Institute of Refractories Engineers

2024: Issue 1 - March

The Refractories Engineer

PRODUCTS
APPLICATIONS
TECHNOLOGY
NEWS ROUND-UP

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Real world problems – PRACTICAL SOLUTIONS

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Iron and Steel Production

The lastest statistics .....page 14

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Institute of Refractories Engineers

The Refractories Engineer

Lynn Postle, FICME

From the editor

As we move into a new year, I note that much talk continues to centre around the transition to net zero and the role that materials and manufacturing processes will play in the carbon neutral journey we are all embarking upon.

In this issue we look at the latest statistics for steel production and consider the "thorny" issue of exporting steel scrap, something that will impact the UK's economic competitiveness and have a detrimental effect on any net zero commitments, see page 17. Whilst we are making strides in global endeavours to reduce CO_2 and move towards green steel, it is vital that we remember the amount of scrap that is exported and ask those important questions.

Of course, one of the most essential aspects of our commitment to a greener world centres around raw materials and minerals. This is another topic that appears throughout the pages of this issue as we as an industry, along with our suppliers and customers in the wider industrial landscape, adapt to a new way of ethical manufacturing.

What is clear, is the abundance of competent engineering knowledge that will be needed to transition effectively and quickly. The presenters and delegates at the *IRE Annual Conference* in Sheffield (UK) in November were a fine example of the developments that can be made when we pool our collective knowledge. Detailed presentations were matched with extensive Q&A sessions – there really isn't any other method of finding solutions to the pressing technical and business matters our industry faces than open forum. Collective thinking and smart engineering will lead the way to a greener, brighter and more prosperous future for us all.

For those who were unable to attend the conference, please think about adding it into your calendar of events for this year, along with the *IRE Australasia Conference* to be held in Sydney, Australia in December (see page 5 for more details).

In the meantime, happy reading.

Front cover image: Steelmaking workshop – Shutterstock

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Message from the PRESIDENT

I firstly would like to wish everyone a happy and prosperous new year.

As you are probably aware, due to the hard work of council, the finances of the IRE have been steadily improving over the past few years. We have increased efforts to attract more members, introduced corporate packages and rationalised our expenditure in a more rational and cost-effective manner. I stated in my last address as Treasurer that we expected to reverse the losses in 2024; but, I am delighted to report that our pre-audit figures say that we managed this ahead of schedule, comfortably moving into the black in 2023. Big congratulations to all involved.

One of the reasons for improved finances was the recent UK *IRE Conference, Dinner and Training Day*. I am sure most who attended would agree that it was a highly enjoyable, informative, and rewarding occasion. We were delighted that the attendance was somewhat more than anticipated, which has resulted in it more than covering its costs. We have analysed feedback and council has already started to work on next year's UK conference: planning for an even bigger and better event. This, of course, is in addition to the conference and training session in Australia later this year – plans are already well advanced in setting up what is bound to be another great success, Mario will give more details throughout the year as we approach the event.

It has always been one of my intentions as the President to make the IRE more global and push for a wider worldwide membership. As such I am delighted to say that Sebastian Klaus, application & market development manager for Almatis, based in Germany, has been voted onto council. Further, we welcome Chris Windle, a former President of the IRE, back to council. He is keen to lend his experience in, and will co-ordinate, training for the *UK Training Day*; something he will do in co-ordination with Michael Walton in Australia. I am sure both will greatly enhance the decision making of council. We are confident of adding more noted individuals to council in due course. We still have vacancies, so should anyone think they have something to offer and would like to join council, please let us know. Council meetings are usually held on Teams, and we offer prospective council members the opportunity to sit in meetings to see if it works for both the individual and council before a vote on joining.

Mike Lamkin, President
Institute of Refractories Engineers

Institute of Refractories Engineers

CORPORATE PARTNERS

The IRE thanks the following Corporate Partners for their support:

Bronze

Almatis, CHB South Africa, Dalmia GSB GmbH, Elkem, Robert Lickley Refractories Ltd, Setic Refractories Ltd, Trent Refractories Ltd, Velco GMbH, Wilfrid Smith Ltd

Silver

Imerys Aluminates Ltd, LKAB Minerals Ltd, Mayerton Refractories Ltd, Mineral Tech

Gold

Calderys, Capital Refractories Ltd StudWeldoPro-UK Group

A corporate partner package is a reflection of an organisation's commitment to the refractories industry and the professional institute that represents the industry. The IRE is appreciative of the support of our corporate partners and is delighted to be working with them for the benefit of the whole sector.

For more information on corporate partner packages refer to page 29.

Events Diary

Upcoming events to be added as dates in your diary

23-24 April 2024
Ceramitec 2024
Venue: Messe Munchen Exhibition Center, Munchen (Germany)
Contact: www.ceramitec.com

5-6 June 2024
Subcon
Venue: The NEC, Birmingham (UK)
Contact: www.subconshow.co.uk

14-19 July 2024
International Congress on Ceramics
Venue: Hotel Bonaventure, Montreal (Canada)
Contact: www.ceramics.org/event

18-19 September 2024
The International Colloquium on Refractories 2024
Venue: Aachen (Germany)
Contact: www.ic-refractories.eu

8-10 October 2024
Aluminium 2024
Venue: Exhibition Centre, Dusseldorf (Germany)
Contact: www.aluminium-exhibition.com

25-30 October 2024
75th World Foundry Congress
Venue: Deyang (China)
Contact: www.75wfc.com

8-10 December 2024
IRE Australasia 12th Biennial Conference
Venue: Sydney (Australia)
Contact email: australia@ireng.org

Update from Australasia

Dear Colleagues and Friends
Happy New Year to all our readers.

There have been a few changes to our management committee with Vice President Don Merritt departing his current company of 4D Delta to be CEO of Predico Software, which is mostly focussed on the energy industry. As a result of this increased commitment, Don aims to retire from the IRE with the Vice President position being vacant by the end of 2024.

David Hollott, a former President of IRE Australasia (2004-2005) after retiring from Hatch Engineering now joins our team as Assistant Treasurer / Secretary and is offering a great contribution to our success.

At the time of publishing, the IRE Australasia committee will have signed the contract to host our next conference at The Fullerton Hotel; a five-star luxury hotel in the heart of Sydney's financial and fashion district and housed in the historic former General Post Office building. Be prepared to receive various notifications; save the date (8-10 December 2024), call for papers, registrations, conference programs etc.

Our conference will include a special full day trip to the local BlueScope Steel Port Kembla works, an integrated steel plant producing 3.3mtpa. Part of the visit includes a tour through the refractory department and installations area.

However, seats for both the conference and add-on tour are limited, members and end users will take preference where we are over booked. So, ensure your membership is up to date and that you book in early to avoid potential disappointment.

The mining and metals industry in Australasia is volatile with shut pressures and growth. Regarding the steel industry, we are having what I call a "decarbonisation renaissance". It means we are seeing significant investment in our local steel industry focussed on efficiency and emissions. Investment in our steel sector includes:

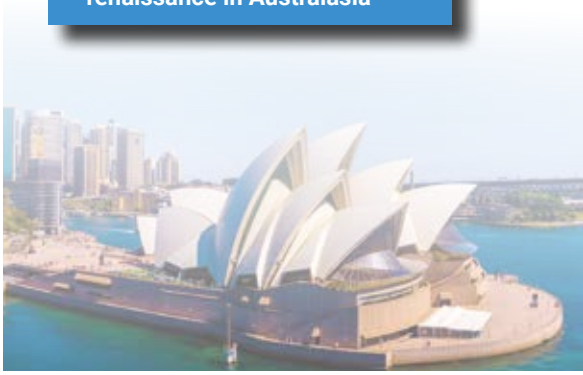
- **New Zealand Steel** – New (80t) electric arc furnace with the latest hot metal charging technology that replaces the KOBM (Approved NZ$300m/£150m).
- **BlueScope Steel Port Kembla, NSW** – No6 blast furnace reline has been approved at a cost of AU$1.15bn (£600m), commission occurring in 2026.
- **Liberty GFG Whyalla, South Australia** – Shut down of coke ovens after 55 years of production. Plant to be upgraded with a low carbon emissions 160t electric arc furnace and a 1.8mtpa DRI (direct reduced iron plant) from locally mined magnetite, lifting steelmaking production from 1 to 1.5mtpa. A reported investment of AU$500m (£265m) with an aim to achieve a ninety per cent reduction in GHG (green house gases).
- **Mid West DRI Plant WA** – using 'green' hydrogen DRI to convert Western Australian iron ore into hot briquette iron for export. Total investment of AU$1.5bn (£800m) and will abate 4mtpa of CO_2. Commissioning expected in 2028.
- **Collie Green Steel Mill, Western Australia** – Located 210km south of Perth, will convert Western Australian scrap steel into rebar for local and international consumption. The plant will use the latest efficient EAF technologies. Construction is expected to commence in late 2024, and early operations beginning in 2026. AU$400m (£210m) total investment.

Though we are far away, we have a lot happening down under. I would welcome our European and Asia Pacific colleagues to join us at our late 2024 conference to learn more about these developments and sharing refractory knowledge.

***Mario Taddeo** MI Ref Eng*
President, IRE Australasia

IRE AUS news this issue:

- **Management Committee changes**
- **Latest update on IRE – Australasia 2024 conference**
- **Steelmaking decarbonisation renaissance in Australasia**



Institute of Refractories Engineers

IRE Australasia 12th Biennial CONFERENCE

Refractory Innovations in the Asia Pacific

held at a a 5-star Hotel In the Sydney CBD

Sydney Australia

8 - 10 of December 2024

Save the date

Mario Tadeo
President - IRE Australia

Greg Connor
Public Officer

Michael Walton
Treasurer

Discussion & Insights

- Conference
- Exhibition
- Bluescope Steel Tour
- Networking Reception
- Technical Papers
- Expert Panel Discussion

Start 6PM
Dec 8

Get in touch
Email: **australia@ireng.org**

Vice President: Don Merritt Secretary: Dean Tredinnik
Asst Treasurer Secretary: David Hollott Training: Michael Broadbent

www.ireng.org

Navigating challenges and celebrating success!

RHI Magnesita CEO Stefan Borgas has reflected on what 2023 entailed for the company and indeed for the refractory sector at large.

"This year brought unexpected demand challenges for the entire industry worldwide – the worst year in the past fifteen years from that perspective," he says. "It put productivity pressures on our employees; we need to fight high inflation in many countries; we deal with quickly rising financing costs. I am mostly proud of how the RHI Magnesita team acted, and how each person fulfilled their role: thanks to them, our company showed operational and financial strength, a testament to dedication and hard work. This serves as a promising sign for the upcoming year.

"To overcome these challenges and maintain a leadership position, we are laser-focused on short-term execution and, at the same time, keeping a rather long-term strategic approach. Over the past four years, we've invested over €850 million in our facilities, focusing on reducing costs, improving quality, optimising our production network, and ensuring the smooth delivery of our commitments. This period of investment has made us much stronger for the future.

"An important part of our strategy involves prioritising the safety and wellbeing of our employees. In 2023, we increased our investments in physical safety infrastructure, expanded our expert staff, introduced digital tools safety, and reinforced safety training. Our longstanding belief is that people drive progress, contributing significantly to our overall resilience."

Despite the turbulence, there were many highlights for the company, such as the completion of strategic acquisitions, including Dalmia Bharat Refractories Limited, Jinan New Emei Industries Co Ltd, Seven Refractories, and P-D Refractories. This brings the total to nine acquisitions in the last two years, expanding the company's global presence and diversifying its product offering. Borgas says: "The latest news is that we offer silica bricks from the Czech Republic and India, ISO thin-slab from India, and true circular solutions in every geography – to mention just several of the new capabilities."

The company also welcomed approximately 4,000 new colleagues across Europe, CIS & Turkey, India, China, and North America, resulting in a workforce of around 20,000 professionals worldwide. "Our commitment to diversity is evident with 105 nationalities represented (compared to 60 last year) and an increase in female representation in senior leadership positions to 29 per cent (up from 19 per cent last year)," Borgas explains. "We have also launched a new internal employee app, to keep everyone connected, informed, and heard, whether you are at the plant or in the office."

The company has also continued its dedication to environmental sustainability, characterised by substantial investments in lowering CO_2 emissions and exploring advanced technologies for even greater reductions, resulting in an annual reduction of CO_2 emissions by 1.3 million tons. "We have switched to renewable electricity in most markets in the world. This December, together with many industrial peers in Europe, we convinced the authorities to keep the allocation of free CO_2 certificates for process emissions on the same level for the next ETS period, which gives us some more time to implement solutions," Borgas is proud to announce.

"We'll use these positive results as motivation to propel ourselves forward because there's always space for further growth and enhancement; all while actively listening to our customers," he concludes. *www.rhimagnesita.com*

New brand platform reflecting a focus on SUPPORTING HIGH TEMPERATURE INDUSTRIES through their energy transition

IRE Gold Corporate Partner Calderys has unveiled its new corporate brand platform composed of the group's purpose and values. This follows the company's change in ownership at the beginning of 2023 and the subsequent combination with HarbisonWalker International, now 'HWI - a member of Calderys'. The new brand platform emphasises what impact the group seeks to make on the world and how.

With the terminology: *"We are the vital partner of all high temperature industries. We support them building a better world through sustainable solutions,"* Calderys is placing sustainability and innovation at the heart of its business. This purpose reflects the critical roles of refractories in the world, the long lasting relationships the group has built with its customer base over the past 150 years, and the part the company intends to play to make a positive impact through its solutions.

The brand platform also emphasises, through a new signature, the heritage of the group which dates back to the 19th century and has been nourished since then with an unwavering quest for excellence with the strapline: *Forged in legacy. Fueled by excellence.*

Michel Cornelissen, president and CEO of Calderys said: "As a world leader in high temperature solutions and a history that spans over more than 150 years, Calderys Group has a pivotal role to play in ensuring that companies – from small-scale entrepreneurs to global industry leaders – are equipped to meet the demands of tomorrow, and in pushing the boundaries of innovation and excellence in our sector. This new brand platform marks an exciting new step in HWI integration into the Calderys Group as we continue to build unity throughout our organisation. It is also the affirmation of a renewed ambition that will position us for future growth".

As part of the platform, a set of values have been developed reflecting the true personality and the foundation of the company culture in four words: tenacity, accountability, multiculturalism, authenticity.

Tenacity refers to the determination to overcome challenges and achieve goals with a collaborative, continuous improvement and innovative mindset.

Accountability embodies ownership and responsibility towards excellence, safety and ethics.

Multiculturalism emphasises the recognition, appreciation, respect and inclusion of people from various backgrounds.

Authenticity fosters trust, integrity, humility and care for people.

"These new values and the overall platform have been developed through an employee led exercise. Therefore, they truly define the essence of who we are and how we do business. They guide our actions and behaviours and help us make the best decisions for the benefit of our customers," said Melissa Bihary, chief people officer and Aurélie de Chassey-Hayot, global vice president communications, in a joint statement.

In January 2023, Calderys became a standalone company, launching at the same time a new visual identity and revised logo. In February, the integration of HWI into Calderys was announced and HWI became a member of Calderys and the brand for the Americas region of the group. Soon after, HWI introduced a new visual identity reflecting its refractories leadership and global stature as a member of Calderys Group.

"The new brand platform for the combined organisation cements our many similarities and is the common ground on which we will build our organisation moving forward and bring it to the next level," concludes Michel Cornelissen. *www.calderys.com*

Elkem celebrates its 120-year anniversary

On 2 January 2024, IRE Bronze Corporate Member Elkem celebrated its 120-year anniversary, having grown from being an industrial start-up in 1904 into a position in 2024 as one of the world's leading providers of advanced silicon-based materials – critical enablers for the digital and green transitions.

Elkem was founded on 2 January 1904 by Sam Eyde, Knut Tillberg, and Knut and Marcus Wallenberg as "the Norwegian stock company for electrochemical industry". Today, the company has around 7,300 employees around the world, delivering revenues of NOK 45.9 billion (2022) and top five per cent climate performance (CDP).

"We are very proud of Elkem's 120 years of history, which demonstrates to our stakeholders that we are in it for the long run. Our colleagues all over the world take a lot of inspiration from our past, but we always remain focused on the future and delivering new and innovative products and services to our customers. We see ourselves not as a 120 years' old company but as 120 years young, and work on continuous improvements every day," says Elkem's CEO Helge Aasen (pictured).

Even though Elkem has developed significantly since its founding, it has also stayed true to the original business concept which was to build a major industrial company with an international outlook. Research and innovation plays a key role in this: with more than 550 researchers around the world, new products introduced within the past five years now represent more than twenty per cent of Elkem's turnover. This ensures the company is well positioned for megatrends like the green transition and digitalisation.

"The Elkem of 2024 is one of the world's leading providers of advanced silicon-based materials shaping a better and more sustainable future. The company develops silicones, silicon products and carbon solutions by combining natural raw materials, renewable energy and human ingenuity. We help our customers create and improve essential innovations like electric mobility, digital communications, health and personal care as well as smarter and more sustainable cities," says Aasen.

Three key milestones for Elkem in more recent times include the integration of a chemical business in France in 2015, adding a strong culture for specialisation, innovation and R&D; the integration of two plants in China in 2017, adding to the dynamic and agile business perspective and positioning for the Asian market; and being listed again on the Oslo Stock Exchange from 2018, where the company is now also part of the ESG Index featuring the forty listed companies with the best ESG risk rating.

200 year anniversary of silicon discovery

2024 also marks the two hundred year anniversary since silicon was first isolated and described as an element by Jöns Jacob Berzelius, a Swedish chemist. It is the second most abundant chemical element in the earth's crust, just behind oxygen.

Silicon is today best known for its semiconductor characteristics and has been vital in the development of solar energy and electronics, driving digital technology – as highlighted by the name of 'Silicon Valley'. Some even use the term 'the silicon age' to characterise the period from the late 20th century to early 21st century.

Silicon in its elemental form is not found in nature. It is present together with oxygen and other elements in various minerals. Silicon is typically produced from quartz or quartzite (SiO_2), with low content of impurities.

Today, around three grams of high-purity silicon produced by Elkem can be found inside most of the world's smartphones. Advanced silicones from Elkem can also be found in more than two million electric vehicles around the world. Elkem's silicon has even made an impact beyond this Earth, as part of thermal batteries which have successfully landed the Perseverance rover on Mars.

www.elkem.com

Driving forward INDUSTRIAL ENERGY EFFICIENCY is key to meeting net zero targets

Manufacturers have been hit by soaring gas and electricity prices hitting record highs, leaving businesses desperate to cut their energy use, according to a new report 'Driving Industrial Energy Efficiencies', published by Make UK and Inspired PLC. The new research delves into how energy efficient practices and technologies can help companies save money and boost productivity while at the same time moving towards their net zero targets.

Net zero is a priority for 92 per cent of businesses and 68 per cent have already made investments to start on that journey with two-fifths (22 per cent) planning to in the next twelve months.

Over the past two years, the cost of energy has been highly turbulent, exacerbated by an increase in operational costs. This has left manufacturers forced to operate with a significantly reduced margin, making introducing energy efficiency projects an attractive proposition.

The *'Driving Industrial Energy Efficiencies'* report shows that businesses have been taking a two pronged approach to reducing energy consumption, from low cost, low effort measures to more costly investments which deliver equipment and process upgrades. Simple steps such as getting the right energy supplier and securing an advantageous contract is critical. Monitoring energy use through smart meters and sub-metering can further cut consumption, providing more granular detail of unnecessary use. One rubber compound manufacturer saved £62,734 through a better energy contract and over £48,000 by reducing waste through circuit-level (sub-meter) monitoring.

Equipping plant machinery with meter reading tools or sensors, can offer real time data access by connecting it to the cloud (Internet of Things Technologies), enabling faults to be spotted as they happen. Implementing voltage optimisation, which only allows the exact amount of energy a business needs to be brought in from the National Grid, can also make significant savings. Also, overhauling compressors – which account for ten per cent of all industrial energy used – can cut energy consumption by 50 per cent.

One energy intensive company which galvanises plant equipment introduced digital controls to deliver variable on-demand power to its furnaces, saving £400,000 on energy bills and reducing its carbon output by one thousand tonnes.

"Britain's manufacturers have made significant steps to cut carbon emissions and move towards net zero. But in order to supercharge that journey, business needs government to play its part in driving the process forward, says Faye Skelton, head of policy at Make UK.

"To that end, government needs to commit to introducing a *National Advisory Energy Service* similar to the model of Made Smarter which helps SMEs digitalise their production processes. This should provide smaller funding to companies of up to £20,000, include an energy audit, sub metering and an implementation plan as well as helping businesses access the right funding.

"We need to also see an immediate extension of the twelve months of one hundred per cent business rates relief on green plant machinery and equipment and building improvements to three years to reflect the business payback period."

Andrew Stubbs, director of optimisation and performance, Inspired PLC added: "As a dedicated energy and sustainability consultant supporting the manufacturing sector, Inspired wholeheartedly endorses Make UK's comprehensive report on energy efficiency in manufacturing.

"Over the last 24 months, an increase in operational costs has forced manufacturers to operate with a significantly reduced margin and it is evident that energy costs now constitute a significant share of operational expenses. Make UK's *'Driving Industrial Energy Efficiencies'* report delves into how energy efficient practices and technologies can support cost reduction.

"One of the other key takeaways from this report is that sustainability makes good business sense. By implementing sound practises and applying continuous improvement processes around energy efficiency, manufacturers can pave the way for a prosperous, cleaner and environmentally responsible future."

With the abolition of the Energy Efficiency Taskforce (EETF), which had expected to put forward policy proposals to support greater energy efficiency, Make UK called on the UK government to use the Autumn Statement to help companies transition to net zero through energy efficiency measures.

Among these calls included in the report, is for government to undertake a gap analysis of the tax incentives available on energy efficiency to check no type of business falls between the cracks.

Heat recovery may have the biggest potential to improve energy efficiency, but as yet is almost untapped. It uses the steam or waste heat from machinery (e.g. compressors, ovens/furnaces, galvanisation baths) or high temperature processes, to heat up other parts of the process (low temperature), hot water, or for the space heating of the building. It can also be used to produce electricity via the Organic Rankine Cycle, a type of thermodynamic process which can use low temperature industrial waste heat.

Read the full 'Driving Industrial Energy Efficiencies' report at www.make.org

Open letter to university leaders

The Institute of Materials, Minerals and Mining (IOM3) has jointly signed an open letter to UK university leaders providing evidence based information about the fundamental role of material, minerals and mining in daily life and the transition to a low carbon, resilient and resource efficient society.

IOM3 and five other signatories have come together to emphasise the need for a high quality education and training pipeline for a skilled, responsible and sustainable materials, minerals and mining workforce.

The Critical Minerals Association (CMA) (UK), Institute of Quarrying (IQ), Mineral Products Association (MPA), Mineral Products Qualification Council (MPQC) and Mining Association of the UK (MAUK) have co-signed the letter in which they stress the need to meet the increasing global demand for resources, such as homes, transport systems, healthcare and clean energy technologies, while highlighting current skills gaps and declining education and training provisions.

Collectively, they aim to combat the inconsistencies of misinformation and decision making with the need to increase sustainability and address the climate crisis. They work to raise the standards and professional competence in materials, minerals and mining, and support industries in driving environmental, social and governance best practice.

For more information visit: www.iom3.org

MOU to develop integrated solutions to support decarbonisation of hard-to-abate industries

Valmet and Saipem have signed a memorandum of understanding (MOU) to develop joint solutions to decarbonise the industrial sectors that face significant challenges in reducing their greenhouse gas emissions, also known as hard-to-abate industries.

The companies will collaborate to offer effective solutions combining Saipem's technologies for CO_2 management with the heat recovery and flue gas treatment units engineered and produced by Valmet for the pulp, paper and energy segments, thus bringing integrated and flexible options to their customers in both existing and new facilities.

Both Saipem and Valmet are committed to supporting customers along their net zero journey and ensure effective end-to-end CO_2 management for emission intensive industries.

"Sustainability is at the core of Valmet's business strategy and operations. In our climate program – *forward to a carbon neutral future* – we have set ambitious targets as we believe that technology plays a key role in mitigating climate change and global warming in the transition to a carbon neutral economy. We have already achieved our target of enabling carbon neutral production for all our pulp and paper customers who have access to fossil free energy sources. We are also continuously improving the energy efficiency of our current offering. Our collaboration with Saipem fully supports these targets, and we are proud to be part of this initiative," says Lari-Matti Kuvaja, director, environmental systems, pulp and energy, Valmet.

"Technology is the key to successfully tackle the decarbonisation of hard-to-abate sectors. Together with Valmet, our ambition is to integrate processes and technologies, providing clients with an end-to-end decarbonised solution in line with their net zero targets. This MOU expands Saipem's portfolio of energy transition innovations, further strengthening our unique ability to cover the entire CO_2 capture, re-utilisation and storage value chain, through our drilling, onshore and offshore know-how, assets and technologies," says Fabrizio Botta, chief commercial officer at Saipem.

Engineers rated as one of Britain's top five MOST TRUSTED PROFESSIONS

The engineering profession is one of the most trusted in Great Britain according to the latest Ipsos Veracity Index that revealed 85 per cent of people across the country trust engineers to tell the truth.

The poll found engineers level with doctors, in fourth place, only eclipsed by librarians (86 per cent), airplane pilots (87 per cent), and nurses (88 per cent). Similar levels of trust in engineers have been recorded in previous years, including a score of 89 per cent in 2020.

The engineering regulatory body, the Engineering Council has welcomed the news. The Engineering Council's purpose is to ensure that employers, government and wider society – both in the UK and overseas – can have confidence and trust in the knowledge, experience and commitment of engineers and technicians, which the organisation does through setting and maintaining internationally recognised standards of professional competence, commitment and ethics.

Professionally registered engineers and technicians are required to maintain and promote high ethical standards in their work and to challenge unethical behaviour. The four fundamental principles for ethical behaviour and decision making are outlined in a *Statement of Ethical Principles*, jointly produced by the Engineering Council and the Royal Academy of Engineering (RAEng).

Paul Bailey, Engineering Council CEO said: "It's great to see engineers maintaining their high ranking on the *2023 Ipsos Veracity Index* as one of the most trusted professions among the British public. Such a high level of trust in engineers is primarily down to their high level of professionalism which is exemplified by professional registration with the Engineering Council, a means of providing that assurance of competence and a continuing commitment to professionally develop."

The *2023 Ipsos Veracity Index* showed that engineers were more trusted by females (86 per cent compared to 85 per cent of males) and by those earning a higher salary (90 per cent of those earning above £50,000 compared to 80 per cent of those earning under £25,000). The index also suggested a higher level of distrust among younger people, and the Institution of Engineering and Technology (IET) has suggested that this is possibly related to limited understanding and knowledge of engineering as a profession.

Although it is regarded as an important and rewarding career, recent research commissioned by the RAEng revealed that many people don't know much about what people in engineering do, or what the job involves. RAEng's survey into the public's perception of engineering and the reasons why many young people choose not to take up engineering courses or careers found that outdated perceptions of engineering as a profession is a key obstacle to young people enrolling in engineering courses.

To help raise public awareness of how engineers make a difference in the world, celebrate how engineers shape the future and encourage more young people, from all backgrounds, to consider engineering careers, RAEng, in partnership with EngineeringUK, has, over the past few years, led an annual *National Engineering Day* campaign.

The IET has also driven awareness campaigns, such as *Engineer a Better World*, and the *Young Woman Engineer of the Year Awards*, which aim to change people's perceptions of engineering,

To read more on the latest Ipsos Veracity Index, visit the IPSOS website.

Funding for UK manufacturing

The UK government has announced £4.5 billion of funding into British manufacturing to bolster economic growth and support key sectors.

Set to roll out from 2025 over a five-year period, this funding aims to provide the industry with long term certainty for their investments, fostering stability and growth.

Eight manufacturing sectors will benefit from this financial commitment, with a substantial £960 million earmarked for clean energy initiatives. The targeted sectors crucial for economic expansion, energy security, and levelling-up include automotive, aerospace, clean energy, and life sciences.

Over £2 billion is allocated to the automotive industry, emphasising support for the manufacturing, supply chain, and development of zero emission vehicles. Simultaneously, £975 million is dedicated to aerospace, focusing on the production of energy efficient and zero carbon aircraft equipment. *www.gov.uk*

Years of MAKING METALS work harder

Wall Colmonoy, a leading global materials engineering group, is celebrating 85 years of business. The company employs six hundred team members across the United States and its European headquarters in the UK.

"We are very proud of our long, storied history, and the successes we've had over the years. Wall Colmonoy has a great future ahead with fourth generation leadership," said William P Clark Jr, chairman and CEO.

Today, Wall Colmonoy remains under the ownership and leadership of its founding family, now in its fourth generation. "This enduring legacy attests to the company's adaptability, ingenuity, and durability," asserts Ann Clark Kendall, VP of global marketing and fourth generation family member.

Wall Colmonoy commemorates this 85th year milestone with a special anniversary logo along with celebrations at each of its six locations.

"Our success and growth could not have been possible without our customers, distributors, and committed and talented people. We continue to focus on our strengths of technical expertise, innovation and passion for our purpose serving the critical manufacturing industry," adds Nicholas Clark, president and fourth generation family member.

In 1937, metallurgists Norman Cole and Walter Edmonds created a new nickel-based alloy containing chromium boride for oil & gas downhole drilling. The alloy became known as Colmonoy®, an anagram of Cole and Edmonds' surnames. The following year, entrepreneur Albert F Wall acquired the company and renamed it Wall Colmonoy Corporation.

Today, Colmonoy® hardsurfacing products are applied in a wide range of surfacing and thermal spraying techniques for a variety of industries such as glass container, oil & gas, mining, waste to energy, steel, and more.

Expanding their expertise in 1950, Robert L Peaslee, materials engineer, introduced a new brazing technology utilisng nickel-based filler metals and hydrogen atmosphere furnaces. This new filler metal was named Nicrobraz® and was commonly used to join hot section components in military jet engines. The technology and Nicrobraz® product line continues to develop today. At its modern furnace brazing school, high temperature brazing is taught by Wall Colmonoy's leading brazing engineers at its brazing engineering centres in the US and UK.

In the 1970s, Aerobraze Oklahoma City developed the first stainless steel heat exchanger re-core procedure to support military aircraft, including at the nearby Tinker Air Force Base. In 2018, investments in aluminium heat exchangers were made to serve commercial aircraft like Embraer CRJs and Boeing 700 series. The 2006 purchase of Aerobraze Cincinnati complemented Wall Colmonoy's brazing, heat treating, welding, coating, and machining capabilities.

In 2014, Wall Colmonoy acquired Franklin Bronze Precision Components, a Franklin, Pennsylvania based investment casting foundry. Initially focused on glass parts, Wall Colmonoy diversified the business into other sectors. Today, the company is a leader in precision investment castings for glass container, pumps & valves, oil & gas, steel, food and metal processing, transportation, and more.

Established in 1969, Wall Colmonoy Limited serves as the company's European Headquarters in Pontardawe, Wales, UK. The facility specialises in manufacturing Colmonoy®, Wallex® and Nicrobraz® products, additive manufactured powders and parts, engineered cast or fully machined components and provides coatings, brazing, and heat treatment. Its products reach Europe, Africa, India, Australia, Middle East, and CIS Countries. The state-of-the-art research centre is at the forefront of developing new applications and investing in emerging technologies. *www.wallcolmonoy.com*

Uncertainties casting a shadow over European foundry sector

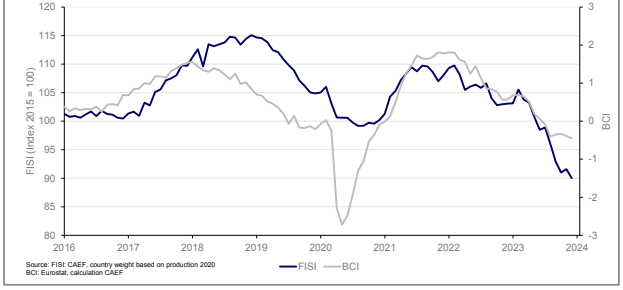
This December, the European Foundry Industry Sentiment Indicator (FISI) records a notable decrease, marking a downturn in the index to 90 points, reports the European Foundry Federation (EFF). This adjustment negates the positive development observed in November, as the index experiences a decline of 1.6 points, settling at 90.0 compared to 91.6 the previous month.

As 2023 was concluded, it became evident that the foundry industry continues to face challenges. The FISI, which commenced the year at 103.1 index points in January, now reflects the impact of persistent challenges such as high energy prices, geopolitical tension and conflicts, (skilled) labour shortages, and uncertainties surrounding the availability of raw materials. These factors collectively exert substantial pressure on foundries across Europe.

Despite struggling with these ongoing headwinds, the EFF says the foundry industry exhibits remarkable resilience. Foundries throughout Europe are navigating through the complexities, demonstrating their adaptability in the face of adversities. It is worth noting that the absence of subsidies and support from national and European policymakers adds to the industry's burden. In contrast, competitors in Asia and the United States find themselves in relatively advantageous positions, encountering fewer challenges in these areas.

Meanwhile the *Business Climate Indicator (BCI)* stands at -0.45 index points in December. This marks the sixth consecutive time that the BCI is below the critical threshold of 0 index points. The index decreased once again by 0.06 points from -0.39 in November. On this occasion the negative BCI can be attributed, as in the previous month, to reduced export order book levels. The ongoing geopolitical tensions in both the Middle East and Ukraine are playing a pivotal role in propelling this development. *www.caef.eu*

European Foundry Industry Sentiment Indicator (FISI) and Business Climate Indicator Euro Area (BCI)
December 2023



Stirring technology for steel plant in South Korea

SeAH Changwon Special Steel has placed an order with global technology company ABB for a second ABB ArcSave® electromagnetic stirrer for use on an electric arc furnace (EAF) at the SeAH Changwon Integrated Special Steel plant in South Korea.

Source: ABB

The plant produces 1.2 million tons of steel and one million tons of steel products annually, putting SeAH in the global top ten of special steel manufacturers. Its stainless steel rods and wires made from high quality special steel have end uses with customers in the automotive, energy and shipbuilding industries.

ABB ArcSave will be installed on an EAF that produces carbon and stainless steel and has a steelmaking capacity of one hundred tons. The technology is expected to improve furnace efficiency, reduce energy consumption and overall operating costs on the continuously operated EAF at Changwon. Steelmakers have typically reported yield improvements of up to one per cent, productivity increases of five to seven per cent and electrical energy savings of three to five per cent when deploying the equipment.

The customer will be able to improve metallurgical conditions in the EAF melt using the ABB technology. The stirring solution has optimised the operation of some of the world's largest arc furnaces and can help reduce the carbon footprint at both existing steelmaking lines and greenfield projects.

"We have experienced the benefits of the ABB ArcSave first-hand and look forward to further improving the efficiency of our electric arc furnace steelmaking operations with a second installation," said Eung-Sou Lee, director, production division, SeAH Changwon Special Steel.

"We are very pleased that SeAH Changwon Special Steel has once again chosen ABB to provide this unique technology," said Zaeim Mehraban, global head of sales, ABB Metallurgy. "It underlines the positive effect that ABB ArcSave has for high alloy steel producers, including overcoming the challenge of bottom skull formation which can impact steel yield, furnace volume capacity, maintenance costs and downtime."

The new order, which will be commissioned in late 2024, is the second from SeAH Steel and follows the installation of an ABB ArcSave electromagnetic stirrer on an EAF with a 70-ton production capacity in 2018. By introducing electromagnetic stirring and replacing an existing bottom gas stirring installation, SeAH was able to reduce bottom skull thickness from up to 1,000mm to less than 200mm. EAF productivity was improved by between five to seven per cent, scrap handling costs were reduced by seventy to eighty per cent, electrical energy savings were at between three and four per cent and there were forty per cent savings on furnace refractory repairs. Other improvements included easier scrap bucket charging and better melt bath level control and tap weight hit ratio.

Source: ABB

Requiring no physical contact with the bottom of the EAF, ABB ArcSave enhances metallurgical performance during the melting of large scrap items, reducing stratification via forced convection. This improves EAF operation by homogenising temperature distribution and chemical composition, while speeding up scrap and ferroalloy melting compared with natural convection alone.

ABB offers the world's most comprehensive range of EMS for both steel and aluminium production processes, delivering metallurgical improvements that are proven to increase productivity, end product quality and reduce operating costs for electric arc, ladle and aluminium furnaces, as well as thick and thin slab and billet and bloom casters.

A complete range of products, services and end-to-end solutions that improve productivity, quality, safety and cost efficiency in iron, steel, aluminium and other metals production processes are available through ABB. Across the whole metals value chain.

www.abb.com

Cement producers strive to mitigate their substantial carbon footprint

Cement production and processes emit over five per cent of all carbon dioxide emitted by human activity. Reducing that environmental impact is a high priority among cement producers, reports ABI Research.

Cement producers are now publishing their environmental, social, and governance (ESG) credentials concerning energy use in their operations, Greenhouse gas (GHG) emissions, and water usage. Digital technologies will enable companies to collate and analyse the data to identify process improvements. In addition, investments in optimising their production equipment and cement quality will also drive investments in digitalisation. According to global technology intelligence company ABI Research, total spending on digitalisation is forecast to reach US$3.54 billion in 2023 (a 5.5 per cent compound annual growth rate (CAGR)).

"With all of the above in mind, cement producers are developing risk frameworks that present opportunities for technology suppliers to help firms assimilate information for presenting credentials and performing scenario planning exercises," says Michael Larner, industrial and manufacturing markets research director at ABI Research.

Cement production accounts for four per cent of global warming. However, concrete, from which cement is the main element, is the key material used in the construction industry and will continue to be required for buildings, roads, and infrastructure projects. "This is the dilemma for the industry and can be considered an opportunity for both engineers and technology suppliers to devise solutions to develop cement that can fulfil industries' requirements while not decimating the environment," Larner explains.

Digital technologies will have a role to play at the production level, and companies are developing and commercialising their expertise, with both TITAN Cement Group and Heidelberg Materials already commercialising their digital expertise in predictive maintenance and application development, respectively.

These findings are from ABI Research's *Digital Transformation in the Cement Industry*. This report is part of the company's Industrial and Manufacturing Markets research service, which includes research, data, and ABI Insights.

ABI Research is a global technology intelligence company uniquely positioned at the intersection of technology solution providers and end-market companies.
www.abiresearch.com

Glass industry partners attend NextGen Furnace launch event

In November, Ardagh Glass Packaging (AGP) welcomed customers, suppliers, policy makers, industry partners and media to an official opening of its new NextGen furnace in Obernkirchen, Germany, to see some of the first amber bottles being produced from the low carbon technology.

As detailed in the last issue of *The Refractories Engineer*, the NextGen furnace started up as a conventional furnace using twenty per cent renewable electricity and eighty per cent gas and is now progressing through a planned startup sequence in switching to a target of eighty per cent renewable electricity and twenty per cent gas over the coming months, to deliver maximum energy efficiency and decarbonisation.

Jens Schaefer, operations director, AGP-Germany, said: "We are delighted with the startup performance of the NextGen furnace. To see the first amber coloured bottles coming off the line has been a proud moment for the team."

To coincide with production of the first amber bottles, a recent independently verified Life Cycle Analysis has indicated that, once the NextGen furnace is operating at eighty per cent renewable electricity and twenty per cent gas, there will be a 69 per cent* reduction in CO_2 from a typical 330ml glass bottle produced in the new furnace, compared with one produced in a conventional AGP furnace.

Martin Petersson, CEO AGP-Europe, says: "This is an incredible breakthrough for the glass industry. The potential to produce a glass bottle with a 69 per cent reduction in CO_2 is a significant step towards decarbonising the glass manufacturing process.

"Throughout this project, AGP has worked closely with SORG, our chosen furnace supplier. We appreciate their expertise in helping us to reach this important milestone and we will continue to work together throughout the next operational stages."

The grant support provided by BMWK[1] and KEI to qualifying energy intensive industries in Germany, is helping to realise the benefits of this new technology.

This news item includes forward-looking statements. *www.ardaghgroup.com*

**The 2023 Life Cycle Analysis demonstrates the carbon savings per glass bottle to be produced in the NextGen Furnace, compared to a bottle from a conventional AGP furnace. A typical 330ml glass bottle produced in the conventional AGP furnace at Obernkirchen produces 140.1g of CO_2, compared with one to be produced in the NextGen Furnace once fully operational at eighty per cent renewable electricity and twenty per cent gas, which will produce 43g of CO_2: a 69 per cent reduction across Scope 1, 2 and 3 emissions. Depending on the production mix, the NextGen Furnace could save up to 45,000 tonnes of carbon every year, compared to a conventional furnace.*

1. Bundesministerium fur Wirtschaft und Klimaschutz (Federal Ministry for Economic Affairs and Climate Action) and KEI: Klimaschutz in Energieintensiven Industrien (Climate Protection in Energy-Intensive Industries).

Workshop expansion in China to enhance services

Primetals Technologies operates three service workshops in China, and recently, the facility located in Changxing, Huzhou City, Zhejiang Province, entered Phase 2 in a strategically planned extension that will further enhance the capabilities of Primetals Technologies' Metallurgical Services organisation.

On 29 November, Primetals Technologies held a ceremony to celebrate the expansion of the Changxing workshop. Guests from the Changxing government, customer representatives, and members of Primetals Technologies' global executive management team participated in the opening festivities. "Thanks to the startup of the Phase 2 facilities, Primetals Technologies will further expand its local service competences," said Tomislav Koledic, CEO of Primetals Technologies China. "We are now able to provide a wider range of services to meet the ever changing customer and market requirements, including manufacturing of core equipment, repair, and long-term maintenance work. The range of these services covers the complete production chain, including steelmaking, casting, ESP plants, long rolling, flat rolling, and processing."

"As an OEM, Primetals Technologies is in a unique position," said Karl Purkarthofer, global head of metallurgical services at Primetals Technologies. "With the combination of our expertise in processes, technology, electrics and automation, maintenance, as well as upgrading and revamping, we are not only able to improve maintenance results but also to support our customers in their ambition to improve overall plant performance. All this goes hand in hand with our motto *'Next level services now'*."

A traditional lion dance performance at the opening ceremony of the extended Changxing workshop

Established in 2019, the Changxing branch measures close to 13,000m² including the approximate 5,900m² added in phase 2. The scope of services now includes long rolling and flat rolling mills, continuous casters, the EAF Quantum, and Arvedi ESP lines. Additionally, the workshop now also acts as a platform for advanced condition monitoring and predictive maintenance services.

With the expanded facilities, Primetals Technologies now aims to expand its metallurgical services business across China, with a focus on further developing top class services for upstream technologies.

New equipment and wider range of competencies allows Primetals Technologies to extend the range of services at the workshop in Changxing. The facility now offers services for the growing numbers of EAF Quantum plants in China – for example, the location executes maintenance work for key components in the company's scrap preheating system, as well as the EAF Quantum lance tip, an important part of the oxygen blowing and carbon injection processes. This part of the electric steelmaking plant is welded using different materials, which ensures high temperature resistance.

Ceramics UK launch unveiled

In a landmark moment for the British ceramics industry, the British Ceramic Confederation has undergone a transformation and officially rebranded as Ceramics UK. The unveiling took place at a high profile event held in Parliament on 6 December, attended by attendees including MPs, Ministers, government representatives, and prominent figures from the ceramics industry.

The ceremony (sponsored by Jo Gideon MP, which featured a line-up of influential speakers) showcased the vital role played by the UK ceramics sector in our daily lives and in the national economy. Speakers included Lord Calannan from DESNZ, Minister Nus Ghani, and Sarah Jones MP. Led by chief executive Rob Flello, Ceramics UK now stands as the unified voice representing ninety per cent of the UK's ceramic manufacturers and suppliers, making a substantial annual contribution towards the economy.

To show the diverse range of products manufactured across the sector, the event featured an intriguing display of unconventional ceramic items. These included a miniature toilet by Ideal Standard, ceramic gin bottles from Mantec, water filters by Doulton, and a collection of very mini sinks courtesy of Armitage Shanks. Attendees were also presented with commemorative brick slips from Ketley Brick, specially crafted to mark the occasion of the brand launch.

The rebranded Ceramics UK will champion the interests of the industry on a broader scale, lobbying for recognition and support from the UK government for the indispensable role ceramics play in daily life and the nation's economic landscape.

www. ceramics-uk.org

Tata Steel will commence statutory consultation as part of its plan to transform and restructure its UK business. The announcement was made on Friday 19 January as news broke about the decision.

Ambitious transformation from blast furnaces to green steelmaking in the UK

In a statement, Tata Steel said the plan is intended to reverse more than a decade of losses and transition from the legacy blast furnaces to a more sustainable, green steel business. The transformation would secure most of Tata Steel UK's existing product capability and maintain the country's self-sufficiency in steelmaking, while also reducing Tata Steel UK's CO_2 emissions by five million tonnes per year and overall UK country emissions by about 1.5 per cent.

Under the transformation plan, Tata Steel will embark on a £1.25 billion investment in electric arc furnace technology in Port Talbot and asset upgrades to secure long term, high quality production at the UK's largest steelmaker.

The proposed investment is supported by the UK government, which has committed up to £500 million to enable the transformation. Tata Steel plans to invest £750 million in the project, alongside funding for a comprehensive support package for affected employees, business restructuring and transition costs as part of its long term commitment to UK production.

Tata Steel has engaged in several months of detailed discussions with the UK Steel Committee and its advisors, which examined feasibility studies and financial analysis of the long term viability of steelmaking at Port Talbot.

In discussions with the UK Steel Committee, Tata Steel has agreed to revise its proposal and would continue to operate the Port Talbot hot strip mill throughout the transition period and in future. It has also carefully considered the committee's endorsed proposal for partial continuity of blast furnace steelmaking assets until electric arc furnace facilities are commissioned in Port Talbot.

As part of the review of the endorsed proposals, Tata Steel commissioned independent engineering studies and analysis of alternative scenarios which concluded that continued blast furnace production while constructing the new electric arc furnace is not feasible because:

The projected operating costs of such a configuration are financially unaffordable.

Building the electric arc furnace in an already operating steel melt shop would be fraught with risk, significantly increasing costs, creating a sub-optimal plant layout, delaying implementation of the plan and jeopardising the proposed business transformation programme.

The near end-of-life condition and deteriorating operating performance of several heavy end assets in Port Talbot.

PROPOSED RESTRUCTURING PROGRAMME

Under Tata Steel's proposed restructuring programme, Port Talbot's two high emission blast furnaces and supporting facilities would be closed in a phased manner. The first blast furnace and coke ovens closing around mid-2024 and then progressively winding down the remaining heavy end assets during the second half of the calendar year. The proposal also includes a wider restructuring of other locations and functions across the company, including the intended closure of the continuous annealing processing line (CAPL) in March 2025.

Tata Steel has developed detailed plans which would enable it to secure continuity of supply through its existing downstream and steel processing sites for UK and overseas customers, utilising imported semi-finished steel including from Tata Steel plants in the Netherlands and India as well as other select strategic suppliers until the commencement of electric arc furnace production.

To be able to deliver the proposed electric arc furnace in 2027, Tata Steel has begun engineering design work and construction planning for a furnace which would be among the most modern in the world. It is in advanced planning discussions with National Grid in relation to enabling infrastructure and has also begun engagement with the local authority and regulators.

The transition at Tata Steel's UK operations is subject to consultation but could be expected to result in up to 2,800 potential job losses across the business out of which around 2,500 roles could be impacted during the next eighteen months. Tata Steel expects that a further three hundred roles could be impacted in three years, which could include the potential consolidation and rationalisation of cold rolling assets in Llanwern once the required investments are completed at Port Talbot.

Throughout the proposed restructuring, Tata Steel remains committed to maximising voluntary redundancy before seeking any compulsory reductions and will support all those potentially impacted through a comprehensive support package.

The proposal to invest in electric arc furnace technology, which would be fed by predominantly UK-produced scrap, follows a comprehensive analysis into all the financial and technological options available. The transition mirrors the successful installation of such low carbon production facilities in other major steel producing markets such as the United States, where it has cut emissions whilst guaranteeing production of complex, high quality steel. On completion, the programme would transform the competitiveness of Tata Steel UK, secure most of its capability in terms of end products, whilst cutting its carbon emissions by about 85 per cent and the UK's overall carbon emissions by about 1.5 per cent. The proposal to use UK-sourced scrap as the raw materials for future steelmaking would also maintain the country's self-sufficiency as almost all the raw materials for the current blast furnaces need to be imported.

Huge step for the production of green steel in Austria

voestalpine has placed an order with Primetals Technologies for a 180-ton EAF Ultimate to be implemented at the Austrian steel producer's site in Linz, Austria. Startup is scheduled for 2027.

The EAF Ultimate will be playing a key role in voestalpine's green transition program 'greentec steel.' As a first step in this ambitious decarbonisation program, one electric arc furnace will be built at each of voestalpine's sites, in Linz and Donawitz.

Latest generation of EAF based steelmaking plants

Primetals Technologies will supply the complete EAF Ultimate equipment, a dedusting system, a waste-heat recovery system, electrical grid stabilisation, and material handling for alloying materials and additives. The order also includes full Level 1 and 2 automation, a power supply system, and the LiquiRob robotic system, which increases efficiency and occupational safety at the plant.

The EAF Ultimate will be designed to incorporate industry leading solutions for environmentally friendly steel production. For example, the heat recovery system will convert much of the waste heat into steam, which is then fed back and used in other production units.

"We are very happy to strengthen our close and long lasting partnership with voestalpine and to support them on their way to becoming CO_2 neutral. The EAF Ultimate is part of our latest generation of electric steelmaking plants and is well-known for its raw material flexibility, fully automated operation, advanced control systems, and environmental efficiency. With this technology, voestalpine is set for a future of decarbonised steel production," says Andreas Viehböck, head of upstream technologies at Primetals Technologies.

In August 2022, Primetals Technologies announced a significant contribution to Salzgitter's SALCOS green steel transition project in Germany. This collaboration and other recent references, as well as expertise in both the production of advanced steel grades and leading automation solutions, were the most important factors influencing the decision to choose Primetals Technologies as the supplier for the new electric arc furnace and meltshop equipment.

State-of-the-art automation system

The automation scope includes the latest generation of the web based DCS process control system, which unites the engineering and operational teams in the same environment. This system ensures intuitive system operation and best-in-class support in maintenance related topics. The Level 2 automation system is state-of-the-art, resulting in superior process control and the possibility to calculate the carbon footprint of the electric steelmaking plant.

Global market leader

Headquartered in Linz, Austria, voestalpine is a global steel and technology group and a leading partner to the automotive and consumer goods sectors as well as the aerospace and oil and natural gas industries. The company is also the global market leader in railway systems, steels for the manufacture of tools, and special sections. voestalpine is committed to global climate goals and has a clear plan for decarbonising steel production via its greentec steel program.

Image source: Primetals Technologies Limited

Primetals Technologies Limited, headquartered in London, UK, is a pioneer and world leader in the fields of engineering, plant building, and the provision of lifecycle services for the metals industry. The company offers a complete technology, product, and services portfolio that includes integrated electrics and automation, digitalisation, and environmental solutions. This covers every step of the iron and steel production chain – from the raw materials to the finished product – and includes the latest rolling solutions for the non-ferrous metals sector. Primetals Technologies is a Group Company of Mitsubishi Heavy Industries, with around 7,000 employees worldwide. *www.primetals.com*

Crude steel production update

World crude steel production for the 71 countries reporting to the World Steel Association (worldsteel) was 145.5 million tonnes (mt) in November 2023, a 3.3 per cent increase compared to November 2022.

Crude steel production by region

Africa produced 1.8mt in November 2023, up 3.1 per cent on November 2022. Asia and Oceania produced 104.8mt, up 2.2 per cent. The EU (27) produced 10.6mt, up 3.2 per cent. Europe, Other produced 3.7mt, up 22.2 per cent. The Middle East produced 4.8mt, up 4.0 per cent. North America produced 8.9mt, up 3.1 per cent. Russia and other CIS + Ukraine produced 7.4mt, up 14.8 per cent. South America produced 3.5mt, down 0.6 per cent.

The 71 countries included in table 1 accounted for approximately 98 per cent of total world crude steel production in 2022.

Regions and countries covered by the table:

- **Africa:** Algeria, Egypt, Libya, Morocco, South Africa, Tunisia.
- **Asia and Oceania:** Australia, China, India, Japan, Mongolia, New Zealand, Pakistan, South Korea, Taiwan (China), Thailand, Vietnam.
- **European Union (27):** Austria, Belgium, Bulgaria, Croatia, Czechia, Finland, France, Germany, Greece, Hungary, Italy, Luxembourg, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden.
- **Europe, Other:** Macedonia, Norway, Serbia, Turkey, United Kingdom.
- **Middle East:** Bahrain, Iran, Iraq, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, Yemen.
- **North America:** Canada, Cuba, El Salvador, Guatemala, Mexico, United States.
- **Russia & other CIS + Ukraine:** Belarus, Kazakhstan, Russia, Ukraine.
- **South America:** Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela.

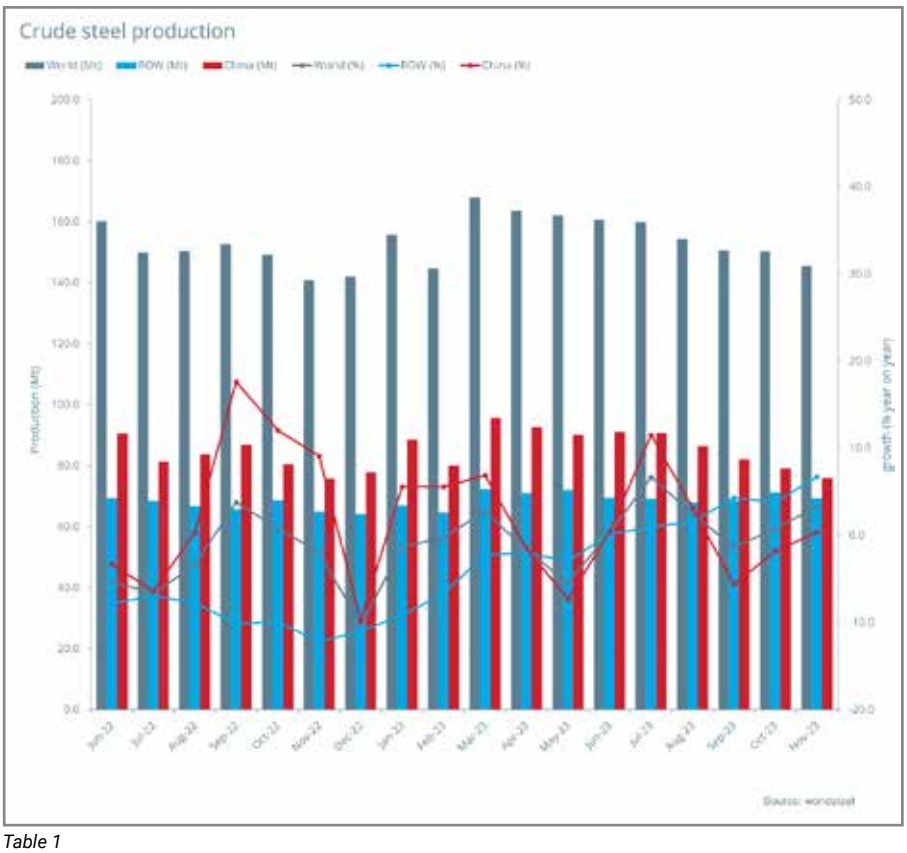


Table 1

Top ten steel producing countries

China produced 76.1mt in November 2023, up 0.4 per cent on November 2022. India produced 11.7mt, up 11.4 per cent. Japan produced 7.1mt, down 0.9 per cent. The United States produced 6.6mt, up 6.1 per cent. Russia is estimated to have produced 6.4mt, up 12.5 per cent. South Korea produced 5.4mt, up 11.9 per cent. Germany produced 2.7mt, down 2.4 per cent. Turkey produced 3.0mt, up 25.4 per cent. Brazil produced 2.7mt, up 3.8 per cent. Iran is

2023 Steel Statistical Yearbook published

Worldsteel's Steel Statistical Yearbook 2023 contains comprehensive statistics from 2013 to 2022 on crude steel production by country and process, steel production by product, steel trade by product, apparent steel use and apparent steel use per capita by country, as well as production and trade of pig iron and directly reduced iron. It also includes data on production and trade of iron ore and scrap. It is available for purchase for €685.00.

Individuals access the data by logging into the worldsteel data platform with a personal username and password automatically issued at the time of purchase. Access is granted once payment is confirmed. The data can be easily downloaded in Excel format once payment has been processed. A PDF version of all the data is also included. https://worldsteel.org/publications/bookshop/ssy_subscription-2023/ worldsteel members can access all the data for free via the extranet.

estimated to have produced 3.0mt, up 7.6 per cent.

The World Steel Association (worldsteel) is one of the largest and most dynamic industry associations in the world, with members in every major steel producing country. worldsteel represents steel producers, national and regional steel industry associations, and steel research institutes. Members represent around 85 per cent of global steel production.

worldsteel makes a limited set of data available free of charge via the *Steel Data Viewer*. A subscription with access to the iron and crude steel production data for all other countries is available for €1,485.00 via the worldsteel bookshop. This subscription includes access to 20 years of data in the *Steel Statistical Yearbook*.

Contact: subscribers@worldsteel.org

	million tonnes		million tonnes	
	November 2023	% change Nov-23/22	Jan - Nov 2023	% change Jan - Nov 23/22
Africa	1.8	3.1	20.1	4.5
Asia and Oceania	104.8	2.2	1,271.4	1.8
EU (27)	10.6	3.2	117.6	-7.8
Europe, Other	3.7	22.2	37.9	-6.3
Middle East	4.8	4.0	48.2	0.3
North America	8.9	3.1	100.2	-2.5
Russia & other CIS + Ukraine	7.4	14.8	81.4	4.4
South America	3.5	-0.6	38.3	-6.0
Total 71 countries	**145.5**	**3.3**	**1,715.1**	**0.5**

Countries	million tonnes		million tonnes	
	November 2023	% change Nov-23/22	Jan - Nov 2023	% change Jan - Nov 23/22
China	76.1	0.4	952.1	1.5
India	11.7	11.4	128.2	12.1
Japan	7.1	-0.9	80.0	-2.8
United States	6.6	6.1	73.9	-0.5
Russia	6.4 e	12.5	70.2	6.4
South Korea	5.4	11.9	61.3	1.1
Germany	2.7	-2.4	32.8	-4.0
Türkiye	3.0	25.4	30.5	-6.1
Brazil	2.7	3.8	29.3	-7.1
Iran	3.0 e	7.6	28.1	0.6

e - estimated. Ranking of top 10 producing countries is based on year-to-date aggregate

Images Source: worldsteel

Source: Shutterstock

A new report by steel sector trade body, UK Steel, urges the government to capitalise on the UK's current competitive advantage – that we generate over ten million tonnes of steel scrap each year – to create the conditions needed for a vibrant, circular economy that makes the best domestic use of this vital material.

UK steel sector calls for ACTION TO SAFEGUARD SCRAP

As steelmakers in the UK and abroad journey towards decarbonising, steel scrap will become an increasingly sought after raw material, with global demand expected to rise by thirty per cent by 2030 and over sixty per cent by 2050.

The report, '*Steel Scrap: A Strategic Raw Material for Net Zero Steel*', says that without action, the UK risks stripping itself of a vital resource to produce net zero steel at a time of rising domestic demand. 43 countries are already taking action to secure their steel scrap supplies and the EU will introduce restrictions of exports to non-OECD countries from 2027 unless they can demonstrate sustainable practices. That alone will cause an additional draw on UK supplies from countries that can no longer source from the EU.

Exporting scrap also has clear environmental impacts. UK Steel estimates that the UK export of steel scrap and subsequent re-import of steel gives rise

..... *continued over*

"Without action the UK risks stripping itself of a vital resource to produce net zero steel at a time of rising domestic demand."

to an additional 1.5mt of CO_2 each year, compared to entirely processing steel scrap in the UK.

The report proposes three key action points to help step up the UK's environmental obligations and safeguard the vital scrap supplies needed for UK net zero steel production:

- ❑ Uphold standards by only allowing scrap exports to countries that can demonstrate their ability to treat waste sustainably.
- ❑ Incentivise retention of scrap to meet domestic demand by reducing price support offered to scrap exports through the Packaging Recovery Note framework.
- ❑ Incentivise and support greater processing of scrap to improve quality such as through R&D funding, removal of VAT on high quality scrap, and inclusion of scrap and the minerals it contains in the Critical Minerals Strategy.

Commenting on the report launch, Gareth Stace, UK Steel director-general said: "The UK's steel sector is undertaking a radical transformation on its journey to net zero and steel scrap will be at the heart of this. What is shocking is that the UK produces more than ten million tonnes of scrap a year, but exports over eighty per cent of it. With so many countries around the world acting swiftly to secure their own supply and restricting their exports, we cannot just sit on our hands.

"The UK steel industry will not use all the domestically generated scrap and some of it will rightly be exported, but we must get the balance right. It just makes sense that, here in the UK, we make the most of this resource which we have in abundance, rather than letting it go and importing raw materials instead. Exporting huge volumes of this precious material only creates a bigger carbon footprint and means we are shirking our environmental responsibilities.

"Steel scrap is core to our rapid transition to net zero. Next to major government funding commitments and competitive industrial electricity prices, scrap policy is the final piece of the jigsaw to enable the decarbonisation of the UK steel sector and a low carbon circular economy."

'Steel Scrap: A Strategic Raw Material for Net Zero Steel' proposes a set of policy recommendations to uphold environmental standards in exports of steel scrap, incentivise the retention of scrap to meet domestic demand and support the development of domestic recycling capability to improve the quality of scrap.

The report is available to download at www.uksteel.org/scrap

The case for intervention:

1. Rising UK scrap demand: To increase by seventy per cent as early as 2027, expected to treble by 2050.
2. Rising global scrap demand: To increase by thirty per cent by 2030 and over sixty per cent by 2050.
3. Restrictions on global scrap supply: 77 per cent of crude steel globally being produced by countries that have introduced or are planning to introduce measures that will limit their export of scrap.
4. Environmental impacts of scrap: Our export of steel scrap and subsequent re-import of steel gives rise to an additional 1.5mt of CO_2 each year. Sixty per cent of UK scrap exports currently go to non-OECD countries with lower environmental, health and safety standards.
5. Maximising value from the UK's scrap supply: Without advanced sorting, we are missing out on the economically significant volumes of valuable materials such as copper, nickel, aluminium and manganese contained in ferrous scrap.

The UK steel sector:

- ❑ Produces 6mt of crude steel a year, around seventy per cent of the UK's annual requirement (annual demand of 8.9mt).
- ❑ Employs 39,800 people directly in the UK and supports a further 50,000 in supply chains.
- ❑ The median steel sector salary is £39,637, 43 per cent higher than the UK national median and 56 per cent higher than the regional median in Wales, and Yorkshire and Humberside, where its jobs are concentrated.
- ❑ Directly contributes £2.9 billion to UK GDP and supports a further £3.8 billion.
- ❑ Directly contributes £4 billion to the UK's balance of trade.
- ❑ 96 per cent of steel used in construction and infrastructure in the UK is recovered and recycled to be used again and again.

For more information about the steel industry, visit www.uksteel.org

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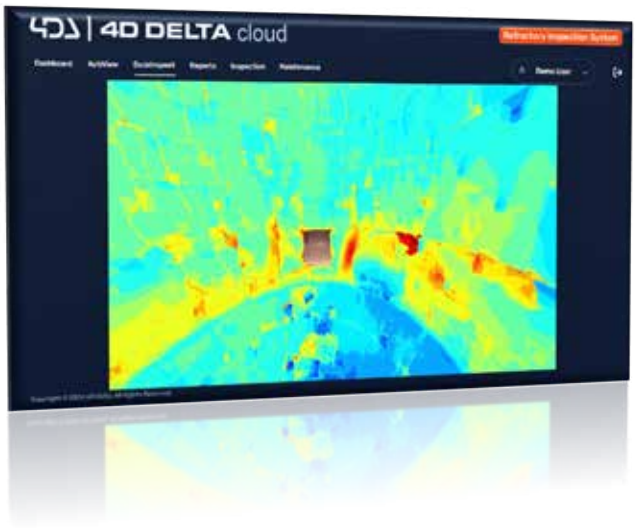
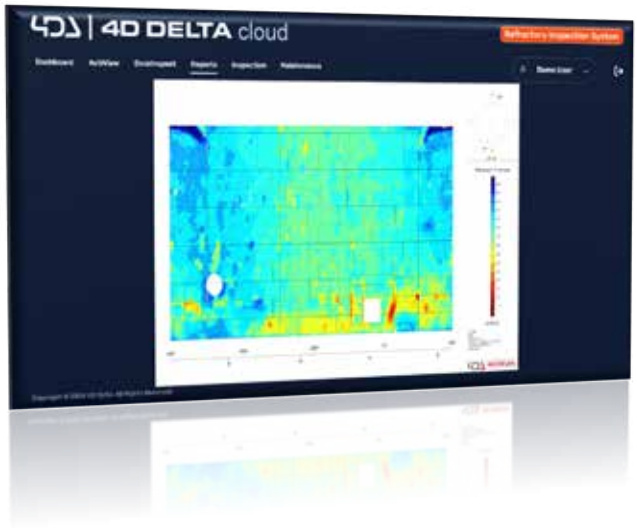


Report – General Arrangement drawings with information overlays including refractory type, installation dates and inspection maps.



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REMOTE ASSET INSPECTION

This article by Madeleine Lake, global industry manager – energy & minerals, AMETEK Land and Neil Simpson, consultant – Simpson Combustion & Energy Ltd is based on a paper presented by Simpson at the 2023 IRE Conference in Sheffield (UK).

In-furnace thermal imaging for HOT REFRACTORY INSPECTION

Development and chronology of the near infra-red borescope (NIR-B)

The near infra-red borescope (NIR-B) originated from the efforts of AMETEK Land's director of technology, Peter Droegmoeller, more than a decade ago. In 2012, the inaugural NIR installation took place in a steel reheat furnace, followed by the first installation in a glass furnace in 2013. In 2014, the establishment of Simpson Combustion & Energy Ltd by Neil Simpson marked a significant milestone. Subsequent years witnessed the collaboration between AMETEK Land and Simpson C&E, with notable achievements, such as the *Glass Focus Innovation Award* in 2017.

The year 2018 marked the installation of the 50th NIR-B glass unit, while 2019 saw the launch of the NIR-B thermal survey as a new service, accompanied by a published patent application. The unveiling of the High Definition 2k with dedicated NIR-B IMAGEPro and IMAGEPro Glass occurred in 2020. By 2021, the installation of over one hundred NIR-B units in glass, some featuring two per furnace, underscored the technology's widespread adoption. Recent years have witnessed the application of this technology in aluminium reverb and cement contexts.

In 2023, Madeleine Lake joined AMETEK Land to spearhead the focus on decarbonisation in energy and mineral applications. Notably, the NIR-B found one of its early applications in the generation of hydrogen through steam methane reforming (SMR), serving as a valuable tool for inspecting reformer tubes. Given the increasing reliance on hydrogen, ensuring reliable and continuous operation becomes imperative. The potential for inspecting the combustion chamber refractory lining and burner blocks is indicated in fig.1.

In most high temperature applications above 1000°C, the majority of heat transfer is by radiation. In many applications, the flame and combustion products heat the refractory, which radiates the energy/heat to the load and/or product. In some applications, like a cement rotary kiln, it is not practical to have as many thermocouples as the process would ideally like, or there is a limitation on the installation. Looking at the cement rotary kiln shown in fig.2, there is the potential to create profile lines, which would not be practical by thermocouples. These show both the temperatures of the product and the refractory. In the specific example in fig.2, isotherms were used to identify the build-up of materials. When the customer was asked if they controlled the kiln to optimise this build-up, they confessed that they had never seen this previously! When discussing the unexpected temperature profile on a glass furnace, the customer said: "Neil, infra-red does not lie! We have just never been able to see it before!" The reality is that this is still just the start of a journey as we start to diagnose thermal data in terms of operation, emissions and refractory inspection.

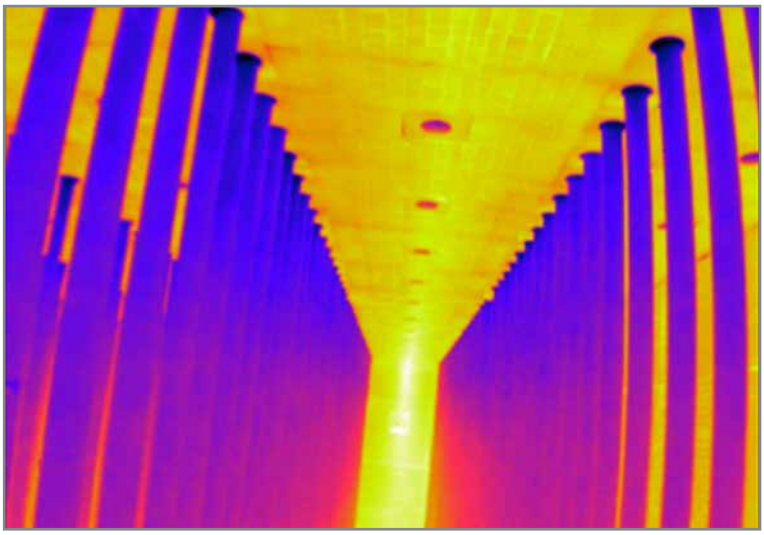

Fig.1 Steam methane reformer

In addition to using the in-furnace thermal imaging to inspect the hot refractory it is clearly possible to also look at the external refractory or, in figs.3 and 4, to look at the steel shells which encase the refractory lining of the electric arc furnace bottom shell and the ladle (fig.4) to distribute to the casting lines.

In all cases there is the potential to consider the in-furnace high temperature thermal images in combination with lower temperature shell temperatures.

Neil Simpson is best known for work on combustion in glass melting furnaces and this is where the bulk of the published articles reside.

Background glass problems conference papers

The following conference papers have been presented on the matter.

2017 – Demonstration of Cross-Fired Furnace Optimisation for Unprecedented Pull Records.

The utilisation of in-furnace real time thermal imaging showcased the potential for optimising the thermal profile of a glass melt tank to achieve energy reduction and increased pull or yield on an unrestrained furnace. Even on a restricted furnace, pull recovery was possible. Through the use of dedicated filter palettes to emphasise peak flame intensity, a correlation was established with NOx formation, offering the prospect of integration into NOx/NH3 reduction strategies. Maintenance wise, the approach also unveiled opportunities to pinpoint areas requiring sealing or over-coating on weak/thin refractory

materials. Moreover, safeguarding furnace assets was attainable with over and under temperature alarms, enabling the identification of refractory regenerator restrictions before blockage/deterioration and the detection of NaOH condensation.

2018 – Reduction of NOx Emissions in End-Fired Furnaces

Building upon the success of the cross-fired furnace optimisation, a case study on a medium sized end-fired regenerative furnace validated previous findings and emphasised the influence of the thermal profile 'engine/pump' on batch patterns. The survey revealed a previously undiscovered regenerator blockage, highlighting the potential to employ target wall temperature modulation to adjust reversal times automatically for potential reductions in energy consumption, emissions, and regenerator protection. The initial demonstration aimed to identify technologies for reducing NOx to permissible levels, emphasising the ability to achieve compliance by optimising existing equipment through the appropriate filter palette for thermal images, thus avoiding additional capital expenses for the glass manufacturer.

2019 – Survey Tool and Glass Temp – Not Just a Pretty Picture

In part of the original sales process, a demonstration thermal imaging camera was inserted into the peephole closest to the proposed camera hole location. The survey was a logical next step where, like a traditional endoscopy, the camera is installed in every peephole.

2020 – Supporting Hot and Cold Furnace

Repairs showed how the thermal camera can be used to identify the parts requiring a small repair versus major intervention. This can be used in combination with ceramic welding to ensure the weld is positioned correctly. In addition, the thermal camera can support the cooldown if a refractory is being re-utilised and the heat up in all cases.

2021 – In-Furnace Thermal Imaging Survey of a Float Furnace for Combustion Optimisation

A six-port cross-fired float furnace had a problem with NOx and was out of compliance. The author had used traditional methods without success, so a five-day thermal survey was performed and included for the first time the survey of the regenerators. The camera identified a previously unseen refractory chimney that allowed the combustion air to short-circuit and create a high excess O2 and resulting NOx. Alternative burner nozzle designs were evaluated as part of the NOx reduction.

2023 – Regenerator Optimisation

Since the times of the first Siemens regenerative furnace and patent, the furnace reversals have been approximately every twenty minutes. Most of the end-fired furnaces today operate with 20-minute reveals irrespective of the furnace pull rate or load. By utilising the AMETEK Land NIR-B and the CelSian O2/CO lasers, the paper demonstrated how the furnace reversal firing time and purge can be optimised and potentially automated to meet the changes in furnace operation.

Additional versions of these papers have been presented at Hotbels KY, Glassman, AFGM, and Furnace Solutions. Additionally, papers have been presented at combustion and also decarbonisation conferences.

While the aforementioned relate to glass, the same techniques are replicable in lower temperature furnace applications.

Glass case studies

In glass melting furnaces, if the furnace is well insulated and has a monolithic seal coat, it is often very difficult to see where a hole or 'rat hole' is developing. At 1388°C and below, the NaOH in the furnace atmosphere can condense. If it

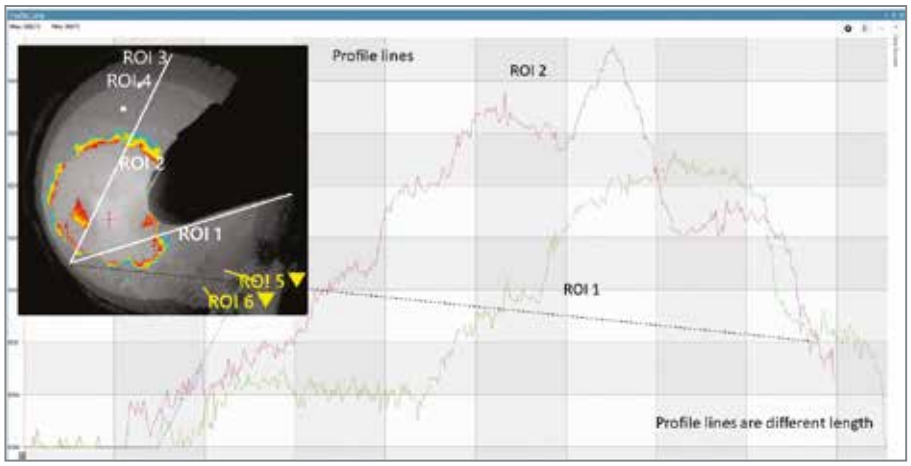

Fig.2 Rotary cement kiln with isotherms and thermal profile lines

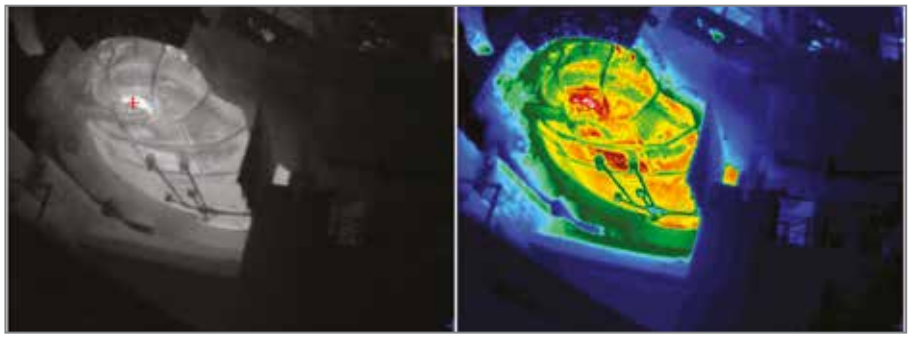

Fig.3 Electric arc furnace bottom shell condition monitoring

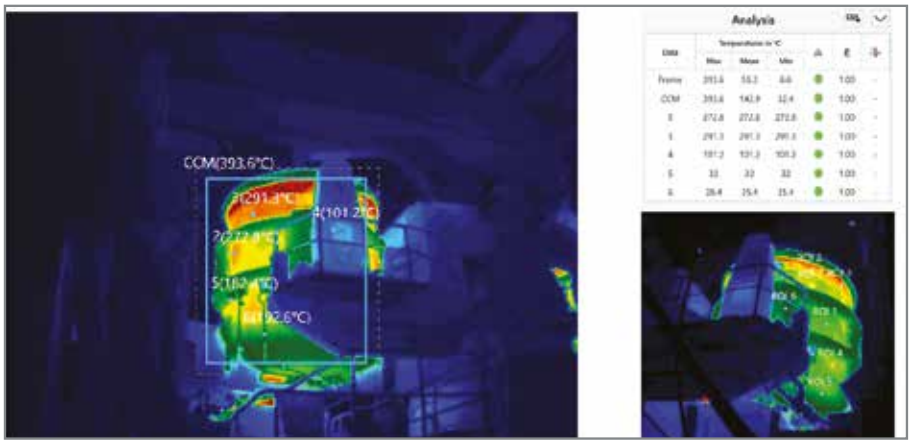

Fig.4 Lade hot spot condition monitoring

condenses on a silica crown (typical construction in soda lime glass applications), it will corrode the silica and form a hole. The further into the hole, the colder the hole becomes since now closer to the cold face there is more potential for the hole to grow. Rarely is the initial path of the hole the shortest route but the path of least resistance through joints. The first thing that most B&F operators notice is when there is a flame or 'sting out' through the cold face insulation. At this stage, it often requires an 'archaeological dig' to remove the layers of insulation to find the source or start of the hole. From a refractory maintenance perspective, it is typically easier to fix a small hole than a large one! By utilising a survey camera, fig.5, it is possible to identify where the hole is originating.

Fig.5 NIR-B 2K survey equipment

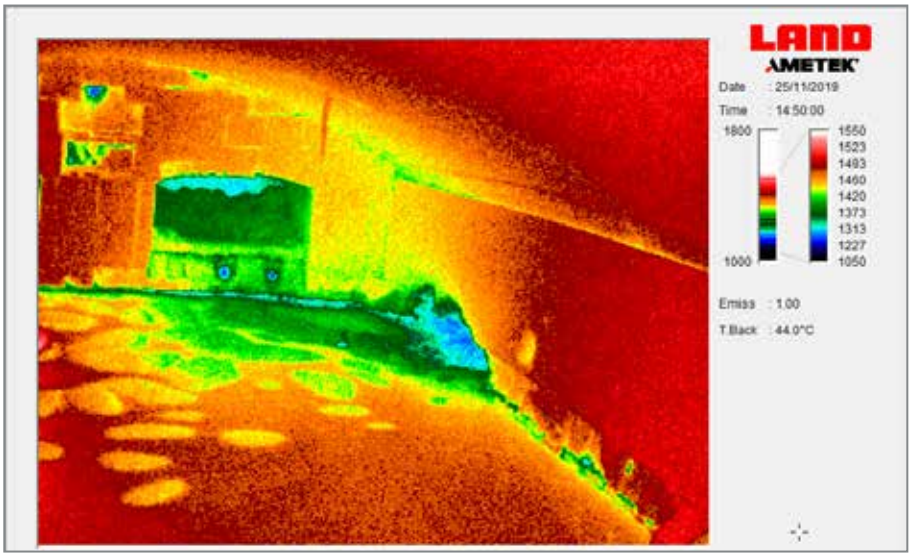

Fig.6 End-fired furnace 2 zoom and isotherms to highlight damage*

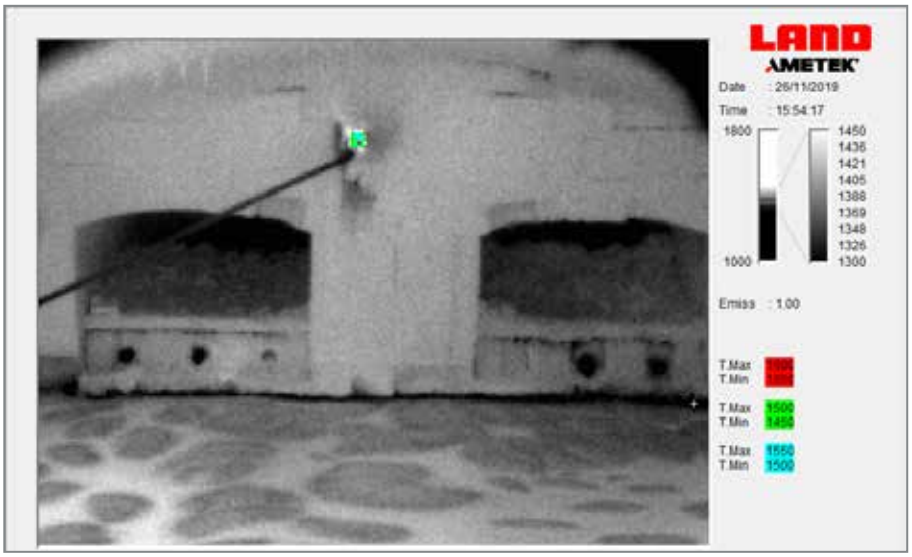

Fig.7 Ceramic welding

At Allied Glass in Leeds in November 2018, there was a significant refractory failure in an end-fired furnace. Whilst a thermal camera was already permanently installed in the furnace, the damage was visible to the 'naked eye'.

The image in fig.6, taken the day before the welding, is from the fixed location in the bridge wall above the throat. By utilising the 2* digital zoom function, the damage to the port end wall is clearly visible.

The image in fig.7 was the end of a 90 minute recording using a 4* digital zoom and isotherms to show the temperature and location of the weld.

The ceramic welding was successful and enabled the furnace to continue to operate for several years.

At a separate Allied site, the furnace was studied in 2018 and 2019, and the furnace cooldown was the subject of the 2020 glass problems paper referred to earlier. Fig.8 shows simultaneous images from a static, permanently installed NIR-B in combination with a survey instrument.

At a previous cold repair, the breast wall had been replaced and was in sufficiently good condition to be used after the repair. The NIR-B was installed for several years and was used as part of the furnace cooldown to monitor the refractory temperature and avoid thermal shock.

Fig.9 is during a reversal and partway through the furnace drain. The blue lines highlight the glass level. The wear on the glass contact 'soldier blocks' is clearly evident, with over-coating repair visible.

A little over 28 hours later is a sad moment for a combustion guy since it shows THE last port flame (fig.10)! Immediately downstream of the port flame, below the region of interest 1, is a pre-mix burner which was used for the balance of the controlled cooldown. An unusual sight is seeing the barrier boost electrodes at the base of the image.

During the presentation at the 2023 *IRE Annual Conference* in Sheffield, additional slides were shown, which showed recordings and images at 12-hour intervals up to sixty hours beyond the initial image.

Whilst AMETEK Land would state that the instrument was below the instrument's calibrated range, the information is significantly more than would be seen in the visual spectrum. The relevance of this statement is more for the resulting furnace heat up following the repair/rebuild. The camera was used as part of the heat up, and whilst Allied permitted the use of the

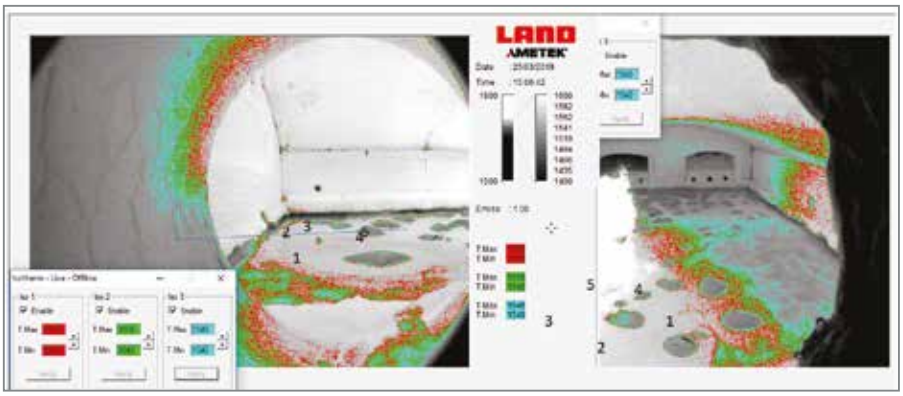

Fig.8 Static and survey images

images, the authors felt that it would reveal confidential furnace design information.

As an alternative and part of the 2023 *Glass Problems Conference*, a long wave infra-red [LWIR] camera was used to measure the Rider Arch temperature at the base of the regenerators. Instruments ranging from 0-500 and 500-1000°C are available for inspections and heat up of low temperature furnace applications using the peepholes for access. It is proposed that this could be the topic of a future conference and/or journal article.

For more information on the AMETEK Land industry team, visit https://www.ametek-land.com/about-us/industry-product-managers or email: land.enquiry@ametek.com

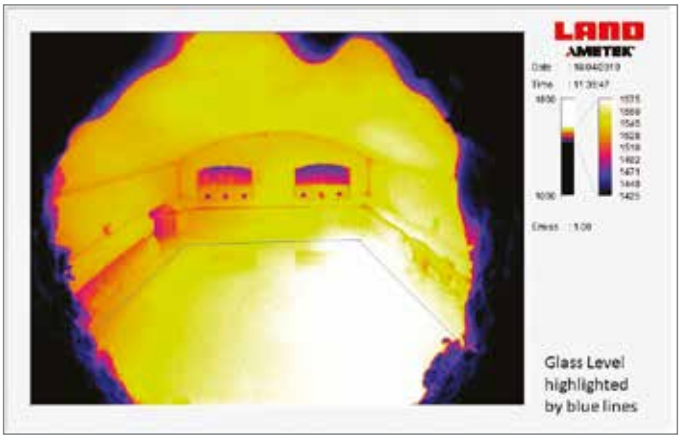

Fig.9 Furnace drain as part of the repair

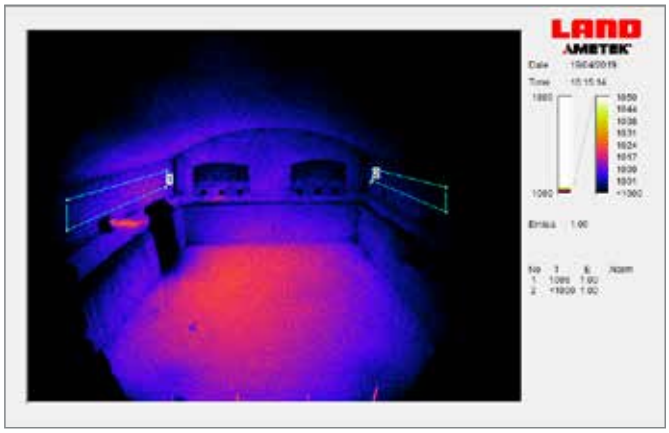

Fig.10 The last port flame

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The readership of The Refractories Engineer is keen to hear about the latest technological advances and research being undertaken to help drive the industry forward. Therefore, we are happy to receive technical papers from interested parties for publication in The Refractories Engineer.

All papers submitted must be original, written in English and have the approval of the author(s) prior to submission. They must either report original research work or be a detailed description of the latest technology or knowledge within a specific field related to the refractories industry.

Technical papers are required to be in a Microsoft Word format with any supporting imagery supplied as separate, high resolution jpeg files.

Submissions should be sent to the editor: editor@ireng.org

Nine hundred alloy recipes and a FOCUS ON SUSTAINABILITY

Steel is a wonderful metal that can be remelted and reused indefinitely, says materials technology expert Alleima. Today, approximately 83 per cent of the company's production is based on recycled steel and melted in an electric arc furnace that runs almost entirely on fossil-free electricity. Through collaborations, products and solutions, Alleima supports energy efficiency, greener transportation, and reduced CO_2 emissions.

Advanced materials and stainless steel have been at the heart of research and development at Alleima for over 160 years. Combining different materials, creating new alloys, and changing the microstructure to enhance performance and efficiency, are all part of the company's daily work.

The materials are lightweight, durable, corrosion resistant, and able to withstand extremely high temperatures and pressures.

Recycled since the 20th Century

There are two different methods for making steel. One is to melt iron ore in a blast furnace, a method that emits "large amounts of carbon dioxide". The second method is recycled steel based manufacturing, through which primary and secondary materials are melted using electricity as the energy source. This is the method Alleima has used for over one hundred years, where the share of recycled materials in the company's products is currently approximately 83 per cent.

"From a sustainability perspective this is very strong, and the best thing is that the products we manufacture in turn help customers reduce their carbon footprint," says Håkan Sundström, head of sustainability and governance, at Alleima.

The process that follows the melting of the steel, and in particular, the hot processing of materials, represents most of the CO_2 footprint from Alleima's operations. The heating furnaces run on liquid propane gas (LPG) or natural gas, along with a mix of biogas. This creates opportunities to reduce carbon dioxide emissions by shifting to fuels with lower carbon impact such as biogas, fossil-free hydrogen, or fossil-free electricity. The goal is to halve the already relatively low CO_2 emissions by 2030.

"We are looking into the possibility of going in the direction of using hydrogen or electric furnaces. We need to make sure that a shift in heating fuel doesn't affect product properties and quality. Sustainability is present in every aspect of our operations and forms an integral part of our commercial strategy," says Sundström.

Buyback programs increase circularity

The company runs buyback programs both as a service to customers and to further the efforts to increase the proportion of recycled materials. The bought back products are products originally manufactured by Alleima that have been installed at the customer's premises for up to twenty years. When the customer chooses to switch to a new product, Alleima is offered the opportunity to buy back the old one. This allows Alleima to keep track of the exact composition of the bought back product material.

A great example is the buyback process set up with Welltec and Rimeco. Welltech, a leading Danish provider of robotic well solutions for the energy industry, uses the Alleima high alloy tubes in the production of its world leading metal expandable packer technology. Welltec buys the tubes from Alleima and reworks them to fit the needs of the specific application. This

typically results in some scrap being left over.

Rimeco is a fifth generation Danish recycling and waste management company that has been providing recycling services to Alleima since 1981. Its principal activity is the collection, recycling, and operational handling of non-ferrous and ferrous scraps and alloys in Scandinavia. As a partner to Welltec and Alleima, Rimeco has all the necessary agreements in place to allow both companies to trust it to take care of their state-of-the-art materials and proprietary designs.

"This is very effective for us! When we know exactly what product it is, we can optimise when re-melting. We get stainless steel back, but we also help the customer to have their used material removed. The customer, like us, wants to make the process as circular as possible," says Sundström.

Once back with Alleima, the material goes through further studies to establish what kind of new product it could be used for.

Alleima purchasing manager Per-Ragnar Moberg explains: "When the material comes to us, we carry out an in-depth analysis to find out how much nickel, chromium, manganese, and so on it contains. This allows us to decide how to best re-use it."

After smelting in the electric arc furnace, the material is further processed in the AOD (argon, oxygen, decarburisation) converter to reduce carbon and sulfur. The third step in the steelmaking process is the ladle furnace, where the final adjustments are made to the composition. After certain elements, like nickel, chromium, and manganese, are added, to get the recipe just right. Today Alleima produces more than nine hundred different stainless steel grades, each of which is made up of a precisely balanced mix of elements, forming a unique 'recipe'.

Transparency and CO_2 reduction

To further increase transparency, Alleima is implementing life cycle assessment (LCA) as a tool to accurately measure and calculate the carbon footprint of advanced materials and products. Customers will be provided with third-party verified and precise data, which supports them on their journeys to reduce their environmental footprint.

LCA is an increasingly important methodology to quantify environmental impact and identify hotspots in a product's life cycle. LCA studies can be used to cover all the stages, from raw material extraction to when the product reaches the market. They can provide calculations of the many different types of environmental impact in product manufacturing, including carbon footprint.

R&D at the company's core

Research and development is at the heart of Alleima. Combining materials to create new alloys and changing the microstructure to enhance performance and efficiency are all part of daily work. It is all about material science and deep customer application knowledge. With more than nine hundred lightweight, durable, and corrosion resistant alloy compositions, Alleima products can be exposed to extremely high temperatures and pressures, they can be more efficient, and ensure a more sustainable process.

How, exactly, can technological developments in materials science support sustainability? Take the Eiffel Tower, for example. By using the advanced high strength steels that exist today, you could build four Eiffel Towers using the same amount of material that was used in the original. Building lighter constructions means less material produced and less transportation required to move it. All these factors lead to reduced CO_2 emissions. Stronger steel also allows aircraft and cars to weigh less, enabling them to consume less energy and, in turn, produce fewer CO_2 emissions.

The key lies in the material design. Alleima researchers and product developers have delved down to the atomic level to design new materials, moving atoms to create new compositions of existing materials to make them lighter and more resilient. Computational modeling shows what kind of new compositions are possible and what would be needed to realise them.

Source: www.alleima.com

Images source: Shutterstock

Real world problems – PRACTICAL SOLUTIONS

Institute of Refractories Engineers

Annual Conference and Training Day 2023

15 -16 November 2023 – The Mowbray, Neepsend, Sheffield, UK

Report by Lynn Postle FICME, Editor

The CO_2 footprint will play a significant role in how refractory products are bought in the future, warned Chris Parr in the opening presentation at the IRE UK Annual Conference.

Held at The Mowbray in Sheffield (UK) on 15 November, the conference attracted many delegates keen to learn from industry experts about practical solutions to real world problems.

Parr of the British Ceramic Confederation (now known as Ceramics UK) urged delegates to place sustainability at the forefront of their minds. "Your customers will need to be able to identify their CO_2 footprint…we need to do better collectively with regards sustainability," he noted. He said that to extend the life of refractories there is a need for:

1. Better products, using less material.
2. Energy conserving.
3. Water to be used more efficiently to produce minerals.

IRE President Mike Lamkin with Past President Katy Moss

He explained that there was a need for change in global steelmaking with several challenges including looking at material systems and process optimisation.

Taking the audience through a series of scenarios and ideas, he considered what raw material producers could do to help with the "transformation" to "replace and lower the active carbon content in certain systems." He talked about how switching to hydrogen for some processes was possible but often it would "not be a simple switch." He said: "The refractory world will be very different depending on whether you are at the burner block or further away.

"The impact on combustion area needs to be analysed. Flame and flame speed, changes in gas flow etc. all needs to be understood. Fuel will also be an issue as hydrogen will not be available universally. Hydrogen networks are being built and large scale installation is ongoing, but hydrogen cannot be acquired at a competitive price for large scale plants – perhaps alternatives such as biofuel need to be investigated.

"It is a real world problem and we need to couple experimental and simulation approach to drive us to solutions."

Picking up the discussions about hydrogen, Mark Allen from the Materials Processing Institute (MPI) detailed the facilities available at the MPI and some of the work being undertaken there. He began with an update on the hydrogen resistance work and some thoughts on how the experiments being undertaken can be run out into industry. He said: "If you are burning hydrogen correctly and safely then you won't have any spare, which is great for the environment but a nightmare for refractories. The question remains: what is it doing when you're producing bricks, cast products etc.? There are a number of questions and potential headaches

before large scale furnace production with hydrogen."

He also queried: "What behaviour exists in a hydrogen combustion atmosphere – fusion, volatisation, water vapour attack? We can't answer all the questions, but we need to pool our knowledge."

He explained that the MPI has capacity to support "decent size thermal experiments". He revealed that combining efforts with Trent Refractories and Kanthal in a three-year pilot program, it was envisaged that some questions would soon be able to be answered, with Kanthal involved because "at least fifty per cent of the industrial people MPI is in discussion with are looking at electrification of reheating and pre-heating for heat treatment."

He concluded that: "the future is a hybrid of highly appropriate technology."

Theoretical examples

In a presentation entitled *'From collapsing glass furnace regenerators to H2 combustion – how refractory permeability can save the day,'* Chris Windle of DSF Refractories and Minerals Ltd looked at how to measure permeability (forcing air or nitrogen through the sample), considering real life problems with real life solutions. He noted that a regenerator in heat recovery systems is "a marvellous way of heat recovery in the glass sector."

He spoke about the history of the regenerative furnace (1892 – Windle Pilkington), highlighting how making low permeability press free is "very difficult, but cast material is an option". He offered several examples of different processes/ options, including the hybrid glass melter option – a combination of electric melting and combustion (hydrogen/oxygen) melting.

As per Parr's earlier presentation, Windle noted that "the consequence when we move to hydrogen will be water." He warned: "Water vapour in the atmosphere can double the effect of global warming according to NASA."

He continued: "We are looking at creating a material that is resilient and have come up with a solution that is giving good results – the material that keeps on giving.

"Permeability, I believe, is an overlooked fact of refractories."

Delegate Dr Mark Jolly of Cranfield University echoed some of the concerns raised, saying: "We must always consider the rebound effect that occurs when we double the grid. This means we will use more steel and more concrete. So, whilst the choice of materials is critical, we will still be producing CO_2."

"We know now that UK steelmaking is going to be electrified," said Dave Bell in his presentation *'A day in the life of a steelmaking ladle'*. "What we need to do is look at theoretical examples of what refractories suppliers can do to improve costs."

He went on to highlight refractory materials and the amount of energy used to produce and use them, such as hot face temperature loss in ladle linings and heat loss from outside the ladle. He asked: "how can we humble bricklayers help?"

He went on to detail a large research project on an energy saving (mag/carbon) brick; the brick has been designed to reduce bulk density which affects heat being held, and a smaller project on a new firebrick.

Highlighting the comparison between the options, he concluded: "I've seen loads of examples where refractories are replaced with much improved materials, but people haven't considered the heat loss! Remember, energy saving is becoming more and more important."

Matthew Davies of TATA Steel UK, Port Talbot presented on shocking bricks, in particular thermal shocks. He tabled examples and warned delegates to consider the "less obvious places where thermal shock occurs." As the only group in TATA Steel UK making virgin steel from a blast furnace, Davies spoke from the heart about best practice. He said: "A very important stage of the ladle is when it is empty – the dark side of the moon. The ladle goes empty from the end of cast to the next time it is used. We have looked at ladle shell design – five metres high and 4.8m internal height – and are coming to a compromise with the ladle shell.

"There are many challenges for the ladle supplier/designer. This is a one-shot ladle, and our people are pretty close to the process, so criticality is high risk for us, which is why we have undertaken a lot of work to manage the fleet. We have a proactive system and need to maintain a free joint in the bottom."

Davies explained there are several places for thermal shock – "that is the problem and the process". Rigorous testing is undertaken, and data is shared with suppliers to show how they compare to other suppliers, offering good feedback. Both trial products/materials and standard products/materials are tested and compared. He said: "We look for best performance, best unplanned failures, cost/tonne, linings etc."

A call to arms

Considering the importance of health related issues, such as stress and respirable crystalline silica (RCS) Natalie Tinsley, HM Inspector of Health and Safety, Engagement and Policy Division – Manufacturing Sector, Stone, Brick, Concrete, Glass, of the Health and Safety Executive (HSE) spoke of the HSE's ten-year strategy to protect people and places. Of particular note was the legal requirement upon employers to protect the health and wellbeing of their employees.

In a shocking statistic, Tinsley announced that "Fifty per cent of work related ill-health is due to stress." She said: "Our inspectors will ask you what you are doing about that."

In terms of RCS, she said "we need to work out how to tackle" it, while other areas are

also prioritised. "Silicosis is currently not a RIDDOR reportable disease, we therefore don't have the statistics on it."

Past IRE President Katy Moss asked the room for assistance, saying: "Dust extraction in refractories is an issue. We can't use water so what do other companies do? Is it just LEV? What about spot cleaning?"

Tinsley confirmed: "If extraction is your control and you have to use dry processes, that is reasonably practicable. However, make sure you have competent advice, the British Occupational Hygiene Society is one option."

Tinsley listed some of the current HSE campaigns and findings, saying that in terms of refractory failings "all areas, including small places onsite, are looked at – not just production areas."

Calling delegates to arms, she noted that the last *'guidance on hazards from the use of refractory fibre'* was in 1999 and that the guidance needed updating. "We are keen to hear your views on this to contribute to the update," she pleaded. "We want the people who do the work to be involved in the update."

An ever evolving industry

Having made the near 17,000km journey from Australia to the UK for the conference and most notably to facilitate the *IRE Training Day* on 16 November, Mike Walton, the Treasurer of the IRE Australasia branch gave a presentation on *'The role of the consultant in the modern refractories industry.'*

He explained how the industry has adapted and, in some cases, rationalised in Australia, meaning that in many project instances in-house experience on certain matters is inadequate. However, Walton made the case for close working relationships between expert organisations like the IRE and industry. "The IRE is trying to help people make the correct decisions to get things done properly," he said. "It is a good idea to start with an appraisal before commencing a project. I've been a consultant for nearly thirty years and nowadays consultants are fully involved with projects, they are no longer just strategically involved."

He explained how in-house politics is something to be navigated with tact with the operator and management often having differing views about a consultant's involvement. "Think of a consultant as an insurance policy," he urged. "Arguably, money is better spent before embarking on a major project than after."

He said the role of the consultant had grown in recent years. "Back in the day companies had a refractory team, so there was little need for additional input, but only major steel companies have that now. The current role of the consultant is to fill the knowledge void as in many cases expertise has been lost at every level. This means the consultant is more hands-on now – both the strategic and tactical line between the consultant and the contractor is very, very fine."

When questioned about what he considered key skills to introduce apprentices to, Walton pinpointed "correct protocols". He said: "Don't let them pick up bad habits. Use the IRE as they have training and skills development options. Then mentor you apprentices. Mentoring is vital."

Latest products

"There are now lots of brands under the Alkegen banner," said Chris McMahon of Alkegen now that Unifrax and Lydall have combined into one company. At the conference McMahon was representing the insulation team, which manufactures and converts materials into different product forms depending upon the application.

He detailed the options now available for "lower energy, better linings and less heat loss."

In his presentation, *'Next generation carbon filters – best of both worlds,'* Ian Andrews of Capital Refractories presented on the mechanisms of traditional and next generation filters, noting that the latter provide more freedom of design. He detailed Capital's next generation filter Metcon C, saying: "We feel it is more cost-effective, efficient, repeatable and has a consistent structure."

Neil Simpson of Simpson Combustion & Energy Ltd also presented (see page 16).

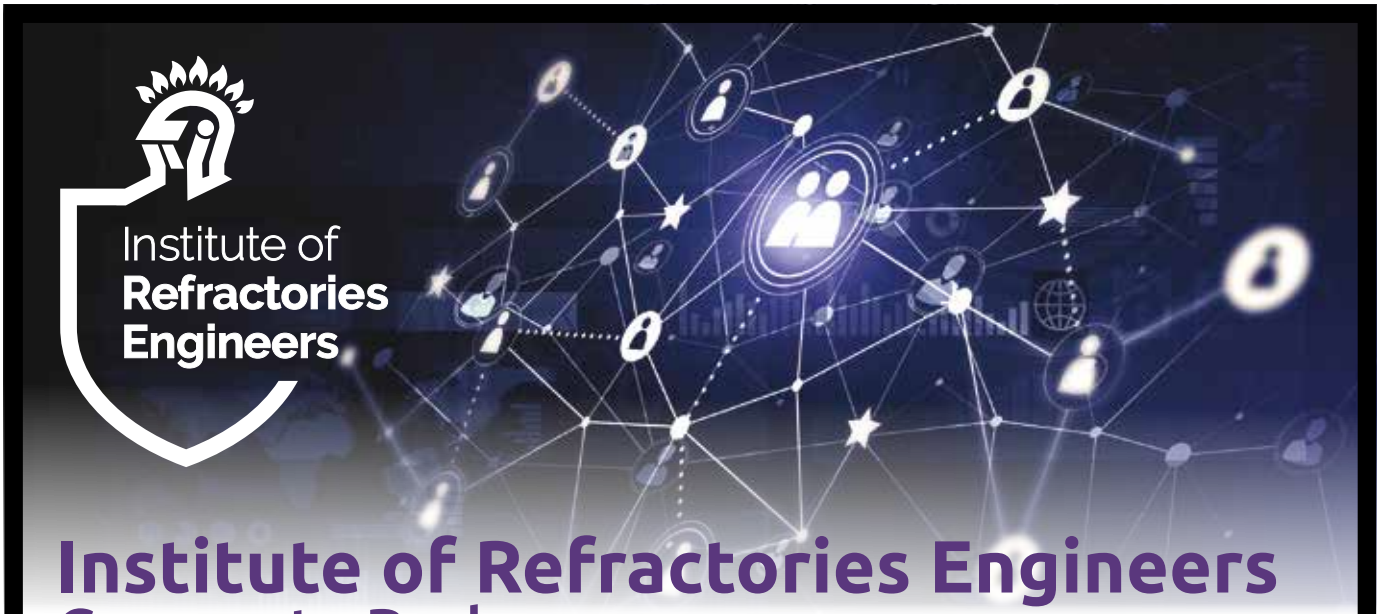
More than a technical conference

In addition to the technical presentations, there was also a late afternoon workshop hosted by TransFire (Transforming Foundation Industries Research and Innovation Hub) on *'Unlocking opportunities through collaboration.'* Regular networking breaks throughout the day and a celebratory dinner on the evening of 15 November, including entertainment and a presentation from Sebastian Klaus of Almatis entitled: *'ECO-TAB – a new alumina aggregate for steel ladle lining.'*

On 16 November the IRE held its annual *Training Day* on *'Castables – 50 shades of grey. How to not mess up.'*

IRE President Mike Lamkin said he was "delighted" with the attendance level and the venue for accommodating a higher number of delegates. "It really shows that people want to get together and discuss the pressing issues in our sector. I was also enthused by the number of questions and debate that the presentations drew. I would like to thank everyone involved in the organisation of the event, particularly Past President Katy Moss and Administration Assistant Georgina Nicol. Also, all the presenters and delegates on the 15 and 16 November, both the *IRE Conference* and *Training Day* were well supported.

Copies of the presentations are available, contact Georgina Nicol for more details, email: secretary@ireng.org
Terms and conditions apply.



Institute of Refractories Engineers
Corporate Packages

The Institute of Refractories Engineers Corporate Packages offer a host of benefits for companies involved in the refractories sector to expand their profile, gain more advantage from their involvement with the IRE, and attract new talent by being seen as a forward-thinking company committed to the industry in which they operate.

IRE Corporate Packages enable existing and new members to access an increasing number of benefits and they encourage greater input from individuals in the company. Each package enables a company to nominate a number of individuals for membership, plus giving the company an opportunity for added value at a highly competitive rate, including complimentary and discounted advertising in ***The Refractories Engineer*** and complimentary and discounted attendance at IRE conferences and courses.

There are three levels of **IRE Corporate Packages** – Bronze, Silver and Gold depending on the level of involvement and commitment required. One thing links them all – the chance to make a difference to your industry and your institute, in a cost-effective manner whilst also promoting your own company and investing in your people.

For more information and to take advantage of all the benefits an IRE Corporate Package has to offer, contact Georgina Nicol at IRE on: secretary@ireng.org or visit www.ireng.org

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- ❑ 2 online conference fees
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- ❑ 2 x *Business Directory* entries
- ❑ 2 IRE individual memberships
- ❑ 1 online conference fee
- ❑ 1 online training fee

£1,023.00 worth of benefits for just £600.00

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- ❑ 10 per cent discount on additional advertising.
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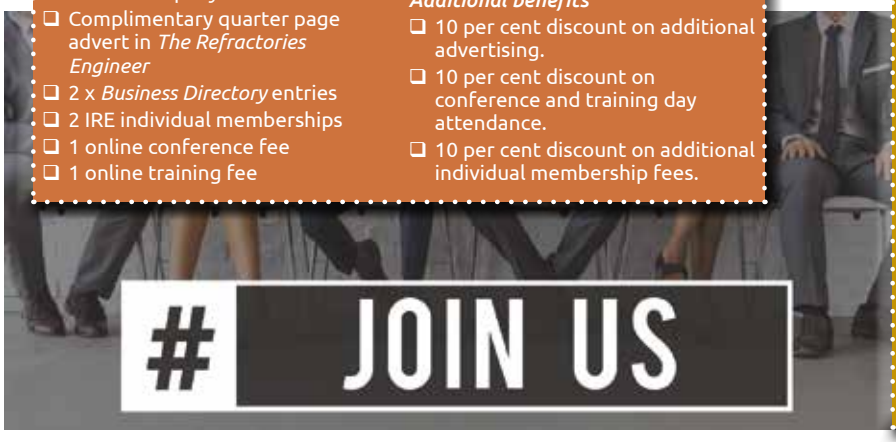
- ❑ 10 per cent discount on additional individual membership fees.



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Website: www.trentrefractories.co.uk

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Advertising Deadline: 12th January 2024

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- ❑ Growth of Hydrogen
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- ❑ Ferrous and Non-Ferrous Foundries
- ❑ International Colloqium on Refractories Preview
- ❑ Decarbonisation

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