REFRACTORY SOLUTONS FOR **REGENERATORS**

HWI

A MEMBER OF CALDERYS

A CLEAR COMPETITIVE EDGE.

FOR ALMOST 100 YEARS, WE'VE PIONEERED REFRACTORY GLASS SOLUTIONS THAT CONTINUE TO SHATTER INDUSTRY EXPECTATIONS.

HarbisonWalker International (HWI) provides the largest refractory manufacturing capacity to the glass industry in North America.

Over 85 years of research and development in the glass market have enabled us to pioneer innovative glass solutions.

Our regenerator technology is leading the way for glass manufacturers around the world. Regenerators utilize checker brick to improve efficiencies by taking advantage of the excellent heat exchange properties inherent in ceramic materials. As the furnace exhausts through the checker packing, the bricks are preheated by the waste gases, providing a source of energy to preheat the combustion air when the cycle is reversed. Regenerator efficiencies can be affected by a variety of factors, from pack design to regenerator size.

REGENERATOR CHECKER DESIGNS

MODULAR CHECKERS
(HYDE AND HPC CHIMNEY BLOCKS)

HWI can supply modular checker settings for virtually any regenerator requirement. Modular checkers offer significant pack interlocking, which provides for greater stability, and their thin wall design increases free flow surface for enhanced heat exchange. All HWI modular checkers are color coded to one-millimeter (1 mm) height groupings to achieve maximum stability, and they can be designed with horizontal cleanouts when appropriate.

CONVENTIONAL CHECKERS

HWI supplies straight brick for all conventional settings. The “Maertz” setting (also referred to as Diagonal Offset or Staggered Pigeonhole) is popular in many container furnace regenerators.

70 IN 10

WE HAVE SUPPLIED REFRACTORIES FOR GLASS FURNACES TO OVER 70 COUNTRIES IN THE PAST DECADE.

REGENERATOR CHECKER MATERIALS

TOP CHECKERS
TYPICALLY FOUR COURSES

The top checker zone has an atmosphere laden with alkali vapors and solid carryover (CaO, SiO2). High temperature cycling is also to be considered, as well as oxidizing/reducing effects. High-purity magnesite brick such as NARMAG® 98B and SUPER NARMAG® B have performed successfully in typical service requirements, especially in basic carryover and/or reducing conditions. For applications with high acidic carryover environments, NARMAG® VZ, a magnesia-zirconia composition with a forsterite bond, has provided superior results due to better protection of the magnesia crystals from silica bursting. NARMAG® VZ is not for use in reducing conditions. For severe conditions, TUFLINE® 98 DM exhibits excellent resistance to carryover and high temperatures. It is a unique 98% alumina composition.

MIDDLE CHECKERS
BELOW TOP CHECKERS, ABOVE CONDENSATE ZONE

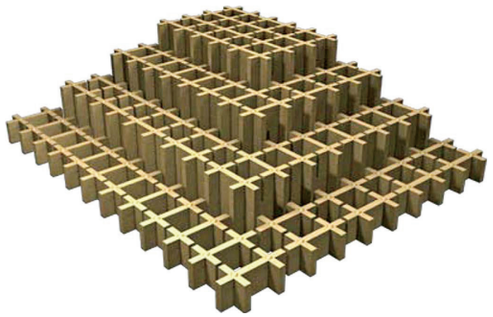
Middle-zone temperature fluctuations are relatively mild, and solid carryover is low and less reactive because of the lower temperature. The atmosphere is rich in alkali vapors, and some deposition of condensate can occur. For superior temperature and load performance, SUPER NARMAG® B, a creep-resistant high MgO, has given excellent results.

CONDENSATE ZONE CHECKERS
1292°F (700°C) TO 2012°F (1100°C)

In the condensate zone, temperatures are quite low, but cycles may be wide (as cold incoming air enters the checker setting) and high load becomes a factor. A large amount of condensating volatile constituents is present from the exhaust gas. Plugging may occur as carryover attaches to the tacky condensate. Reducing conditions can also affect refractory selections. In gas-fired furnaces, SUPER NARMAG® B is the material of choice for chrome-free settings. Due to its low silica content, it is also a good solution for reducing conditions. NARMAG® 50 DBRG, a 50% MgO direct-bonded magnesia chrome, has a long and successful history in the condensate zone. In oil-fired furnaces, NARMAG® VZ, a mag-zirconia, provides superior resistance to sulphate attack and when vanadates are present. NARMAG® VZ is not recommended for reducing conditions typical with some NOx reduction processes.

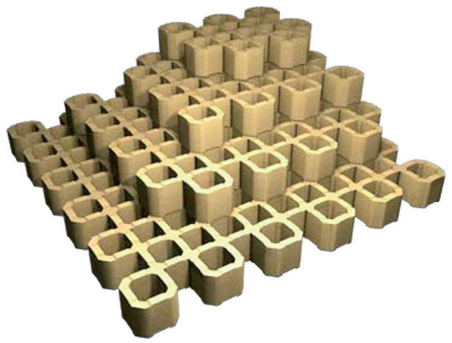
LOWER CHECKERS, RIDER TILE, AND SECONDARIES
BELOW CONDENSATE ZONE

Cycling and sulphate condensate can still be an issue in these zones. KALA®, a unique 50% alumina, provides superior cycling and creep resistance in comparison to conventional high-fired superduty, such as KX-99®. KX-99® has a successful history in normal service conditions.



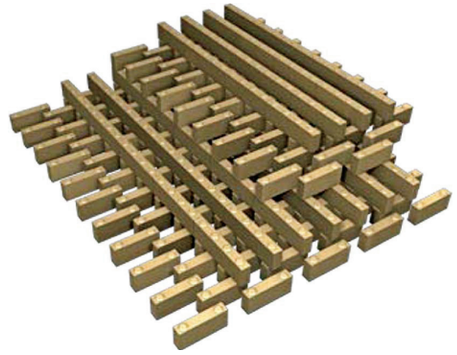
HYDE CHECKER

This patented modular design offers significant pack interlocking and horizontal contact area to provide greater system stability. Thermal efficiencies are similar to other thin-wall modular settings when flue sizes are equal. Standard flue sizes available for HYDE Checker are 5½" (on 7½" centers) and 142 mm (on 180 mm centers).



HPC CHECKER

This widely used chimney-type modular design provides for good thermal efficiencies and stability. It is available with and without “mouse holes.” Use without mouse holes for top checkers' condensate zones and secondaries. The standard flue size available is 5⅜", with block heights of 5½" or 6".



CONVENTIONAL CHECKERS

HWI supplies straight brick for all conventional straight-brick checker settings. Additionaly, they can be supplied with “interlocks,” which increase the stability of the Maertz (offset or staggered pigeon hole) and the basketweave settings, both of which can be prone to spin and block the flues.

REGENERATOR WALLS AND CROWNS

REGENERATOR CROWNS, UPPER WALLS, AND UPPER DIVISION WALLS

Regenerator upper walls and crown refractories must resist solid carryover attack and are typically subjected to high temperatures. Careful consideration of insulation being used on crowns must be taken regarding hot face temperature and expected mean temperature of the hot face refractory.

For **Magnesite Systems,** SUPER NARMAG® B, a creep-resistant, 98% MgO, has given superior chrome-free performance. Although NARMAG® 50 DBRG, a direct-bonded 50% mag-chrome, has had a long and successful history in this application, increasing concerns for chrome disposal of the spent refractory have caused the furnace designer to look to alternative materials.

For **Non-Magnesite Systems,** NIKE S65W and NIKE S75 (creep-resistant high-purity andalusites) provide good performance with the added advantage over MgO in regard to low thermal expansion characteristics and lower thermal conductivity. For superior performance when high temperatures and creep resistance are even more important, NIKE S75 HF is recommended.

TARGET WALLS

Target walls are most vulnerable to attack because of solid carryover from the facing ports. End ports and the first two or three ports of side-port furnaces normally have the worst issues. Narrow chambers also increase the batch attack phenomenon.

For **Magnesite Systems,** SUPER NARMAG® B, and NARMAG® 50 DBRG provide superior service in normal service conditions. NARMAG® VZ is recommended for acidic carryover conditions.

For **Non-Magnesite Systems,** NIKE S75 HF and GEM® are recommended for normal service conditions. VISTA®, a sintered AZS, has provided good service in high-carryover environments, and TUFLINE® 98 DM is recommended for the most extreme conditions.

MIDDLE WALLS (BELOW TOP CHECKERS) AND LOWER DIVISION WALLS

For **Magnesite Systems,** NARMAG® 50 DBRG, a direct-bonded 50% mag-chrome, has a long history in both upper and middle walls as well as division walls. Since this product contains chrome, furnace designers have turned to SUPER NARMAG® B for chrome-free options with similar performance.

For **Non-Magnesite Systems,** NIKE S65W, NIKE 60 AR, and UFALA® XCR (andalusite products) perform well and have the added advantage over high MgO because of their low thermal expansion which enhances structural stability.

LOWER WALLS

KX-99®, a high-fired superduty, has been standard for lower walls in normal conditions. When upgraded refractories are necessary due to higher-temperature applications (such as lower primary walls of regenerators having secondaries), NIKE 60 AR, UFALA® XCR, or KALA® are recommended. KALA® is a 50% alumina material with a unique mineralogical makeup that results in lower permeability.

BACKUP

Typically, KX-99®, GREENTHERM 23 LI (2300°F IFB), or INSBOARD 2300 HD (2300°F Board) are utilized for insulation purposes.

SEALING

KAST-O-LITE 20-45 G PLUS applied by gunning is recommended for monolithic sealing/insulation of regenerator walls. An HWI representative can further provide options for monolithic sealing/insulation material selections and installation of regenerator crowns.


PRODUCTS
THAT PASS
THE TEST.
EVERY DAY.

REFRACTORIES COMPOSITION AND PHYSICAL PROPERTIES

PRODUCTS	CHEMICAL COMPOSITION, wt. %								APPARENT POROSITY, %		K @ MEAN TEMP, BTU-in/ft2-hr-°F (W/m-K)					RECOMMENDED MORTARS
	MgO	Al_2O_3	SiO_2	CaO	Fe_2O_3	ZrO_2	Cr_2O_3	other		BULK DENSITY, lb/ft³ (g/cm³)	2000°F (1093°C)	2500°F (1371°C)	THERMAL EXPANSION, % AT 2552°F (1400° C)	CMOR, lb/in² (N/mm²)	SAFE MEAN TEMP. °F (°C)	
NARMAG® 98B	98.1	0.2	0.2	0.9	0.6	-	-	-	**15.8**	183 (2.93)	33.0 (4.7)	34.0 (4.9)	1.92	2700 (18.6)	2550 (1399)	**NARMAG® HS**
SUPER NARMAG® B	98.0	0.2	0.4	0.9	0.5	-	-	-	**14.6**	186 (2.98)	33.0 (4.7)	34.0 (4.9)	1.90	2300 (15.9)	2650 (1454)	**NARMAG® HS**
NARMAG® VZ	80.1	0.3	6.5	0.7	0.4	12.0	-	-	**13.5**	194 (3.11)	25.0 (3.6)	25.0 (3.6)	1.70	1800 (12.4)	2550 (1399)	**NARMAG® HS**
NARMAG® 50 DBRG	50.6	9.0	1.6	0.8	13.1	-	24.9	-	**17.5**	200 (3.20)	21.0 (3.0)	21.0 (3.0)	1.40	900 (6.2)	2750 (1510)	**NARMAG® HS**
NIKE 60 AR	-	63.0	35.0	0.06	0.9	-	-	1.04	**14.0**	158 (2.53)	13.2 (1.9)	14.3 (2.1)	0.81	2100 (14.5)	2575 (1413)	**TASIL® 317, MEXI-KOMO®**
UFALA® XCR	0.1	60.3	36.8	0.1	1.1	-	-	1.6	**15.0**	158 (2.53)	12.5 (1.8)	13.4 (1.9)	0.74	2200 (15.2)	2550 (1399)	**ZIRMUL® 362, MEXI-KOMO®**
NIKE S65W	-	64.8	33.5	0.2	0.9	-	-	0.6	**15.7**	159 (2.55)	13.5 (1.9)	16.4 (2.4)	0.81	1600 (11.0)	2650 (1454)	**TASIL® 317, MEXI-KOMO®**
NIKE S75	-	75.0	24.0	0.2	0.5	-	-	0.3	**16.0**	167 (2.68)	12.1 (1.7)	13.4 (1.9)	0.66	1800 (12.4)	2725 (1496)	**ZIRMUL® 362, TAYCOR® 342D**
NIKE S75 HF	-	74.0	24.4	0.3	0.6	-	-	0.7	**16.9**	165 (2.64)	12.1 (1.7)	13.4 (1.9)	0.68	1700 (11.7)	2775 (1525)	**ZIRMUL® 362, TAYCOR® 342D**
TUFLINE® 98 DM	0.16	97.6	0.12	0.04	0.09	-	-	1.99	**14.6**	204 (3.27)	24.8 (3.6)	24.2 (3.5)	1.05	2000 (13.8)	2800 (1538)	**ZIRMUL® 362, KORUNDAL®MORTAR**
KALA®	0.1	49.6	46.5	0.1	1.3	-	-	2.4	**14.1**	151 (2.42)	14.5 (2.1)	14.5 (2.1)	0.80	2000 (13.8)	2450 (1343)	**TASIL® 317**
KX-99®	0.2	42.1	53.0	0.2	1.3	-	-	3.2	**13.5**	142 (2.27)	10.6 (1.5)	11.1 (1.6)	0.70	1700 (11.7)	2200 (1204)	**TASIL® 317**
VISTA®	-	57.8	14.6	-	-	24.6	-	3.0	**14.0**	189 (3.03)	15.2 (2.2)	16.2 (2.3)	0.81	5100 (35.2)	2750 (1510)	**ZIRMUL® 362**
GEM®	-	74.6	24.2	-	0.1	-	-	1.1	**15.0**	165 (2.65)	12.0 (1.7)	13.3 (1.9)	0.68	2500 (17.2)	2725	**ZIRMUL® 362, TAYCOR® 342D**

GLASS TANK REGENERATOR BRANDS

NON-MAGNESITE SYSTEMS

CROWNS, UPPER WALLS, & DIVISION WALLS
NIKE S75 HF
NIKE S75
NIKE S65W
GEM®

TARGET WALLS
NIKE S65W
NIKE S75
NIKE S75 HF
GEM®
VISTA®
TUFLINE® 98 DM

MIDDLE WALLS
NIKE S65W
UFALA® XCR
NIKE 60 AR
UFALA®

LOWER WALLS
KALA®
KX-99®
UFALA® XCR
NIKE 60 AR
CLIPPER® DP
UFALA®

TOP CHECKERS
TUFLINE® 98 DM
NARMAG® VZ
VISTA®
SUPER NARMAG® B
NARMAG® 98B

MIDDLE CHECKERS
SUPER NARMAG® B

CONDENSATE ZONE CHECKERS
SUPER NARMAG® B
NARMAG® VZ (FOR OIL-FIRING)
NARMAG® 50 DBRG

LOWER CHECKERS,
Rider Tiles & Arches
KALA®
KX-99®
NIKE S65W
UFALA® XCR

MAGNESITE SYSTEMS

CROWNS, UPPER WALLS, & DIVISION WALLS
SUPER NARMAG® B
NARMAG® 50 DBRG

TARGET WALLS
SUPER NARMAG® B
NARMAG® VZ
NARMAG® 50 DBRG

MIDDLE WALLS
SUPER NARMAG® HF
SUPER NARMAG® B
NARMAG® 50 DBRG

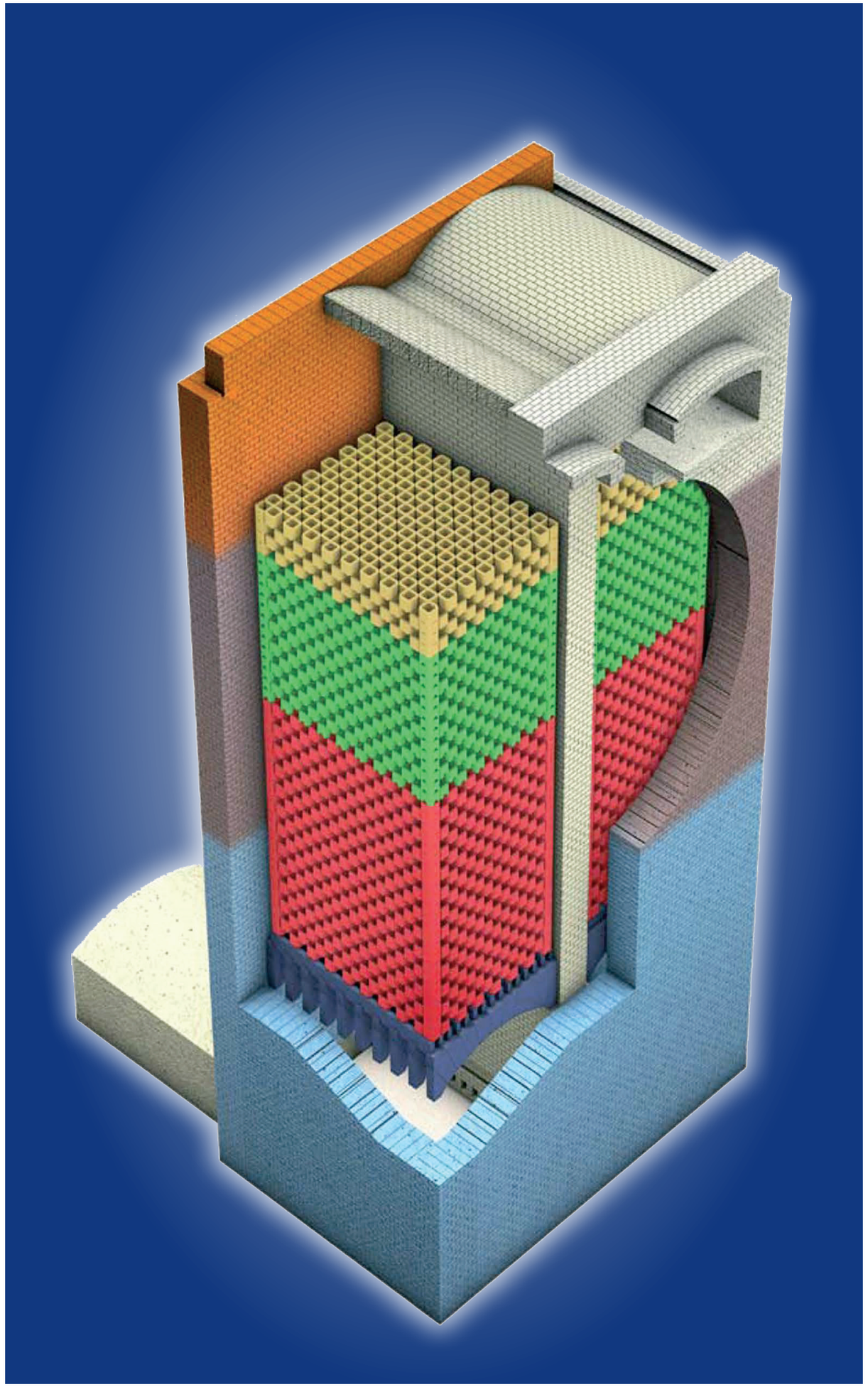
LOWER WALLS
KALA®
KX-99®
UFALA® XCR
NIKE 60 AR
CLIPPER® DP
UFALA®

TOP CHECKERS
TUFLINE® 98 DM
NARMAG® 98B
SUPER NARMAG® B
NARMAG® VZ
VISTA®

MIDDLE CHECKERS
SUPER NARMAG® B

CONDENSATE ZONE CHECKERS
SUPER NARMAG® B
NARMAG® VZ (FOR OIL FIRING)
NARMAG® 50 DBRG

LOWER CHECKERS, RIDER TILES & ARCHES
KALA®
KX-99®
NIKE S65W
UFALA® XCR















PUT OUR INTENSITY TO WORK FOR YOU

Every day, our people and products stand up to the challenges of every job. As a global supplier, we'll save you time and money. And our experience in heat containment makes us the safest, most reliable choice for your investment.

We are your one-stop shop for refractory solutions. And we can take your inventory or new build to the next level. To learn more, talk with a HWI representative at **800-492-8349** or visit **thinkhwi.com**.

HWI A MEMBER OF CALDERYS

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