

Low-Alpha technology:
The innovative refractory solution
for steel devices subjected
to high thermomechanical loads



Optimized refractory concepts for the steelmaking industry

In modern steel production, plant reliability is playing an increasingly important role. Innovative and comprehensive refractory concepts are decisive when it comes to optimizing steel production processes in terms of performance and costs. In close cooperation with our customers, we develop, test, and supply perfect solutions.

Refractory linings must withstand extreme temperature changes, e.g. during cyclic tapping and casting operations.

After addressing this challenge in detail, Refratechnik has developed an optimum solution: The new Low-Alpha technology.



The challenge:
Thermomechanical loads of MgO-C refractory bricks

Thermal expansion using the example of a casting ladle

When being tapped into a casting ladle, the molten crude steel still has a temperature of 1650 up to 1720 °C. These temperature cycles represent a considerable stress for the joint structure (cobblestone formation). Further infiltration between wear lining and safety lining can even result in deformation of the ladle's steel top plates.

Our commitment: Clear reduction of thermal expansion without negative effects on the typical properties of the MgO-C refractory bricks.

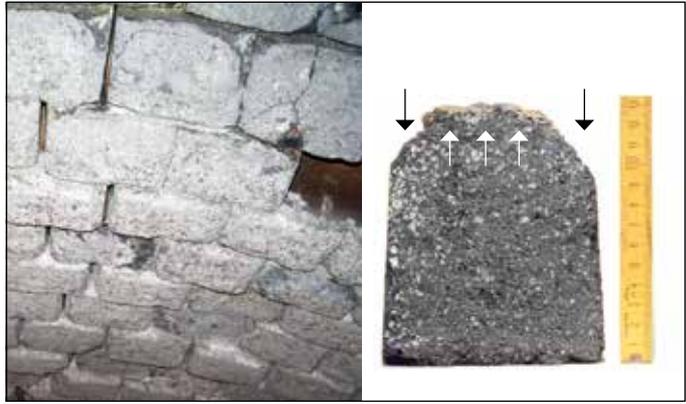


Fig. 1: Steel casting ladle with typical wear at the joints, "cobblestone formation", and open joints.

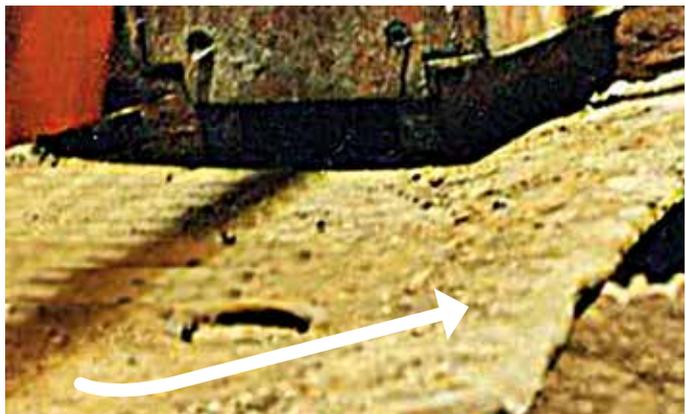


Fig. 2: Deformation of the ladle's steel side plates

Thermomechanical loading

High thermomechanical loads are caused by the high thermal expansion of the MgO-C bricks.

Typical thermal expansion of an MgO-C brick with 10% remaining carbon.
1.1% at 1000 °C → 10 mm expansion / 1 m brick,
1.9% at 1500 °C → 19 mm expansion / 1 m brick.

This expansion can lead to high mechanical stresses in the refractory lining, which can reach critical levels in systems that are subjected to particularly high temperature changes. Finally, the stresses can exceed the brick's mechanical strength, leading to fractures, spalling, joint wear, and generally reduced service life.

Oxides	Thermal expansion at 1000 °C (%)
MgO	1.40
CaO	1.30
SiO ₂	1.00-1.40
MA spinel	0.85
Al ₂ O ₃	0.80
ZrO ₂	0.80
Cr ₂ O ₃	0.75
Mullite	0.45

The solution: Low-Alpha technology!

Based on the established MACARBON® brick versions, it was possible to prove that thermal expansion could be reduced by up to 30% by using Low-Alpha technology. The implementation of Low-Alpha technology in several German steelworks (10 casting ladles with more than 90 heats) demonstrated the high performance of this novel development:

- No open joints or steel infiltration between wear lining and safety lining
- Reduced joint wear ("cobblestone formation")
- Thermal expansion reduced by 30%
- Significantly improved performance of the refractory lining
- Increased service life
- The necessary wall thicknesses are maintained
- Improved assessment of remaining brick thickness

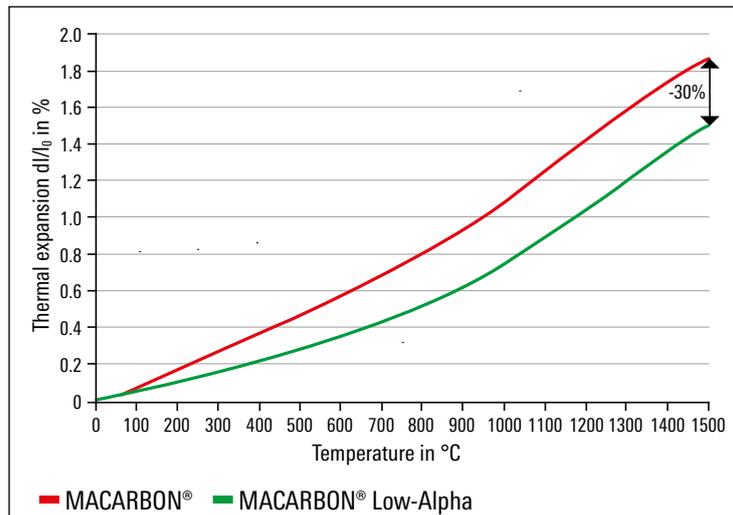


Fig. 3: Reduction of thermal expansion by 30% (integral)

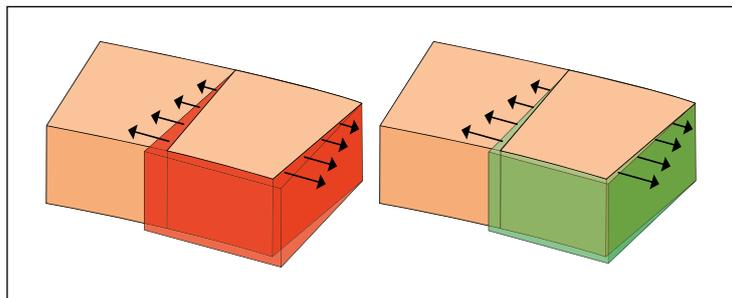


Fig. 4: Lower thermal stresses in the lining

Low-alpha technology: The decisive success factor

Refractory systems with Low-Alpha technology are essential for:

- Extreme operating conditions with large temperature changes, e.g. modern steel casting ladles,
- Steel devices subjected to high thermomechanical loading,
- Complex and demanding operating procedures.

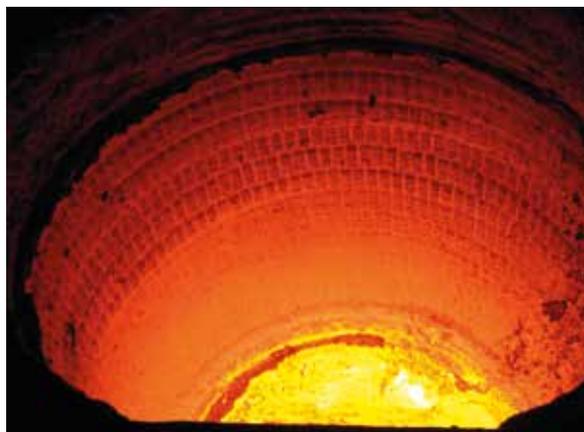


Fig. 5: Field test in a German steelmaking plant: MACARBON® lining with Low-Alpha technology after 50 heats

Let's talk about your goals.
We will find the right way.



Refratechnik Steel GmbH is a member of the Refratechnik Group. Based on a solid foundation of more than 60 years experience, Refratechnik Steel GmbH focusses on solutions for the iron & steel industries as well as the non-ferrous and aluminium industries, which consequently involves environmental, energy, and chemical aspects.

The production facilities of Refratechnik Steel GmbH are located in Bendorf and Dülmen, Germany. Furthermore production capacities of the group facilities in Germany, Spain and China have been assigned. Administration and R+D are in Düsseldorf and Bendorf.



The Refratechnik Group is certified according to **ISO 9001** – Quality management systems, and **ISO 14001** – Environmental management systems.

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