

Germany

## UNITECR 2023: An Event of Superlatives

The German Refractories Association was the organiser of the 18<sup>th</sup> biennial World Refractories Congress UNITECR and hosted 1122 visitors at Kap Europa in Frankfurt from 27–29 September 2023. The motto “The Carbon Challenge” alluded to the role of the refractories sector in the global transformation of the user industries towards CO<sub>2</sub>-neutral production of steel, glass, cement, non-ferrous metals, chemicals and many other products. The oral presentations and panel debates were framed by a large poster show, including a poster slam and a trade exhibition.

### Introduction

Over three days, UNITECR 2023 offered an excellent platform for exchange between experts from the worldwide refractory sector together with professionals from the user industries.

The statistics published by the organisers confirmed impressive figures – real superlatives:

- as many participants (1122)
- as many speakers (219)
- so many proceedings pages (894)
- so young (53 % <45 years)
- so many women (237)
- so many countries (48)

and also important – about 100 delegates from the end-user industries.

### Welcome addresses

The transformation under competitive conditions is a major challenge for all stakeholders, be it from business, industry or society. This transformation is only possible with the help of refractory products. Without refractory products, there will be no wind power plants, no photovoltaic plants, no DRI, no hydrogen. The refractory industry is an essential technology partner for the entire industry and stands ready with all its know-how to help, shape and develop the processes of the future.

Andus Buhr (Fig. 1), UNITECR President, said: “The Carbon Challenge: steps and leaps to master the future” is not only our motto at UNITECR but also in the coming years as we drive forward the transformation of our industry”. He continued:



**Fig. 1** UNITECR President 2023 Andus Buhr

(Source: Jenny Wolf)



**Fig. 2** UNITECR Vice President Prof. Dr Christos Aneziris (Source: Jenny Wolf)



**Fig. 3** Dr Marie Jaroni, thyssenkrupp Steel (Source: Jenny Wolf)

"Refractories are an important tool for the energy-intensive high-temperature industries that are striving towards reduced CO<sub>2</sub> emissions and achieving carbon-neutrality in the not too distant future. Steps or incremental improvements of refractory materials and lining concepts enable lower heat losses in processes. This aspect is gaining momentum in the industry. Disruptive technology changes such as carbon-neutral steel production and the replacement of fossil fuels in high-temperature processes require leaps in refractories and lining concept development. Both steps and leaps are addressed in our technical programme."

An important element is the recycling economy to conserve limited resources and reduce the ecological footprint in the refractory industry. Regional value chains with close cooperation between suppliers, users and other stakeholders involved are essential. There are good examples of this already taking place. Modern tools such as big data analysis, machine learning, and the development of suitable models help to increase the speed of innovation in our industry. The job of a refractory engineer offers interesting challenges for young talent, both men and women. It provides meaningful work by contributing to new technologies enabling reductions in CO<sub>2</sub> emissions.

In his role as UNITECR Vice President, Prof. Dr Christos Aneziris stated: "In 2003 in Osaka, ECO Refractories for the Earth" was the main message at UNITECR. 20 years later, as a response to the global climate and energy challenges, this sustainable trip to ITHAKA is the main topic of UNITECR 2023 in Frankfurt for all industries as well as the refractories sector. And doubly so at this UNITECR; our discipline deals with sustainable materials for high-temperature processing as well as for sustainable processing of high-temperature materials. It is a unique opportunity for our materials, not to be used only as hidden heroes, but to show to the world that we can successfully meet this challenge with our materials, with refractories.

I am very happy that more than 219 lectures, more than 50 posters accompanied by an Open Access Scientific Special issue of the European Ceramic Society are contributing to a better understanding of their thermomechanical, thermochemical as well as their functional properties, from basic sciences up to application, providing an excellent tool for continuous development and engineering solutions with consideration of ecological as well as economical aspects; the electrification of high-temperature processes or the processing in new CO<sub>2</sub>-free atmospheres gets a "refractory colour of innovation". Everything is flowing, "ta panta rei" as Heraclitus mentioned two and half thousand years ago, and please keep in mind, not only one way will bring us to ITHAKA; different combinations of firing, hybrid firing, composite smart refractory material systems, supported by computational materials design, will give the answers for these emerging and challenging topics. UNITECR is the chain of knowledge-exchange for all members all over the world, as a stimulus for the generation new ideas, networks and perspectives in the disciplines of high-temperature processing and high-temperature materials."

He expressed his thank to the members of the Scientific Committee: Dr Christoph Wöhrmeyer, Prof. Dr Olaf Krause, Prof. Dr



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## Opening and keynote session

In the opening session, Andus Buhr reflected on various aspects that led to the selection of specific themes under the conference motto.

At the UN Climate Change Conference 2015 in Paris (COP21), the first legally binding international treaty on climate change was signed (Paris Agreement). This has meanwhile been adopted by 196 countries and only eight countries are missing globally. This also set the scene for this conference. Its overarching goal is to hold "the increase in the global average temperature to well below 2 °C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1,5 °C above pre-industrial levels." The EU's Green Deal defines a target of being climate neutral by 2050, and reducing CO<sub>2</sub> emissions by 55 % by 2030 ("Fit for 55"). Germany targets climate neutrality by 2045.

Refractories are needed for all high-temperature processes. These materials are the basis for civilization and our way of life; annually about 1,8 Gt of steel, 4,2 Gt of cement; and 36 Mt of refractories.

Fossil fuels used in production processes, leading to a carbon footprint of about 2 t CO<sub>2</sub>/t for steel, 0,7 CO<sub>2</sub>/t for cement, 1,5 t CO<sub>2</sub>/t for refractories (raw materials have a big share). Countermeasures against global warming require a drastic reduction in CO<sub>2</sub> emissions and therefore carbon/fossil fuels are to be replaced by hydrogen both, as fuel and as a reducing agent, for example in steel production.

New technologies and processes will have an impact on the refractory linings of furnaces and vessels, and R&D is necessary to develop new materials and lining concepts to cope with new challenges. This is what is meant with leaps. It will keep engineers busy for many years to come. 53 % of participants <45 years (and about 20 % <35 years) make me optimistic about achieving our targets. Working on solutions for these challenges is interesting and meaningful, it can motivate young people to become engineers or natural scientists. Energy consumption and accordingly CO<sub>2</sub> emissions are now much more in focus than 20 years ago. Refractory linings can have a significant impact on energy efficiency and CO<sub>2</sub> savings, for example through better insulating properties – typically in the back lining – but also through lower thermal conductivity and heat capacity in front linings of cyclic vessels such as steel ladles. These stepwise improvements of refractory lining concepts are also important for more sustainability in high-temperature processes. In general, it is important to see energy/CO<sub>2</sub> effects in context, not just the carbon footprint of the refractory product itself, but also what and how it contributes to energy savings and CO<sub>2</sub> reduction in application. Although this approach is not yet included in standardised and certified ways to calculate product carbon footprints. Refractory linings are safety-relevant and important for successful industrial production. Therefore, no surprise that the approach to changes



**Fig. 4** Dr Ranga Yogeshwar

(Source: Jenny Wolf)



**Fig. 5** Ulf Frohneberg honouring the plenary speakers (Source: Jenny Wolf)

is generally conservative, leading to long periods for the qualification and implementation of new solutions. Modern tools such as big data analysis, machine learning, and the development of suitable models will help us to increase the speed of innovation in our industry. Last not least, material saving thanks to low specific refractory consumption as, for example, with monolithic steel ladle linings or the recycling of spent refractories, for example of BOF and EAF bricks into high-quality steel ladle bricks, contribute to energy saving and the reduction of CO<sub>2</sub> emissions. Regional supply and value chains are an important element for successful application of recycling concepts."

Dr Marie Jaroni (Fig. 3) represented a major customer industry with her keynote. Leading the team "Decarbonization and Sustainability" at thyssenkrupp Steel, she explained how 6 Mt of CO<sub>2</sub> can be avoided by thyssenkrupp annually by 2030 in her talk: "Steel industry on the way to a decarbonized future: opportunities and challenges of the green transformation".

Moreover it was possible to win Dr Ranga Yogeshwar (Fig. 4) for a keynote. With a degree in particle physics Ranga has created and hosted numerous television programmes and has received more than 60 awards, including honorary doctorates from the universities of Koblenz-Landau/DE and Wuppertal/DE as well as an honorary professorship from Bonn-Rhein-Sieg University of Applied Sciences/DE. Today he is one of the leading independent science journalists and keynote speakers in Germany. Inspired by the world of his little grandson, he chose the title "Emil's World – A Society in Transition". Emil's generation will grow up with a bunch of new kinds of implicitness: speaking machinery, artificial intelligence, advanced medicine, changes in the way people in our society deal with one another. His world will be the result of a global transformation and the question arises about what the new priorities and values will be in this world. The talk was about the urgent need for a deeper culture-shift and what it means to grow up surrounded with talking devices, artificial intelligence and changing social interactions. The clear message was transition is not only



**Fig. 6** Panel on transformation of the steel industry

(Source: Jenny Wolf)

in the technical world, it is society that has to be taken on board and involved to make it happen. Ulf Frohneberg (Fig. 5), Chairman of the Board of the German Refractories Association (DFFI), closed the plenary session expressing his thanks to the speakers.

**Panel discussions**

In selected sessions on five hot topics, panel discussions were arranged as a new element at UNITECR, and these were very well attended. Thanks to the interactive discussion of the speakers, many crucial elements were analysed.

- Transformation of the Steel Industry: Smelting of DRI (Fig. 6)
- Transformation of the Steel Industry: Hydrogen Resistance of Refractories
- Refractories Recycling
- Monolithic Steel Ladle Lining
- Models and Digitalization in Industrial Practice.

**Gustav Eirich Award**

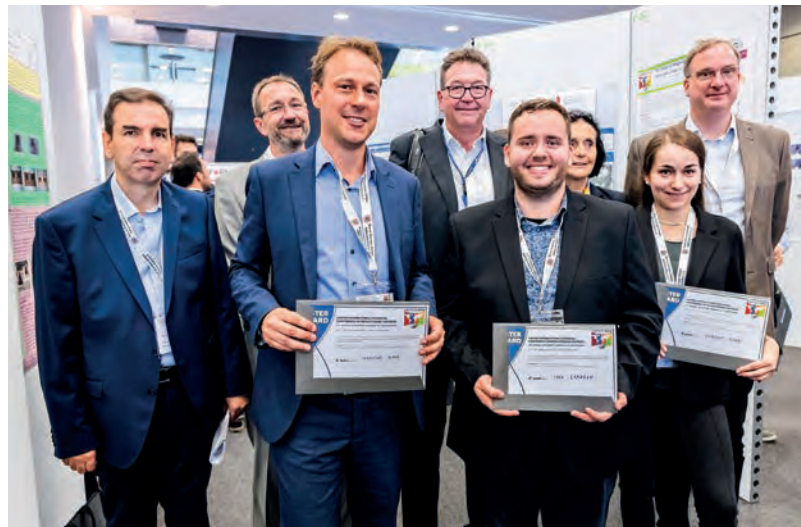
The winners presented their work in a special session dedicated to the 13<sup>th</sup> Gustav Eirich Award. Stephan Eirich, Managing Director at Eirich (see pages 20–22), presented the prizes to the winners after their presentations. The papers are published in this issue:

- 1<sup>st</sup> Prize: Audrey Tixier, CEMHTI-CNRS UPR 3079/FR (pages 54–60)
- 2<sup>nd</sup> Prize: Maciej Ludwig, Arcelor Mittal Refractories/PL (pages 46–53)
- 3<sup>rd</sup> Prize: Dominik Hahn, Calders/DE (pages 41–45).

**Poster exhibition – with poster slam**

With over 50 contributions and 30 participants at the poster slam (1 min for presenting the essence of the work), there was strong competition on a very international level (16 countries). It was sponsored by Steuler and refractories WORLDFORUM (Fig. 7). The jury awarded:

- 1<sup>st</sup> Prize: Study on Chrome-Free Purging Plug for Steel Ladles, S. Klaus (Almatis/DE)
- 2<sup>nd</sup> Prize: Understanding how the Binder System Influences the Properties and Process Performance Indicators of Taphole Clays, I. Cameron (University of Pretoria/ZA, now Elkem/NO)



**Fig. 7** Poster Award ceremony

(Source: Jenny Wolf)



**Fig. 8** Conference Dinner at Palmengarten

(Source: Jenny Wolf)



**Fig. 9** New Distinguished Life Members

(Source: Jenny Wolf)

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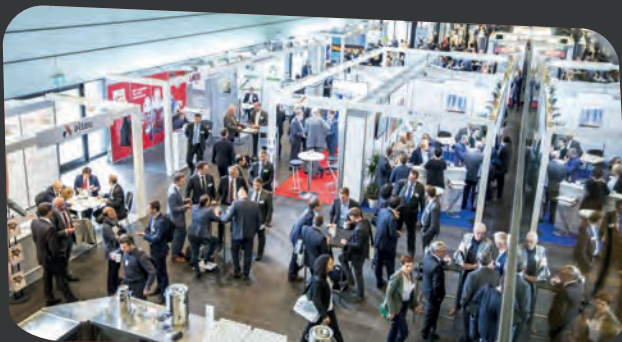


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3<sup>rd</sup> Prize: Hydrogen-Induced Attack of  $Al_2O_3-SiO_2$  Refractories – Application of SEM Techniques and Thermodynamics, I. Henn (University of Koblenz/DE).

The event “Women @ Refractories” was sponsored by RHI Magnesita and the “Young Professionals REFRAup lounge” by Refratechnik. The students met with the sponsor’s team to discuss latest developments, e.g. virtual reality.

The Conference Dinner in the famous Palmengarten was sponsored by Refratechnik (Fig. 8). One of the highlights was to honour Nancy Bunt, Chris Parr and Prof. Dr Peter Quirnbach for their contributions to the refractory society with the Distinguished Life Membership (Fig. 9).

**Conclusion**

It was an event that will have long-term impact on the community of refractory experts and their user industries.

Comment from distinguished life members: The best opening and keynote event ever, panel discussions enriched the scientific programme with input from industry and



**Fig. 10** Handing over of FIRE Certificates to the students by Dr Sido Sinnema, Secretary of FIRE (l.), Prof Dr Victor Pandolfelli (2<sup>nd</sup> l.) and Prof. Michel Rigaud (middle)

(Source: Jenny Wolf)

research, back to a real international event with 48 different nations, important contributions from delegates of the user industries. The great conference dinner at. These have been selected to reflect the positive, interactive atmosphere at Kap Europa in Frank-

furt. Many more comments could be added. Compliments to everybody involved in the organising committee!

Let us meet again from 18.–19.09.2024 at ICR in Aachen/DE and at UNITECR in Cancún/MX on 27.–30.10.2025. KS



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