Sustainability meets intelligence—shaping the future of refractories at UNITECR 2025

In the age of the Fourth Industrial Revolution,[1] the refractory industry continues to make great strides toward adopting sustainable practices.

As most refractories are extracted from natural materials, developing environmentally friendly mining practices remains vital to the industry. Additionally, the high temperatures required during refractory manufacturing use significant energy from fossil fuels, which can contribute to greenhouse gas emissions. Common refractory materials also contain carbonate minerals that release CO_2 when heated during processing, which makes it challenging to immediately reduce greenhouse gases in this sector.[2]

Despite some of the challenges that come with fostering a sustainable future in the refractory industry, there are also many opportunities on the horizon. For example, the carbon footprint of the refractory industry can be reduced by using renewable energy to power industrial processes, implementing water waste management and storage protocols, and reusing mining waste.[3]

Also, methods to recycle, reuse, and responsibly source refractory raw materials have gained traction. In 2023, the European Union adopted the Critical Raw Materials Act (CRMA), with one goal being to increase the EU's domestic ability to extract, process, and recycle critical raw materials by 2030.[4] In June 2023, the EU announced proposals to emphasize this aspect of the CRMA, with goals to raise the level of processing capacity to 50% and recycling capacity to 20%.[5]

Looking ahead, emerging technologies such as artificial intelligence (AI) and machine learning (ML) can help support sustainability through better mining, manufacturing, and use of refractory materials. For example, from an equipment maintenance perspective, AI and ML algorithms can recognize patterns in data, effectively minimizing energy consumption. Digital sensors in kilns can keep track of conditions in real time, while predictive algorithms can anticipate equipment malfunctions or refractory corrosion through analyzing historical equipment data.[6]

These technologies can also minimize risk to employees and improve safety measures in the workplace. Due to the high temperatures used in blast furnaces, it is nearly impossible to predict the state of the inner refractory lining without shutting down the machine for human assessment.[1] AI and ML technologies may also affect areas such as thermal efficiencies, pollution mitigation, and waste reduction, which all have strong impacts on sustainability.

In recognition of the refractory industry's sustainability efforts, the theme for this year's Unified International Technical Conference on Refractories (UNITECR) is "Sustainability Meets Intelligence – Shaping the Future of Refractories." The goal is to spark conversations around sustainability in the refractory industry through collaborating with all types of refractory industry sectors, including extraction, processing, manufacture, deployment, maintenance, and recycling.

UNITECR 2025, which will take place in Cancun, Mexico, on Oct. 27–30, 2025, invites everyone with an interest in these topics to join the conversation and push boundaries in an enlightening atmosphere. Visit https://unitecr2025.com to register for UNITECR 2025 and learn even more about sustainability in the refractory industry.

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About UNITECR

The first Unified International Technical Conference on Refractories (UNITECR) took place in Tokyo, Japan, in 1987. Founding members include The American Ceramic Society, Latin American Association of Refractories Manufacturers, German Refractories Association, and Technical Association of Refractories, Japan.

Since its inception, the biennial conference has served as an influential forum for the international refractories community to exchange industry ideas and knowledge. This year, the organization of UNITECR is led by president Daniel Llaguno and vice president Jessica Fernández. ■

References

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