasion resistant, mullite based, two component, no cement castable
	Repairs	DURAGUN® 90 CR	Thermal shock resistant, low cement castable, high metal fiber content
SHAFT FURNACE	Barrel Cone/Burner Section Burner Blocks Hearth Taphole	DURALAST SiC Alumina-Chrome Brick	Nitride-Bonded Silicon Carbide Brick 90% Alumina, 10% Chrome Brick
	Lower Launder	TUFF-FLO 80 SIC	80% silicon carbide containing, low cement castable
		TUFFCRETE® 60 SIC	60% silicon carbide containing, low cement castable
		ARMORMAX® 28 SIC	Low cement castable, high needle with silicon carbide addition
		FLOMAX® AZS	Low cement, chemical resistant castable
	Tundish	ARMORMAX® 28 SIC	Low cement, high metal fiber containing castable with silicon carbide
		TUFFCRETE® 60 SIC	Low cement castable with silicon carbide addition
		FLOMAX® AZS	Low cement, chemical resistant castable



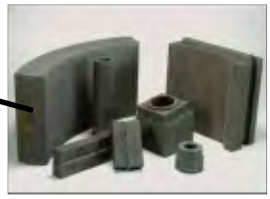
Precast shape concept for Anode Furnace Bib (right)

Anode Furnace Bib precast shape using ARMORMAX®

Anode Furnace Cover lined with no cement product



Shaft Furnace

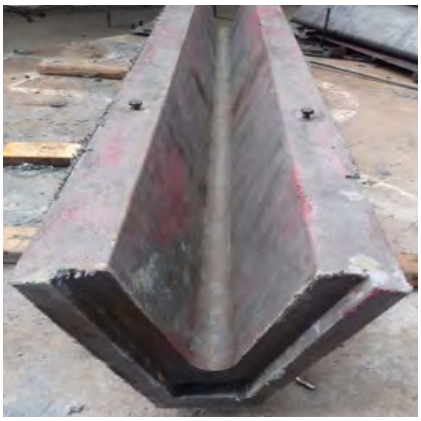


DURALAST SiC Brick

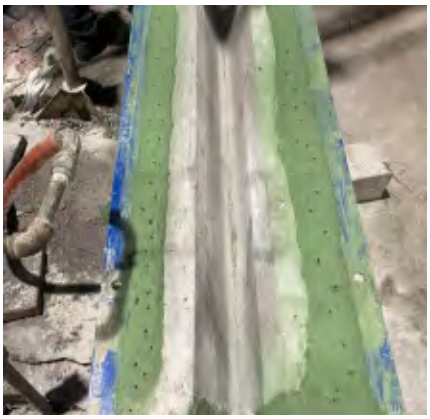
Anode Furnace Mouth lined with ARMORMAX®

REFINING AREA

Area	Application	Products	Description
LAUNDERS & LADLES	Catch basin	ARMORMAX® 28 SiC	Low cement castable containing metal fibers with silicon carbide
		NANO-TEK® 418 A	Two component, no cement castable with silicon carbide
		TUFFCRETE® 60 SiC	60% silicon carbide containing, low cement castable
		TUFFCRETE® 80 SiC FINE	Fine grained, SiC based, low cement castable, ideal for precast shapes
		ARMORMAX® 608	Low cement castable with high metal fiber content
	Launders	ARMORMAX® 28 SiC	Low cement castable with silicon carbide for enhanced performance
		NANO-TEK® 418A	Two component, no cement castable with silicon carbide
		TUFFCRETE® 60 SiC	60% silicon carbide containing, low cement castable
		TUFFCRETE® 80 SiC FINE	Fine grained, SiC based, low cement castable, ideal for precast shapes
		ARMORMAX® 608	Low cement, high metal fiber containing castable
		FLOMAX® AZS	Low cement, chemical resistant castable
		NANO-TEK® AZS	Two component, no cement castable
	Intermediate & casting ladles, ladle tips, and tundishes	ARMORMAX® 28 SiC	Low cement, metal fiber containing castable with silicon carbide
		NANO-TEK® 418A	Two component, no cement castable with silicon carbide
		TUFFCRETE® 60 SiC	60% silicon carbide containing, low cement castable
		TUFFCRETE® 80 SiC FINE	Fine grained, SiC based, low cement castable, ideal for precast shapes
		ARMORMAX® 608	Low cement castable, high metal fiber content
	Sacrificial/Coatings	T-COAT® 692M	Magnesia based insulative coating
		PLASTER 1700	Andalusite based patching plaster with cement bond
	Repairs	STEEL-PAK CR	Bauxite based, phos bonded plastic with chromic oxide



Precast Anode Launder



Installed precast insert

Precast inserts without sacrificial lining

Precast ladle insert

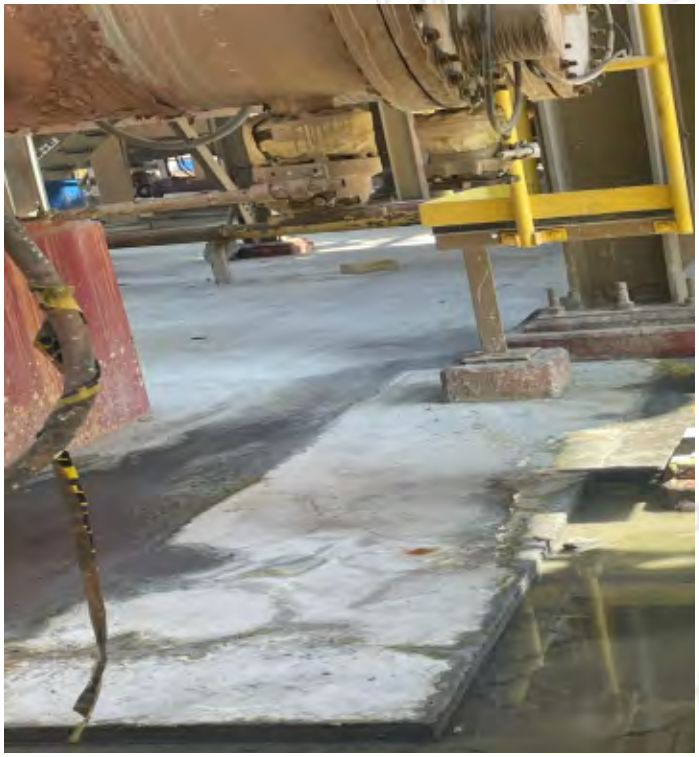
Precast Lip/Chin Block

T-COAT® sacrificial coating

ACID PLANT

Area	Application	Products	Description
ACID PLANT	Direct, continuous contact with acid	STACKLINE B PC	Two component, silica based, liquid acid contact resistant castable
	Infrequent, occasional contact with acid	PG 135	Silica based, high cement castable with chemical resistant binders for exposure to acids and salts

STACKLINE B PC in Acid Pond



STACKLINE B PC platform in contact with acid

PG 135 Pump Base exposed to occasional acid contact

PG 135 Pump Base showing acid exposure

CHALLENGES

Product Development & Testing

Challenges in Primary Copper

- **Thermal Cycling** is inherent to batch operations. It is important to use products that are volume stable and retain physical strengths despite thermal shock.
- **Mechanical Abuse** results from the removal of slag, matte and copper, and movement of equipment. It is important to use products with excellent mechanical strength properties.
- **Chemical Attack and Erosion** results from oxidation and reactions with concentrate and matte. It is important to use products that resist chemical attack and erosion from matte and slag.
- **Abrasion** results from movement of large volumes of matte, blister, refined copper and slag. Refined copper is particularly abrasive. It is important to use products with high strength and abrasion resistance at operating temperatures.
- **Limited Time and Resources** are barriers faced by maintenance and refractory teams. Finding solutions for quick and easy preparing, installing, and heat-up is key.

Allied experts can help operators troubleshoot challenges, create custom designs, and be available onsite during installations to maximize furnace performance.

Product Development and Testing

Allied is continuously developing new products. Each copper smelter is unique because every mine and resulting ore and concentrate composition is unique. This requires tailored refractory ceramic solutions. To determine the most appropriate products and systems for an application, Allied studies matte, blister, refined copper, and slag from the individual smelter, as well as refractory interactions under simulated conditions.


Alumina-chrome no cement Slag


Alumina-chrome no cement Matte


Z-TEK 90-10 CR


Z-TEK 90-10 CR


TUFFCRETE® 28 SIC Z Slag


TUFFCRETE® 28 SIC Z Matte


TUFF-FLO 80 SIC Slag


TUFF-FLO 80 SIC Slag

PRODUCT INNOVATIONS

High Metal-Fiber Containing Refractory

ARMORMAX®

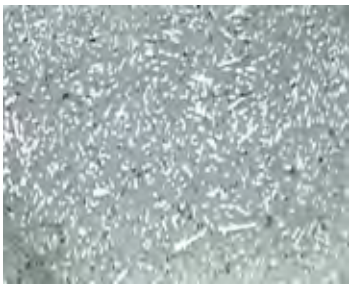
ARMORMAX® can withstand repeated thermal cycling, mechanical impact and abrasion due to its high metallic fiber content. The metal fibers are pre-blended and uniformly distributed within the refractory product.

- High fracture toughness when thermally cycled
- Low abrasion loss
- High mechanical impact resistance
- Well suited for applications up to 1200°C (2200°F) continuous exposure
- Optimized for low water requirements (as low as 4.5% by weight)
- Low cement and no cement versions available
- Excellent flowability characteristics for high metallic fiber refractory castables

METAL-ROK®

METAL-ROK® can withstand a wide variety of very destructive high temperature environments and is sold as precast, pre-fired shapes. Metal fibers are uniformly distributed in the refractory structure, which is a process that offers multiple advantages.

- Mullite-based composite castable
- Low water and low cement
- High density, low porosity and high refractoriness for a metal fiber-containing product
- Metal fiber type carefully chosen to provide high toughness, enhanced refractoriness and high flexural strength
- Maintains strength after thermal shock
- Metallic fibers ensure structural integrity after thermal cycling
- High abrasion resistance
- Excellent for applications up to 1200°C (2200°F)



PRODUCT INNOVATIONS

No cement product line

NANO-TEK® & Z-TEK

NANO-TEK® is a two-component, no cement product requiring liquid colloidal silica to be added on-site.

Z-TEK is a single-component, no cement product with bond included in the dry material at manufacturing. Only water is required to be added on-site.

Z-TEK Launder

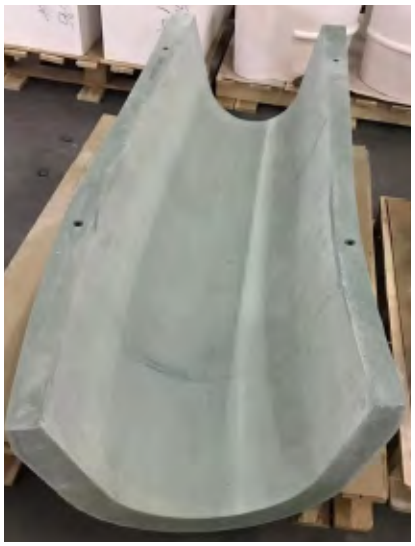
Benefits

- Accelerated heat-up
- Quick turnaround
- Excellent thermal shock resistance
- Abrasion resistant
- Superior high temperature properties
- Resistance to slag attack and spalling
- Good mechanical strengths
- Adheres well to existing refractory

PRECAST SHAPES

Benefits

- Reduced installation time
- Reduced heat-up
- Labor and energy savings
- Improved performance



BLASCH CERAMICS

In Partnership with Allied Mineral Products

Precision ceramic solutions replace steel or iron castings with exact refractory castings selected based on the application. Refractory materials must be chemically and physically stable at high temperatures. Depending on the operating environment, they must also be resistant to thermal shock and abrasion, chemically inert, and have specific ranges of thermal conductivity and expansion.

Blasch VERKAPSE™ Cyclone and Hydrocyclone Liners

Blasch high performance monolithic drop-in replaceable silicon carbide liners are specifically engineered for classifying applications in sizes up to 60 inch diameter. These liners are designed for highly abrasive ores such as coal, iron ore, gold, copper, cement, FGD and phosphate mining. With a variety of highly abrasion-resistant compositions available, both OEMs and single plants can optimize classification efficiencies, maximize cyclone life and eliminate costly installation traditionally found in epoxied tile constructions.

Blasch CERALINE™ Ceramic Lined Elbows

Available as a turnkey unit with steel pipe & flanges, Blasch ceramic lined elbows are engineered for unparalleled life. Blasch pre-cast tight tolerance shapes are used to line pipe with diameters ranging from 1/2” inch to several feet. Premature wear and interrupted flow are eliminated with CeraLine’s engineered joints and smooth bore, reducing pressure drop and flow restriction.

Blasch CERALINE™ Pipe and Spool Linings

Blasch’s unique casting process contributes to the successful application of smooth bore abrasion-resistant pipe linings. Pipe diameters ranging from ½” up to several feet can be lined with Blasch pre-cast tight-tolerance shapes available with engineered joints and smooth bore that eliminates premature wear and interrupted flow. Available in a variety of premium refractory materials and complete turnkey units with steel pipe and flanges, these systems are individually engineered and offer unparalleled life and ease of installation.

Blasch Flash, Quench, Blast and Impingement Block Linings

Autoclave and pressure oxidation developers continue to improve in scale and process conditions. They appreciate the limitless size and shape capability that Blasch offers to help them engineer very complex, high temperature, abrasion and corrosion resistant lining systems for items like flash pots, quench vessels, choke tubes, vent blast tubes, impinge-ment blocks, oxygen injection nozzles, pipe and valve systems.

Blasch Abrasion-Resistant Valves and Components

Blasch helps designers and process engineers control costs with refractory solutions throughout their operation. Reliable high performance valves and other shapes are custom engineered to convey and control fluids and gases. Superior dimensional control afforded by the Blasch process results in close tolerance net shape parts like valves, nozzles, seats, bearings and other ancillary parts that help minimize process variability.

PRODUCT DATA

Products	Chemistry				CCS 815°C (1500°F)		Material Required		Grain Size	
	Al_2O_3	SiO_2	SiC	Cr_2O_3	MPa	psi	g/cm^3	lb/ft^3	mm	inch (mesh)
ALPHA PASTE 1133	2.7	75.3	-	-	-	-	-	-	-	-
PG 135	13.5	67.4	-	-	-	-	2.16	135	3.3	6
PLASTER 1700	59.2	33.4	-	-	-	-	2.21	138	2.5	8
RAM MAX® 45 AS	42.2	52.7	-	-	-	-	2.29	143	4.7	4
Low Cement										
ARMORMAX® 28 SiC	45.4	21.8	27.3	-	81.6	12000	2.69	168	2	8
ARMORMAX® 70 SR	70.4	24.8	-	-	117.2	17000	2.66	166	2	8
ARMORMAX® 608	59.9	27.1	8.2	-	104.0	15100	2.64	164	2	8
DURACON® 35 LS	98.4	0.1	-	-	91.1	13210	3.03	189	6	.25
DURAGUN® 90 CR	86.3	5.0	-	5.3	-	-	2.69	168	3.4	6
FLOMAX® AZS	62.6	21.1	-	-	89.1	13000	2.69	168	4.7	4
METAL-ROK® 70 M	70.2	25.4	-	-	117.7	17085	3.06	191	1.0	16
REZIST ABRADE 50 G	48.8	44.7	-	-	18.0	2620	2.16	135	4.8	4
REZIST ABRADE 65 G	66.5	26.8	-	-	60.0	8700	2.31	144	4.7	4
T-COAT® 691M	1.9	36.6	-	-	-	-	2.00	125	18	1
TUFFCRETE® 60 SiC	21.7	11.4	62.8	-	113.7	16500	2.59	162	4.8	4
TUFFCRETE® 80 SiC	13.0	5.8	77.7	-	128.8	18700	2.61	163	1.4	14
TUFF-FLO 50	49.7	44.7	-	-	81.3	11800	2.32	145	12.5	.50
TUFF-FLO 85-10	85.0	0.5	-	10.1	24.8	3600	3.16	197	6	3
No Cement										
ARMORMAX® ZT 80 10 CR	80.4	9.3	-	9.8	27.6	4000	3.04	190	6.7	3
NANO-TEK® AZS	54.0	21.8	2.7	-	89.6	13000	2.87	179	7	3
NANO-TEK® 28 SiC Z	42.1	24.2	28.0	-	124.1	18000	2.48	155	7	3
NANO-TEK ® 70 ABR	70.9	24.7	-	-	66.4	9630	2.56	160	7	3
NANO-TEK® 80 C	79.4	15.9	-	-	89.57	13000	2.74	171	6.7	3
NANO-TEK® 90-10 CR	86.9	2.6	-	10.1	108.9	15800	3.08	192	6.7	3
NANO-TEK® 418A	70.7	7.8	-	-	11.1	1605	2.88	180	9.5	.375
STACKLINE B PC	0.1	99.7	-	-	-	-	2.10	131	4.8	4
Z-TEK 90-10 CR	86.9	2.6	-	10.1	120.6	17500	3.01	188	6.7	3
Z-TEK 91	90.8	8.5	-	-	140.9	20400	3.02	188	6	.25

in our element

NOTES

The Allied Difference

Being There Worldwide with Refractory Solutions

in our element

NOTES

The Allied Difference

Being There Worldwide with Refractory Solutions

Manufacturing Locations

- Columbus, Ohio USA (Headquarters)
- Ontario, Canada
- Pell City, Alabama USA
- Brownsville, Texas USA
- Pocos de Caldas, Brazil
- Santiago, Chile
- Tholen, The Netherlands
- Izmir, Turkey *(Coming soon!)*
- Gujarat, India
- Germiston, South Africa
- Tianjin, China
- Guangdong, China

Scan for Locations

Revised 7/25/2024