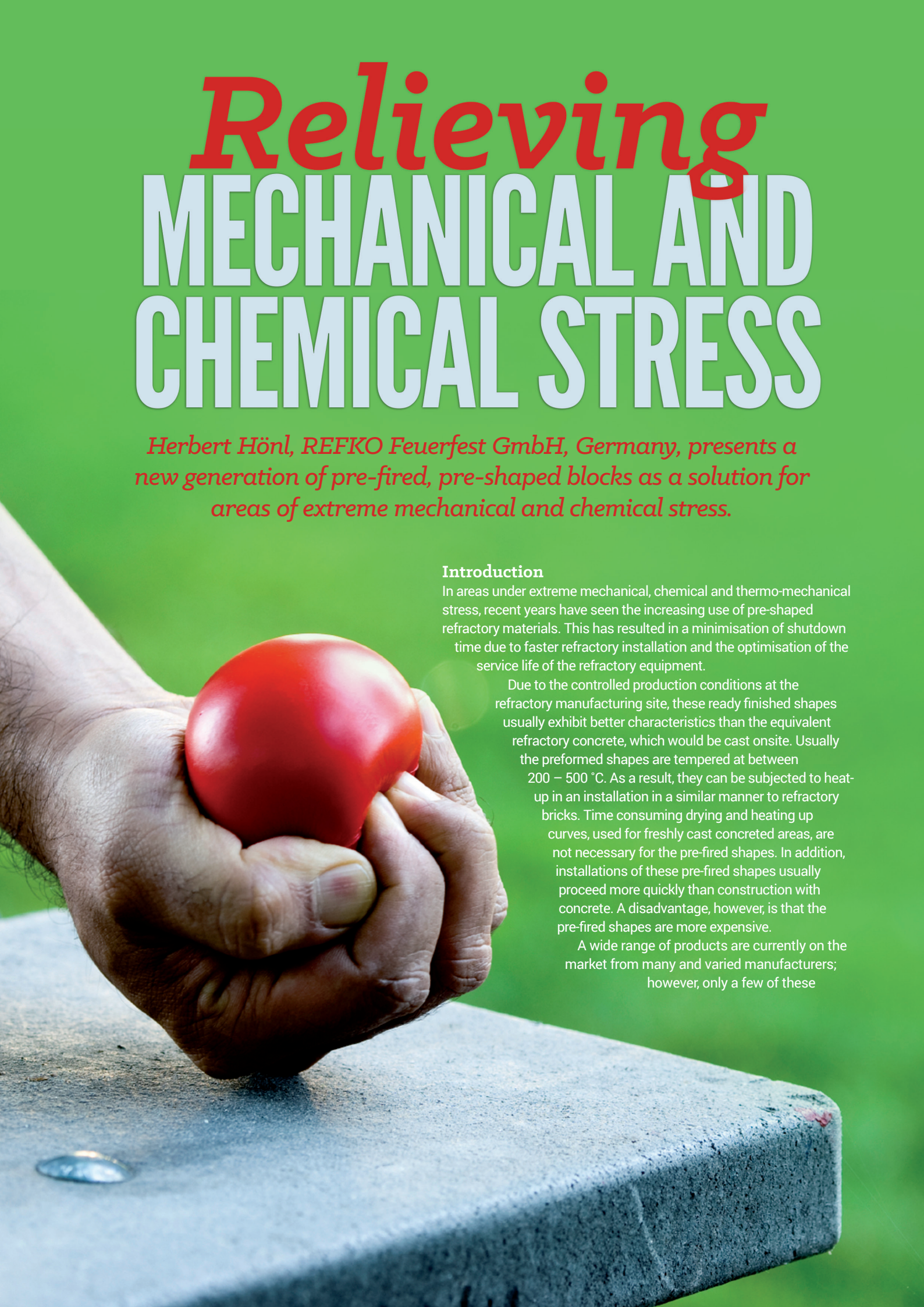
Relieving MECHANICAL AND CHEMICAL STRESS

Herbert Hönl, REFKO Feuerfest GmbH, Germany, presents a new generation of pre-fired, pre-shaped blocks as a solution for areas of extreme mechanical and chemical stress.



Introduction

In areas under extreme mechanical, chemical and thermo-mechanical stress, recent years have seen the increasing use of pre-shaped refractory materials. This has resulted in a minimisation of shutdown time due to faster refractory installation and the optimisation of the service life of the refractory equipment.

Due to the controlled production conditions at the refractory manufacturing site, these ready finished shapes usually exhibit better characteristics than the equivalent refractory concrete, which would be cast onsite. Usually the preformed shapes are tempered at between 200 – 500 °C. As a result, they can be subjected to heat-up in an installation in a similar manner to refractory bricks. Time consuming drying and heating up curves, used for freshly cast concreted areas, are not necessary for the pre-fired shapes. In addition, installations of these pre-fired shapes usually proceed more quickly than construction with concrete. A disadvantage, however, is that the pre-fired shapes are more expensive.

A wide range of products are currently on the market from many and varied manufacturers; however, only a few of these

Figure 1. ZSI alkali bursting test, in comparison with unprotected and SiC materials.

Figure 2. Wall construction procedure.

products deliver the full potential possible from this type of refractory. It is Refko's intention to realise the optimum performance from these components and, by extending the service life of refractory equipment, increase the advantage for the end user.

By means of a specific choice of raw materials and an optimised production process, together with modern design concepts, the company produces high performance systems of pre-fired, ready-shaped, refractory components: the Refko RR and Refko RR-Z systems.

Material

Due to the increased use of secondary fuels, the demands on refractory materials have massively increased in recent years. Onerous conditions, such as aggressive alkali attack, must be mastered. In part, the introduction of high amounts of SiC into the refractory mixes could solve this problem.

However, a passive oxidation of the SiC raw material (caused by the presence of an atmosphere containing water vapour) due to the use of wet secondary fuels, is to be avoided.

To address this problematic application, Refko has introduced its ZSI technology. The technology is based upon a combination of Zirkon-based raw materials and a low SiC content. The products of the ZSI range have given excellent results over many years of use in parts of cement kilns subject to great duress. Figure 1 illustrates one of the advantages of the ZSI technology, shown by the alkali bursting test.

Unprotected materials undergo an extreme degree of volume expansion, and even destruction, due to the forming of minerals high in alkalis. SiC-rich mixes (ca. 60% SiC) withstand the effects of the alkalis and the structure is maintained. Nevertheless, occurrences of infiltration can be detected that, with time, will lead to a deterioration in the mechanical and thermo-mechanical properties. If a moist atmospheric presence is added, the SiC will convert to SiO_2. As a result, an extreme volume expansion will occur, which is similar to alkali bursting. ZSI products, on the other hand, develop a clear border layer that prevents alkali bursting and passive oxidation from taking place. The material characteristics are maintained over a long period.

Production

An advantage of pre-fired, finished shapes is that they are made in the factory using carefully controlled preparation of the refractory materials. Refko makes use of the most modern mould-making techniques, mixing equipment, vibration tables and dryers and kilns. The personnel are trained accordingly and have gained years of experience in the manufacture of pre-shaped refractory materials.

The company's LCC-concrete REFCAST V 663-ZSI serves as the basis for all of the finished pre-fired shapes. These are produced in many different shapes using optimum conditions and with the help of vibration. After curing/drying the process is completed with a ceramic firing operation. The firing temperature usually lies well above the temperatures at which the product is to be used in service later. This method of manufacture for Refko's systems differs distinctly from those used by most of the other companies producing pre-shaped materials for the market. By means of the firing process, ZSI-HF-S quality develops excellent characteristics with regard to mechanical strength and resistance to chemical attack, whilst simultaneously having a high thermal shock resistance. Due to the ceramic firing process, the reduced porosity permanently hinders penetration and the adhesion of cement raw material powder or clinker/slag.

Design

The company observed the following guidelines when designing its pre-shaped materials:

- Simple installation from the kiln interior outwards.
- No damage to the existing sheet steel structure (e.g. by the drilling of holes).
- The possibility to exchange individual shapes.
- No casting of any anchors inside the pre-shaped block. As a result of this, the component can be used again, even in the case of a premature wearing of the metallic anchorage. Only the metal anchors have to be replaced and the expensive refractory shapes can be reused.

Examples in use

Cooler sidewall

As shown in Figure 2, loops are fixed onto the steel plate and special adjustable anchors are hung onto these. The

Figure 3. Installation of a cooler sidewall in REFKO ZSI-HS-F Standard blocks.

Figure 4. Drawing of tyre chute.

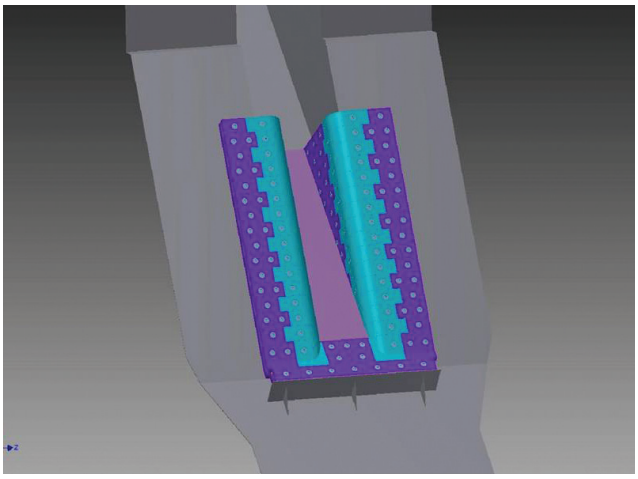


Figure 5. Completed tyre chute.

finished shapes are then screwed into place. After fixing any necessary subsequent course of shapes into position, this row of blocks is back-filled with insulating castable material. To protect the metal connection, the hole is sealed off with a ceramic screw.

Figure 3, which illustrates the installation of the system, indicates at the same time the difficulties experienced with the normally available block installation systems. In this case, normally available blocks supplied by a market leader were installed before the Refko blocks. Those blocks were screwed into position from the outside through holes in the steel plate and the result was an almost unusable, perforated steel plate. Furthermore, the anchors were completely cast into the refractory blocks. After just one year in service, the blocks fell out due to corrosion of the anchors. All of the shapes had to be replaced, even though the refractory concrete part of the blocks still looked almost new.

As this widely available system offered no possibility of renewing the anchors, or of using an alternative anchor material quality, the result was a total loss and inconvienience for the end user.

Tyre chutes

For areas with slopes, the company has developed the RRZ-system (Figure 4 and Figure 5). As an extension to the standard system, this is installed on distance spacers and is fitted with a flexible-gap system, which in this case also permits the exchange of individual blocks. The exchange of individual metal anchors and the re-use of blocks is also possible.

This system was installed in a tyre chute that had suffered for years under extreme stress: for example, the intensive use of high-pressure water cleaning systems. For the operator, the tyre chute was an area of the plant requiring an extreme degree of very costly maintenance. Generally available pre-shaped block systems from other manufacturers were worn out in the shortest possible times.

With a combination of the Refko RRZ-system, the Refko Honeycomb system and reinforced ZSI concretes on the edges, it has been possible to significantly reduce a previously troublesome problem.

Conclusion

Refko has considered the problem areas of cement kilns and developed a solution using pre-fired, pre-shaped refractory blocks that differs from the readily available products already on the market and offers the end user significant service life and cost saving advantages. In addition to the beneficial characteristics of the Refko-ZSI materials, the possibility to exchange individual blocks and metallic anchors could set new standards for the future.

Acknowledgement

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