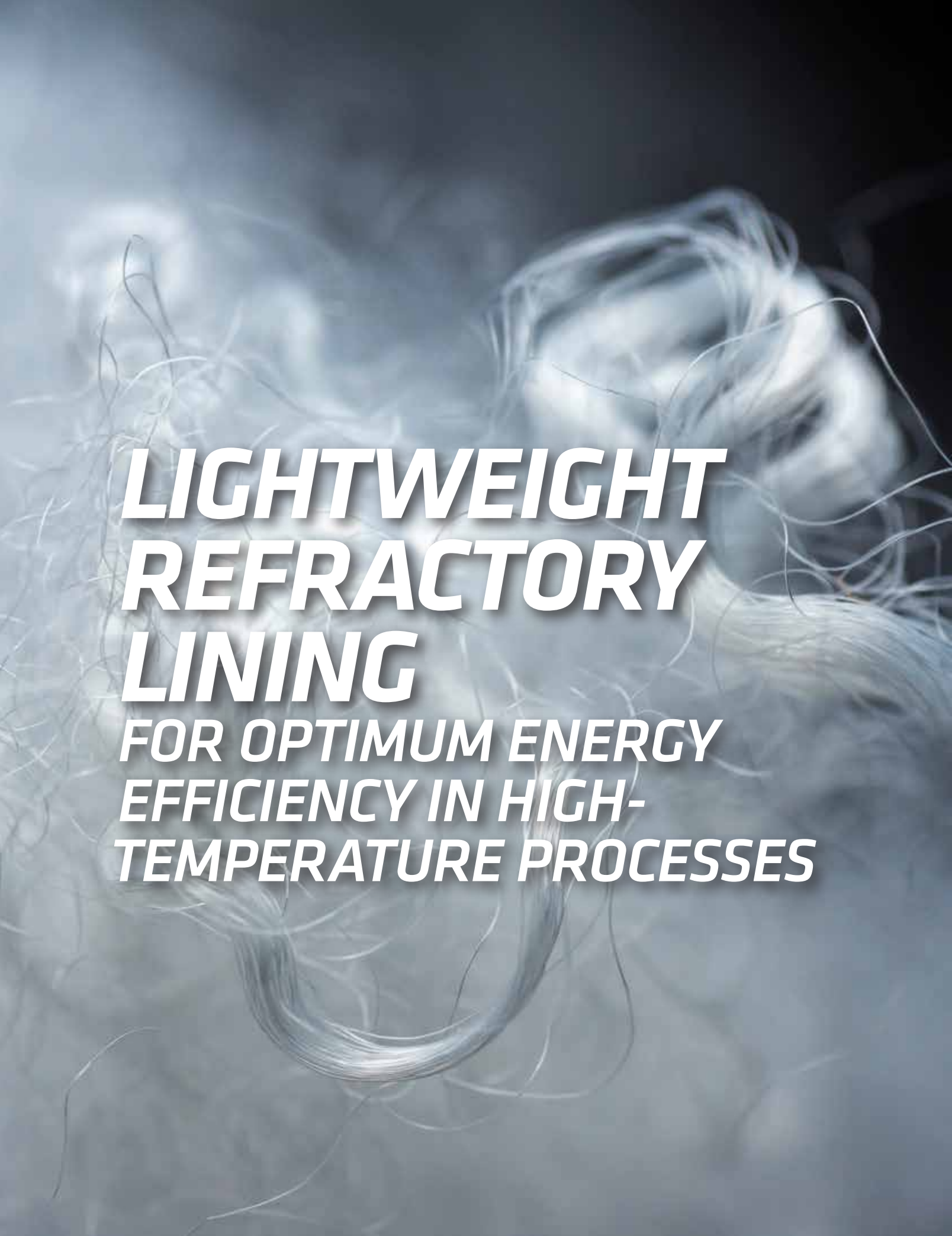

LIGHTWEIGHT REFRACTORY LINING

FOR OPTIMUM ENERGY EFFICIENCY IN HIGH-TEMPERATURE PROCESSES

The targeted combination of certain physical properties makes high-temperature wool exceptionally energy-efficient, and, combined with common refractory materials such as bricks and concretes, it is the ideal complement for a complete refractory lining.

By RICHARD JÄGER

All industrial sectors with high-temperature processes, from ceramics to metal and steel, face major challenges related to energy and environmental issues, including the need to reduce energy consumption, decrease pollutant emissions, and lower the CO2 footprint. In this context, optimal refractory linings for high-temperature furnaces play a key role. Linings tailored to specific production processes can significantly contribute to energy savings, with lightweight and ultra-lightweight refractory linings increasingly being used in these efforts.

For example, the brick industry also faces the challenges mentioned above. Refractory lining is a critical factor for achieving energy savings in the production processes of this energy-intensive sector. The use of lightweight or ultra-lightweight refractory linings for high-temperature kilns represents a key development here, and offers significant advantages: reduced heat losses, simplified repair procedures, and reduced downtimes. It not only makes repair and maintenance work more efficient but also results in substantial energy savings.

This is demonstrated by the lightweight lining of a tunnel kiln car that RATH has developed for a company in the European brick industry. With the newly designed tunnel kiln car, which absorbs very little process heat, RATH has been able to show that equipping it with lighter refractory materials can lead to savings of up to 70 percent in its specific energy consumption, without changing the process parameters or the dimensions of the furnace.

ALTRA® 1500C is a non-classified polycrystalline high-temperature wool, available as bulk fiber, blankets, or modules. It has been optimized for applications of up to 1,400°C. (Courtesy: RATH)

HIGH-TEMPERATURE INSULATION WOOL

With a comprehensive and versatile product range, RATH offers a variety of refractory lining options, including dense bricks, concretes, insulating bricks, components, and high-temperature wool. The latter in particular plays a crucial role in lightweight refractory linings and enhanced energy efficiency. The targeted combination of certain physical properties makes high-temperature wool exceptionally energy-efficient, and, combined with common refractory materials such as bricks and concretes, it is the ideal complement for a complete refractory lining.

CASE STUDY: PROVEN SUCCESS IN REFRACTORY LININGS

As part of its ongoing research and development work, RATH has been working intensively on high-temperature insulation wool for a long time and is now offering a new product designed to help companies meet the challenge of operating more sustainably. ALTRA® 1500C is an enhanced version of the proven polycrystalline wool from the ALTRA® brand. This non-classified polycrystalline high-temperature wool, available as bulk fiber, blankets, or modules, has been optimized for applications of up to 1,400°C. In addition to excellent cost efficiency, it offers several benefits, including extended service life and highly efficient thermal insulation that helps to reduce costs. Lightweight and strong, this high-temperature insulation wool is easy to handle and install.

ALTRA® 1500C is ideal for applications involving rapidly alternating heating and cooling cycles. In recent months, it has been successfully used by several steel and metal companies in Austria and Germany, including as linings in the roof, wall, and door areas of bogie hearth forging furnaces, chamber forging furnaces, rolling mill furnaces, walking beam furnaces, and rotary hearth furnaces.

The use of non-classified high-temperature insulation wool (HTIW) is becoming increasingly important. Fibers with low biopersistence serve as non-classified alternatives in some processes, but they are limited in their thermal and chemical resistance. Polycrystalline fibers are also non-classified due to their unique microstructure and high fiber diameter, but their performance often far exceeds the requirements of the processes, while the investment costs are higher compared to other HTIWs. ALTRA® 1500C has been specifically tailored to offer all the advantages of polycrystalline fibers while being more economical in terms of investment costs.

COMBI-MODULES MAKE HEAT TREATMENT FURNACES MORE ENERGY-EFFICIENT

There are various ways to line a furnace optimally, whether with high-temperature wool, lightweight refractory bricks, concrete, or dense bricks. The key is to find the most effective solution for maximizing energy efficiency. A prime example is the use of combi-modules in bogie hearth forging furnaces in the metal and steel industry, where they are crucial to the smelting process. The intermittent operation, the need to treat various grades of steel individually, and the diverse processing techniques all require refractory materials with both mechanical resilience and chemical resistance. The optimum mix of heavy and light lining meets the extremely high demands in terms of wear. That means, for example, a bogie hearth forging furnace is lined with a mix of different products: RATH Combi-modules in the upper furnace and roof, but dense castable solutions for the lower walls and the kiln car, which guarantees optimum, energy-efficient lining.

Combi-modules are one of many proven products RATH relies on, e.g. for the refractory lining of forging furnaces: A combination of different high-temperature wool qualities provides a technically and economically optimal solution for the customer. These modules are available according to specific customer requirements and are produced at the RATH plants in a wide variety of shapes and sizes.

RATH developed lightweight lining for a tunnel kiln car, which now absorbs very little process heat. (Courtesy: RATH)

RATH's engineering experts present the technologically optimal lining for the plant. (Courtesy: RATH)

CREATING THE RIGHT BASIS FOR THE OPTIMAL REFRACTORY LINING

Every refractory lining, regardless of which products are used, requires a detailed analysis beforehand. This is the only way companies can effectively use refractory materials to help save energy and reduce costs. After all, energy savings always result from the interplay of many factors working together to deliver a sustainable outcome.

The first step in this analysis is to define the basic requirements before each installation. The approach varies significantly depending on whether the plant is being newly built, completely or partially renovated, or merely refurbished. The next step is to clarify the specific objectives for the planned refractory lining. While cost reduction is often a key factor, environmental concerns or technological objectives can also come into play.

It is equally important to analyze the plant and its operating parameters. Factors such as periodic or continuous operation, dimensions, operating temperature, temperature curve, and frequency of use of a plant are just a few of the critical elements to consider. Additionally, the specific operating process, the materials being heated and the atmosphere in which this occurs play a crucial role. These factors, alongside the technological considerations, represent vital business components and must be fully accounted for.

The next step involves calculating energy performance, where all relevant parameters are compared. Some parameters complement each other, while others may conflict. Scenarios are developed to evaluate the effects of different lining concepts. At this stage, the analysis can be refined and the outcome can be optimized by adjusting specific factors.

The final step: RATH's engineering experts present the technologically optimal lining for the plant, along with the potential savings (in kWh). In addition, a business assessment is drawn up for the plant adaptation, followed by a proposal for the procedure. RATH's ECOREF analysis and concept approach, developed for such in-depth evaluations, has been successfully implemented by numerous companies in recent years.

ABOUT THE AUTHOR

Richard Jäger, RATH, has been responsible for the Metals & Fuels, Chemicals and Energy sales division worldwide since 2021. He has worked for the international refractories manufacturer for 19 years. RATH specializes in refractory technology with a broad product range of refractory materials for application temperatures of up to 1,800°C. RATH AG, headquartered in Vienna, has established itself internationally as a renowned supplier of refractory solutions, with about 600 employees and sales representatives in several countries worldwide. The RATH Group manufactures a wide range of innovative, high-quality refractory products at a total of seven production sites in Europe (Austria, Hungary, Germany) and the U.S. For more information, go to www.rath-group.com/en.