Dismantling a spent furnace lining can yield sought-after refractory minerals after sorting, cleaning and processing
Image: REF Minerals

Refractory mineral recycling

The smart solution for sourcing and the circular economy

Refractory minerals recycling has never been more important in both today's and tomorrow's refractory markets.

With refractory manufacturers' over reliance on limited mineral sources, vulnerable supply chains, the prevailing climate of tariff implementation and ongoing threats of more disruption, recycling refractory minerals provides a welcome and necessary alternative source option.

Moreover it rightly reinforces the refractory industry's 'green' credentials, in getting serious about adopting suitable practices that contribute to the circular economy and help the environment in general.

Since 2016 IMFORMED has been successfully hosting its Mineral Recycling Forum event, highlighting the latest trends and developments in recycling industrial minerals across a range of consuming markets including the steel refractories sector, while bringing together the leading players pioneering this swiftly evolving minerals industry sector.

Europe is leading the field in refractory mineral recycling but other regions and countries are catching up quickly, such as Turkey, India and South Korea.

Seen and heard

Last year's event revealed exciting developments in recycling refractories, andalusite, graphite, alumina and ceramics. These are just a few of the presentation highlights from 2025:

Remining, recycling & reshoring of critical minerals for the refractory industry by Ellis Sullivan, CEO and founder of ROC Minerals, USA

ROC Minerals is a development partnership working to build the next generation of American midstream mineral infrastructure to provide a cleaner, safer, more secure future.

Specific to refractory minerals, the US is currently import dependent on most of them, which is why there is strong bipartisan support for reshoring mineral production capacity, including mining, processing, refining and the recycling of mineral waste streams.

Remining is all about tapping into the overlooked value sitting in tailings ponds, mine dumps and other legacy waste sites across the US – they are untapped resources potentially rich in critical refractory minerals.

The next pillar is recycling, which is about converting by-products, spent materials and scrap metals into high-purity inputs for the refractory industry.

Lastly, reshoring is the backbone of ROC Minerals' mission. This is where everything comes together: domestic mineral inputs, clean tech processing and infrastructure investment in the US.

ROC Minerals is building out the midstream capacity to connect these recycled and remined feedstocks to downstream industries, under tolling and offtake agreements with mining companies, manufacturers and commodity brokers.

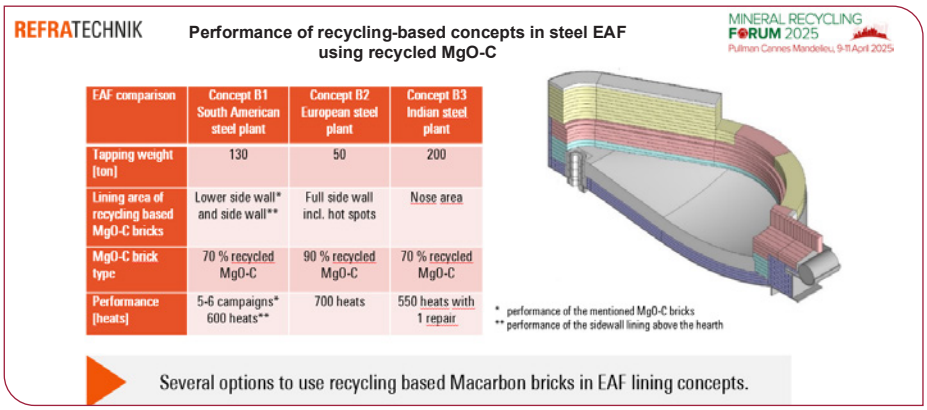
Ellis Sullivan highlighted examples, such as ElementUSA activities in refractory brick recycling and red mud recycling, plus Evergreen Alumina's patented process technology for recycling secondary aluminium salt dross.

Developments in glass refractories dismantling, recycling and waste management by Werner Odreitz, CEO, REF Minerals, Germany

Werner outlined the different glass furnaces and explained the anatomy of a typical glass furnace, highlighting the specific refractory materials used in their locations.

Dismantling operations were explained for glass, glass fibre, quartz glass and container

Careful demolition and sorting are required for successful recycling of spent refractories
Image: REF Minerals



glass furnaces, plus regenerators and feeders, before emphasising the importance of the next stages of sorting, waste management, cleaning and then processing the recovered materials.

MgO-C recycling by Dr Helge Jansen, managing director, Refratechnik Steel, Germany

Helge's presentation covered the sources and technology of MgO-C recycling, technical features, the performance of recycling-based concepts in the steel industry, what the refractory-maker needs, as well as issues and limitations.

Recycled raw materials will gain more importance with the pressure to use products with a low carbon footprint

With the highest quality MgO-C recycled material it is possible to create bricks with elevated properties in portions of 50% or even more. However, these bricks are not suitable for areas with high loads, such as the BOF, EAF and ladle.

In smartly designed concepts, high grade recycling materials can improve the performance of the refractory lining. Depending on the quality of the recycled MgO-C, it can be used for different applications.

In summary, recycled raw materials will gain more importance with the pressure to use products with a low carbon footprint and the chance of lowering the raw material dependency from China. Quality, consistency and sustainability of supply are the dominant features that users of MgO-C-Rec require.

Smart research strategies to boost secondary raw material use in refractories by Dr Kerstin Hauke, research associate, Forschungsgemeinschaft Feuerfest, Germany

The technical challenges in recycling refractory materials can be sorted into three categories: quality and availability; processing properties and high temperature properties.

Kerstin Hauke explained the refractory mineral andalusite, its chemistry, the challenges in sourcing the material (limited availability, import dependence) and pricing.

Solutions can include substitution of andalusite in the matrix, secondary andalusite in the coarse fraction, plus high quality andalusite matrix and secondary andalusite in the coarse grain fraction.

Three key properties need to be understood and tested in refractory materials: corrosion resistance, thermal shock resistance and volume stability.

The research at FGF is ongoing, with the team directed in answering:

- Which material properties are really relevant for my area of application?
- Which component leads to good high-temperature properties?
- Which test facilities reflect the conditions that prevail in the use of my refractory material?
- Does my product meet the required high-temperature properties with the recyclate-containing refractory material?

Graphite recycling in South Korea by Yongdon Joo, CEO, Korea Material, South Korea

Korea Material operates three recycling plants and processes on average about 3000 tpm (max. 7000tpm) of a range of materials including silicon carbide, calcined and fused aluminas, graphite, mullite, magnesia, chamotte and pyrophyllite.

Regarding graphite recycling, the company uses physical and chemical processes to produce graphite powder and recarburiser used in refractories, steelmaking and casting.

A research project is currently underway to recycle graphite from black mass recovered from used batteries, achieving initially fixed carbon grades of 80-87%, thereafter using a wet purification process and heat treatment to achieve a fixed carbon grade of more than 99%.

The purified graphite can be used for high purity recarburisers and secondary battery anode material. Work is also ongoing to recycle alumina catalysts.

Recycling induction furnace refractory lining in Turkey by Nafiz Özdemir, general manager, SİMBİO REFCYCLE, Turkey

Presented by Nafiz Özdemir and Dr Beyhan Özdemir, this paper revealed a growing refractory recycling market in Turkey, with a focus on induction furnace (IF) lining recycling.

With an annual consumption of 260,000 tonnes of refractories in Turkey, a waste refractory volume of 60,000tpa has been estimated.

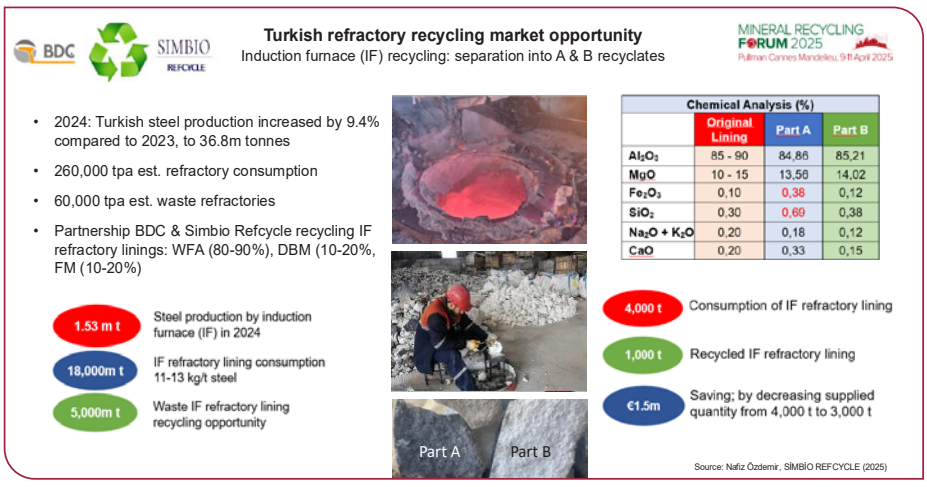
The main components of an IF refractory lining were outlined as white fused alumina, fused magnesia and dead burned magnesia. Careful demolition, separation, classification and processing can yield usable recycled material that can replace 25% of the original required IF lining materials each year.

Conventional and alternate comminution processes by Dr Karl Friedrich, research associate, Mineral Resources Engineering, University of Leoben, Austria

Friedrich outlined the ReSoURCE project before going on to examine upscaling electrodynamic fragmentation, and comparing conventional and alternative comminution processes in liberation evaluation.

The ultimate objective of the project is to develop automated sorting solutions for refractories with the following features:

- High reliability and robustness
- Handling of entire breakout, including fines
- The highest sorting accuracy for spent refractories
- Mobile character to enable local sorting at customers
- Approved sustainability benefits by LCA
- Enable material usage for alternative products.



In 2024, RHI Magnesita & MIRECO developed MAESTRO to transform the handling of recycling at scale. Image: RHI Magnesita

It's all about sorting: the future of refractory recycling by Alexander Leitner, head of pioneer research, RHI Magnesita, Austria and Lucas Zimmermann, head of project management, MIRECO, Germany

This presentation illustrated the latest pioneering innovations for sorting waste refractories developed by MIRECO and RHI Magnesita – summed up with the phrase "From dusty gloves to digital eyes – A sorting evolution".

Key attributes for a modern sorting system were highlighted as smart sensors, smart engineering, smart people and real experience.

Representing another facet of the EU Horizon ReSoURCE project, two complementary new generation digital mobile plant concepts were launched in December 2024. The result has been the successful development of the MIRECO MAESTRO – Mobile Automated Efficient Sorting Technology for Recycling Operations, and the RHI Magnesita RAPTOR – Refractory Automated Precision Technology for Optimised Recovery.

The presentation claimed that utilising traditional manual sorting methods would result in one chemical analysis conducted per 25 tonne batch, compared with using MAESTRO/RAPTOR which would result in 10,000-1,000,000 analyses per 25 tonne batch.

Recycling spent refractories by Marc Faverjon, sales engineer, Deref, Italy

Marc Faverjon's presentation focused on the treatment and recycling of spent refractories from a CO_2 emissions viewpoint, and use of the company's developed ReStoRe technology (REfractory and STeel REcovery).

Under examination in steelmaking in particular, were spent refractories; the impact of refractories and lime on CO_2 emissions; treatment of spent refractories; recycling of basic refractories to cut costs and reduce CO_2 impact; transport and energy impact on CO_2 emission saving; and off-site recycling alternative scenarios.

Refractories contribute to the CO_2 emissions of the steelmaking process, but recycling of spent refractories allows a substantial reduction of this impact.

Most of the savings are obtained by steel scrap recycling and reuse of basic granulates, in substitution of lime inside the steel process itself (as implemented by ReStoRe technology).

Recycling of some qualities for new refractory production also contributes to saving CO_2 emissions, if recycling is carried out in nearby countries. ReStoRe technology which combines on-site and off-site recycling allows maximisation of the CO_2 saving.

This year IMFORMED is back on the French Riviera in springtime holding the Mineral Recycling Forum 2026, in Mandelieu-La Napoule, near Cannes, 15-17 April 2026, with a superb panel of expert speakers.

Author

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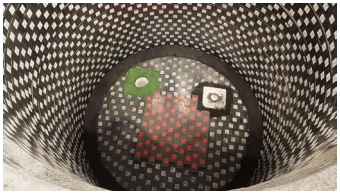

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