

NFM / LINING CONCEPTS

Lining Concepts for the Nonferrous Metal Industry



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**

We are RHI Magnesita

Refractory Competence — Nonferrous Metal Industry



Waelz Kiln

Ausmelt Technology

ISASMELT™

Teniente Converter

Anode Furnace

Slag Cleaning Furnace — EAF

Kaldo — TBRC — Converter

Flash Smelting Furnace

Six-In-Line Concentrate Smelting

Short Rotary Furnace

PS Converter



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We are RHI Magnesita

Refractory Competence — Nonferrous Metal Industry

RHI Magnesita is the global leader in refractories. We have the largest number of locations around the world and the most innovative, reliable products and services. Our exceptional vertical integration — from mining to full service solutions — ensures our customers the most robust reliability of supply with the best quality.

The RHI Magnesita brand comprises a large number of successfully established trademarks (Radex, Didier, Veitscher, Interstop, Agellis), which combine tradition with innovative technology and highest quality standards.

We are a global partner for the nonferrous metal industry. The complete program of products and services ranges from basic and non-basic mixes and bricks to prefabricated products, slide gate plates, isostatically pressed products, special machines and repair systems, and technical equipment used to install refractory products into the various production units of the nonferrous metal industry.

RHI Magnesita stands for optimum refractory solutions for pyrometallurgical vessels in the nonferrous metal industry. This means lining concepts and process solutions for any type of primary furnace, slag cleaning furnaces, electric arc furnaces (AC and DC), PS converters, anode furnaces, ladles and launders used in the base metals industry. The quality and service offered by RHI Magnesita are based on carefully selected raw materials which have provided good service results for many years, state-of-the-art manufacturing plants, continuous and intensive research and development work and competence of all RHI Magnesita employees. The refractory materials and systems applied for base metals production make a significant contribution to the efficiency and safety of the nonferrous metal smelters. A prerequisite for optimum application of the refractory products is extensive knowledge of all steps of the production process and conditions at customer plants. Our metallurgists and process experts are active around the globe and cooperate with renowned research facilities and universities in Austria and other countries. In addition, the partnership and close cooperation with the customers are contributing factors that ensure enhancement of processes in the nonferrous metal industry.

RHI Magnesita is not just a reliable supplier of high-grade refractory products but also partner for the nonferrous metal industry to work on complete all-inclusive solutions:

- Refractory material concept and lining designs
- Heat flux, heat transfer and stress calculations by CFD and FEA modeling
- Metallurgical process analyses by FactSage
- Refractory lining installation drawings
- Instructions for furnace heat-up or shutdowns
- Instructions for refractory material storage
- Process and flow control solutions such as purging plugs, purging and injection tuyeres and slide gates
- Installation service (e.g. by the RHI Magnesita-owned company RHI Magnesita Installation Services) and installation supervision
- Post-mortem analysis of refractory materials in our own R&D facilities

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Product Classification Methods

Wedge splitting test (WST)

The WST is a tension test carried out in a hydraulic press to quantify the thermal shock resistance or the flexibility of refractory materials. Thereby a wedge is pressed into a sample of the refractory material, which is prepared in a special shape with notches to guide the crack propagation in a defined direction. The evaluation of the fracture mechanical characteristics allows calculation of the characteristic length (L) as an index for thermal shock resistance or flexibility based on the following equation:

$$L = \frac{G_F \cdot E}{\sigma^2}$$

E Young's Modulus
 G_F Fracture work
 L Characteristic length
 σ Tensile strength

The higher the value for L, the higher the flexibility of the material and therefore also the thermal shock resistance. The wedge-splitting experiment can be conducted under controlled atmosphere from ambient temperature to 1500 °C.

Scanning electron microscopy (SEM)

Examinations based on SEM can be done on polished sections as used for light microscopy, but also on powders or fractured surfaces. A finely focused electron beam, emitted from a glowing tungsten filament, scanned across the surface of the sample, generates secondary electrons, backscattered electrons and characteristic X-rays. These signals are collected by different detectors to form images on a screen or to generate a spectrum for chemical analysis. Materials are usually viewed with magnifications from 10 to 10,000 times but a close look at even up to 300,000 times is possible. Features seen in the SEM image may then be simultaneously analyzed for composition using an EDS (Energy Dispersive System) or a WDS (Wavelength Dispersive System). These kinds of examinations are of great importance for studying reactions taking place in the refractory material during operation, for instance interaction between the refractory material and the slag.

Rotary kiln test (RKT)

The RKT is a more labor-intensive, expensive and time-consuming slag testing method, which is conducted with bricks in the final stage of development. Different sizes of kilns are available, whereby 3 rings with 20 bricks each can be applied for testing in the biggest one. Chemical corrosion by molten metal and its slag, thermal fatigue (stress) as well as mechanical abrasion can be simulated close to practical conditions. The kiln rotates 2-10 times per minute while a gas burner heats the kiln up to 1700 °C. After the test, the wear is evaluated as wear area on the sections of the test bricks and compared to each other.

Hot modulus of rupture (HMOR)

The HMOR (N/mm² or MPa) can be applied to a cuboid-shaped sample performed with the three point bending technique. According to international standards, the sample size is 25 x 25 x 160 mm. The determination of the limiting forces at high temperatures is one of the most important thermo-physical methods for quality control and development of refractory materials. The HMOR is also an indicator of adhesive forces between the grains and the surrounding matrix. It can be used to characterize the hot abrasion resistance of a material at specified temperatures up to 1600 °C, either in oxidizing or reducing atmosphere.

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Waelz Kiln

The Waelz kiln is a rotary kiln used for Zn recycling. Zn-bearing residues (filter cakes from Zn smelters, steel mill dust, steel EAF dust) are treated in refractory-lined rotary kilns. The efficiency of the Waelz process and also the performance of the refractory lining strongly depend on the raw material preparation. The air oxidizes the volatilized metals and CO from the reduction reactions inside the feed.

There are two different operation modes known:

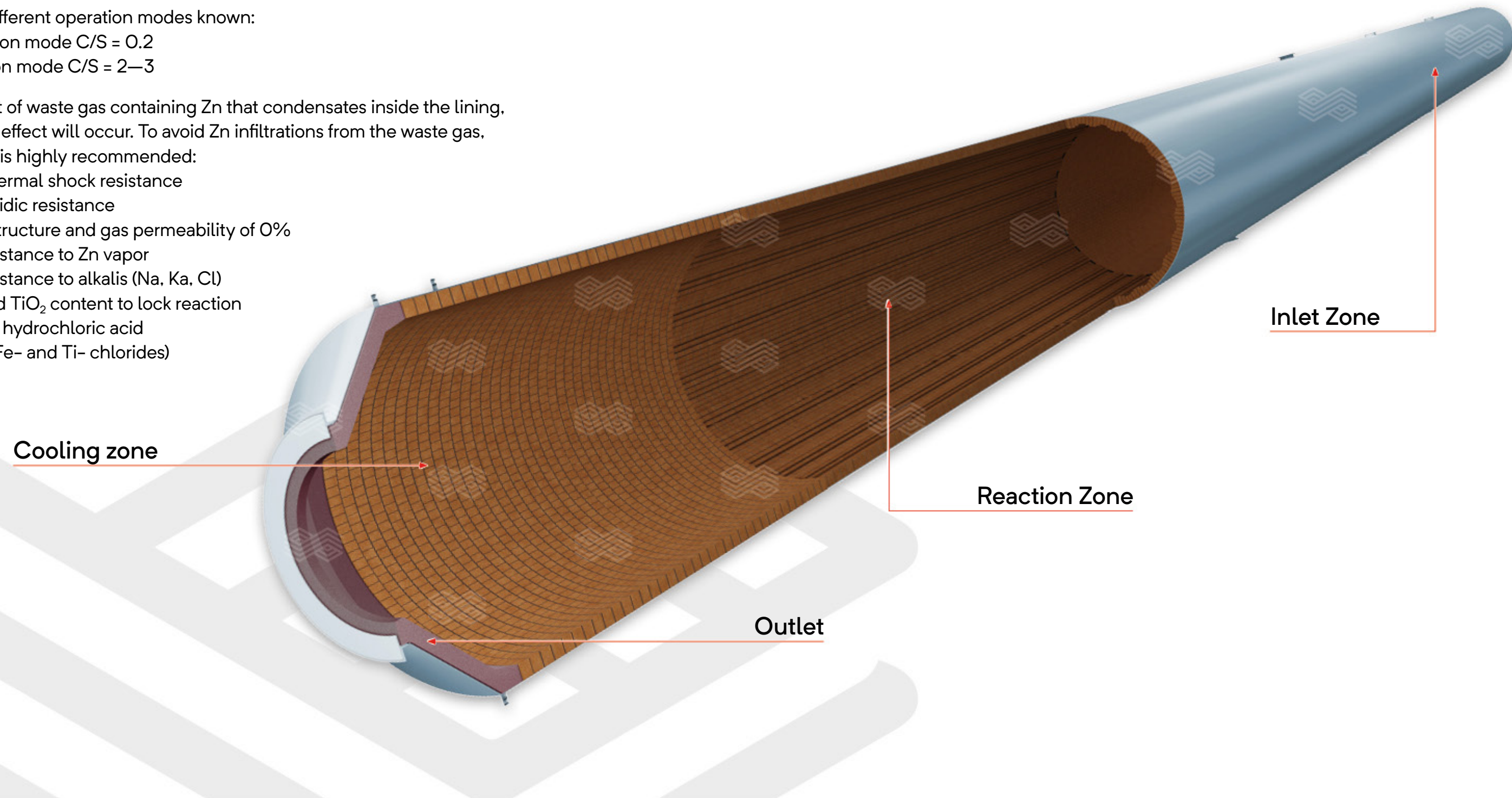
- Acidic operation mode $C/S = 0.2$
- Basic operation mode $C/S = 2-3$

Due to the effect of waste gas containing Zn that condensates inside the lining, a high corrosion effect will occur. To avoid Zn infiltrations from the waste gas, IS impregnation is highly recommended:

- Increase of thermal shock resistance
- Increase of acidic resistance
- More dense structure and gas permeability of 0%
- Increased resistance to Zn vapor
- Increased resistance to alkalis (Na, Ka, Cl)
- Low Fe_2O_3 and TiO_2 content to lock reaction potential with hydrochloric acid (formation of Fe- and Ti- chlorides)

Standard lining concept and lining recommendation for WAE LZ kiln

The lining recommendation is an engineered lining concept according to customer process parameters.



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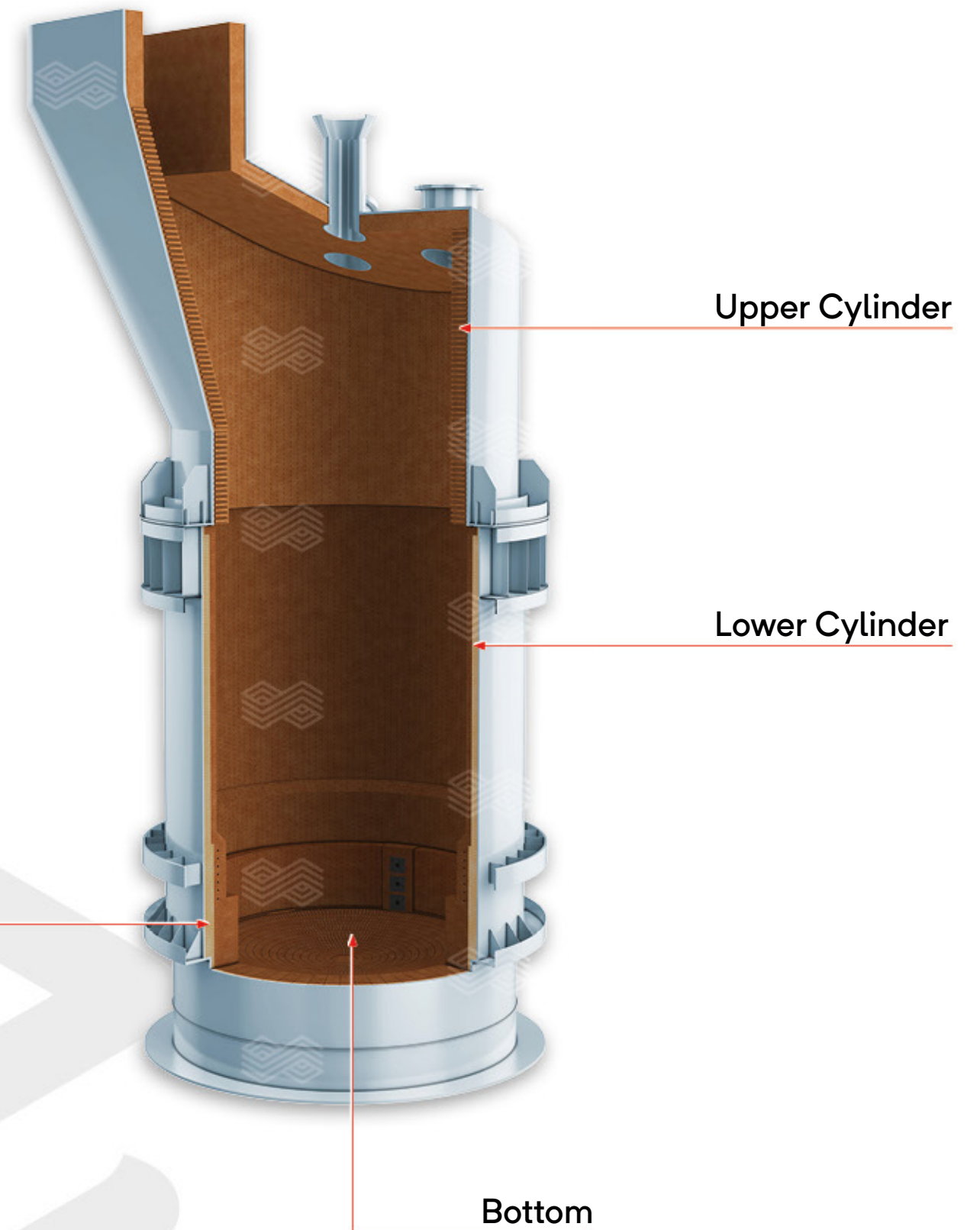
Ausmelt Technology

The Top Submerged Lance — TSL technology was invented in the early 1970s and permanently developed by Ausmelt to process a range of nonferrous, ferrous and waste materials. Feed materials, fluxes and reductant coal are charged through the roof of the furnace and drop directly into the molten bath. The degree of oxidation and reduction is controlled by regulating the fuel-to-oxygen ratio supply to the lance which enables operation from strongly oxidizing to strongly reducing conditions. Ausmelt technology bath smelting is able to process a variety of different concentrates and secondary raw materials to produce copper, lead, nickel, tin and zinc. A further development step by Ausmelt was taken by implementing continuous converting technology. The Ausmelt C3 technology produces blister copper directly from copper matte with a second converting TSL-vessel.

Different developments connected to Ausmelt's copper, lead, zinc and tin smelting posed an additional challenge for RHI Magnesita involving refractory engineering and the further development of new lining concepts. Especially new slag systems and changed process parameters showed the necessity for application of high grade refractory materials.

Refractory material challenges:

- Enhanced abrasion effects due to strong bath agitation
- High chemical attack by low viscosity melts and slag
- Increased thermal shocks and splashing slag due to lance operation mode



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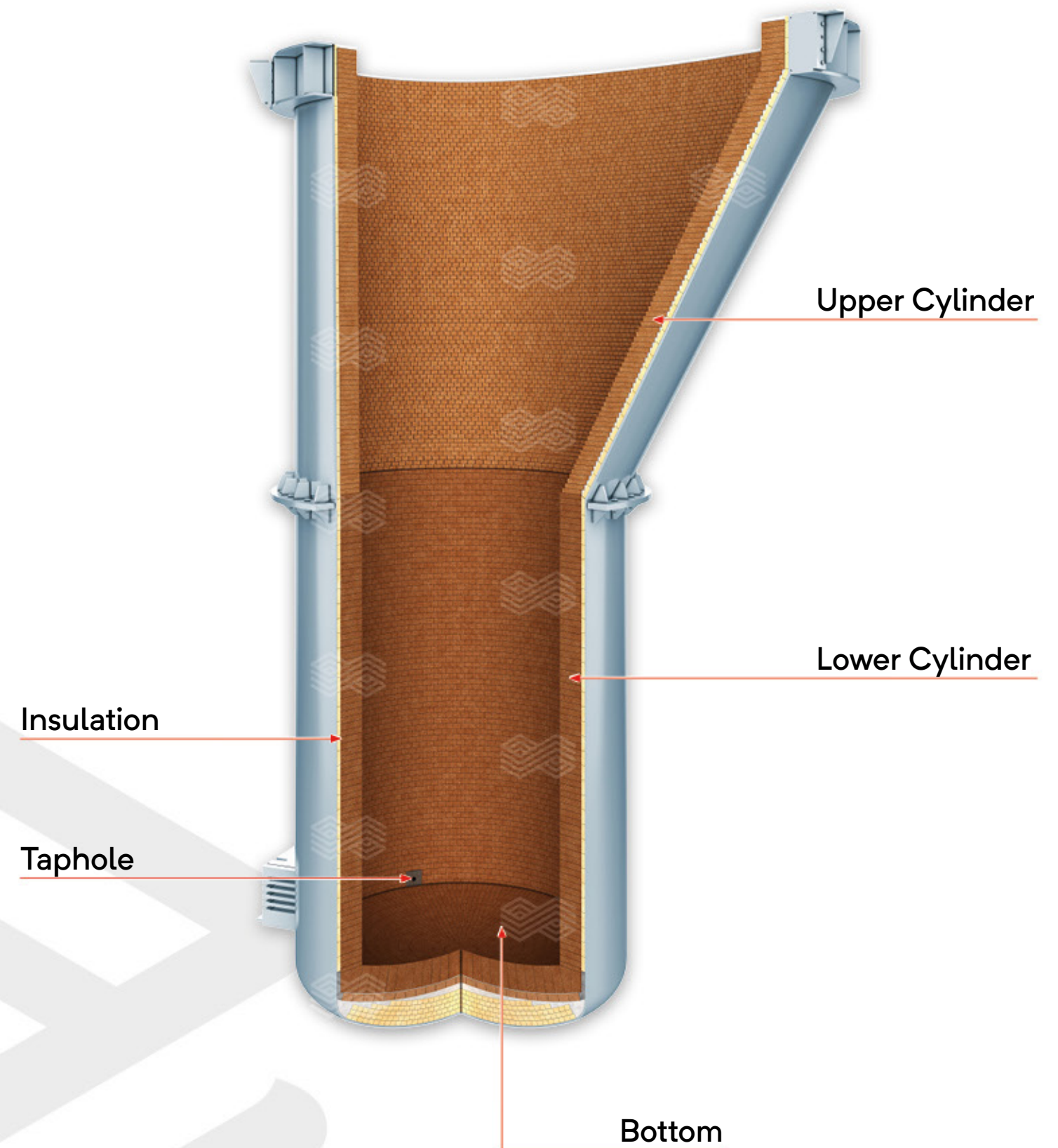
Technology



ISASMELT™

The ISASMELT™ process is a top submerged lance (TSL) process developed by Mount Isa Mines Ltd. in Queensland, Australia, in cooperation with CSIRO. The versatility of this technology enables a wide variety of primary and secondary materials to be processed in either batch or continuous modes. The furnace is a stationary vertical cylinder lined with refractories. Concentrate, fluxes, metal scrap, fuel and metal-bearing residues are charged through the furnace roof and fall into a molten slag bath. Oxygen and air are injected through the ISASMELT™ lance. The tip of the ISASMELT™ lance is submerged into the molten slag creating a turbulently mixed environment that ensures rapid process kinetics. Xstrata Technology and Mount Isa Mines have jointly provided the ISASMELT™ technology to numerous clients around the world. RHI Magnesita is able to provide individual refractory solutions to satisfy specific customer or OEM demands. Although ISASMELT™ is mainly used for copper and lead concentrate smelting, it is also applied to recycling of lead and copper-bearing materials.

A further development by Xstrata Technology is the ISASMELT™ process — continuous copper converting where granulated copper matte is converted into blister copper in an ISASMELT™ furnace. The blister is subsequently refined in an anode furnace. New slag systems have been developed to suit the continuous converting process. RHI Magnesita is developing new lining concepts according to the changing requirements of the TSL technology. The refractories must resist enhanced abrasion effects due to the strong bath agitation and chemical attack from low viscosity melts and slag.



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Teniente Converter

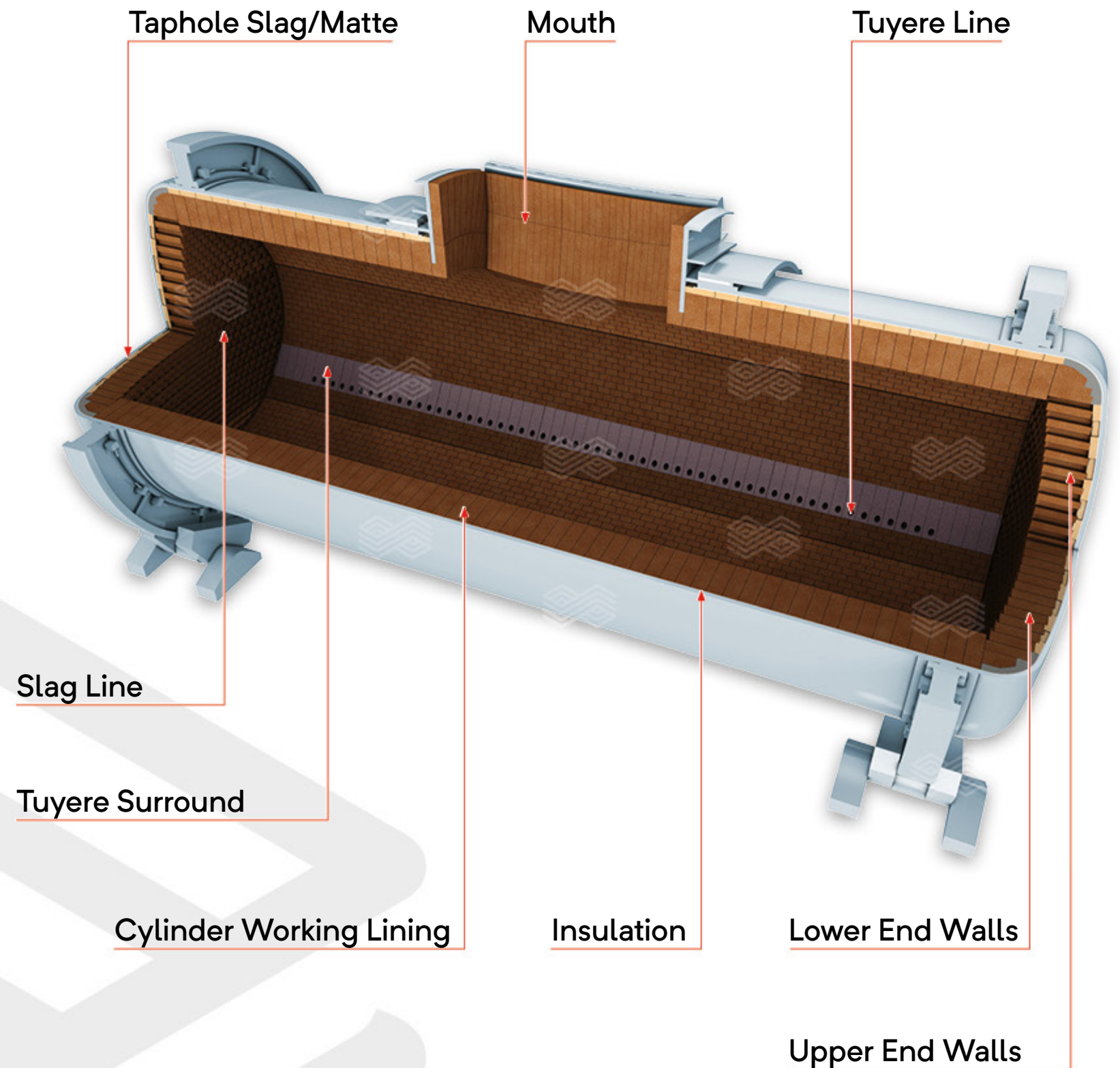
The requirement to produce blister copper or high-grade matte, respectively, in a continuous process combined with an optimized energy balance and a high SO_2 concentration in the waste gas can be met with this type of pyrometallurgical furnace. This kind of a primary smelting unit belongs to the submerged-tuyere smelting process family. The Teniente Furnace is a horizontal steel barrel refractory-lined vessel with submerged tuyeres. Concentrate feed is dried and blown into the matte/slag bath through tuyeres or charged moist onto the bath surface. Tuyere injection technology is applied more frequently due to heat distributions, high thermal efficiency and a decreased dust evolution during the process. Flux, secondary raw material and moist concentrate are charged on the matte/slag surface. A submerged blow causes heavy bath movement and a stirring effect of the matte/slag bath. This violent stirring supports extensive smelting of scrap and reverts.

Process developments such as direct to blister smelting with new changed slag systems have also effected changes of lining concepts and refractory engineering for this furnace.

Refractory requirements for this smelting unit are:

- Extraordinary resistance to hot erosion in the tuyere area as well as in the bath section of the end walls
- High resistance to chemical attack of the process slag
- Sufficient structure flexibility of tuyere linings
- Minimized porosity of high wear areas to reduce infiltration potential of low viscosity phases such as CuO , CuS to decrease structural spalling during oxidation processes

The following illustration shows a lining concept recommendation which can change due to different process parameters.



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Anode Furnace

Converted blister copper from a PS converter contains ~0.01% S and ~0.5% O. Blister from continuous converting processes contains approx. 0.2—0.4% oxygen and up to 1% sulfur. If there were no refining step in the anode furnace, sulfur and oxygen would combine during solidification and form SO_2 bubbles in cast anodes.

Fire refining removes S and O from blister copper:

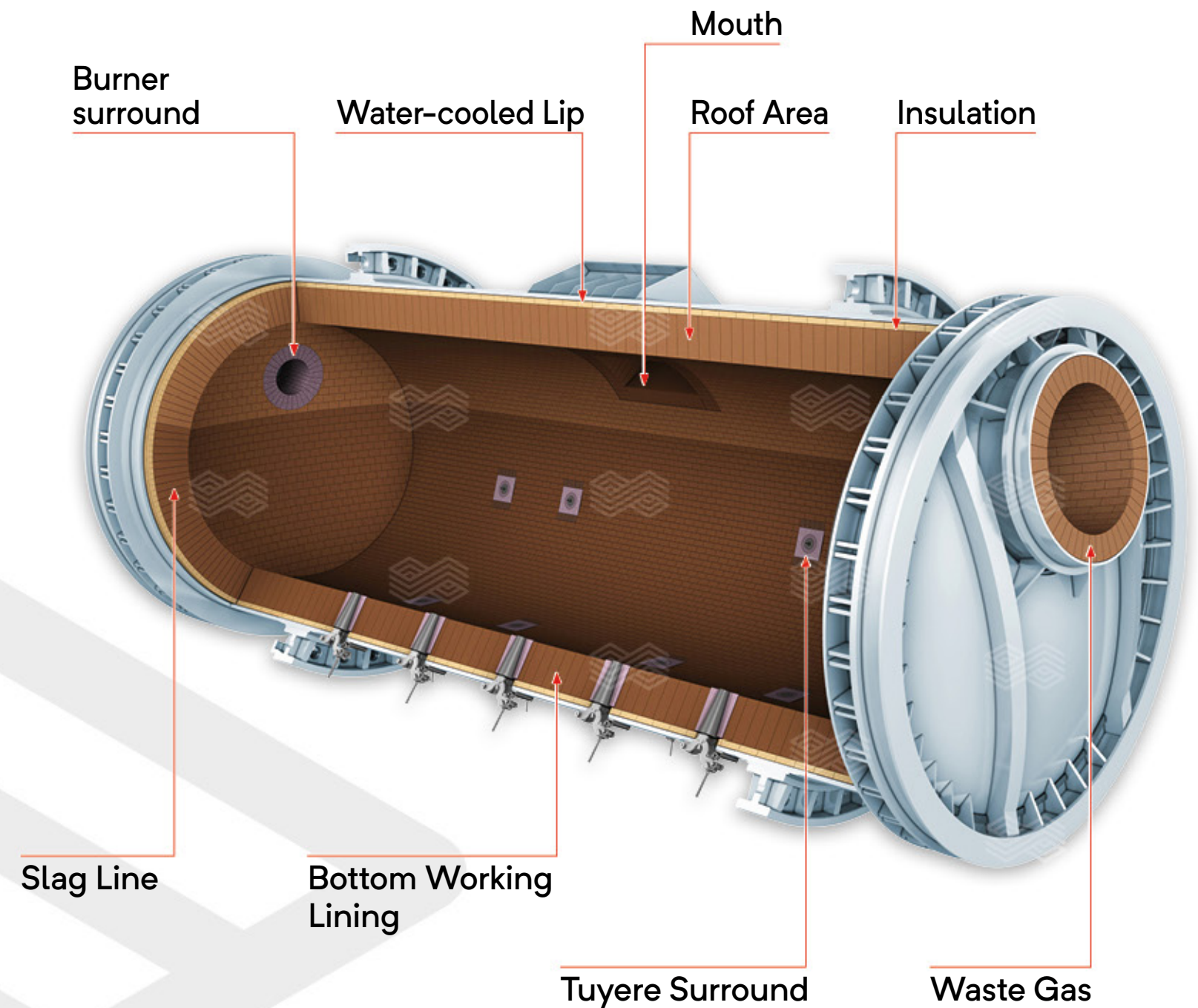
- Air-oxidation removal of sulfur as SO_2 to ~0.002% S
- Hydrocarbon-reduction removal of oxygen as CO and $\text{H}_2\text{O(g)}$ to approx. 0.15% O

As a result of metallurgy (oxidation and reduction step or reduction period only), a different wear profile has to be expected. Beside the slag line, the poling area is exposed to high wear.

- Thermal cycling
- Hot erosion

The prevailing fayalitic slag becomes even more aggressive due to the reduced viscosity caused by increased CuO during oxidation. The use of hydrocarbons may degenerate the brick matrix. To improve efficiency of the poling process, application of RHI Magnesita Nonferrous Process Technology purging systems COP KIN is highly recommended. Oxidation and reduction time can be reduced significantly.

Drum type



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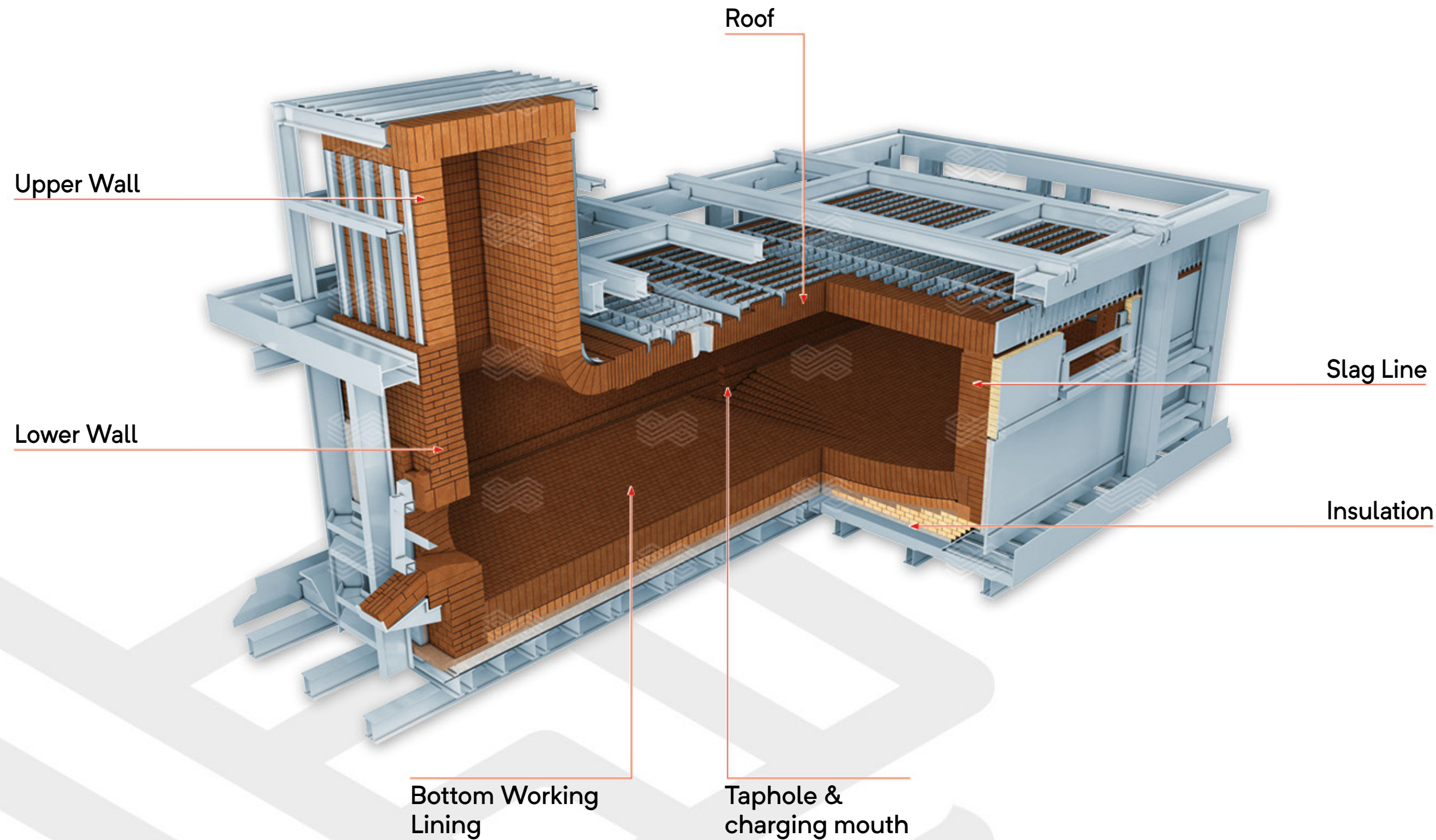


Technology



Anode Furnace

Rectangular type

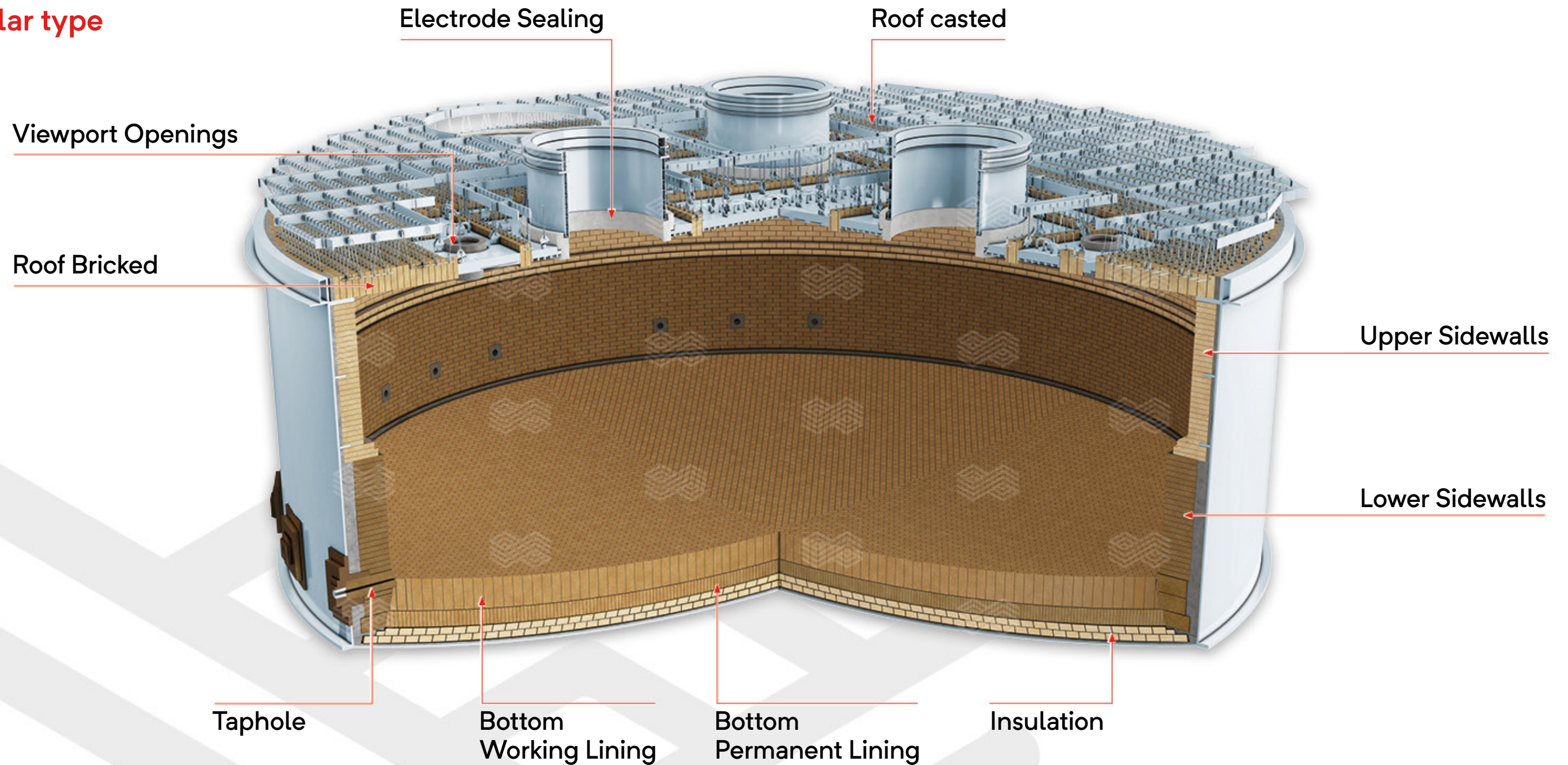


Slag Cleaning Furnace — EAF

A well-established method of slag cleaning is the Electric Arc Furnace (EAF) Process to clean copper and nickel slag. The slag cleaning furnace is operated batch-wise in circular or rectangular vessels. Tapped slag from primary vessels or tapped slag from converting vessels runs via launders through a coke layer into the furnace.

Reduced metal droplets will be collected by a settling effect at the bottom of the EAF to form a matte or metal alloy layer. Chemical resistance of used refractory materials is an key parameter to conduct a sufficient slag cleaning process without any process interruption.

Circular type



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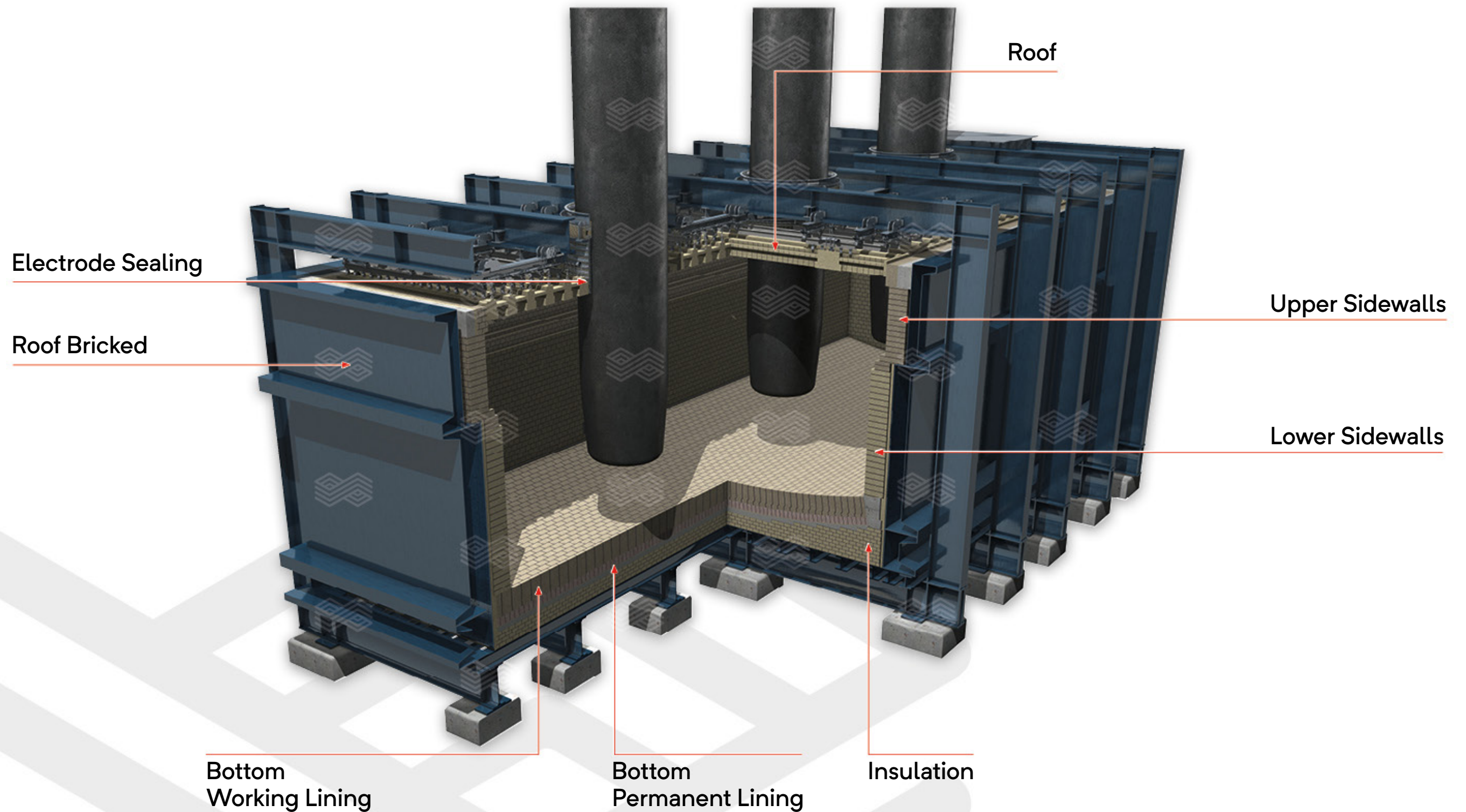


Technology



Slag Cleaning Furnace — EAF

Rectangular type



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Kaldo — TBRC — Converter

Contrary to standard smelting and melting processes, the refractory lining of a TBRC is additionally exposed to the rotation of the vessel. If the TBRC is fully utilized to its technical limits, only superior brick grades can meet the challenge of wear parameters such as:

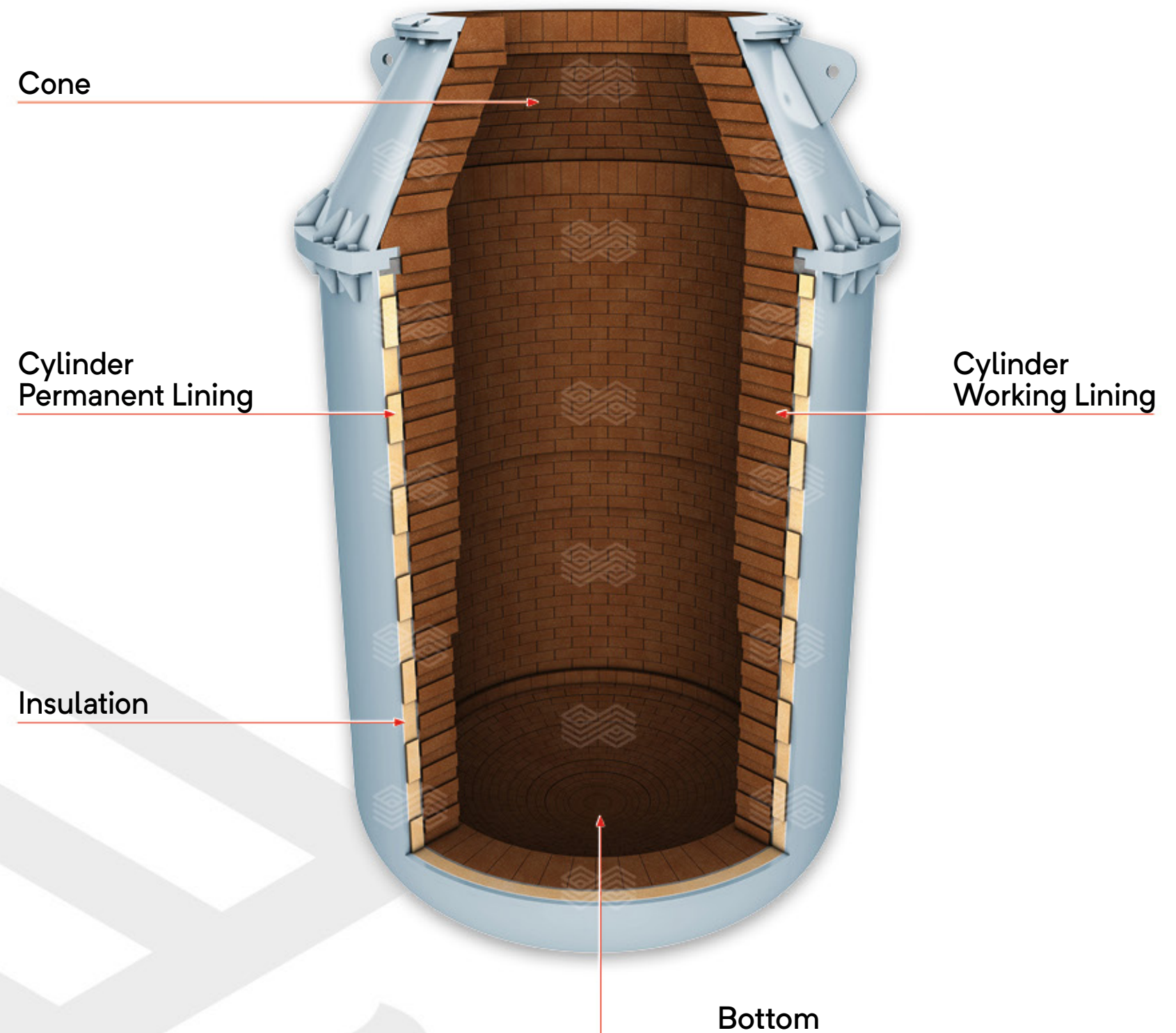
- Hot erosion
- Chemical attack by slag and metal oxides
- Thermal shock
- Redox reactions in case of scrap treatment

Benefits:

- The rotation of the vessel improves heat transfer and accelerates the reactions involved in refining and smelting processes
- Oxygen-propane combustion produces an intense, stable and compact flame with very efficient heat transfer capabilities and low exhaust volume flow
- Oxygen and fuel ratios can be controlled over a wide range to produce reducing, neutral or oxidizing conditions
- The precision tilting facility promotes good slag-metal separation and easy charging
- The absence of submerged lances and tuyeres increases shell life and simplifies operating procedures

A wide range of applications are possible due to the versatility of the TBRC:

- Matte blowing
- Pre-melting
- Reductive and/or flux smelting of metal ores
- Oxidative and/or flux smelting for removal of base metals (lead, copper, zinc, etc.)
- Detoxification of flue dust, e.g. removal of arsenic
- De-halogenation of electric arc furnace dust (removal of chlorine and fluorine)
- Processing of anode slimes from electrolytic refining
- Fuming reactions for antimony, bismuth, etc.



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Flash Smelting Furnace

The Flash Smelting Process was developed in 1949 at Harjavalta, Finland. During the past years the principle remained the same, but the process has been continuously improved and developed due to customer requirements and technology updates.

The refractory-lined furnace vessel contains three sections:

- Reaction shaft
- Settler
- Uptake shaft

A sulfide feed mixture is distributed through the top of the reaction shaft by a concentrate burner. This concentrate burner contains several concentric ducts where process gases and concentrate are blown and mixed into the reaction shaft of the flash smelting furnace. Individual particles heat up as they fly inside the furnace, and after ignition they start to combust with the produced process gas. The molten particles follow a downstream movement and finally they are collected in the settler where slag and matte are separated by their different densities. The generated waste gas flows through the uptake shaft in direction of the waste heat boiler, where it is cooled down and the thermal energy is recovered as steam. Flash smelting has been established in the copper and nickel industries and lead smelting has also been tested on a production scale in a pilot plant in Finland.

Another improvement of the flash smelting process has been achieved by implementing the direct to blister flash smelting. All process improvements and developments in flash smelting create a new challenge for refractory applications. Newly developed slag systems, new temperature profiles in the furnace and possible changes of other influencing parameters also effected a continuous development of lining concepts and refractory engineering for flash smelter installations. The process requires direct-bonded, high-fired magnesia-chromite refractories and products with specially developed raw materials to achieve the necessary chemical and corrosion resistance to acidic fayalitic, calcium-ferritic or calcium-enriched slag.

The predominant wear mechanisms are:

- Thermal stress and physical erosion inherent with oxygen flash smelting technology at relevant temperatures
- Chemical attack by acidic slag and metallic sulfides
- Abrasion effects in the settler and uptake shaft caused by deposits from the waste gas
- Infiltration by matte as well as base metal oxides
- SO₂-attack



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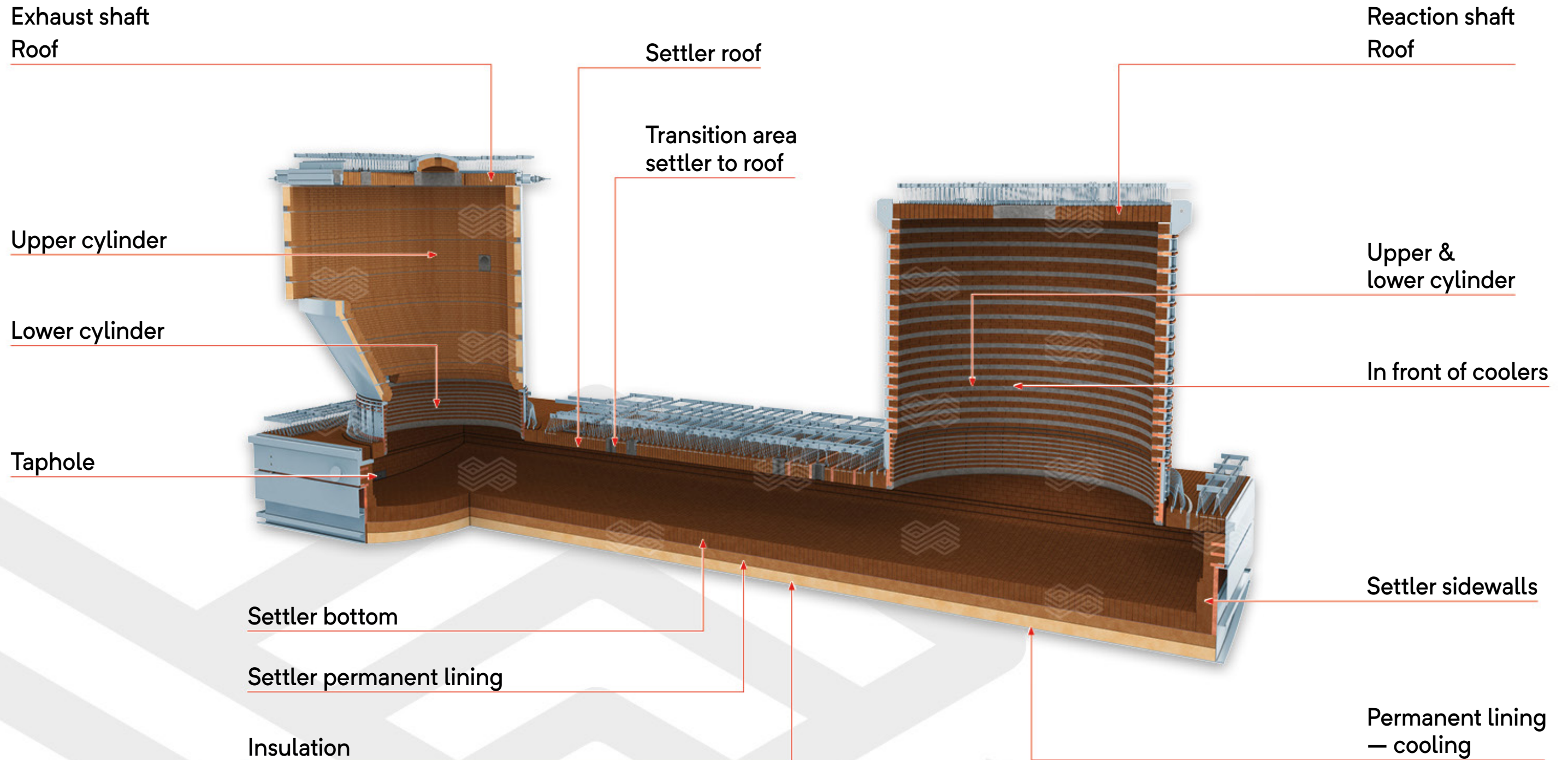
Solutions



Technology



Flash Smelting Furnace

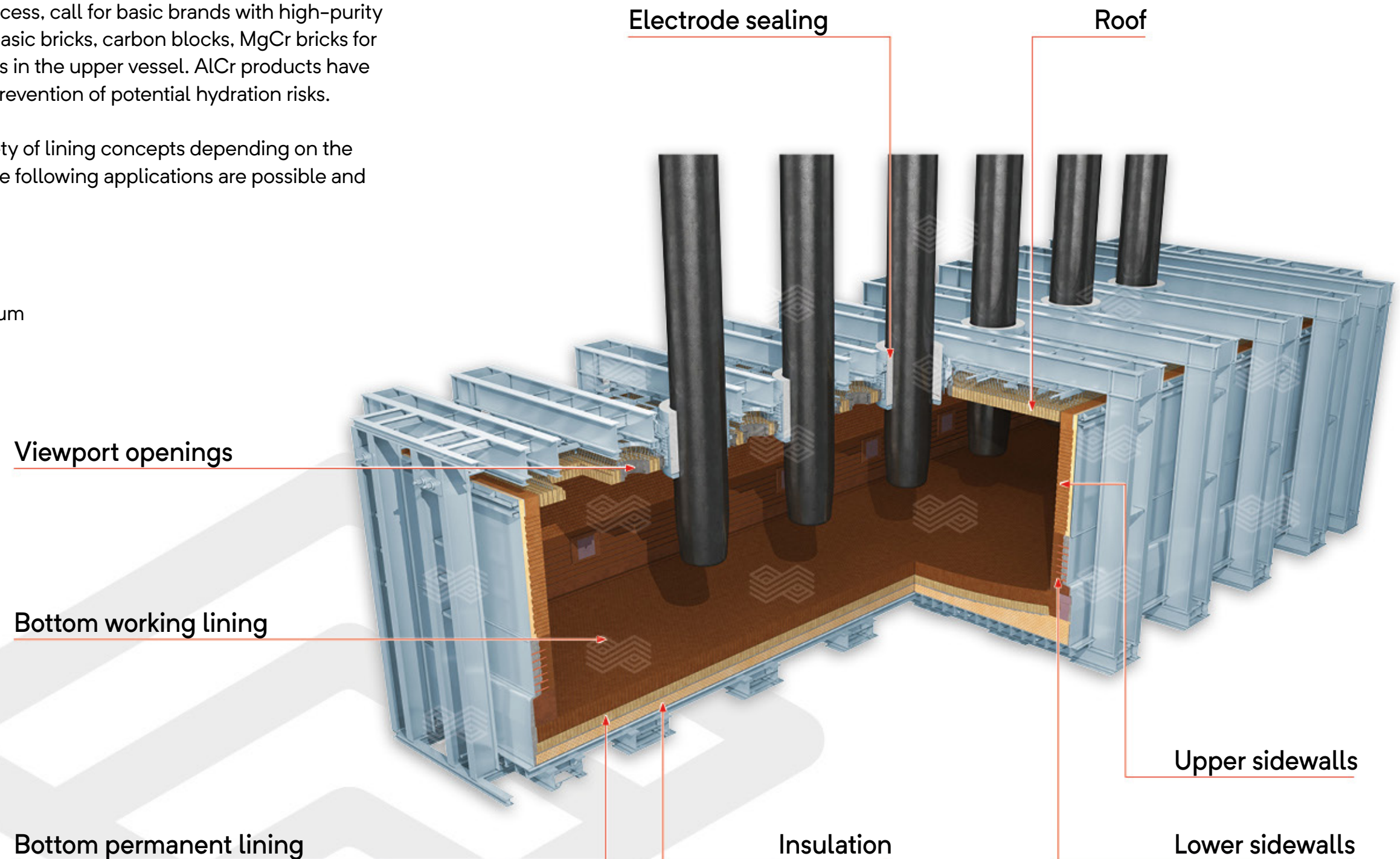


Six-In-Line Concentrate Smelting

A traditional production unit for the treatment of mainly primary raw materials. The lining concepts, depending on the process, call for basic brands with high-purity raw materials, tar/pitch-impregnated basic bricks, carbon blocks, MgCr bricks for the hearth, alumina-silicate refractories in the upper vessel. AlCr products have provided an effective solution for the prevention of potential hydration risks.

RHI Magnesita can recommend a variety of lining concepts depending on the process of the concentrate smelter. The following applications are possible and show the versatility of this unit:

- Copper matte
- Copper nickel matte
- Silicon metal
- Pig iron with titanium slag or vanadium
- Ferrosilicon
- Ferromanganese
- Silico-manganese
- Ferrochromium
- Ferronickel



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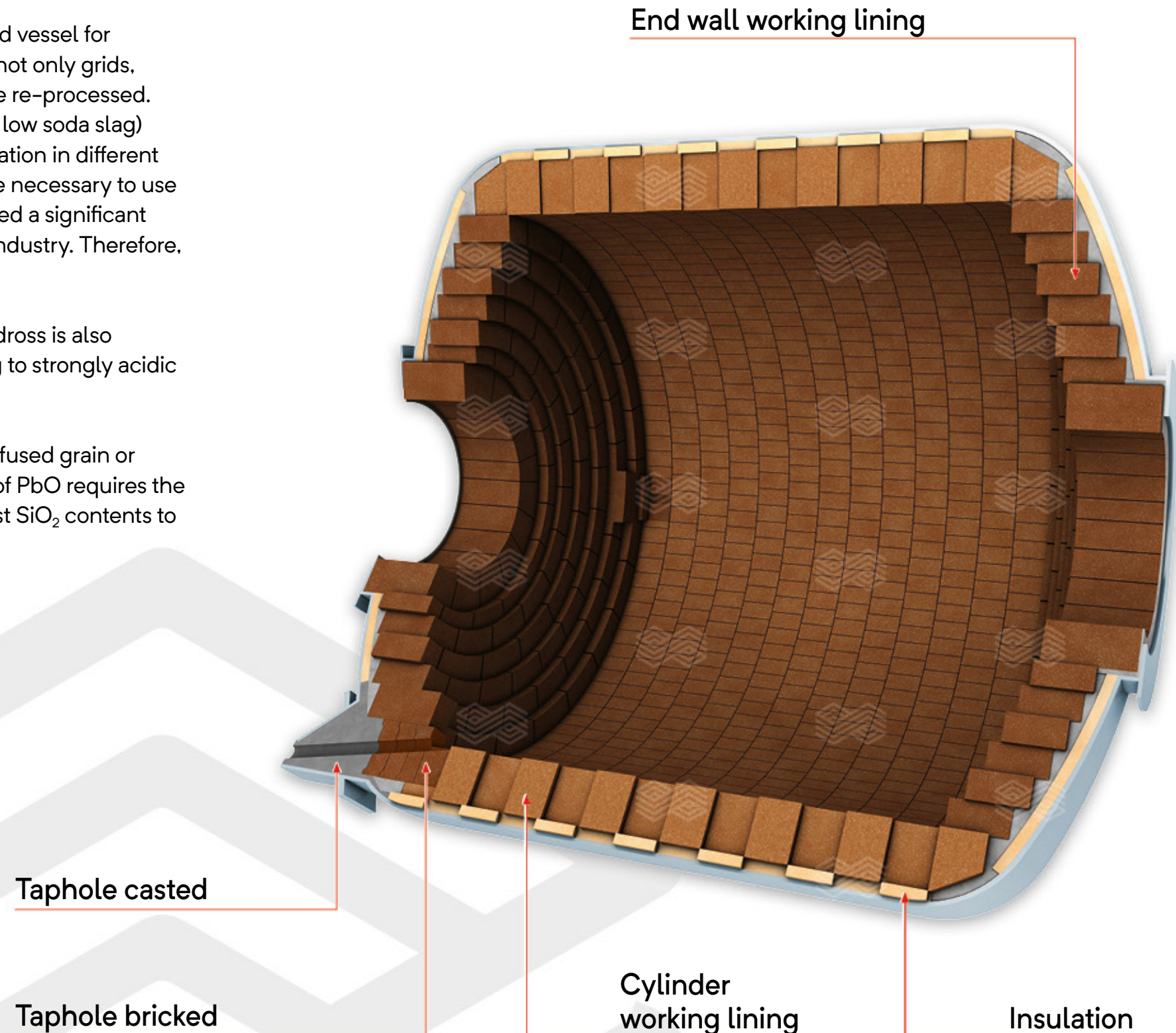
Short Rotary Furnace

The Short Rotary Furnace (SRF) remains the most widely used vessel for Pb recycling. In rotary reverberatory or short rotary furnaces not only grids, poles and lead paste but also by-products of lead refining are re-processed. Depending on slag chemistry and process (high soda slag or low soda slag) different lining concepts are in use. Due to the political legislation in different regions of the world, new treatments and slag chemistries are necessary to use the slag as landfill material. This new process handling showed a significant change for approved lining concepts in the secondary lead industry. Therefore, new solutions are possible and can be recommended.

Furthermore, the manufacture of copper matte from copper dross is also possible. The different slag types in the range from basic slag to strongly acidic disposable slag are possible depending on the process.

Experience showed that high-purity MgCr brands, based on fused grain or OXICROM products, perform best in the SRF. The presence of PbO requires the application of products with special porosities and with lowest SiO_2 contents to avoid eutectics with low melting points.

- Low porosity
- High chemical resistance
- High abrasion resistance



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PS Converter

Converting means oxidation of molten Cu-Fe-S matte to form blister copper (~99% Cu). Copper matte is tapped at approx. 1200 °C from primary smelters and charged via transport ladles into the Peirce Smith Converter. Other raw materials for the converting process include silica flux, air or/and industrial oxygen. Different Cu-bearing secondary materials are re-melted in the converter (reverts, scrap).

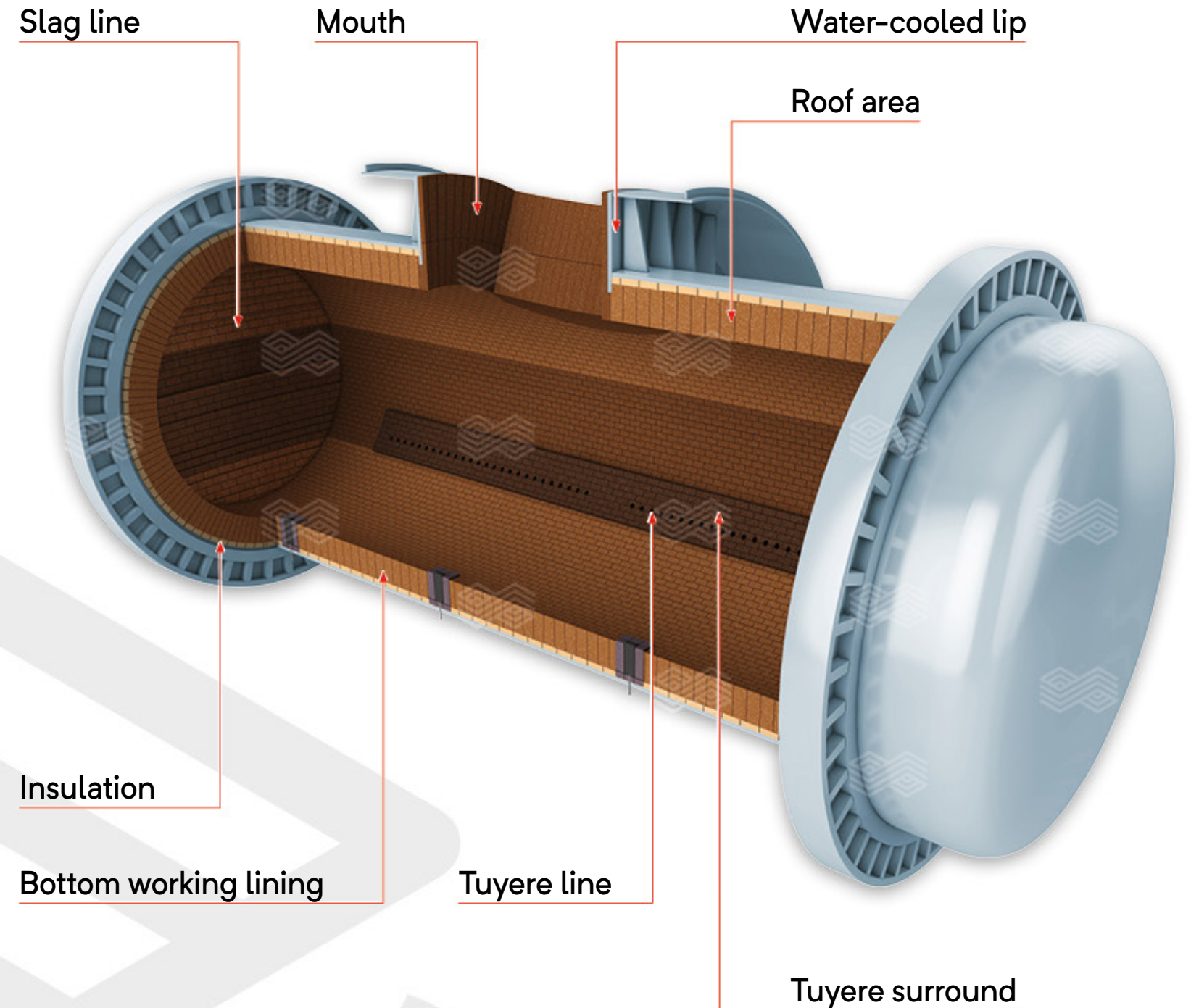
Converted products are:

- Molten blister copper which will be charged to the anode furnace for fire refining
- Molten iron-silicate slag which will be charged to the slag cleaning units (Cu recovery)
- SO₂-containing waste gas, H₂SO₄ production and dust removal

The choice of the most adequate product mix requires a detailed knowledge of the predominant wear mechanisms such as:

- Thermal shock especially in the tuyere zone and converter mouth
- Hot erosion in the tuyere zone due to intensive bath movement
- Chemical wear due to acidic fayalitic slag
- Copper bursting due to infiltration of copper oxides, copper sulfides and metallic copper combined with different O₂ and SO₂ partial pressures

The application of the COP KIN purging system has shown a significant improvement of the converting process in conjunction with cost savings for the process.



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RHI Magnesita Installation Services — Owned 100% by RHI Magnesita



Founded in the year 1950, MARVO Feuerungs- und Industriebau GmbH now has a total of 145 employees at four locations. In addition to the headquarters in the North Rhine-Westphalian city of Kerpen, the Huebitz subsidiary in Mansfelder Land in Saxony-Anhalt was successfully established in 1994 after Germany's reunification. In 2005 RHI took over 100% of Marvo. In 2011 Marvo established a new operating site in Nuremberg with specialists for the subject area industrial chimney and in 2012 set up a new operating site in Ploiesti/Romania. In 2014 Marvo's company name changed to RHI MARVO. We use our extensive know-how to overcome the toughest challenges encountered during refractory installation. All demands are met and implemented using state-of-the-art machine technology and through the continuous training of permanent staff.

Of utmost importance for RHI Magnesita Installation Services is meeting the demands for quality of our customers while staying within the agreed costs and deadlines throughout the entire installation process. As a supplier with high demands for quality, we perform our tasks according to up-to-date technology and the requirements of the construction contract and local legislation. This provides us with the means to offer our customers the highest degree of flexibility in every phase of the whole construction work, from planning to the implementation of the project.

Controlled responsibilities and quality

Our modern ISO 9001:2008 certified company structure guarantees maximum quality, safety in the workplace and environmental protection. The operational procedures and responsibilities are regulated in our company-specific QM manual with process and working instructions.

Personal and environmental protection

RHI Magnesita Installation Services places the highest priority on personal and environmental protection. We have implemented the SGU management system for safety, health and environment in accordance with legal guidelines to achieve a general reduction of the potential dangers to personnel and the environment. This system conforms to SCCP (Security Certificate Contractors) and BS OHSAS 18001:2007 guidelines. The SGU management system is aimed at practicing and improving the safe, healthy and environmentally friendly operation of companies.

Error prevention instead of error correction

Our philosophy "error prevention not error correction" is based on the knowledge that optimum results can only be achieved where quality is repeatedly checked and evaluated at every stage of the construction process. Error-free completion of our past construction contracts at the agreed deadline serves as an indicator of the effective implementation of our quality policy.

Customer benefit — receipt of a perfect refractory lining

- Mastery of all conventional and prevalent techniques
- Bricklaying of shaped refractories
- Casting, ramming, pumping and gunning of unshaped refractories
- Installation of industrial chimneys
- Demolishing of refractory linings and industrial chimneys
- Installation of ceramic fiber modules
- Welding, including the stud-welding technique
- Access to a state-of-the-art, company-owned equipment park
- Long-standing experience in all industrial areas
- Company training for new employees and continuous training of permanent employees concerning the latest techniques
- Production of molds for on-site casting of pre-shaped forms
- Fast and flexible emergency service 24 hours a day, 7 days a week



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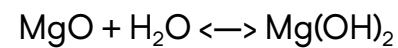
Technology



Hydration

RHI Magnesita enjoys a leading position and is on the forefront of technological developments in the global refractory market. After long years of successful research and development efforts, a unique, optimized hydration protection treatment for magnesia and magnesia-chrome fired bricks is offered only by RHI Magnesita. Specified by the suffix “R1” after the brand name, this treatment is a special feature of all basic fired bricks supplied to the ferroalloy industry. This treatment represents a very efficient protection against hydration, hydration being a serious problem for basic refractories, with consequences that range from low performance to furnace run-out. Refractories are exposed to the risk of hydration during most of their life cycle. During transport and storage, by contact with liquid water or vapor; during installation by contact with moisture from atmosphere, mortars and castables; during heat-up by water vapor brought into the furnace by gaseous fuels or evolved from the lining; and during operation, coming from moist raw material or from failures in the cooling system or furnace shell.

The main hydration mechanism is the transformation of the magnesia into brucite (see equation) which is directly related to a volume expansion of 115%.



The risk of hydration damage can be minimized by using our special brick hydration protection treatment. This treatment is not limited to a simple surface protection, but it goes through the brick structure and is maintained even if there are intensive mechanical operation conditions.

The hydration test is performed in a state-of-the-art steam chest, which operates with saturated steam under ambient pressure. This testing method was established because of its practicability and easy determination of crack formation. The test is conducted in 24-hour intervals up to 96 hours.

The bricks without any impregnation show hydration signs already after 24 hours, while the impregnated version endures 96 hours without any hydration. RHI Magnesita also offers special hydration-resistant brands, indicated with the suffix “HR” after the brand name, tailored for special furnace area application. Please contact your RHI Magnesita sales representative for more information on the “R1” protection treatment and for the “HR” special brands.

Any whitish discoloration of the brick surface is the result of the protection treatment and has no negative effect whatsoever on the brick quality. The brick characteristics, as specified in our data sheets, remain almost unchanged by our treatment.

The long shelf life of magnesite bricks achieved by this special protection system is a further advantage, especially in regions with high humidity even if stored in precipitation-protected areas. Additionally, RHI Magnesita offers special packaging to increase shelf life of basic refractory brands. This special packaging is called ALUVAC. The bricks are sealed in a special wrapping (high strength) under vacuum.



Magnesia brick with “R1” impregnation after 96 hours



Magnesia brick “R1” impregnated



Magnesia brick not impregnated after 24 hours



Magnesia brick with “HR” Technology after 600 hours in the steam chamber

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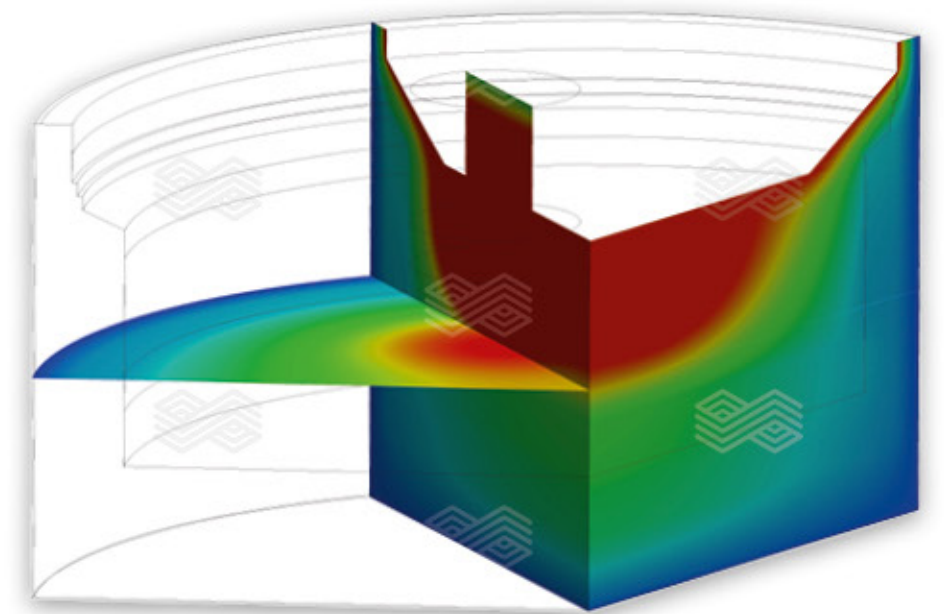


Technology



CFD, FEA & FactSage Modelling

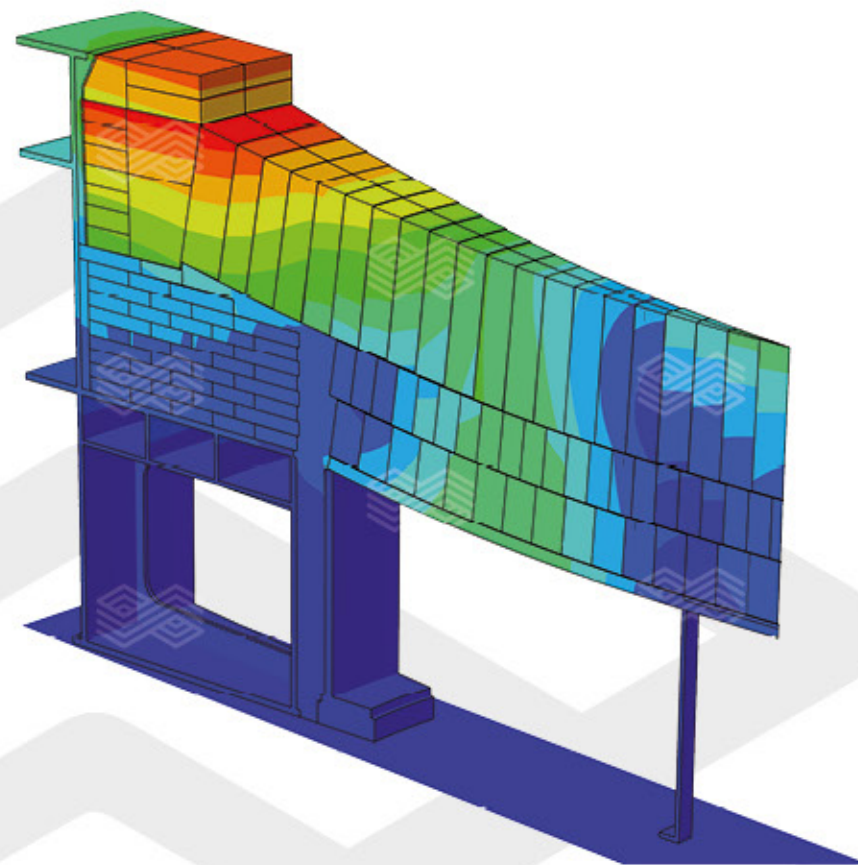
The simulation of complex metallurgical processes, temperature profiles, isothermal calculations, definition of heating procedures, efficiency of cooling systems and their impact on the refractory design, as well as the efficiency of purging system designs by applying computational fluid dynamics (CFD), are very important components of RHI Magnesita's customer-oriented package at the Nonferrous Metals Technology Center. In close cooperation with our customers, both finite element analysis (FEA) and CFD modeling have become essential tools in the achievement of vessel integrity and the development of tailored refractory lining systems as a result of the given operational parameters. Furthermore, RHI Magnesita calculates slag conditioning and models of the refractory corrosion mechanism with the help of FactSage.



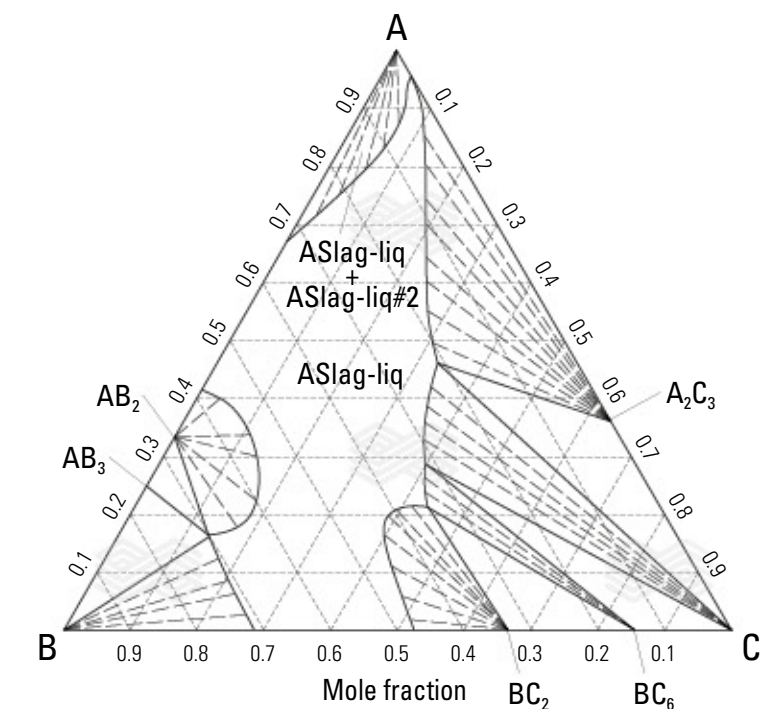
Thermal profile



Ladle purging — flow patterns



Displacement profile



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Technology Leadership

The objective of research and development (R&D) is to obtain a competitive advantage based on technology leadership for RHI Magnesita and its customers.

The challenge for refractory material manufacturers is to design optimum refractory products from suitable raw materials for each of the customer's production processes. The optimum formula is decisive. RHI Magnesita possesses more than 20,000 formulas allowing them to offer customized products tailored to meet the requirements for the respective application.

RHI Magnesita invests more than 1% of its annual revenue into extending the global technology leadership. This position is based on decades of successful research and development work, which has continuously enhanced refractories knowledge — from raw materials to applications in all relevant industries — and, above all, refractories expertise in the application processes.

Integrated Management System (IMS): Quality

Quality, environmental conservation and work safety are integral parts of the corporate policy of RHI Magnesita. Our company and all its employees are committed to pursuing the principle of contributing to quality, environmental conservation and industrial safety, and thus to increasing the value of the company by their activities.

The quality standard ISO 9001, the environmental standard ISO 14001 and the legal requirements regarding occupational health and safety including legal security have been installed within the RHI Magnesita Group.

The objective of RHI Magnesita is to take maximum advantage of market opportunities by satisfying the customer and thus maintaining and improving the future of the company and welfare of its employees by providing products of constant high-end quality. Personal and plant safety are also central topics of the integrated management system.

Training, apprenticeship programs

Measures for the education and further training of our employees are of great importance to us. Their expert knowledge and abilities are constantly updated and adapted to the technological developments.

In addition, young people who are “especially disadvantaged” are to be integrated, thus giving them a fair chance for a better future.



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