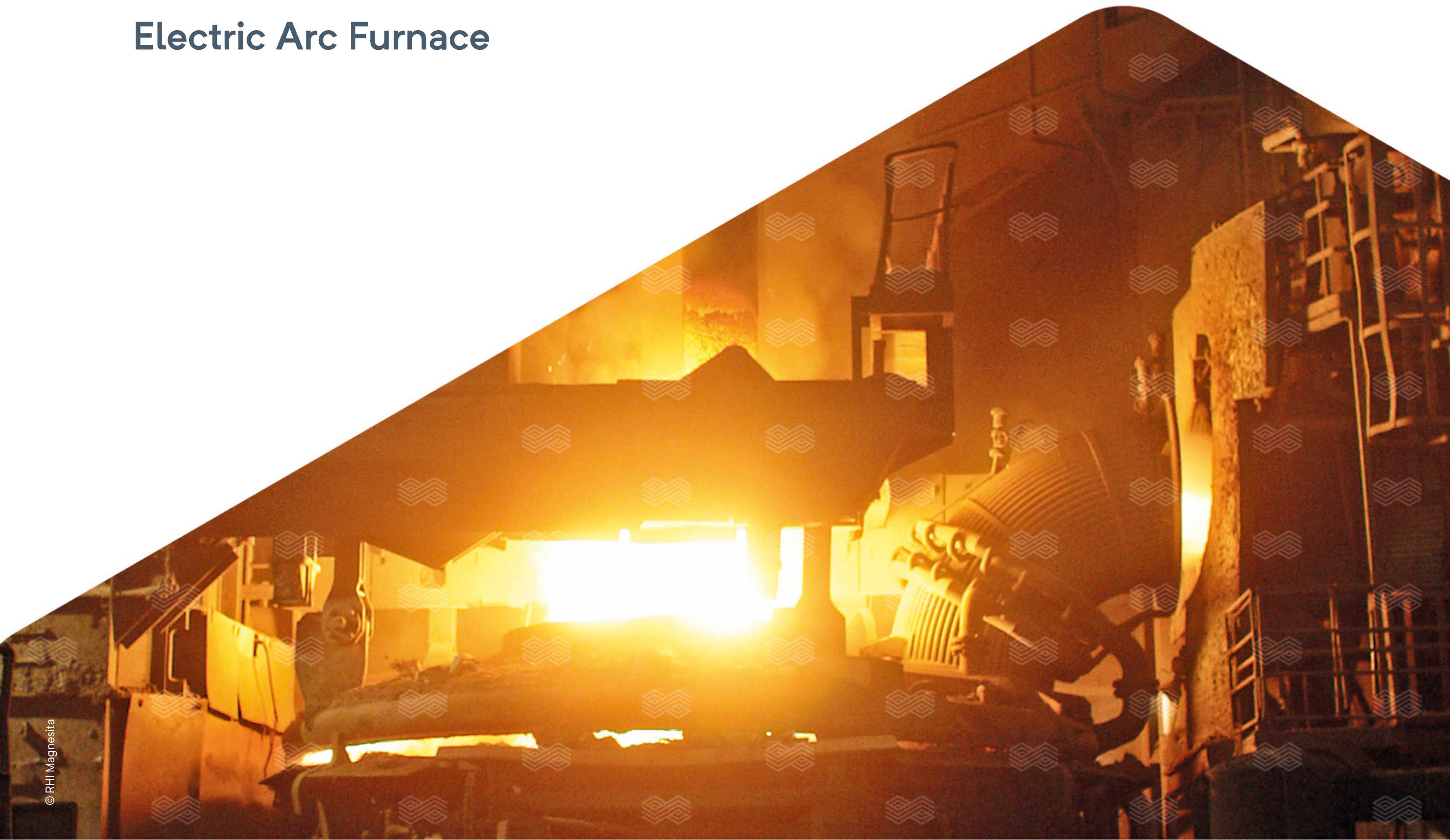




RHI MAGNESITA

STEEL

Electric Arc Furnace



There for you, wherever you need us



The more closely we work with our customers, the greater the impact we can make for them. So a global network of offices, research centers, and production sites is important to us, and to them. We are continuously extending our global reach to be closer to even more customers.

Being closer to customers doesn't just mean we can be more responsive to their needs. It also helps us to listen better — to understand their concerns, cultures and ways of working. It makes us alert to new ways of thinking and ideas that enable us to deliver even better advice, services, and solutions.

Our exceptional resources and expertise extend far beyond making and selling products. We provide solutions to customers worldwide for cover projects, material specifications, thermal studies, numerical simulations, follow-ups and technical support in application of minerals, and maintenance and electromechanical services for refractory equipment.

**North
America**

3 COUNTRIES
1 R&D CENTER

35
Main production and
raw material sites

70
Sales offices

180
Countries shipped
to worldwide

6 COUNTRIES
1 R&D HUB

**South
America**

Europe

17 COUNTRIES
1 R&D HUB
1 R&D CENTER

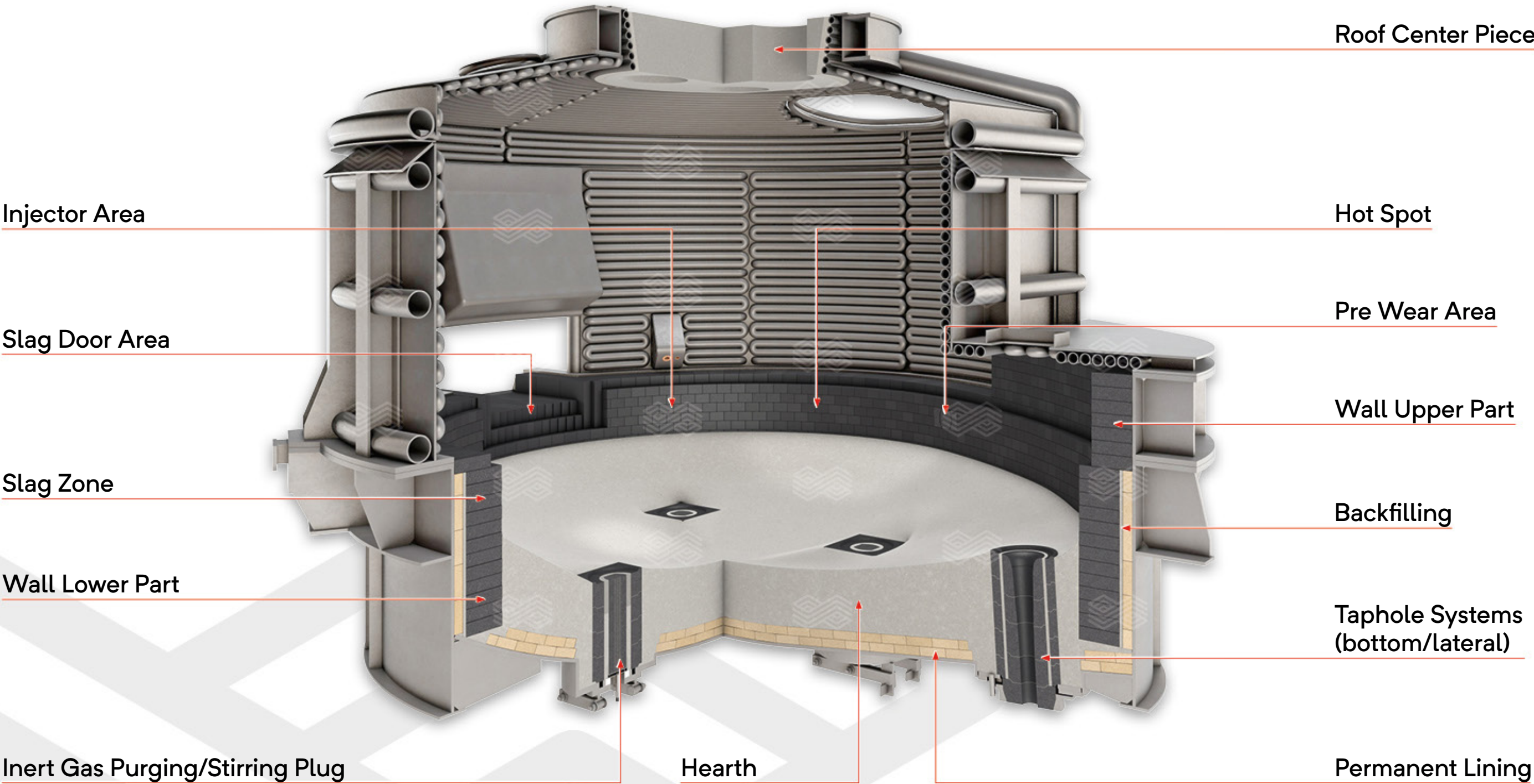
**Middle East/
Africa**

2 COUNTRIES

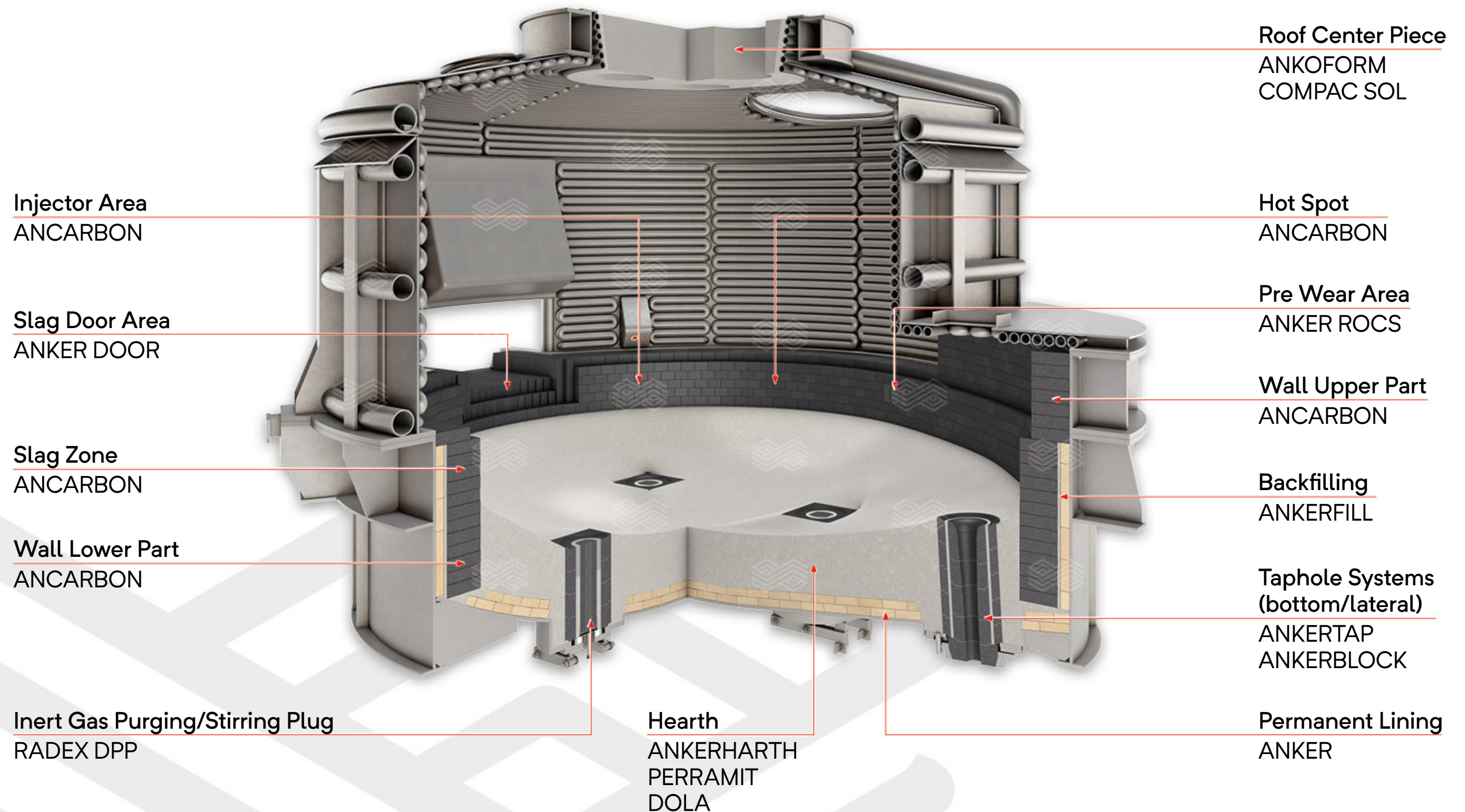
9 COUNTRIES
3 R&D CENTERS

**Asia
Pacific**

The Electric Arc Furnace



Electric Arc Furnace — Our Refractory Solutions and Innovations



Content



Lining



Purging



Tapping



Solutions



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Bricks Overview Electric Arc Furnace

ANCARBON

Magnesia Carbon Bricks

- Universal usability in all areas of the working lining
- Highest refractoriness
- Carbores or resin bonded
- Dense or ULTRA dense pressed
- Adapted special additions

ANKROM

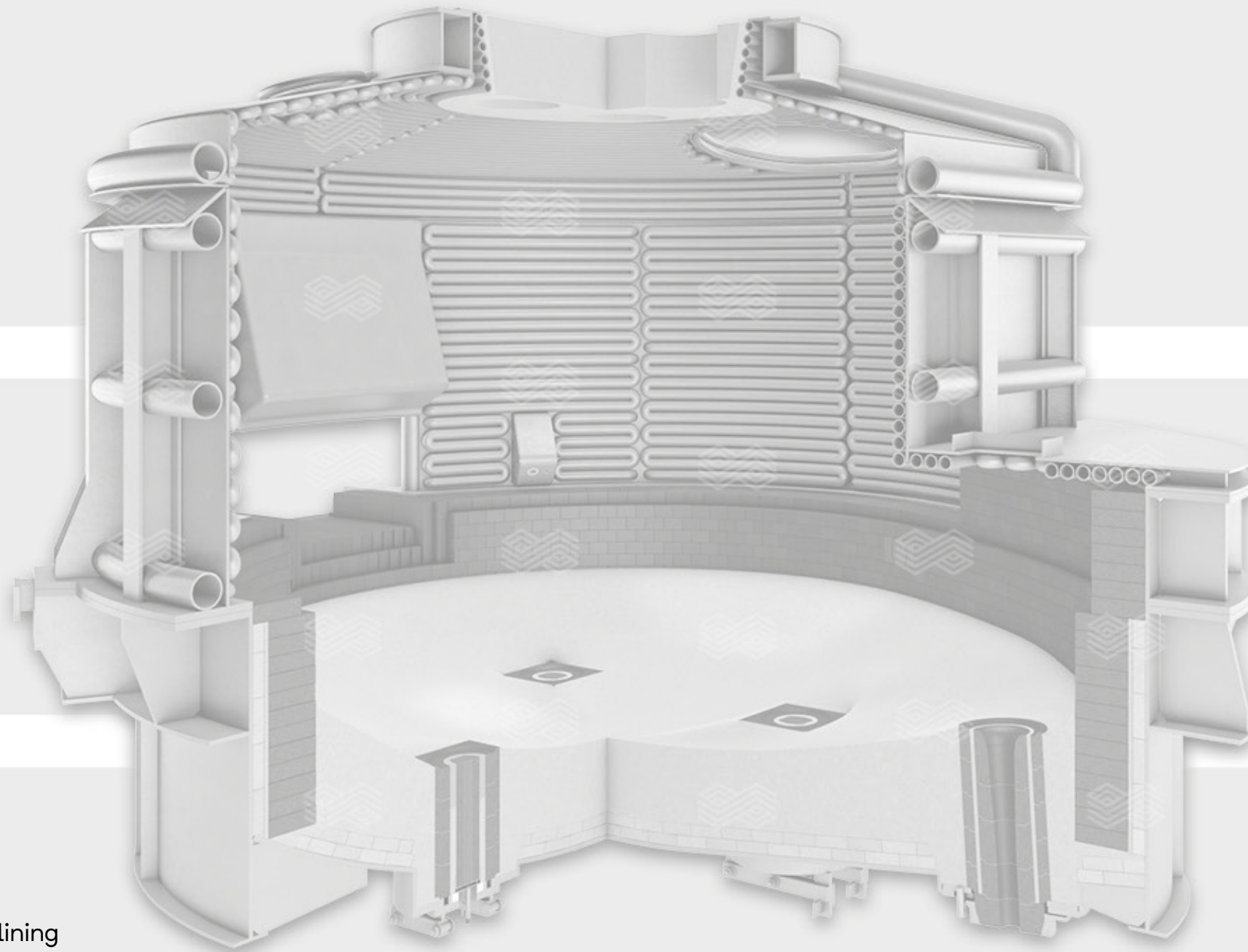
Fired Magnesia Chromite Bricks

- Standard solution for foundries
- Available with chromium oxide or pre-reacted oxicrom
- High hot erosion resistance
- High slag resistance

ANKER

Fired Magnesia Bricks

- Standard solution for the permanent lining
- Ceramic bonded — no decarburization
- Low thermal conductivity
- High cold crushing strength



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Mixes Overview Electric Arc Furnace

ANKERHARTH, ANKERFRIT, ANKERJET

Magnesia Mixes

- Versatile range of mixes for ramming, fettling, gunning and backfilling
- High refractoriness
- Adaptable to specific customer demands

DOLA

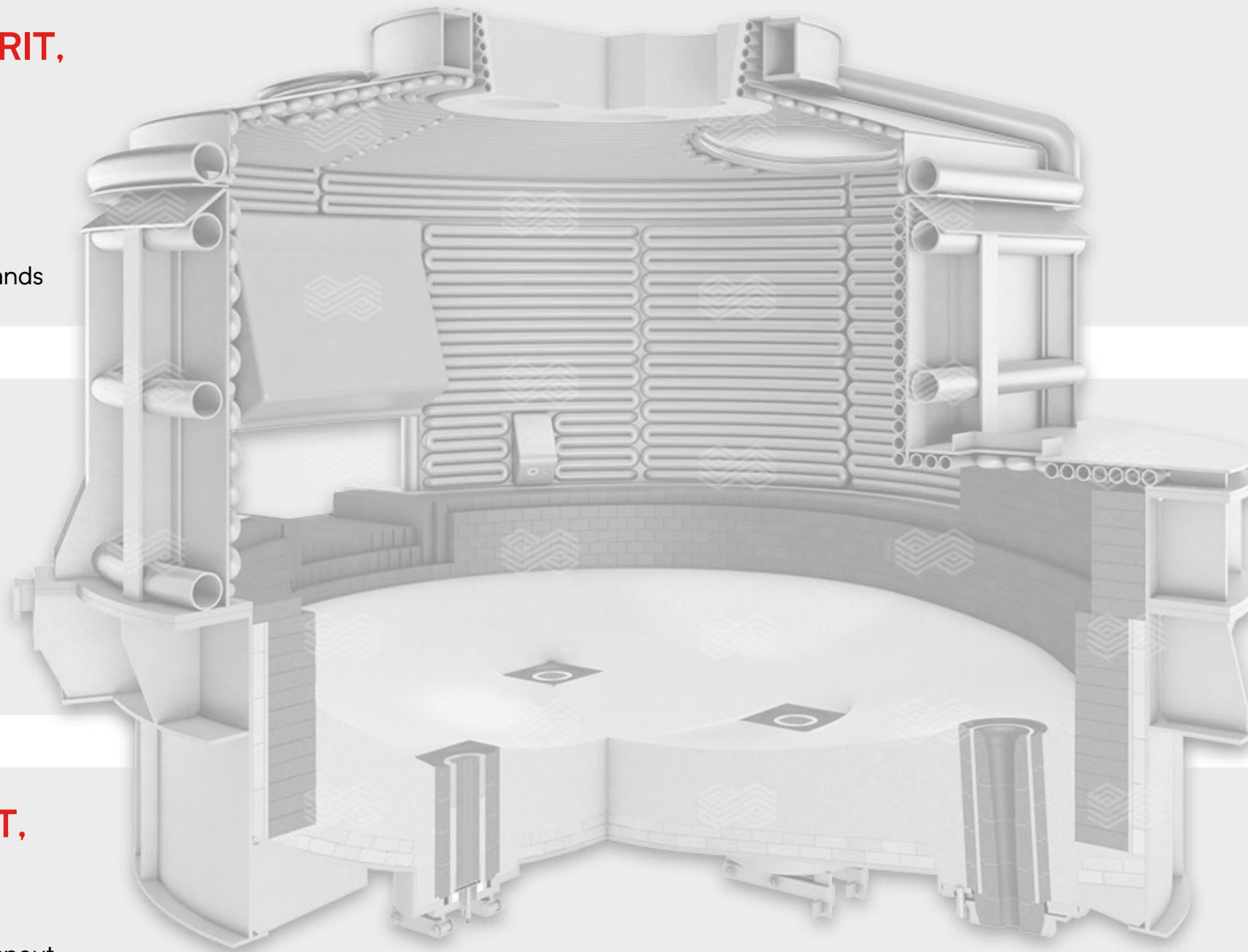
Magnesia-Doloma Mixes

- Usable as an alternative hearth ramming mix

COMPAC SOL, COMPRIT, DIDURIT

Alumina Mixes

- Usable for the roof center piece and spout
- Monolithic prefab — ANKOFORM
- Cast-on-site mix — e.g. COMPAC SOL
- High thermal shock resistance



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ANKER DOOR — The Slag Door Solution!

Pre-assembled Block for the Highly Demanding Slag Door Area

Functionality

- Usage of wedged bricks at the sill level, eliminates the loosening of bricks due to cleaning
- Increased mechanical stability at this highly stressed area due to big rectangular bricks as door jambs

Benefits

- Simple and quick slag door installation
- Reduced specific refractory consumption (maintenance effort)
- Reduced downtime of the EAF



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Lateral Taphole System

Nowadays modern lateral taphole systems are composed of a prefabricated taphole block and a prefabricated spout.

Prefabricated Spout

Benefits

- High end sol gel-bonded prefabs
- Simple and fast installation
- Excellent hot properties
- Excellent corrosion resistance
- Increased service life/productivity

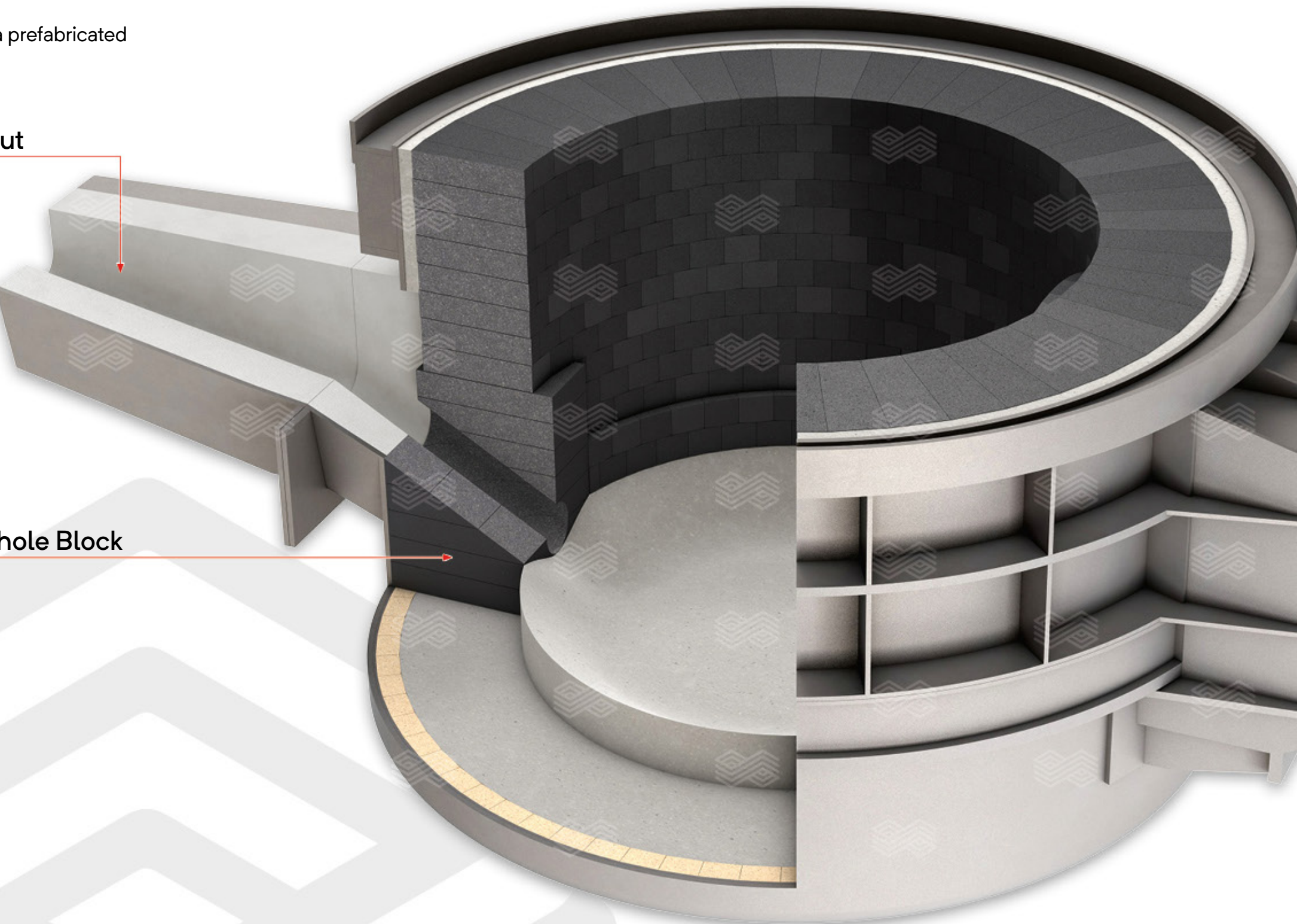
Prefabricated Taphole Block

Benefits

- Higher mechanical stability
- Simple and fast installation
- Fewer joints along the taphole channel
- Increased service life/productivity

Spout

Taphole Block



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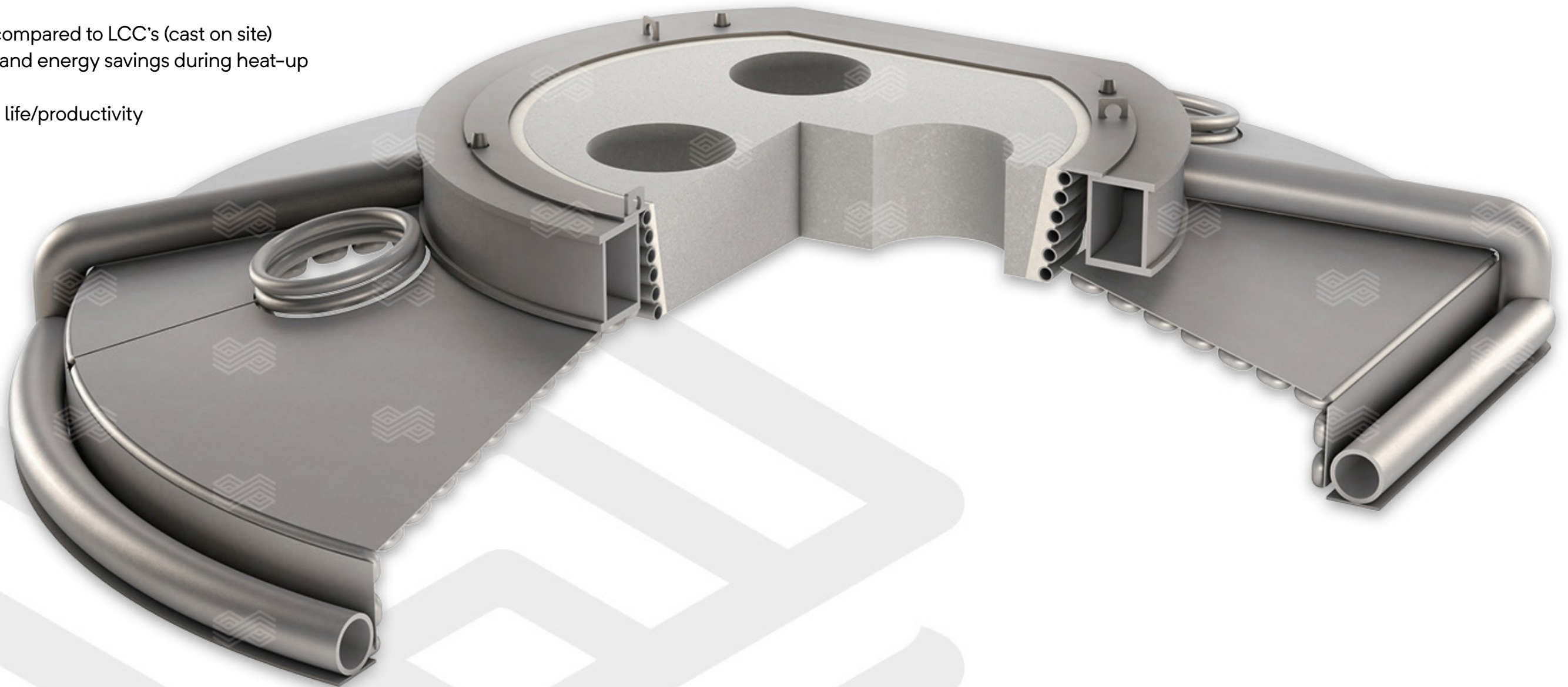


Monolithic Roof Center Piece

The new generation of sol-bonded products has shown impressive results both as cast-on-site solution as well as in prefabricated deltas.

Benefits

- Excellent hot properties
- Excellent corrosion resistance
- No special requirements regarding mixing equipment (cast on site)
- Longer shelf life compared to LCC's (cast on site)
- Remarkable time and energy savings during heat-up (cast on site)
- Increased service life/productivity



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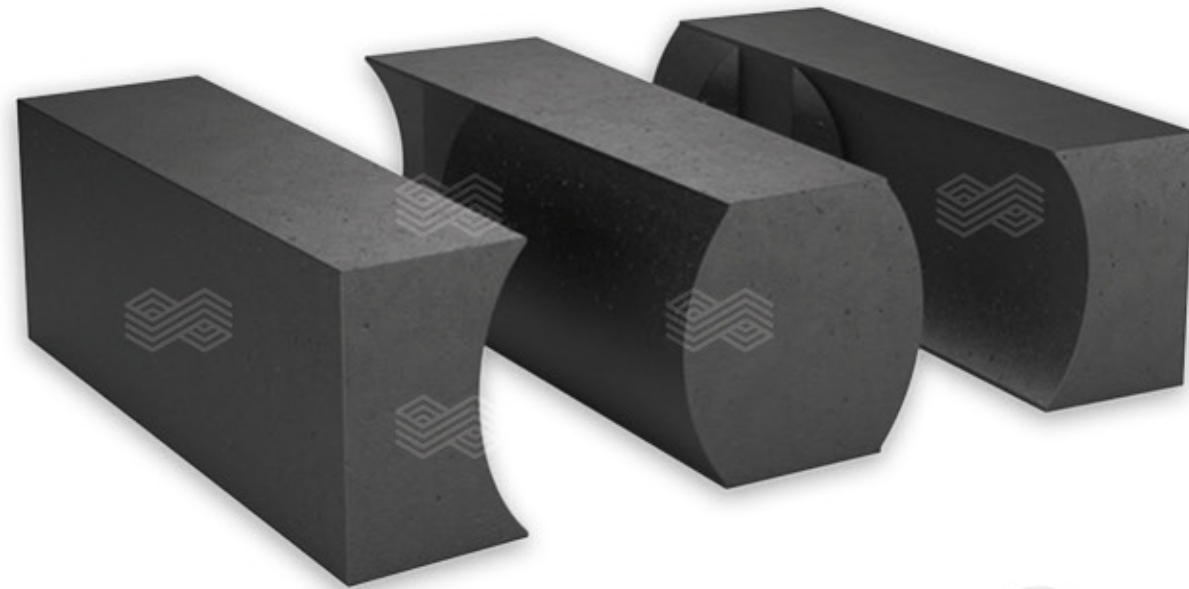


Maintenance



ANKER ROCS — The Smart Brick

ANKER ROCS — The **R**efractory **O**bserving **C**ontrol **S**ystem — is a brick that tells you the remaining sidewall thickness at any time during the operation.



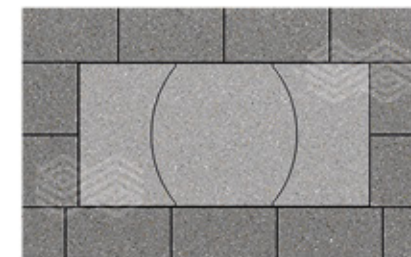
Functionality

- Refractory wear is indicated by changing the surface joint patterns on the hot face as the brick wear increases
- For best visibility of “glowing joints” the contact surfaces are coated with a special mortar

Benefits

- Enhanced operational safety
- Enhanced process control
- Identification of pre wear areas
- Improved utilization of the refractory material- decreased wastage (Gunning indicator)
- Reduced overall costs

ANKER ROCS — Indication of Wear



Minor wear

Residual thickness: > 20 cm

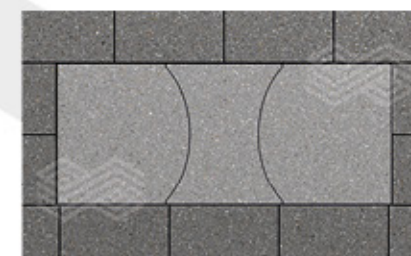
Operational safety: ■■■■■



Medium wear

Residual thickness: 20–8 cm

Operational safety: ■■■■



Heavy wear

Residual thickness: < 8 cm

Operational safety: ■■■■

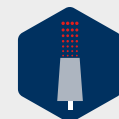
Content



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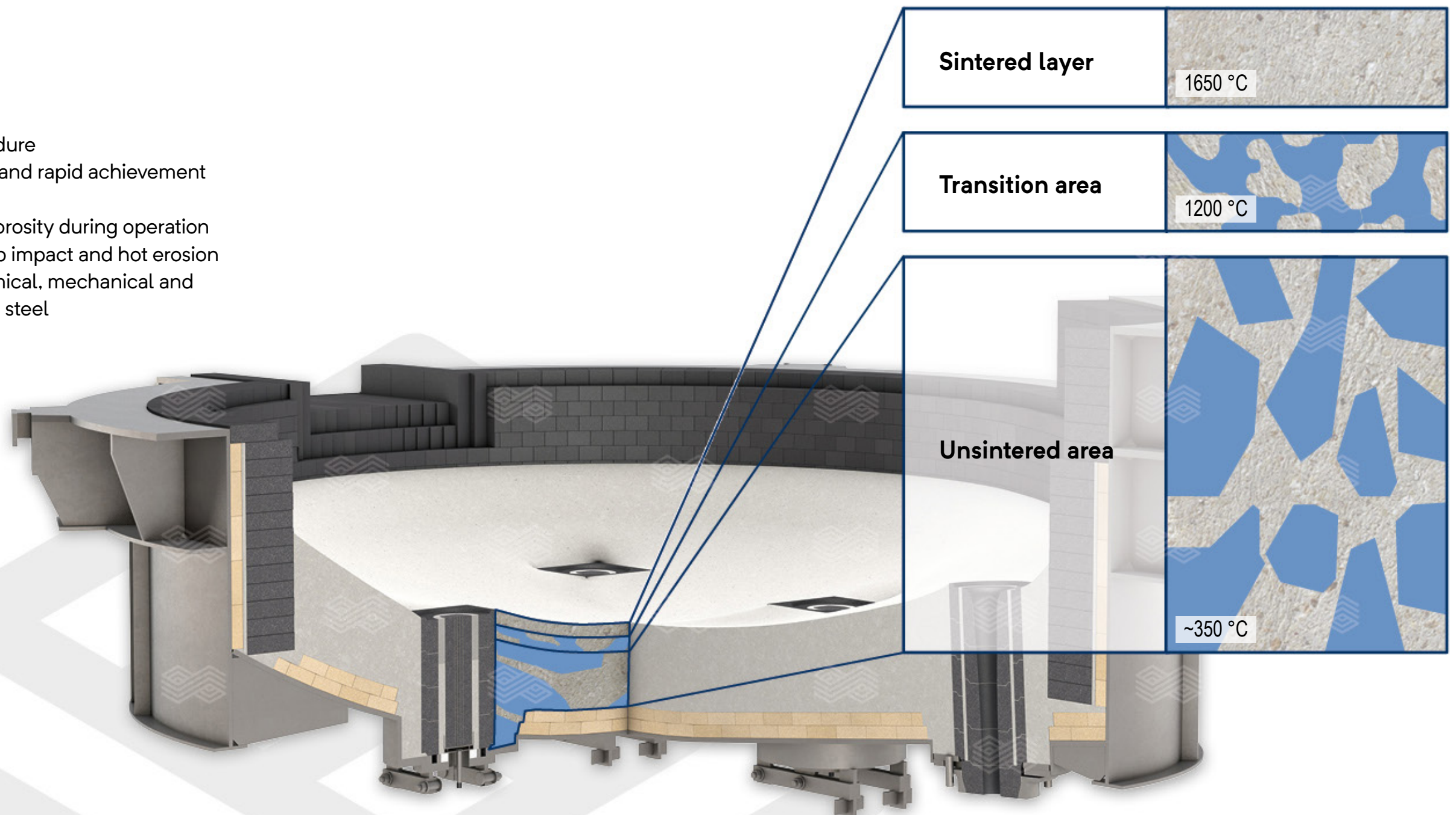
ANKERHARTH — The Worldwide Benchmark for Hearth Mixes

RHI Magnesita offers a comprehensive portfolio of hearth mixes combining the best of two companies to provide the right solution for every customer:

- ANKERHARTH
- DOLA
- PERRAMIT

Benefits

- Quick and easy lining procedure
- Excellent sintering behavior and rapid achievement of ceramic bond
- High bulk density and low porosity during operation
- High resistance against scrap impact and hot erosion
- Best resistance against chemical, mechanical and thermal attack from slag and steel



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ANKERHARTH — Special Solutions

ANKERHARTH Only — No Permanent Brick Lining!

- Several customers worldwide confidently rely on ANKERHARTH only — without installing a bricked permanent lining in their bottom lining!

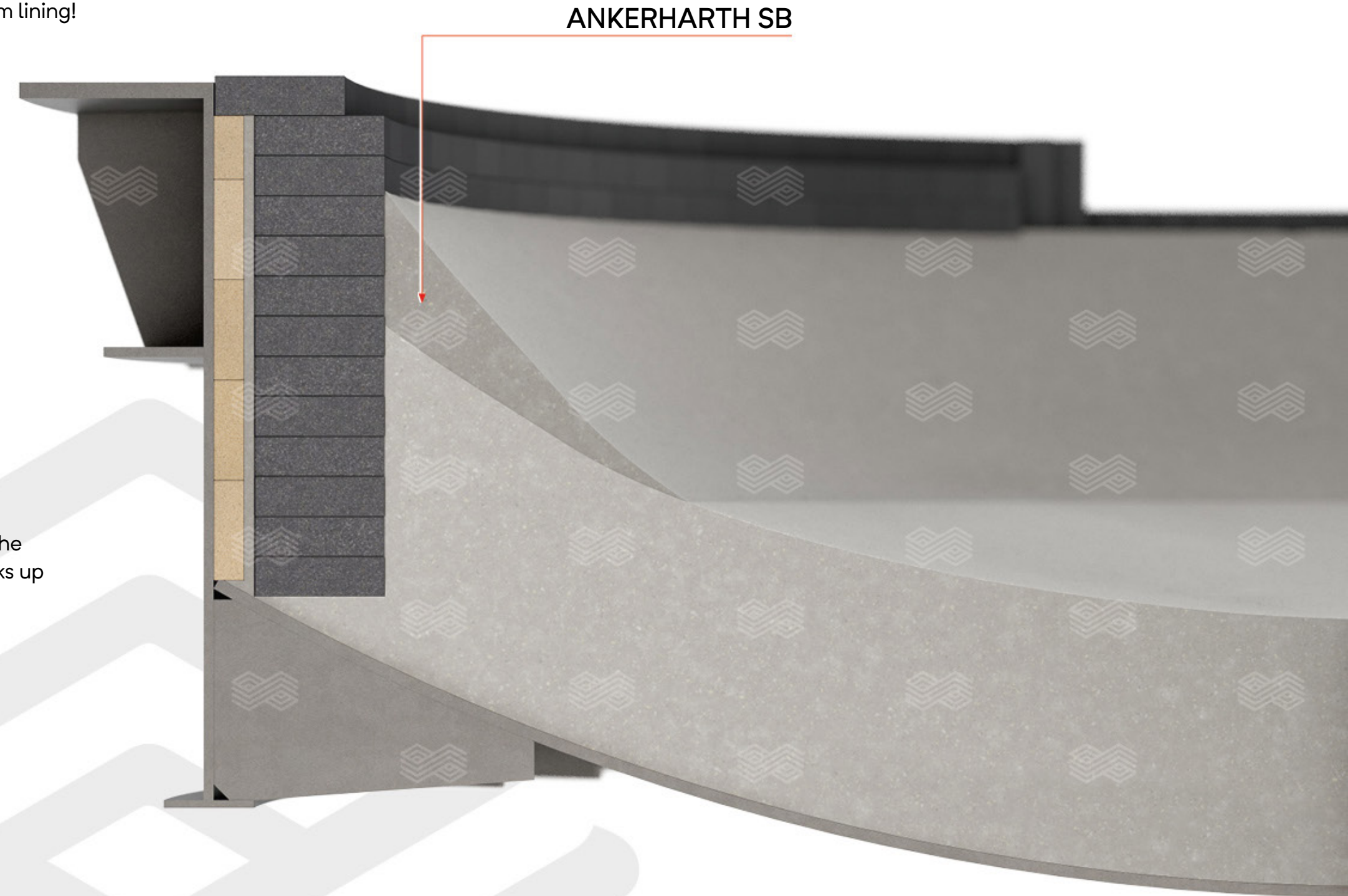
Benefits

- Equally safe operation
- Longer EAF campaigns possible
- Lower shell temperature
- Easier initial installation of hearth lining

ANKERHARTH SB — The “Steep Bank” Mixes

Benefits

- ANKERHARTH SB contains a special component to make the mix more plastic and sticky! This allows shaping steep banks up to an angle of 80° — without using templates!
- Quick & easy installation



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The Hearth Checker — For Maximum Hearth Performance

The **HEARTH CHECKER**® is a simple measuring device to check the right degree of densification of our ANKERHARTH mix during installation in order to achieve the maximum performance.



Benefits

- Quick and easy monitoring of densification of ANKERHARTH mixes during installation
- Ensure maximum hearth performance
- Enhanced installation procedure

Measurement Process



Case 1

Optimal densification

Densification: ■■■■■



Case 2

Densification sufficient, but rework recommended

Densification: ■■■■



Case 3

Densification insufficient,
rework is necessary

Densification: ■■■

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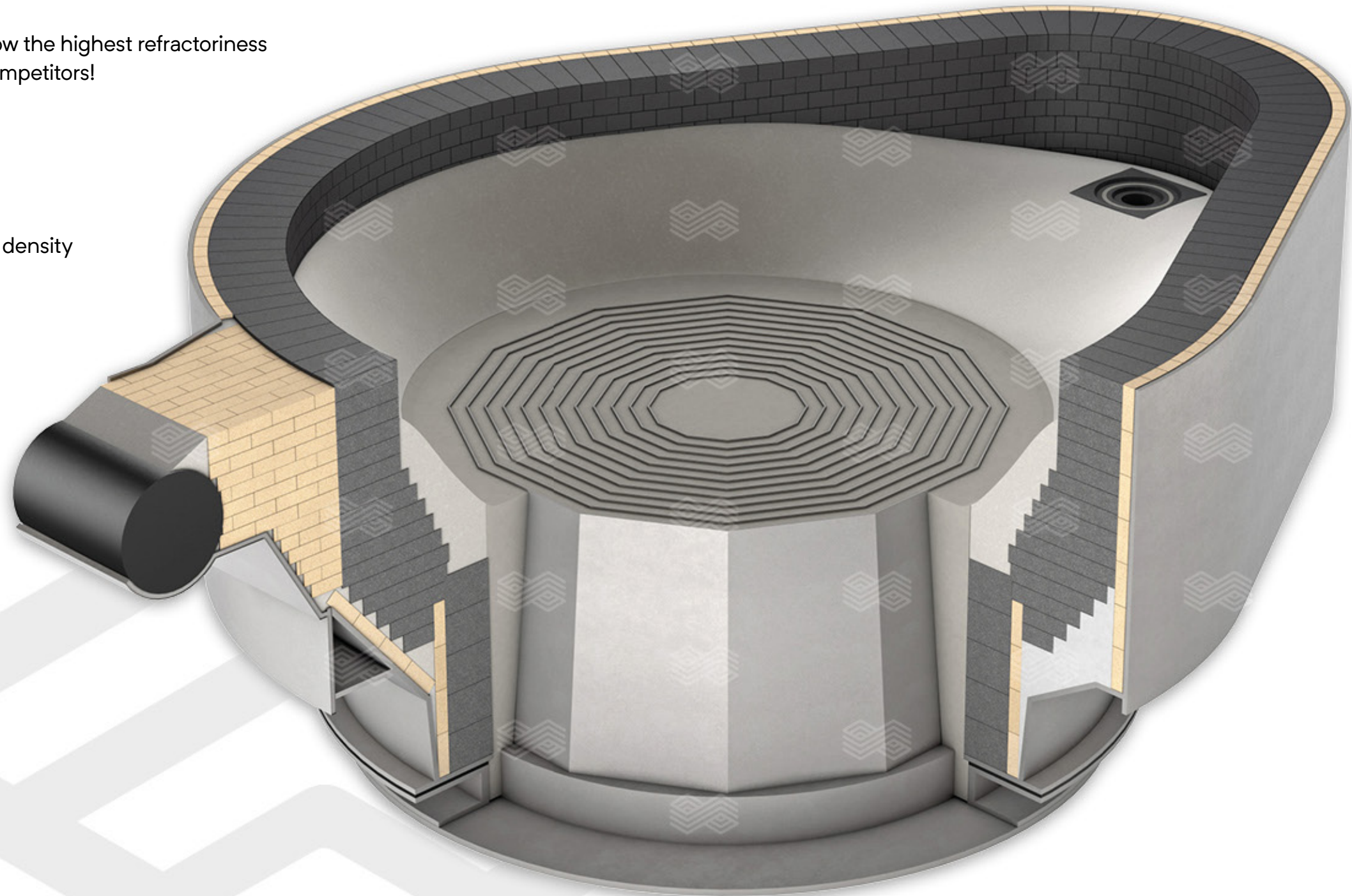
Anode Mixes — Our Solutions for DC Electric Arc Furnaces

Hearth mixes in the anode area of DC electric arc furnaces (fin, pin, billet & conductive bottom) are exposed to extreme conditions.

RHI Magnesita DC bottom anode mixes show the highest refractoriness in the market that cannot be reached by competitors!

Benefits

- Unique raw material bases
- Adapted mineralogical composition
- Special grain size distribution for highest density



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Inert Gas Purging / Stirring — RADEX DPP System

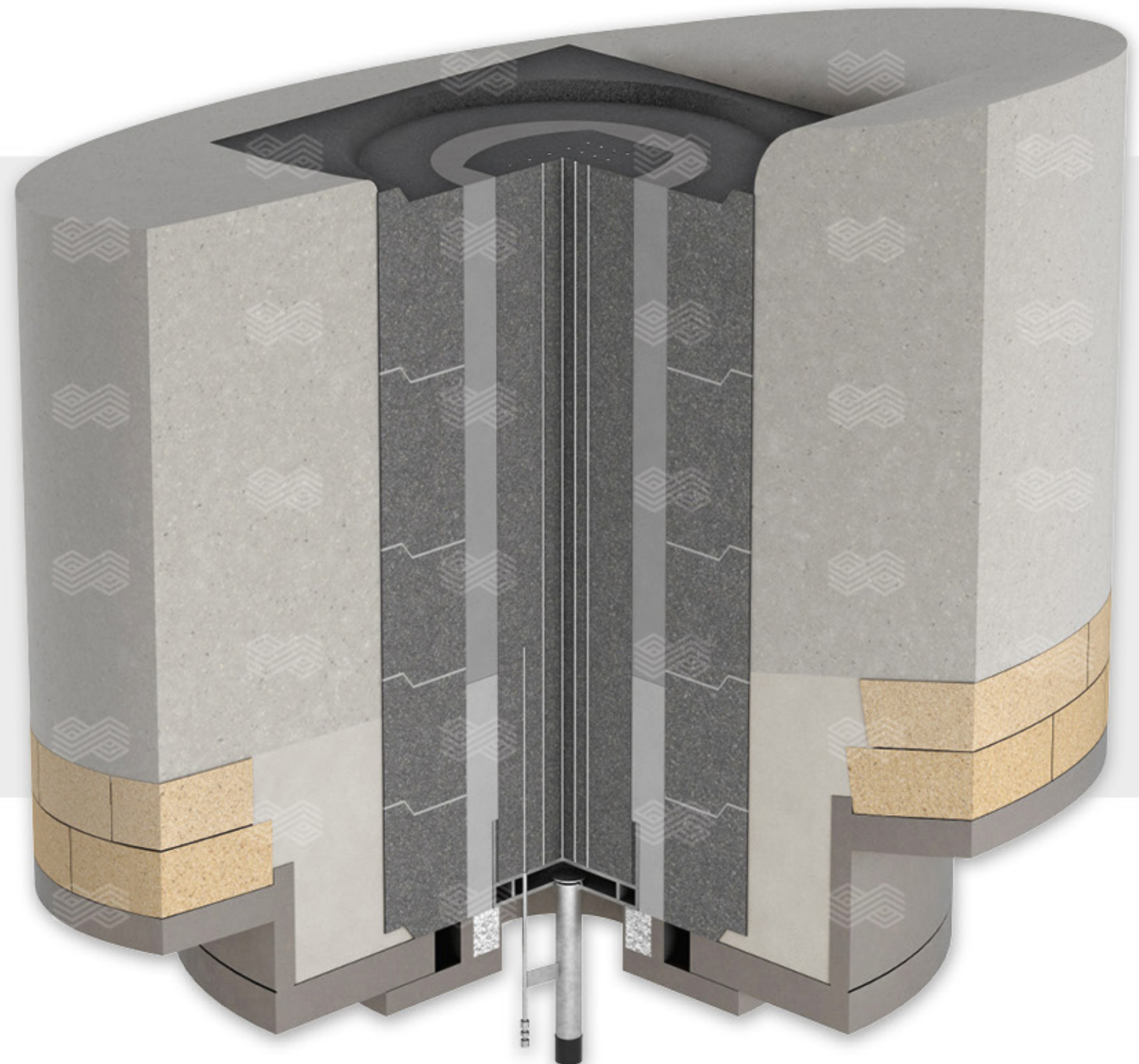
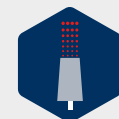
Optimization of EAF process operation by introducing an inert gas flow to the steel melt with a gas purging plug.

Significant process improvements in the steel melt:

- Increased mixing behavior, mass and energy transfer
- Increased thermal homogeneity
- Increased chemical homogeneity
- Provision of continuous degassing

Benefits

- Decreased melting time of scrap, DRI, HBI, etc.
- Decreased specific electrical energy demand
- Increased metal yield
- Increased oxygen efficiency
- Avoidance of delayed CO boiling and slopping
- Improved control on and higher reliability of temperature and metal composition probe

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Eccentric Bottom Taphole (EBT)

Eccentric bottom tapping technology has occupied an established place in steel making throughout the world and is an important element to ensure an optimized furnace performance.

As a technology partner RHI Magnesita is the only refractory producer who can supply unique customized taphole solutions, which are designed to fit your needs.

CFD Taphole: The Perfect Tapping Solution!

Benefits

- Revolutionary patent-protected technology
- Outstanding performance, due to flow optimized design
- Increases your productivity
- Next step towards cleaner steel
- Designed to fit your needs



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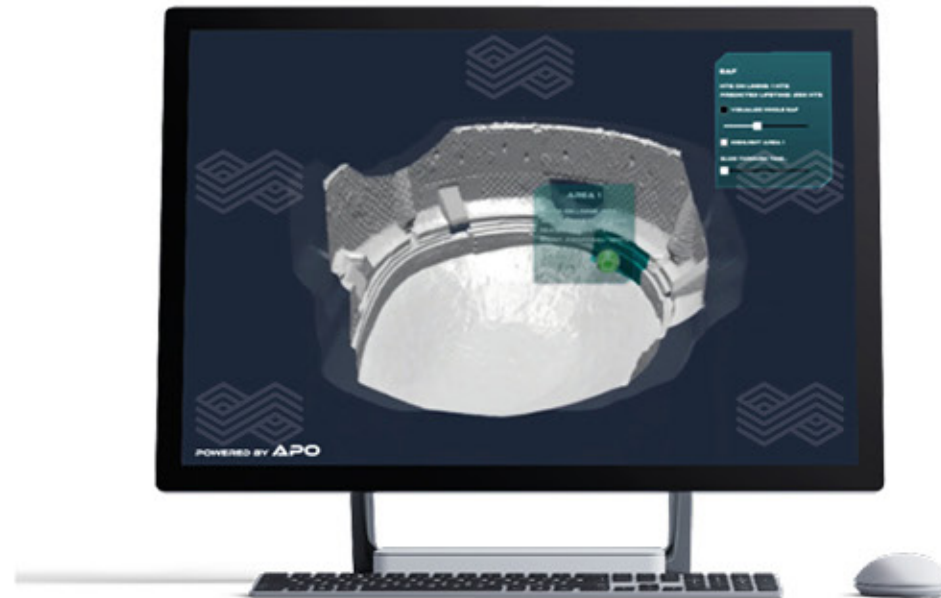


Maintenance



APO Automated Process Optimization

Fostering a greater understanding of the correlation between steel production parameters, maintenance and refractory by analyzing data on a central master computer, using artificial intelligence methods.



Easily accessible via mobile devices



Example of APO lifetime prediction

Customer Challenges

- Unforeseen downtimes / excessive maintenance — casting interruption and delayed delivery
- Inefficient processes — increased energy costs
- Unsafe operations

APO Value Proposition

- Digital refractory wear model
- Identification of wear influencing parameters
- Refractory benchmarking
- Automated maintenance

Customer Benefits

- Matching refractory cycles with plant cycles enables better use of refractory and reduces refractory waste
- Optimized plant scheduling and saves energy costs
- Increased operational safety

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EMLI-EAFLevel

Electromagnetic steel level tracking in EAF

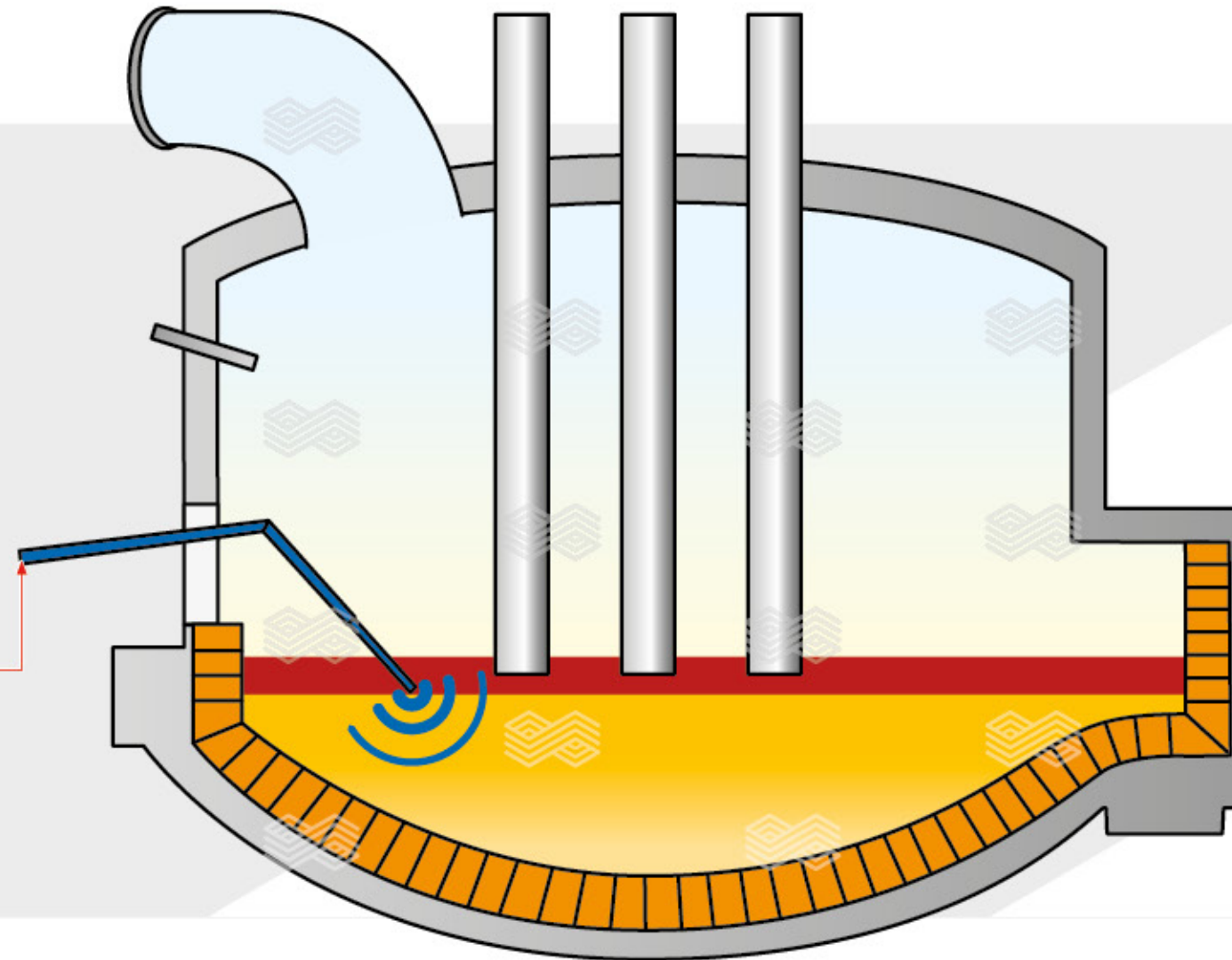
User Benefits & Advantages

- Measure steel level accurately, when taking sampling
- No time loss for an additional measurement
- No additional consumables
- Optimize side wall injection efficiency, by knowing and managing the steel level
- Provide tracking of the steel level assisting the hot-heel management

More Information



EMLI-EAFLevel



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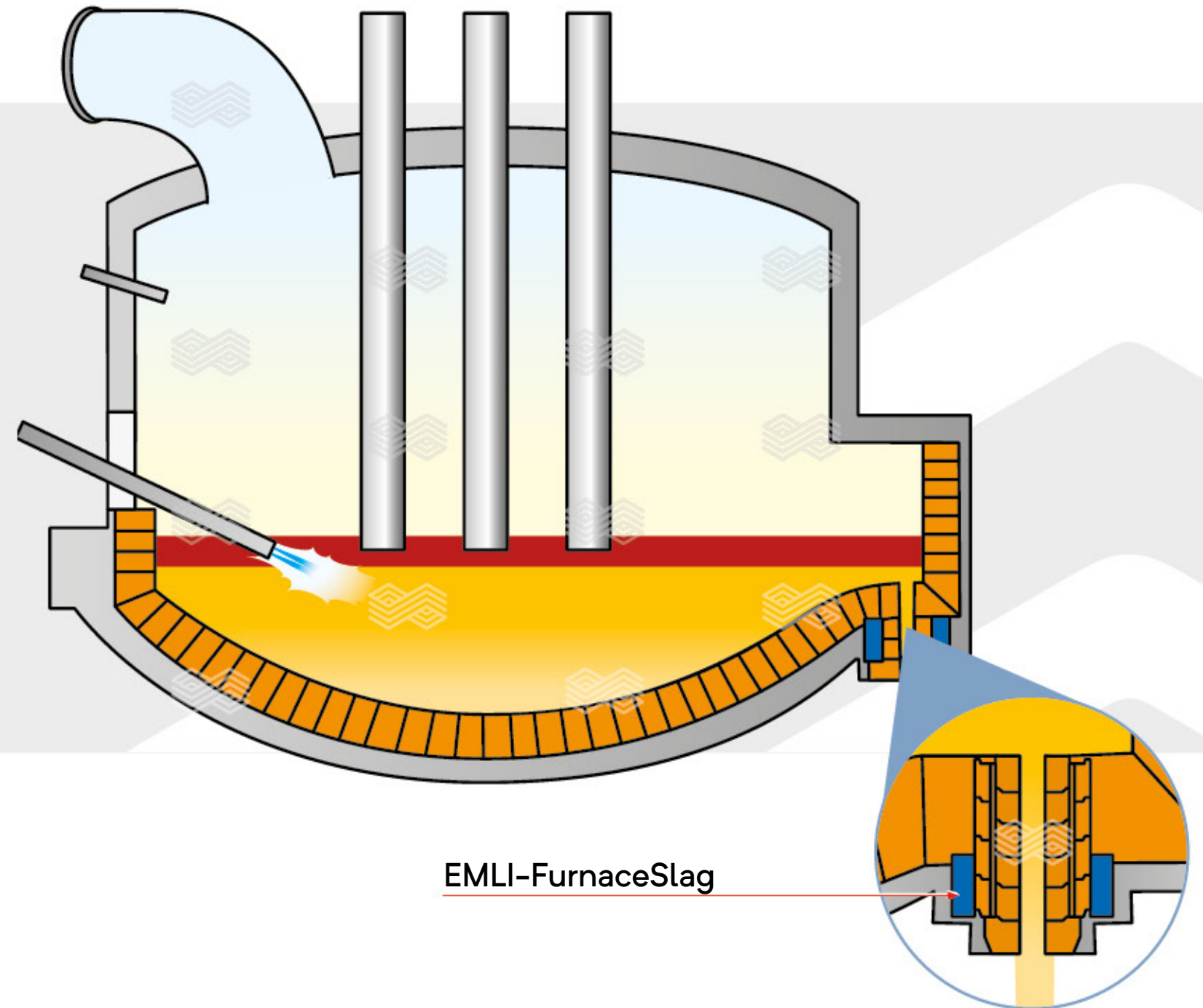
EMLI-FurnaceSlag

Electromagnetic slag detection for furnaces

User Benefits & Advantages

- Control slag carryover with a fast response time
- Calculation of slag transfer amount
- Detect and avoid vortex formation during tapping
- Flames and smoke do not affect the system
- Ensure consistent secondary metallurgy process

More Information



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EAF Maintenance

Three main application areas of EAF repair mixes:

- Cold repair of hearth and banks:
Hearth mixes — ANKERHARTH
- Hot repair of hearth and banks:
Fettling mixes with advanced sintering properties — ANKERFRIT
- Repair of sidewalls, door area and slag zone:
Gunning mixes containing different binders — ANKERJET

Benefits

- Easy application
- Self-compaction and quick sintering
- Individual customer solutions can be developed on request
- Prolonging sidewall lifetime and achieving a balanced lining
- RHI Magnesita offers a broad range of standard gunning mixes
- Excellent results in combination with RHI Magnesita gunning robots

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ANKERJET A

Application:

Multi-purpose pressure vessel machine for basic and non-basic mixes

Advantages:

- Useable in a variety of aggregates
- Consumption data recording
- Different equipment variants available (e.g. load cells, detachable silo, ...)
- Charging by crane or forklift
- Low maintenance and wear costs
- Easy-to-use automatic and manual operation
- Transportable by crane and forklift



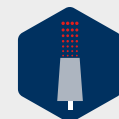
Content



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ANKERJET M

Application:

Multi-purpose pressure vessel machine for basic and non-basic mixes

Advantages:

- Useable in a variety of aggregates
- Small hopper with bag ripper for charging 25 kg paper bags
- Mobile design means flexibility of application
- Low maintenance and wear costs
- Pneumatic driven machine (no electricity required)
- Easy manual operation



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ANKERGUN

Application:

Multipurpose rotary gunning machine for basic and non-basic mixes

Advantages:

- Useable in a variety of aggregates
- Small hopper with bag ripper for charging 25 kg paper bags
- Mobile design allows flexibility of application
- Continuous gunning mix feeding



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Vibra Spike

Application:

De-airing of hearth mixes for the installation

Advantages:

- Improved de-airing of banks
- Improved service life of hearths and banks due to higher lining density
- Less physical strain on operating personnel
- Substantially shorter lining times



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ANKERHARTH

Application:

Compacting of hearth mixes for the installation

Advantages:

- Optimal compaction of the surface



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ANKERFRIT

Application:

Repair of the bank and hearth area in EAF

Advantages:

- Precise application of the fettling mix to the bank and hearth area
- Dust free processing of the fettling mix
- Minimizes segregation of the fettling mix during application
- Improves lifetime and reduces mix consumption
- Time saving through high flow rate and precise mix application
- Pneumatically powered machine



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ANKERFRIT RC

Application:

Repair of the bank and hearth area in EAF

Advantages:

- Improved visibility and work safety for operators by means of a radio remote control
- Battery powered machine
- Precise application of the fettling mix to the bank and hearth area
- Dust free processing of the fettling mix
- Minimizes segregation of the fettling mix during application
- Improves lifetime and reduces mix consumption
- Time saving through high flow rate and precise mix application



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ANKERROTO DRY

Application:

Repair of the bank area in EAF

Advantages:

- Improved de-airing of banks
- Improved service life of hearths and banks due to higher lining density
- Less physical strain on operating personnel
- Substantially shorter lining times



Content



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ANKERROTO WET

Application:

Repair of the slag zone and hot spots in EAF

Advantages:

- Short repair times
- Sector selection enables precise mix application
- Mix shut-off device reduces mix consumption
- Big bag charging
- Pneumatically powered machine
- Easy to use



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TERMINATOR S

Application:

State-of-the-art gunning manipulator for highly efficient gunning repair of any part of the EAF

Advantages:

- Highly accurate gunning repair
- Reduces rebound
- Less physical strain on operating personnel
- Minimum preparations
- High flow rate ensures short repair times
- Application of two different mixes
- Increased EAF availability
- Reduction of refractory and maintenance costs



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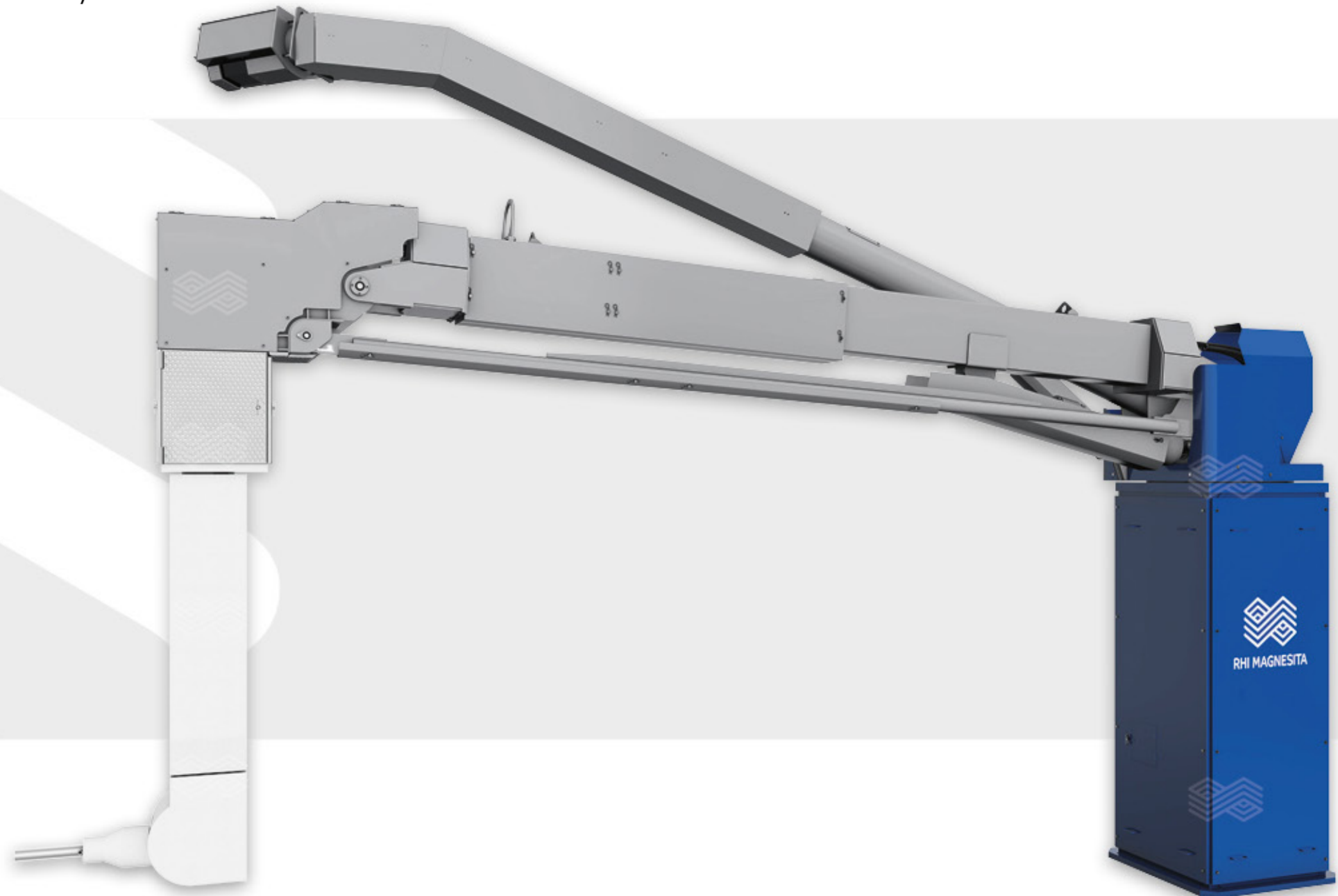
TERMINATOR XL

Application:

EAF gunning manipulator with laser scanner for residual refractory lining measurement

Advantages:

- Fast scanning of the EAF lining thickness
- Fully automatic gunning repair
- Reduces rebound
- Less physical strain on operating personnel
- Minimum preparations
- High flow rate ensures short repair times
- Application of two different mixes
- Increased EAF availability
- Reduction of refractory and maintenance costs



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ANKERTWIN

Application:

Gunning and fettling machine for EAF

Advantages:

- Useable for multiple furnaces on the same floor
- Gunning and fettling with one single machine reduces repair time
- Reduces rebound
- Increased EAF availability
- Improved visibility and work safety for operators by means of a radio remote control
- Less physical strain on operating personnel
- Low maintenance and wear costs



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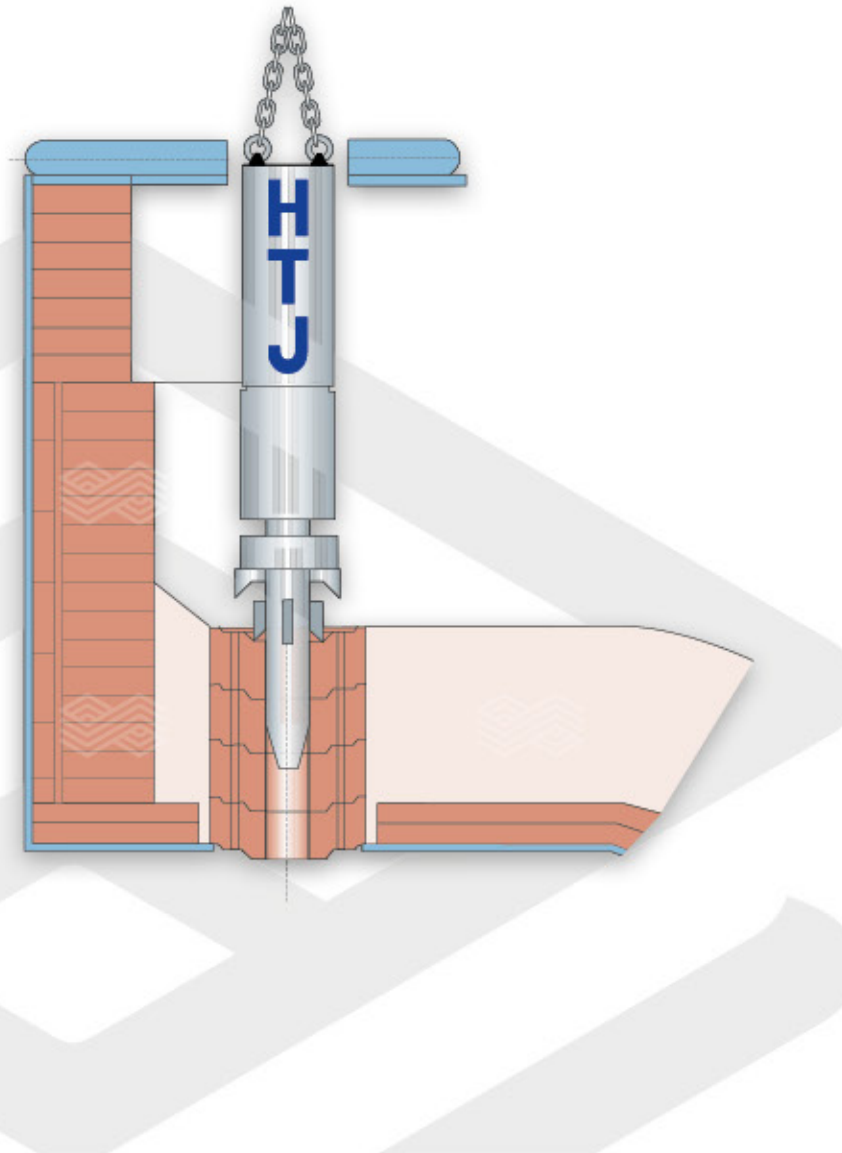


Application:

For quick break out of the worn EAF taphole

Advantages:

- Rapid breakout of the hot taphole elements from above
- Higher availability of the furnace
- Less physical strain on operating personnel
- Low maintenance costs
- Pneumatically powered (no electricity required)
- Quick return on investment
- Clean inner surface of the surrounding blocks



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Application:

For fast EAF taphole exchange in hot condition

Advantages:

- Rapid change of the taphole from below
- Higher availability of the furnace
- Less physical strain on operating personnel
- Safe working conditions
- Complete solution
 - > Removal of end brick
 - > Breakout of the channel bricks
 - > Installation of new taphole bricks
 - > Pumping of refractory mix into the annular gap



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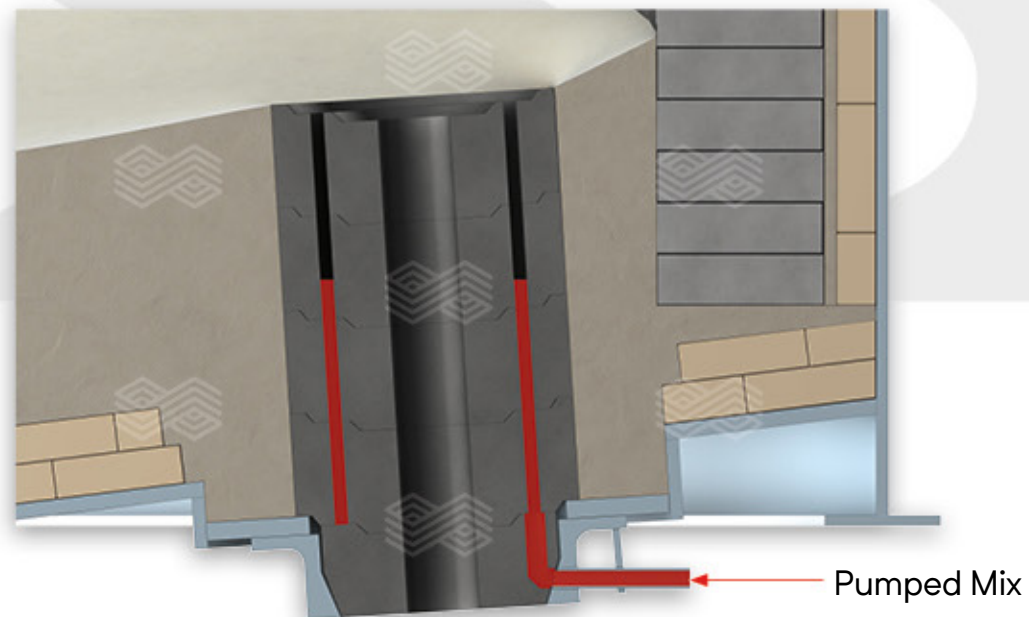


Application:

For filling the annular gap between taphole surrounding elements and taphole sleeves

Advantages:

- Optimal filling of the annular gap
- Less steel infiltration
- Longer life time of the taphole
- Easy handling
- Increased EAF availability



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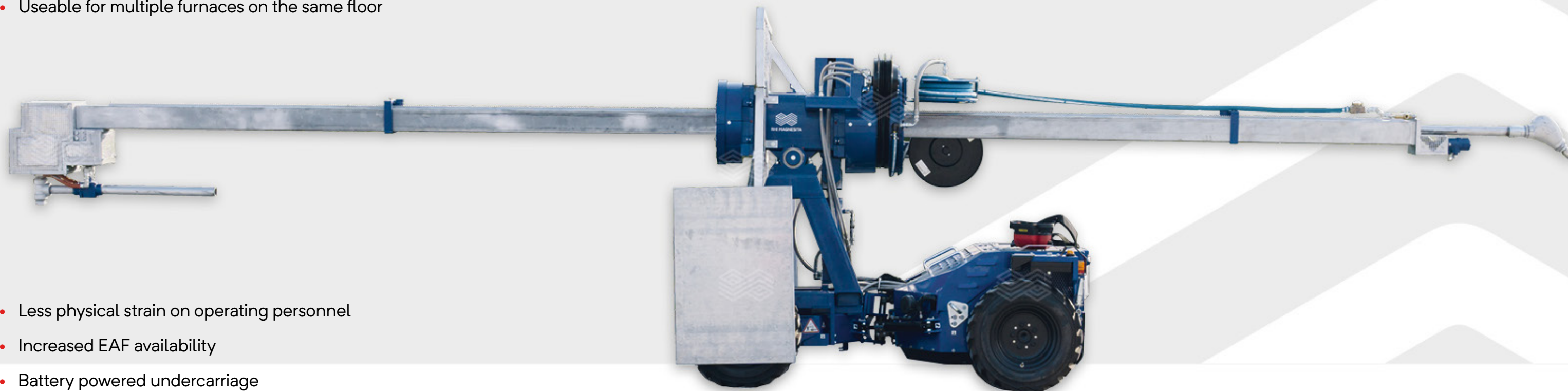
GEKKO EAF

Application:

For rapid gunning repairs in the EAF

Advantages:

- Precise gunning repair
- Useable for multiple furnaces on the same floor



- Less physical strain on operating personnel
- Increased EAF availability
- Battery powered undercarriage
- Four-wheel drive
- Gekko can be operated by cable and radio remote control

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