

DRI solutions - Green transformation for steel industries



BACKGROUND
Customers needs



CONCEPT
Calderys solution



SUMMARY
Recap of
the solution



RESULTS
Concrete
benefits

The background situation

Steel industry, one of the major contributors to the direct CO₂ emission, produce on average 1.85 tonnes of carbon dioxide per ton of steel in the BF-BOF route. To achieve net zero by 2050, steel makers are more and more replacing their iron production with the Direct Reduction technology, that significantly reduces the CO₂ emissions.



The request from the customers

DR process uses CO and H₂ to reduce the iron ore pellets in the solid state. The success of these processes is critically dependent on the refractory lining used in the furnaces that guarantee the process integrity at high temperatures. Traditional refractory materials for the CO/CO₂ environment are well understood and developed. As the DRI technologies are moving towards to operate under 100 % hydrogen environment, the refractory materials need to be re-designed based on the understanding of the high temperature interactions of hydrogen with these materials.

Calderys being the pioneer in the high temperature refractory materials was approached to develop and supply these refractories.





Analysis of the customer request

The requirements were analysed to great details by our in-house experts from R&D and engineering departments. Based on the analyses, key parameters were identified. A comprehensive product testing and development program was set up.

Test samples with existing chemistry and new chemistries were fabricated in house, tested and analysed at external laboratories.

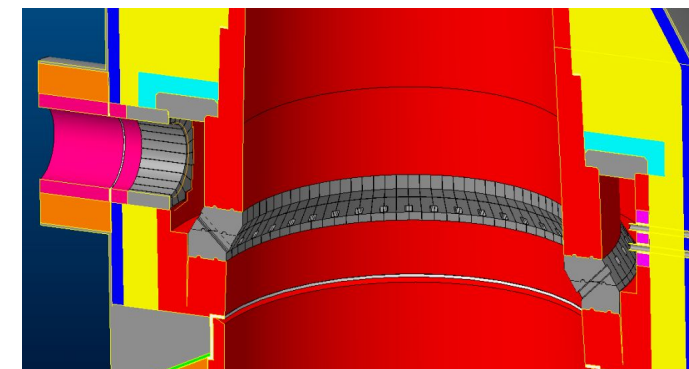
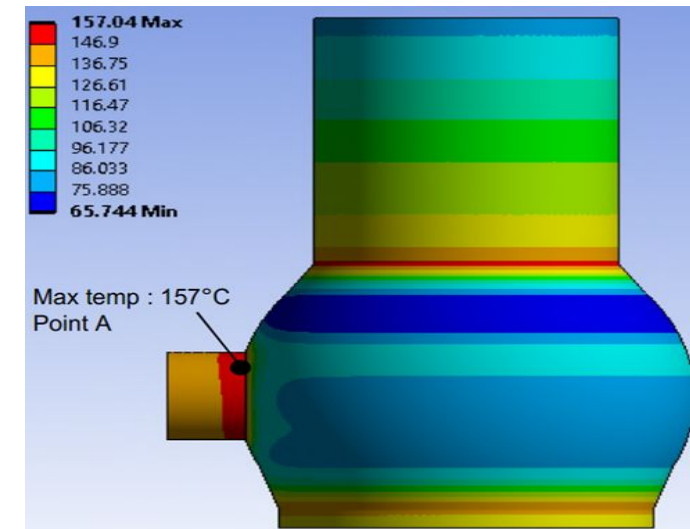
Finite element simulations were carried out to ensure that the properties of the newly developed solution meet the stringent design and operational requirements.

Description of the solution developed by Calderys

The main points of the solution can be described as follows:

- **Chemistry** - Low iron oxide and silica chemistry were developed as they offer simultaneous resistance to carbon monoxide and hydrogen
- **Thermomechanical state of the lining** - thermal stress conditions were simulated to minimize stress on the linings, backup layers and on the shell. Stress load evaluations were carried out to ensure a stable operating vessel
- **Zone specific solution** - DRI reactor was divided into different zones based on the operational parameters and zone specific refractory solutions were optimized to achieve minimum wear pattern.

Temperature Profile simulation



Zone specific solution

Benefits brought by the solution

The combined effect of specific refractory product design, engineering and simulation has resulted in positive value creation for our clients.

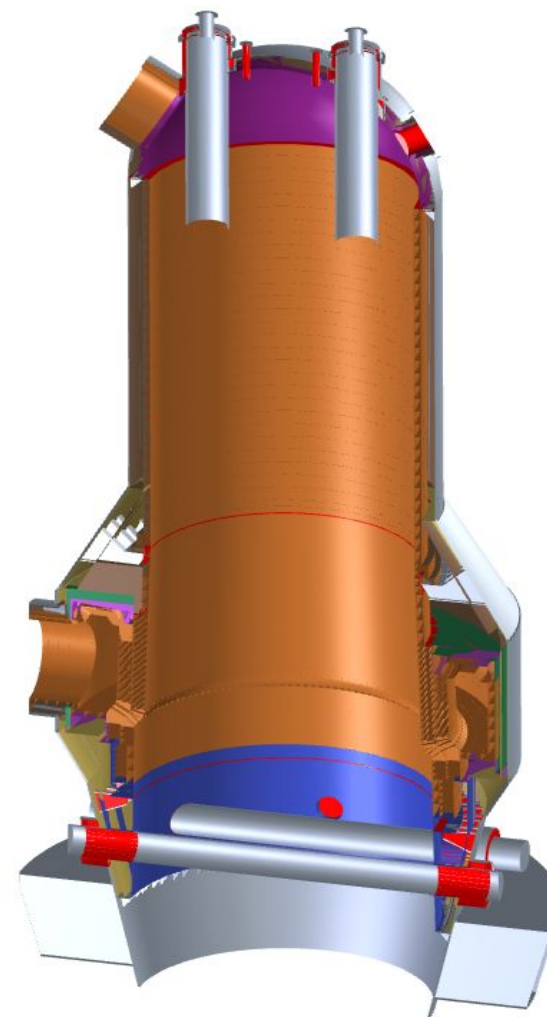
- In one specific case the refractory lifetime has exceeded by 40 % beyond the designed life.
- Engineering, installation along with captive refractory product supply has brought a positive impact on client confidence.
- Clients have the benefits to work with a single contact from the engineering design to installation and annual inspection.

Dome

Upper
Shaft

Plenum

Ring
(injection
Nozzle)



CALDE BRICK F45 CO, CALDE
TROWEL HA 40/ HA 55

CALDE BRICK M 75 CO, CALDE
BRICK A 65 CO, CALDE BRICK F45
CO, CALDE TROWEL HA 55, CALDE
TROWEL HC 85 U

CALDE BRICK M 75 CO, CALDE
BRICK A 65 CO, CALDE TROWEL HC
85 U, CALDE TROWEL PC 85 U

CALDE BRICK C 90, CALDE BRICK C
92 FM, CALDE TROWEL PC 90 U,
CALDE TROWEL PC 85 U

Product presentation

The products are designed as per the zone, considering the most severe operating conditions. This ensures product stability and differentiates our offerings from the competitors.

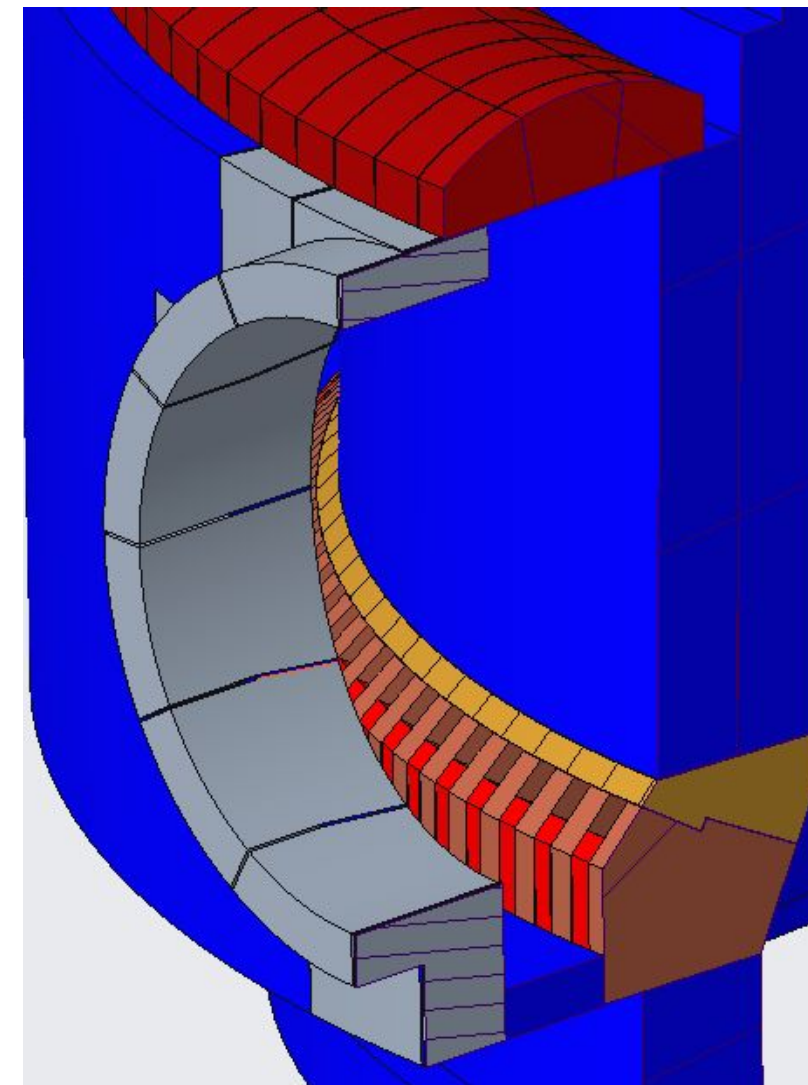
Simulation and engineering capabilities ensures the structural integrity and functioning. For example, the back up lining is optimized to avoid the acid dew point and acid deposit. Shell temperature is optimized in order to avoid acid condensation.

Services - Expertise

Calderys accompanies its steelmaking customers in the green transition for tomorrow.

In the case of the DRI, we provide turnkey project solutions starting at the early project stage engagement. Our global project solution approach takes into consideration engineering design, materials manufacturing, installation and inspections services. In each stage of the project EHS is given the utmost priority.

Projects executed by Calderys exceeds the design life, showcasing our experience and commitment to the green transformation.



Thank you for your attention

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