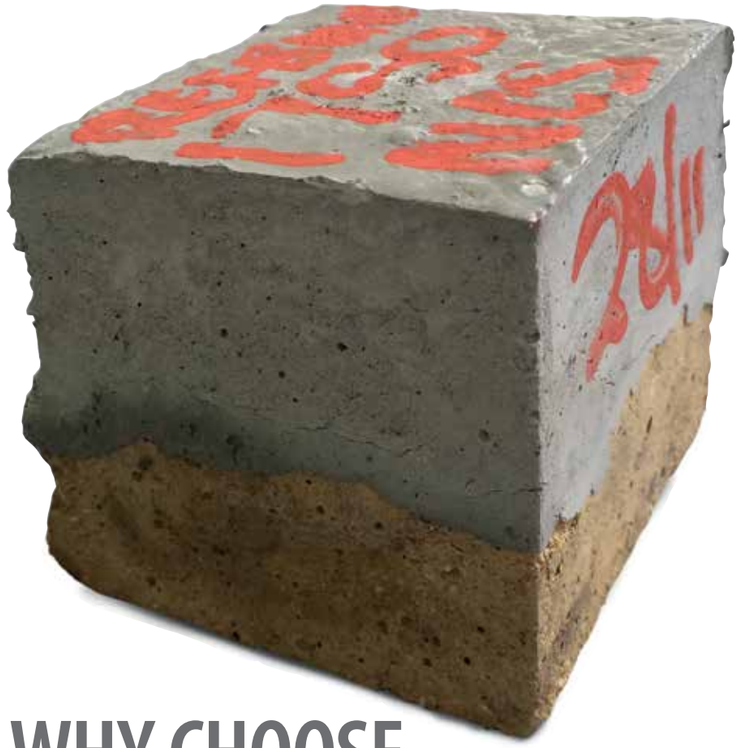
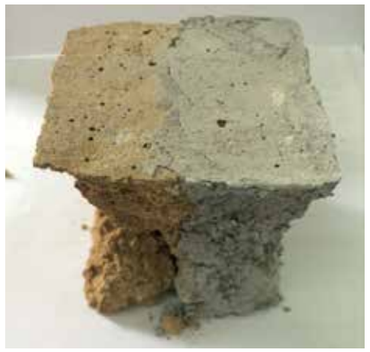


WHY CHOOSE GEL-BONDED LININGS?

Manfred Rösch details the technology that reduces cost of ownership of refractory lined vessels

Refractory castable has been around since the invention of calcium-aluminate cement (CAS) in 1908 by Lafarge, also known as "Ciment Fondu". Conventional castable mixes were made by adding CAS to a crushed refractory aggregate keeping the particle size distribution in mind to balance different fractions of aggregates and fines. Since then, constant improvements and developments have targeted the improvement of performance of castable to match the performance of refractory bricks. The fundamental development aim was to reduce the porosity of the castable to match the porosity of bricks. As a rule of thumb, we can conclude that the mixing water multiplied with the density of the aggregate results in the porosity. For example, a conventional castable uses 10% water multiplied with 2.5Kg/m^3 equals 25% porosity. Compared with a refractory brick of 12-14% it is easily understood why conventional castable cannot match the performance of bricks. When this was understood by developers, a constant drive led to mixes with a reduced CAS and with the addition of finer micro particles of



LEFT: **Refbond nano-gel on a brick This image shows a fired test cube**
ABOVE: **Crushed test cube - with the bond still intact**

fumed silica and reactive and calcined alumina to build up the matrix from the finest commercially available particles. Today's low cement and ultra-low cement castable use between 4-6% water, which brings them in line to perform equally to refractory bricks.

GEL-BONDED CASTABLE

Gel-bonded castable has been around since the turn of the century. This relatively new bonding technology brings many advantages. The gel-bonding is a no-cement, no-hydration technology to set castable with ultra-fine nanoparticles.

With these nanoparticles, we can now build the particle size distribution of a mix from a smaller base and therefore build much denser castable. Another great benefit in the use of nano particles is that these ultra-fine particles can act as anchors into the micro porosity of an existing refractory lining and form a bond equivalent to the bond of a newly casted lining.

Case study of a endless lining system in a ladle for ferro-manganes

	New Lining	Gunning Repair	Refbond nano-gel
Performance campaign	100%	70%	100%
\Cost of lining per heat	100%	115%	80%
Duration of reline	12 days	3 days	3 days
Production gain/performance	100%	50%	125%

ENDLESS LINING SYSTEM

Refractory linings are a consumable and subject to wear under extreme high temperatures and pyro-chemical conditions. This requires linings to be replaced periodically when 50% wear has occurred. Since traditional repair methods cannot bond well to worn refractory linings, a repair will therefore not bring the lining into the same condition as new. So plant engineers are faced with two choices. Either they repair a lining and get a compromised lifetime, or they break out the entire lining and replace it, throwing the good and expensive remainder of the lining into the bin.

The use of gel-bonded linings is the answer to this problem as it enables the plant engineer to repair the worn lining with a refractory castable that has the same properties as the original lining and bonds with its nano particles into the micro porosity of the existing lining.

This cost-effective repair eliminates the cost and time to demolish a worn lining and reduces the amount of refractory castable used. The result is a repair that is cost-effective, fast and brings the lining back to its original property.

REAL-WORLD CASE STUDY

A recent case study on the endless lining system from Refraline showcases its technical advantages on a torpedo ladle in South Africa. The table on p32 details the improvements that the Refbond nano-gel brought about.

IN SUMMARY

We hear a great deal about new technologies with buzzwords such as "nanotechnology", and mostly we cannot imagine how these new technologies can be applied in our daily lives. Here is a real-world example of a development being taken from the laboratory environment into a real industry problem and making a notable difference – both financially and technically. ●

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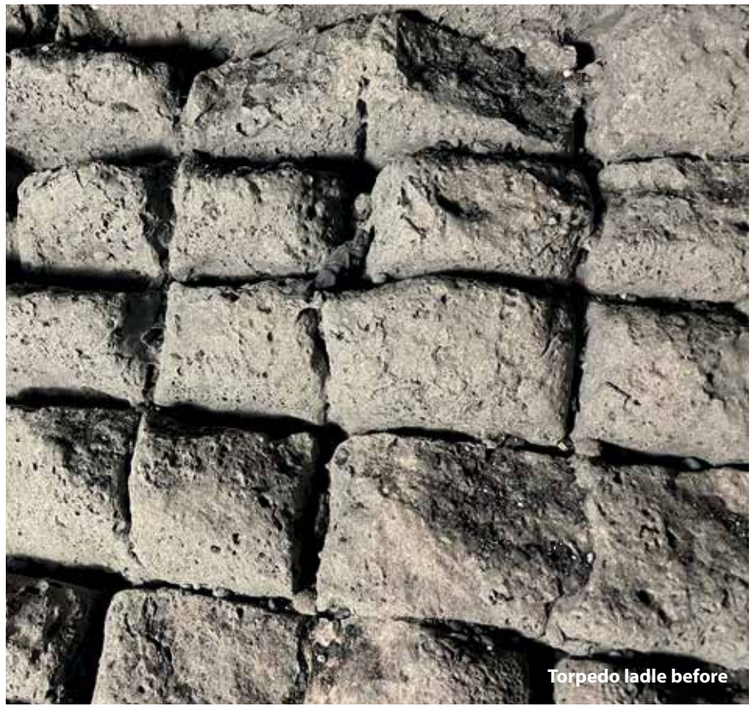
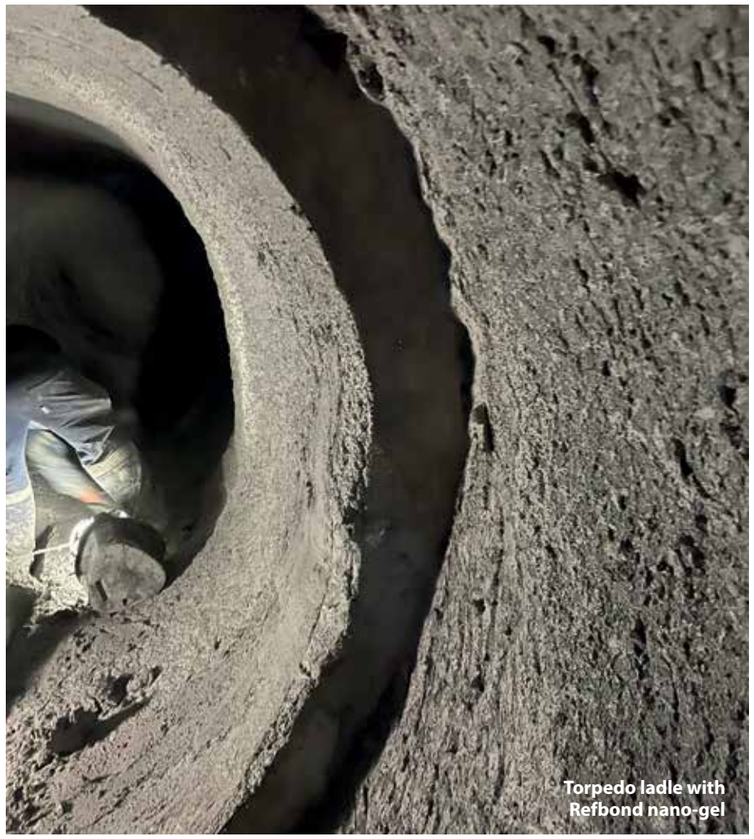


Torpedo ladle before



Torpedo ladle with Refbond nano-gel