Decarbonizing the glass industry: the role of refractory solutions

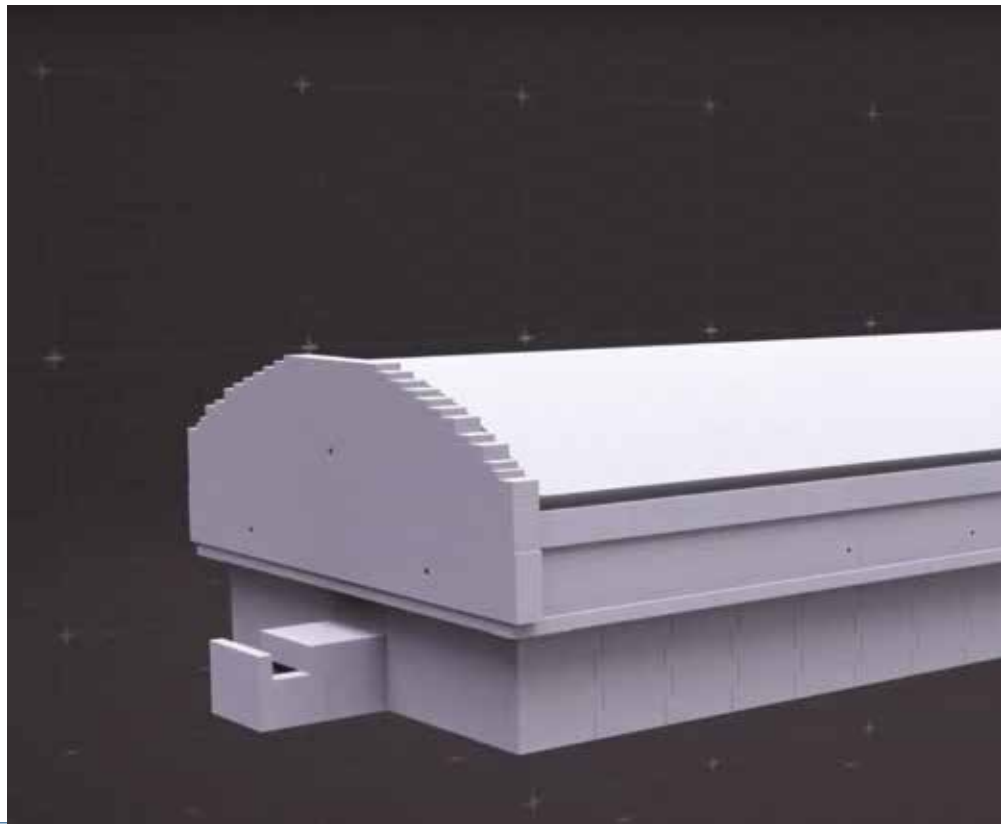
In addition to the typical challenges of sustainably producing high-quality glass at optimised costs, the glass industry is facing new paradigm-shifting challenges, namely carbon-neutrality and circularity.

Dr Michel Gaubil,
Director Refractory Solutions, SEFPRO

Mélanie Allen Larut,
Stategic Marketing Manager, SEFPRO

Achieving low carbon glass production marks the first key challenge of the glass industry over the years ahead. Many governments and companies have announced clear targets to reach carbon-neutrality in the coming decades. The glass industry must play its part.

Circular economy is the second key challenge for the glass industry. Beyond an increased use of cullet, the full furnace lifecycle must be considered, including its end of life and refractory recycling. Refractory solutions are essential to glass



furnaces and their performance. As such they play a key role to support glassmakers in these new challenges.

SERVICES TO SUPPORT THE SHIFT TO CARBON-NEUTRALITY

The path to the industrial production of carbon-neutral glass still faces many obstacles, the most significant being the switch to renewable energy sources. Two main contenders -electricity and hydrogen- are currently being tested and developed by many industry players. Other options, such as biogas and biofuels, are also under investigation.

Despite this uncertainty, as to switching fuels we know that there will be an impact upon glass furnace refractories and that more flexibility will be needed in the energy mix - especially during the transition period.

To anticipate and make the best refractory choices, numerical simulation services based on an expert knowledge of refractories will be key to mitigating risks respecting furnace safety and lifetime. Corrosion models allow for analysis of the impact of such parameters as glass temperature profile, glass velocity profile, refractory composition and cooling efficiency on refractory lifetime. These numerical simulation services help choose the best refractory solutions specific to glass furnace conditions.

Such changes to operating conditions –never seen at this scale before- will also reinforce the need for real-time furnace monitoring. Instrumenting refractories with sensors to follow in real time the evolution of furnace wear will secure furnace operations, trigger necessary adjustments to operating conditions or if necessary, prompt maintenance or repair operations before a critical incident.

HIGHER PERFORMANCE REFRACTORY SOLUTIONS

Technologies and measures enabling the shift to carbon neutrality – such as electrical boosting, greater insulation at both glass contact and superstructure and hydrogen combustion technology - are demanding higher refractory performance.

Superstructure using ER 1851 Lowex

In superstructure application, the use of oxy-combustion technology and higher thermal insulation results in increased exudation and corrosion.

There are several high quality products in the refractory portfolio that meet these requirements. The use of low exudation fused cast AZS in combination with high alumina and/or high zirconia fused cast materials has proven to be highly suitable to cope with more soliciting furnace conditions.

USE OF HIGH ZIRCONIA FOR TUCKSTONE APPLICATION

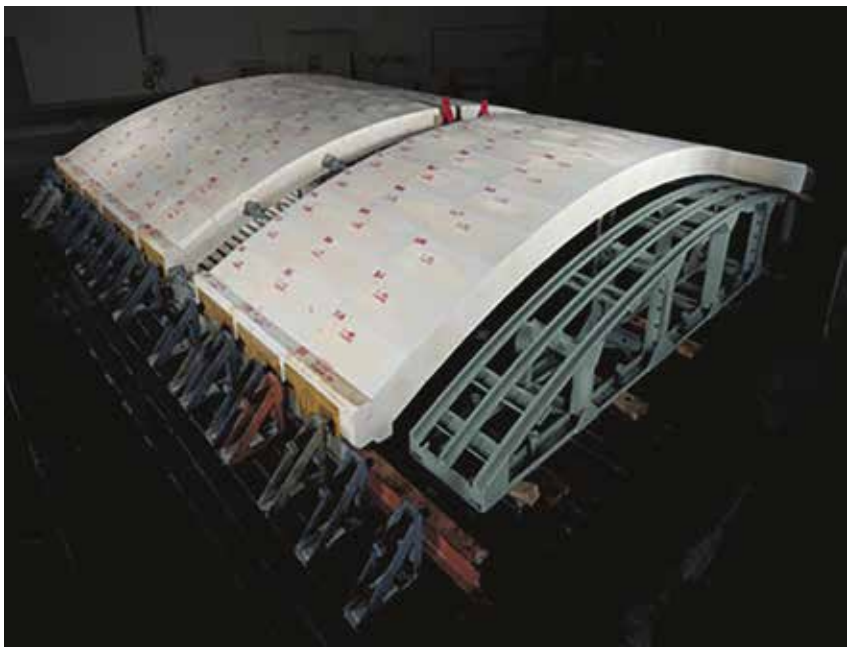
Superstructures and tuckstones in particular will undergo more corrosive atmospheres. High zirconia tuckstones will ensure the required higher resistance to corrosion but will typically be more susceptible to thermo-mechanical stress. Associating a composite ceramic shield - with high compression resistance and low thermal conductivity - to a high zirconia tuckstone will protect it from the risk of cracks due to these stresses. As such, the insulated tuckstone will be able to play its role in avoiding thermal losses. The stability of the superstructure as well as the thermal protection of the below located soldier blocks significantly increase and contribute to a longer furnace lifetime.

ER 1195 RT TuckPro

Albeit not a new technology, oxyfuel combustion is reclaiming its relevance for both hybrid and hydrogen furnaces. This technology induces comparably high

running temperatures combined with high water vapours and alkaline concentration within the fumes. Refractories must withstand these new conditions - particularly in the crown.

Performance of mortars can hardly be overlooked either. Harmonised dilatation of the various layers of tiles and mortars is essential to avoid unexpected glass infiltration.



The first choice for crowns in oxyfuel combustion are fused-cast refractory solutions such as low exudation-AZS materials or fused-cast high alumina. An assembly with very tight specifications ensures the required corrosion and creep resistance properties of the furnace crown.

Electrical boosting directly results in higher temperature at the bottom of a glass furnace, in parallel with an increased convection flow rate of the melt. Using fused-cast tiles is a well-known answer to those challenges. However, this may no longer suffice: a complete refractory solution for the furnace bottom should be considered.

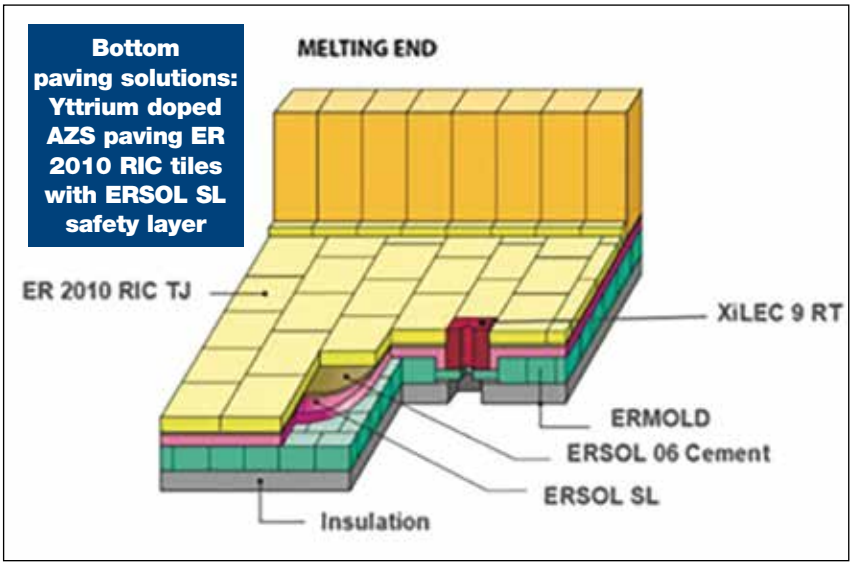
Void free fused cast tiles constitute the first element of this solution. Beyond higher corrosion resistance, they must ensure joint closure after heat-up in order to guarantee safety of the furnace bottom.

For furnaces with high electrical power the use of extra high electrical resistivity fused cast refractory solutions particularly designed for such extreme conditions as Xilec 9, must be considered. Such materials are the premium choice and safest option for harsher operating conditions, due to high current density.

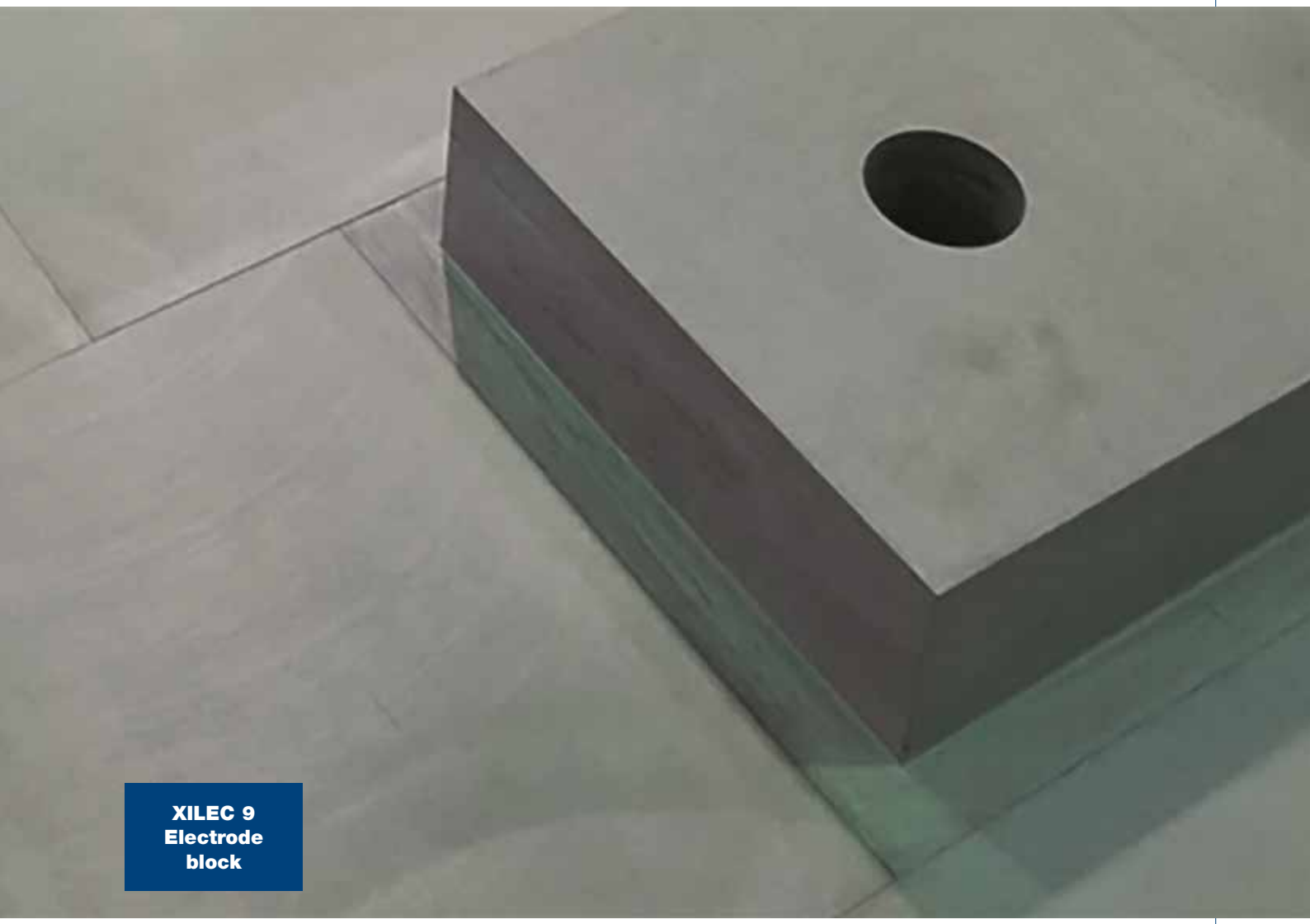
Beyond the impact on the furnace paving, higher temperatures at the bottom of the glass furnace also impact the lower section of soldier blocks. Reinforced filling is required in this area where end cast once needed only a move to reinforce blocks with a further reduced and tightly controlled casting cavity.

CIRCULARITY

A first step towards circular economy is reducing the quantity of materials needed to achieve a similar performance. Extending furnace lifetime and maximising the use of the refractory asset through the use of high quality refractories and targeted repair service operations can support this objective. At the end of the production lifecycle, all glass furnaces face the same issue: a high quality product becomes waste, and in some cases even hazardous waste. Several established providers in the market are offering demolishing and waste-evacuation services. Some offer the revalorization of waste materials transformed and recycled into new raw materials. The responsibility of the glass industry for the 'afterlife' of their process materials becomes even more evident



Bottom paving solutions: Yttrium doped AZS paving ER 2010 RIC tiles with ERSOL SL safety layer



XILEC 9 Electrode block

when refractories can get classified as hazardous waste at the time the furnace is shut down - such as for materials containing chrome oxides.

Conscientious exposure with the question of what happens to those materials does not stop after they are evacuated and removed from the site. Many sustainability charters include the treatment of waste material and drive the glassmakers' responsibility yet further.

Those questions become particularly sensitive in countries where legislation holds the furnace owner responsible even beyond the evacuation of the waste materials. It becomes crucial in such places to find a service provider that grants approved utilisation.

Refractory suppliers are part of the third objective of the glassmaker, namely that of selecting refractory providers which can ensure a high use of secondary raw materials and a low carbon energy mix - a key competitiveness factor for glassmakers in the years to come.

CONCLUSION

The glass industry faces the paradigm-shifting challenges of carbon-neutrality and circularity. This journey will mobilise all industry partners working together to achieve ambitious targets. As a part of the glass industry, dedicated refractory suppliers and their service providers have a key role to play and can support glassmakers in the transition by relying on their refractory expertise, innovation capabilities and customer centric approach. ■