



RHI MAGNESITA

**RHIM's Solutions for the Glass  
Industry**

# **INNOREG - Next Evolution Step in Regenerators**

September 2024



# Market Leader INNOREG



**INNOREG is the most installed regenerator system world-wide, used by all leading glass groups**

## Advantages

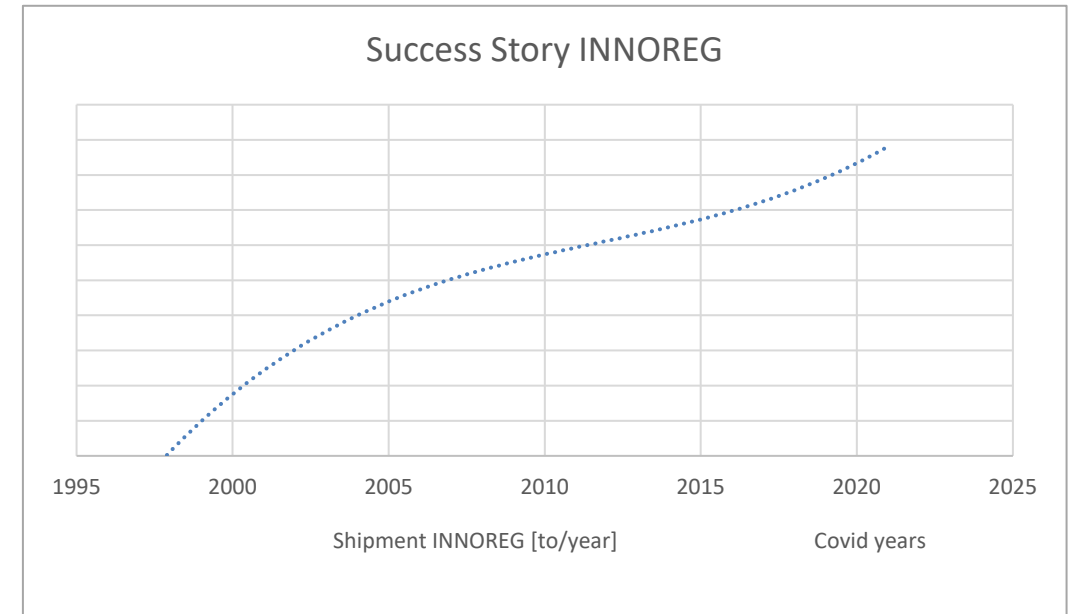
- Large portfolio of materials available
- Large number of checker shapes available



Both together allows a tailor-made solution for each regenerator to the individual operational conditions

- Most stable checker work in the market
- Easy and fast installation

**Sales volume : > 40K tons/year of chimney blocks installed during the last 20 years**



# What is INNOREG ?

## INNOREG is a tool-box with the following features

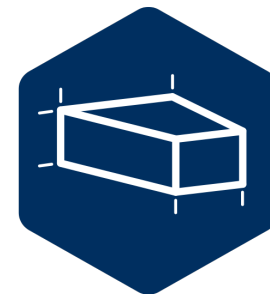
- A complete regenerator  
(Checker work, transition tiles and rider arches, casing)



- Optimized material Choice

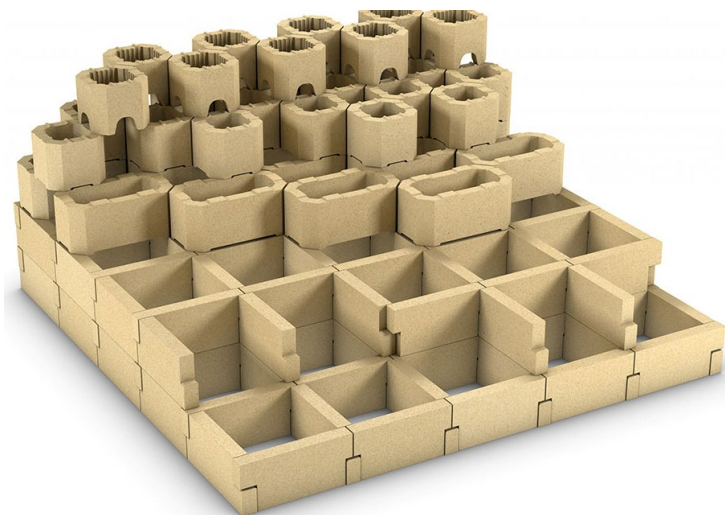


- Optimized checker shapes



# Complete Regenerator

## Checker-work



**LCP** offers a larger flue cross section area to reduce the risk of clogging due to sodium sulfate

**Top Layers**  
 RUBINAL VZ  
 DURITAL AZ58 TS  
 DURITAL RK10 TS  
 DURITAL K99 Extra



TG

**Hot Zone**  
 RUBINAL VZ  
 ANKER DG1



TL



TLW

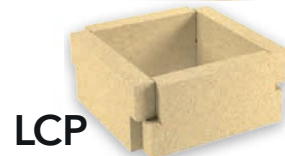
**Condensation Zone**  
 $<1100^{\circ}\text{C}$   
 RUBINAL EZ  
 RUBINAL ESP



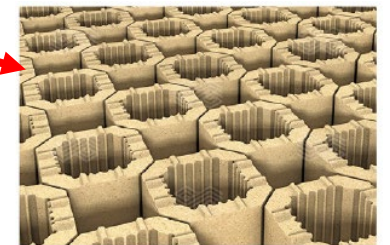
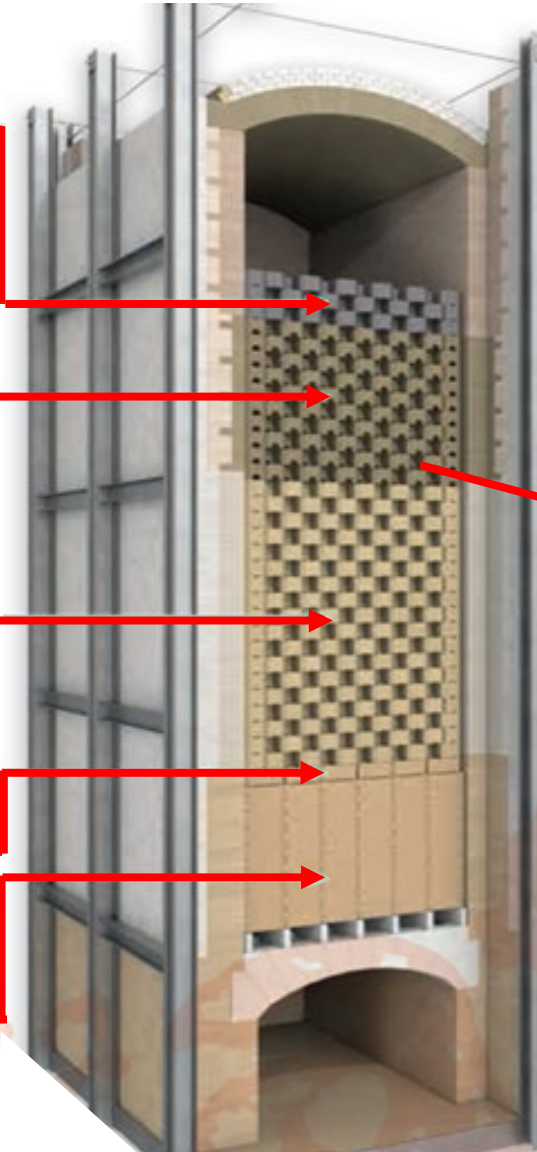
TG



TG32



LCP



# Checker-work

## High Efficiency Shapes - Optimized shapes for different temperature zones

TG



- Top courses
- Condensation zone (800 – 1100 °C)
- Bottom courses (< 800 °C)

TL



- Hot zone (> 1100 °C)
- Condensation zone (800 – 1100 °C)

TLW



- Hot zone (> 1100 °C)
- Condensation zone (800 – 1100 °C)

TG32/175



- Condensation zone (800 – 1100 °C)

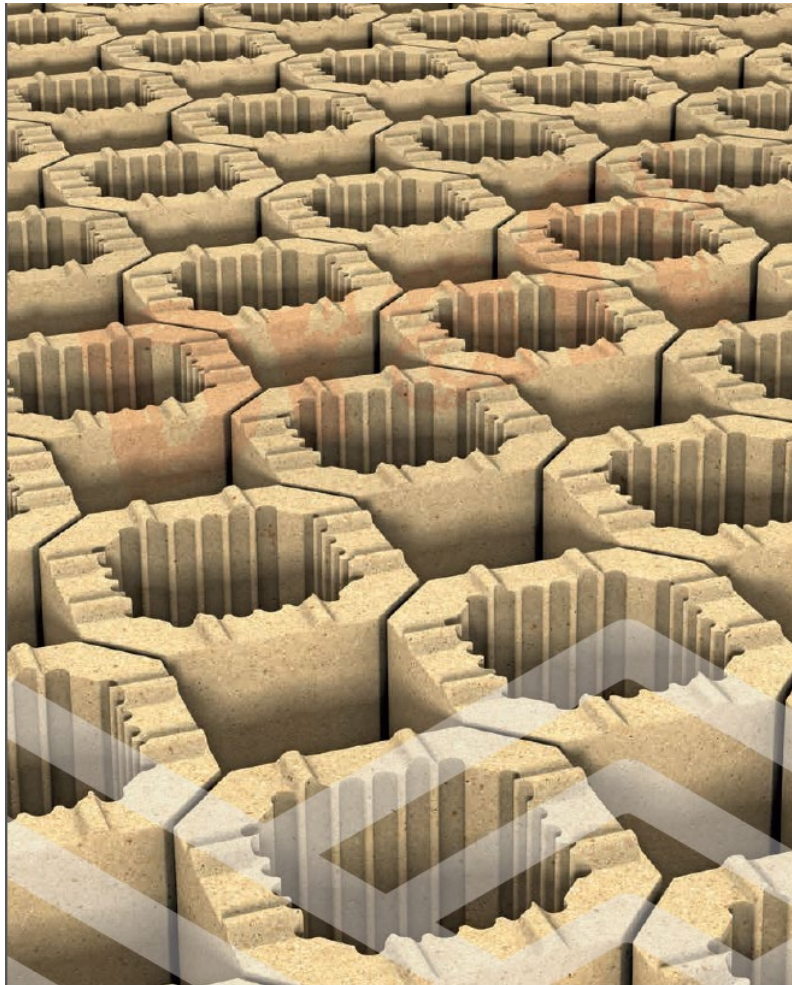
LCP



- Condensation zone (800 – 1100 °C)

# Checker-work

## High Efficiency Shapes - Optimized shapes for different temperature zones



TLW-shape  
with wavy inner surface

### **Improve of the thermal efficiency for hot zone**

Surface increase by 14%  
in comparison to TL 14/175

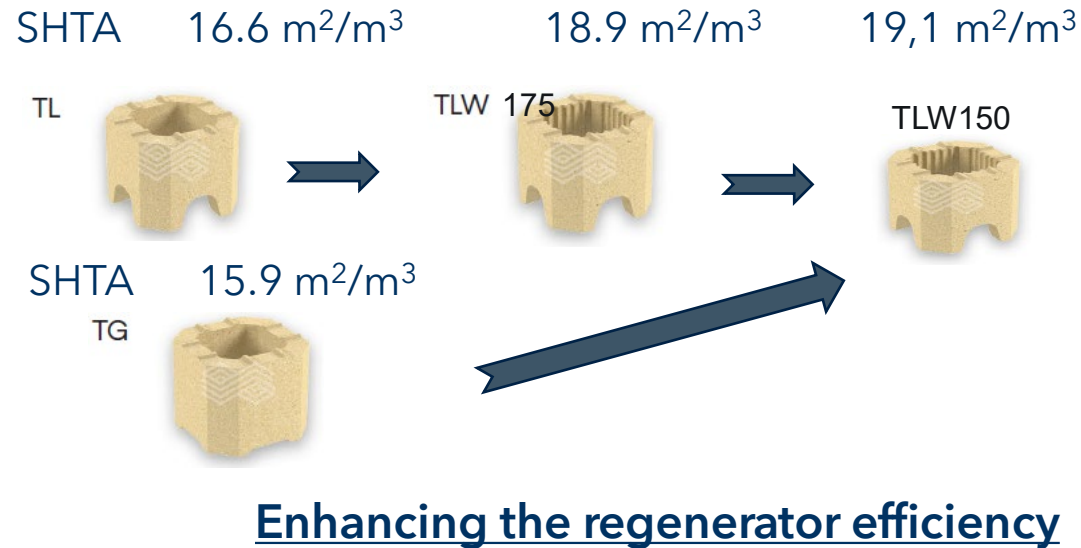
Spec. heat area: 19 m<sup>2</sup>/m<sup>3</sup>

No additional clogging risk due to the vertical orientation of the "waves"

**The application of new TLW shape in the hot zone offers 1% higher efficiency for the total checker package compared to a standard checker work.**

# Checker-work

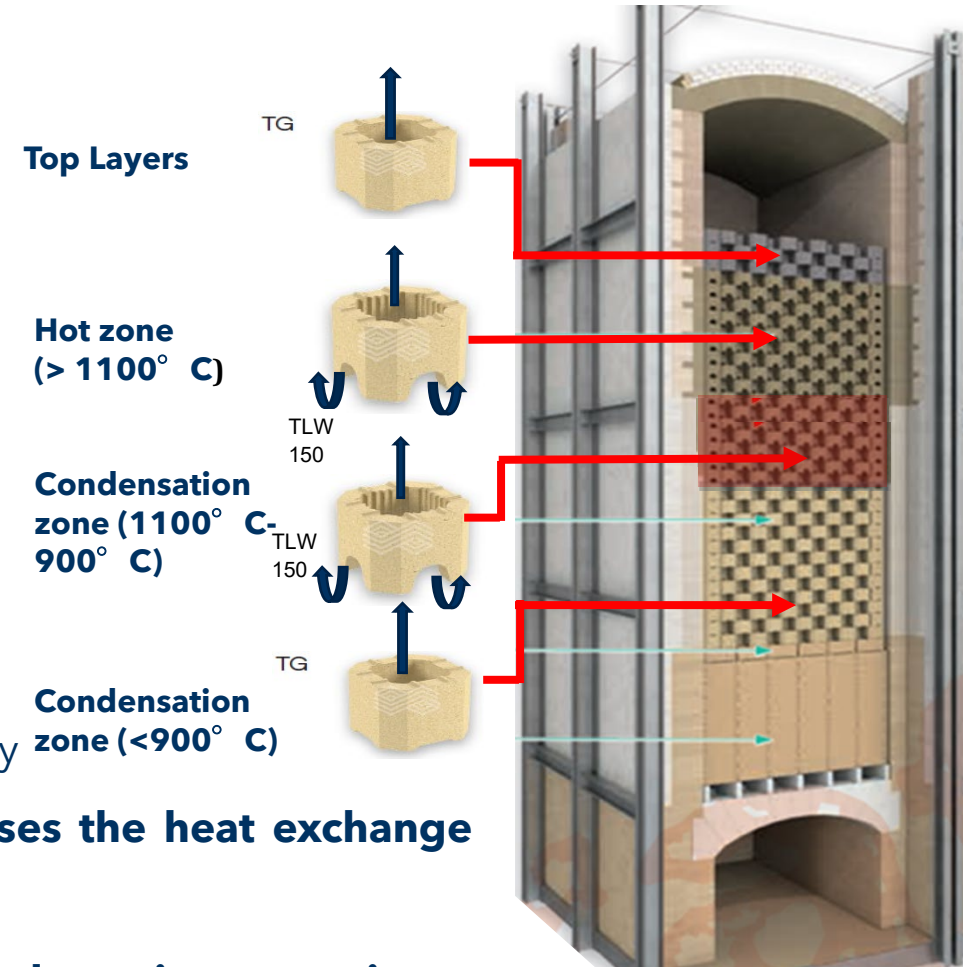
## High Efficiency Shapes - Improved Lining Concept



Increasing the heat exchange area increases the efficiency  
Passing from TL 175 to TLW175 in the hot zone has proven this theory

**Consequently, passing from TLW175 to TLW150 further increases the heat exchange area and the additional openings improve the gas distribution**

**Replacing TG shapes with TLW shapes also in the upper condensation zone is an additional option depending on the operating conditions**



# Checker-work

**High Efficiency Shapes - Optimized shapes for different temperature zones**



## Anti-Clogging

**Large flue size in the lower part**

Long chimney blocks (TG 32/175):  
e.g. flue size = 322 x 142 mm



Large Channel Piece (LCP)  
e.g. flue size = 310 x 310 mm



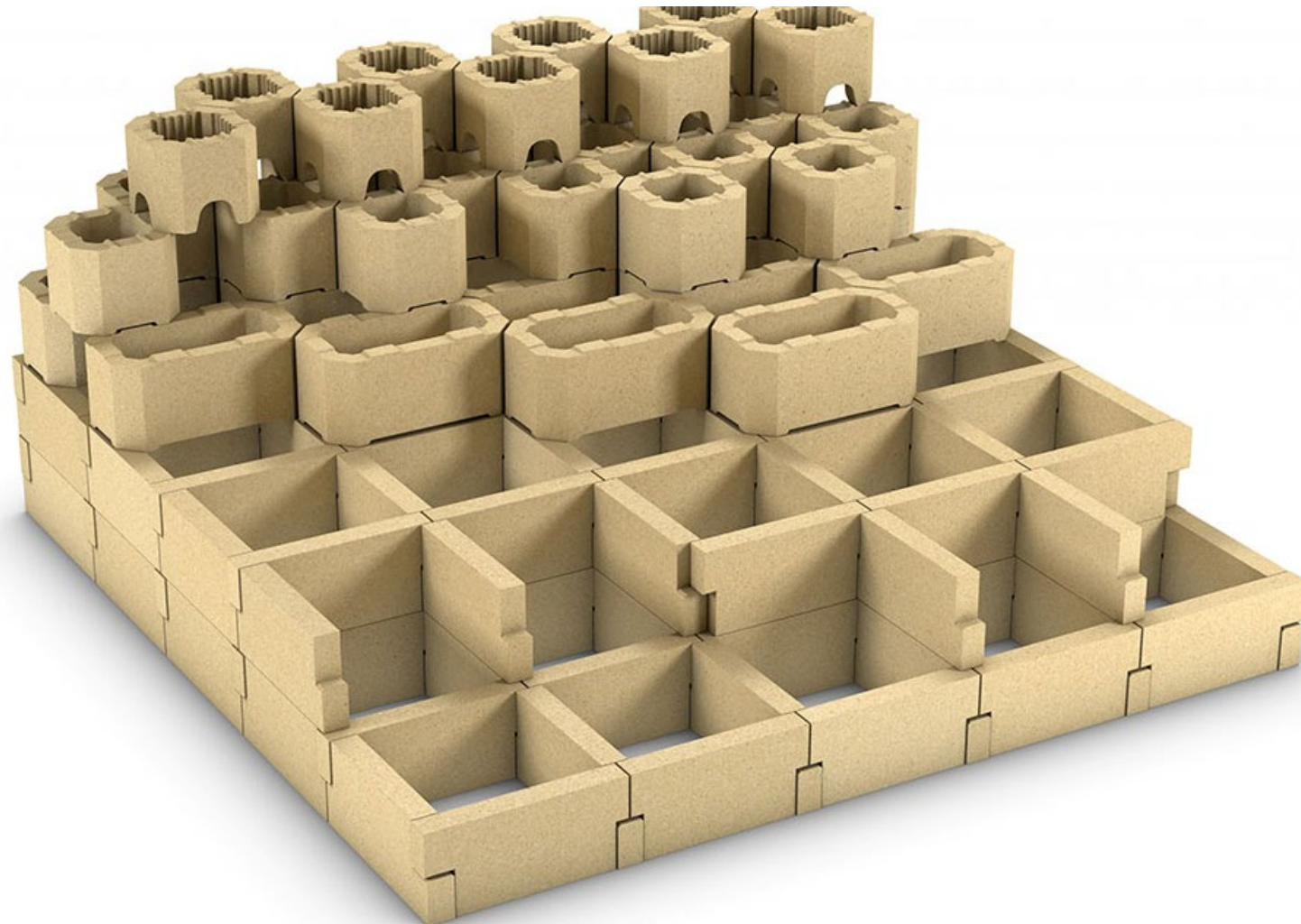


# Checker-work

**High Efficiency Shapes - Optimized shapes for different temperature zones**



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## **INNOREG**

- **Corrosion resistant**
- **Stable**
- **Efficient**
- **Anti-clogging**

# Checker-work

## Optimized Material Choice

### Checker Top Layers: material choice

Sand carry-over	Sand carry-over with CaO	Fine glass cullet	"Worst case" Carry-over + cullet
Magnesia Zircon	Re-bonded fused Corundum	Zirconia Mullite	Chrome Corundum
RUBINALVZ	DURITAL K99EXTRA (use for > 1350°C)	DURITAL AZ58	DURITAL RK10



**DURITAL RK10 has become our standard, as it shows the best performance in all situations**

# Checker-work

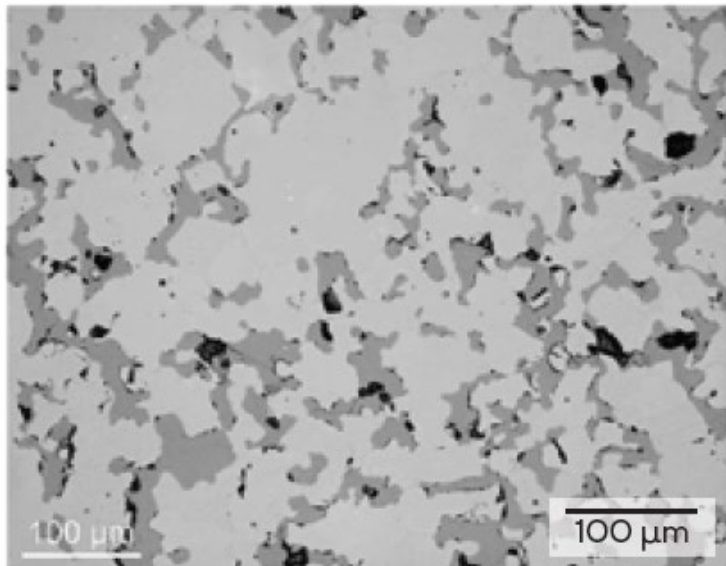
## Optimized Material Choice

Checker for hot zone > 1100°C :

**For gas firing**

ANKER DG1

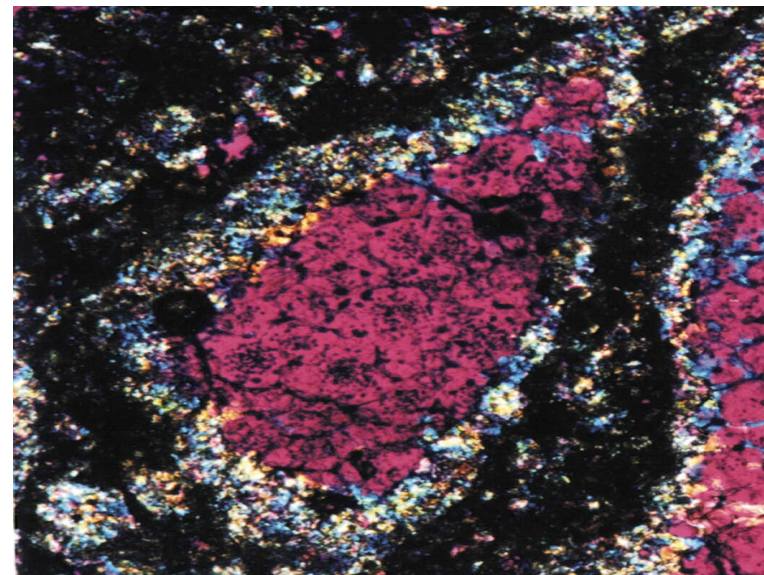
MgO-MgO-direct  
bonding



**For oil firing**

Rubinal VZ

MgO-protected by a Forsterite  
bonding phase



# Checker-work

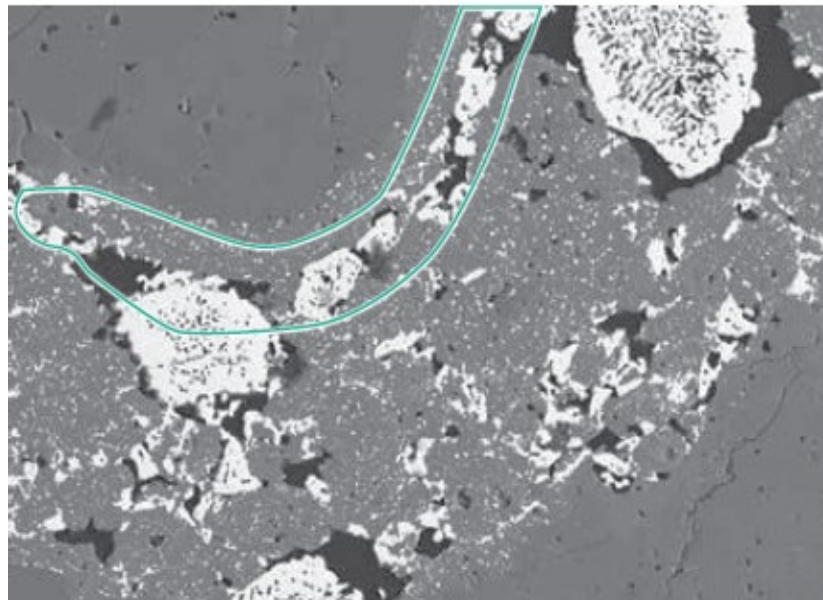
## Optimized Material Choice

Checker for condensation zone : 1100°C -800°C

Two proven solutions

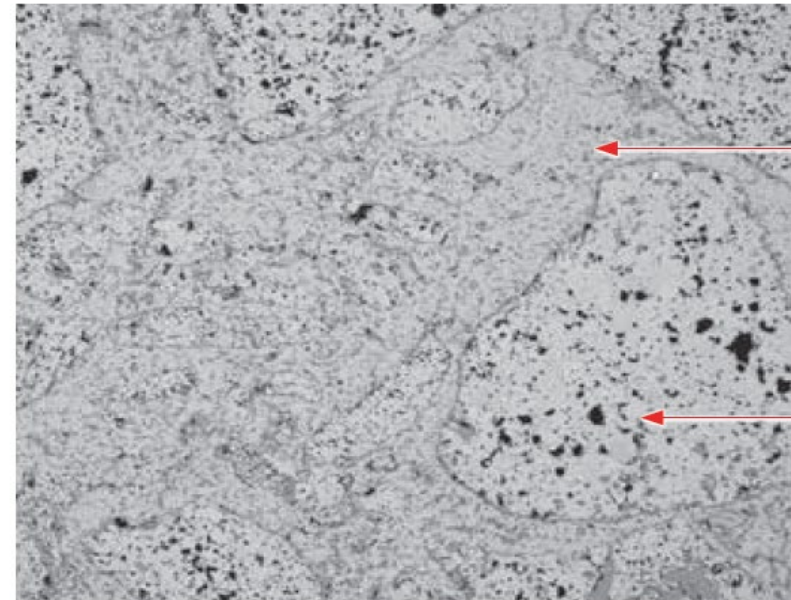
Rubinal EZ

MgO-protected by a  
Forsterite bonding phase



Rubinal ESP

MgO-protected by a  
MA-Spinel bonding phase



# Checker-work

## Optimized Material Choice

Checker for condensation zone : 1100°C -800°C

RUBINAL EZ



Example:

Used in regenerator of a float glass furnace

14 years in application

**Very low corrosion**

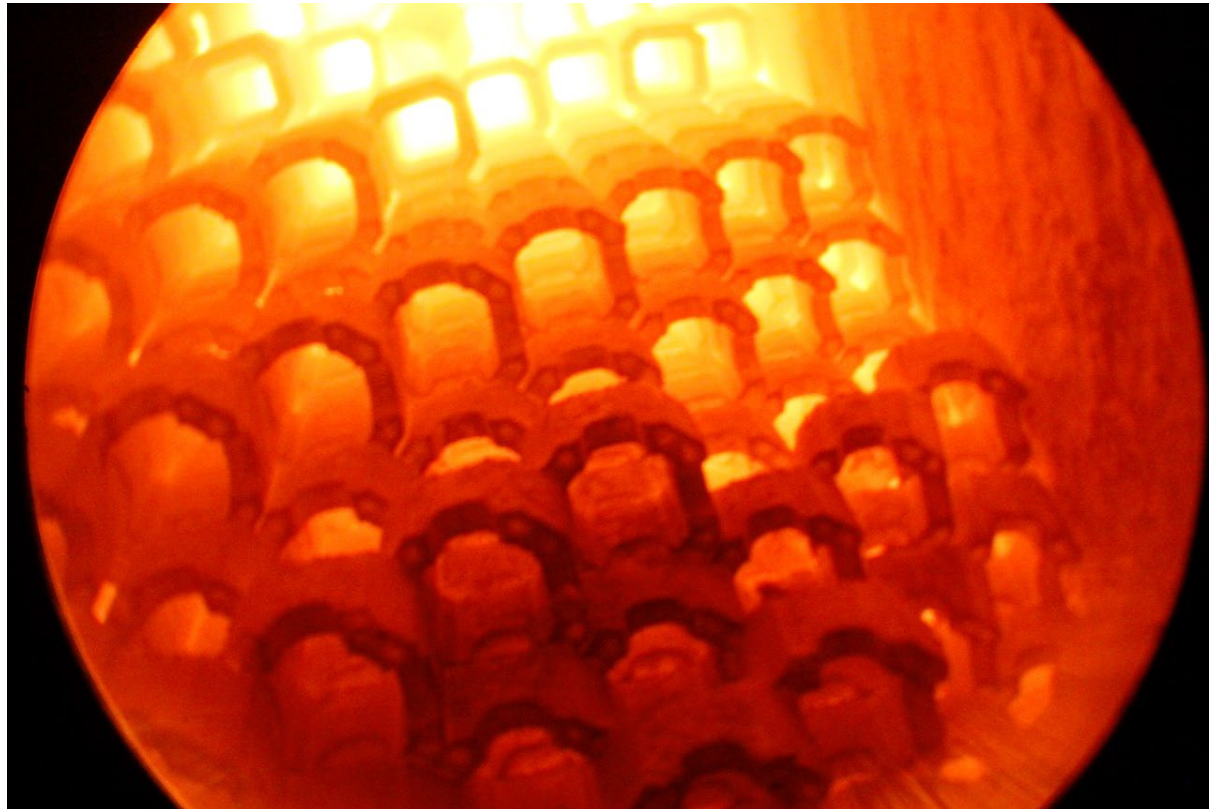
# Checker-work

## Optimized Checker Shape



- Stability -

**Chimney blocks are most the most stable checker system in the market**



Looking upwards:

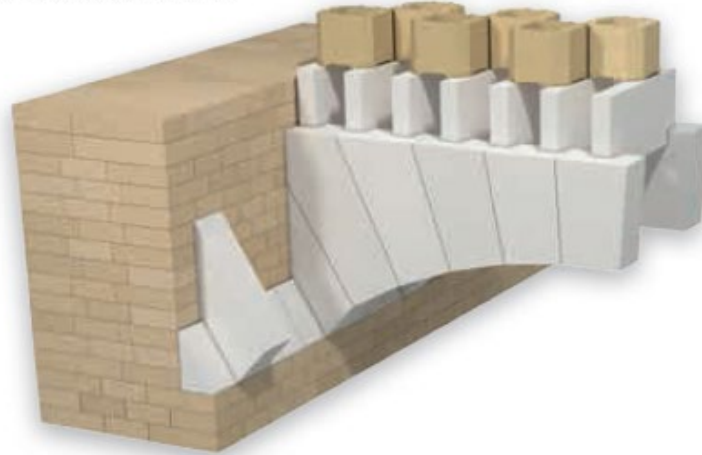
After falling down of transition tiles, the chimney blocks contributes to create a bridge by wedging each other

(this photo was made from regenerator bottom)

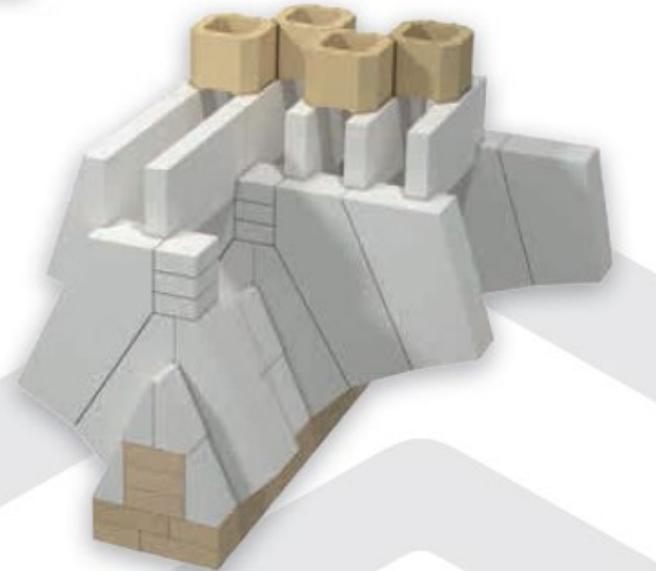
# Complete Regenerator

## Transition Tiles and Rider Arches

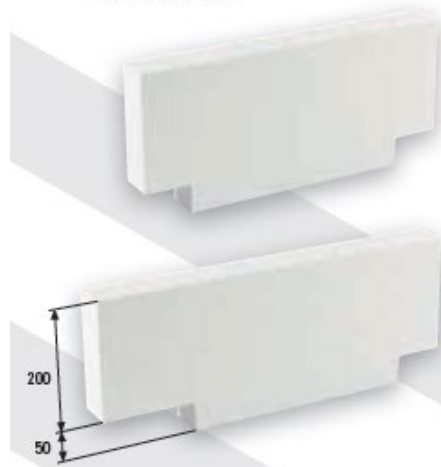
Rider arch with outer wall



Rider arch with mid wall  
(double rider arch)



Transition tiles



Skew



# Complete Regenerator

## Casing



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Magnesia concept  
Crown and side walls

T: 1250 - 1600°C

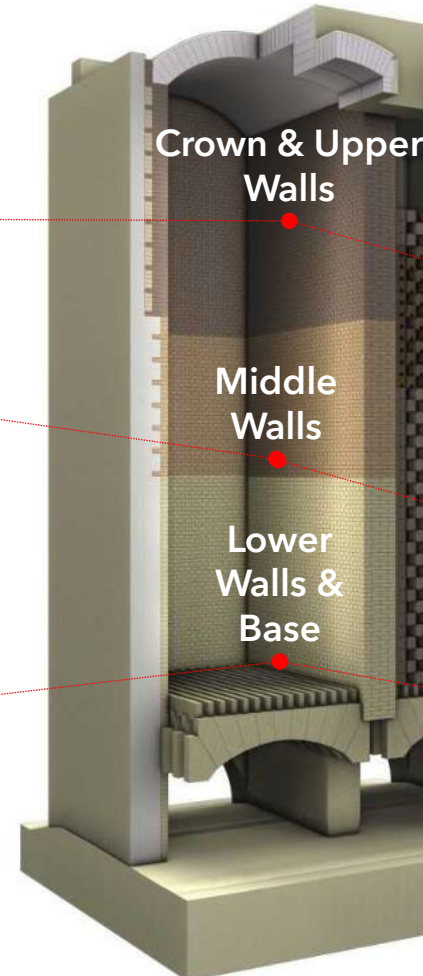
ANKER DG10  
RUBINAL VZ *Target Wall*

T: 800- 1250°C

ANKER DG3

T < 800°C

RHIM-F41  
RHIM-F40  
RHIM-F35  
MAXIAL 310



Crown & Upper Walls

Middle Walls

Lower Walls & Base

Mullite Concept

T: 1550 - 1600°C

RHIM-S70+  
RHIM-M75f  
DURITAL E75EXTRA

T: 1450 - 1550°C

RHIM S72  
DURITAL S70HM (1470-1550°C)

T: 1300°C - 1450°C

RHIM-S65+  
DURITAL S65G (1300°C-1470°C)

T: 800 - 1425°C

RHIM-S65  
RHIM-S60

T: 800 - 1300°C

RESISTAL S65  
RESISTAL S60

T < 800°C

RHIM-F41  
RHIM-F40  
RHIM-F35  
MAXIAL 310



# Complete Regenerator

## Casing



### Optimized material choice for the Regenerator Chamber

Materials for Regenerator crown and upper walls

	Low	High
Alkali in waste gas	>> Low creep magnesia >> Mullite	>> Low creep magnesia
SiO <sub>2</sub> carryover	>> Low creep magnesia >> Mullite	>> Mullite
Waste gas temperature	>> Low creep magnesia	>> Low creep magnesia >> Mullite



RHI MAGNESITA

# Thank you for your attention

## Get in Touch

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