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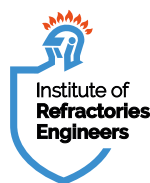
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**Don't miss the
THE REFRACTORIES ENGINEER
2023: Issue 3 - September**



The Refractories Engineer



Lynn Postle, FICME

From the editor

It is noticeable that this month we are again dedicating much attention to the ongoing need to develop materials, processes and overall manufacturing methods that enable us to drive technological advances whilst maintaining a commitment to a more environmentally sustainable way of operating.

Living and working with a greater emphasis on social (and commercial) environmental responsibility is something that each and every one of us is aware of. Now the time has come to make firm commitments to that in our business plans and our R&D projects. I am encouraged by the focus placed on improvements to drive the industry and associated industries towards ambitious net zero targets. I am also encouraged by the fact that many refractories companies are already well on their way to meeting said targets, having invested in the latest equipment and technology to save energy and adapt many traditional practices.

We have spoken about green steel before and of course it is a subject that will be covered on an ongoing basis. In this issue we also look at material developments in the concrete sector, with much work being undertaken to improve the "green" credentials in that industry.

As would be expected, eco technology will be a prime focus in Dusseldorf, in June when the foundry industry and metallurgical industries come together at the *Bright World of Metals* quartet of trade fairs. There will be much to consider as attendees look to develop relationships with the industrial partners that they will be working with in the future. It is fair to say that "preferred supplier" status will be given to those companies exhibiting a real devotion to sustainable manufacturing. It is no longer a "nice thing to do," but has become an ethical and commercial necessity.

The matter was also a hot topic at the *IRE AUS* conference in Sydney in March, read more about that in the next issue of *The Refractories Engineer*. In the meantime, remember please let us know of any developments at your company, so we can continue to promote the industry around the world.

The Refractories Engineer is published four times a year and is circulated to Members of the Institute of Refractories Engineers. Whilst every effort is made to ensure the accuracy of material submitted, the Institute of Refractories Engineers cannot be held responsible for comments made by contributing authors.

Advertisement Sales:
Email: advertising@ireng.org

Editorial Content:
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Design & Artwork:
Rivers Media Services
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Publisher:
Institute of Refractories Engineers
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Website: www.irengineers.co.uk



Message from the President

Hello fellow members of the IRE. A shorter message this time with a mention of what's been happening recently within the IRE.

After the successful conclusion of the conference and training day in Sheffield (UK) at the end of November, our attention has been focussed more on a couple of events in Australia.

Firstly, a one-day training workshop held in Perth, Western Australia, organised by the Western Australian sub-branch. Congratulations to the organisers for such a well-attended event. I hope that those who took part gained some useful insights.

Next, (at the time of writing) we are about to hold *IRE AUS 2023*, the

Australasian (includes Australia and New Zealand) branch conference, at the Rydges Hotel at Sydney Airport.

It looks like we will have almost one hundred attendees with a total of fourteen speakers on Monday 27th March. We are thankful to our Platinum sponsor Calderys, the Gold sponsors Antec Refractory, SOTO Engineers, Veolia and Vesuvius, and the Silver sponsors Morgan Advanced Materials, Pyrosales, RHI Magnesita and Shinagawa Refractories Australasia.

We will also welcome Lynn Postle (journal editor) and Andrew Turner (advertising manager) from the UK who will be attending the conference and mini-expo.

On the home front, I'd like to thank Matthew Davies (Tata Steel) for volunteering to join the IRE council, and who, together with Peter Rooney (ANH Refractories), has taken on responsibility for sourcing technical aspect articles for The Refractories Engineer.

We are looking at further expanding council and so if you would like to get involved please contact Georgina at secretary@ireng.org

Hope you enjoy this issue.

All the best

Phil Walls

President, Institute of Refractories Engineers

Membership Renewals

Membership of the Institute of Refractories Engineers offers a wealth of benefits and highlights a commitment to YOUR industry.

Remaining loyal to the Institute of Refractories Engineers shows to the wider industry that you and your company are proud of the heritage and professionalism of your leading sector organisation.

Members benefits include:

- A copy of the journal *The Refractories Engineer*, mailed direct to your door.
- Access to meetings and social media groups enabling networking opportunities with our refractories' community.
- The opportunity to submit papers for publication by the Institute.
- An IRE Membership Certificate to display in your premises.
- Discounted rates for meetings and other functions.

Make sure you don't miss out on all the latest refractory news and exciting improvements from the Institute of Refractories Engineers. Renew your membership for 2023 today, or sign up by sending an email to secretary@ireng.org



CORPORATE PARTNERS

The IRE thanks the following Corporate Partners for their support:

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

Silver

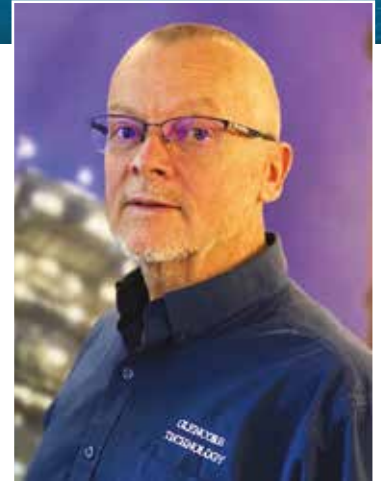
Imerys Aluminates Ltd,
LKAB Minerals Ltd,
Mayerton Refractories Ltd,
Mineral Tech

Gold

Calderys,
Capital Refractories Ltd

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 37.



Update from Australia

Dear readers, hello from Australia. As I write this, we are fast approaching and almost on the eve of our Australian branch conference, being held in Sydney on 26-27th March. Our organising committee has been busy with preparations with speakers, presentations, and talking with our sponsors, without who, running such an event would not be possible. Thanks to you all, for the efforts and contributions you have made, they are deeply appreciated and truly valued.

We had fourteen speakers arranged to present across a wide range of topics, among which are several from end user plants, which is a subject always close to my heart. Understanding the impacts of an operation on the chosen refractory linings and learning how to look after the refractory linings in a pyrometallurgical process is something that I'm personally very attached to. I'm really glad that mentors took the time to impress on me the importance of getting this right, decades ago.

With the current focuses on energy costs, efficiency, recycling and urban mining and the treatment of metals, glass, and many other products and residues in furnaces, utilisation and optimisation of refractory linings will be required for decades to come. Therefore, there remains an important role for an organisation such as the IRE to ensure that the skills and knowhow in materials, manufacturing, installation and operation are preserved and strengthened.

If you are reading our journal and are not yet an IRE member, please consider joining our ranks as an individual or having your organisation contact the IRE and discuss taking out a corporate package.

We will be having our AGM, following the conference, and it gives me great pleasure to announce that I will be handing over the reins of the Australian Branch to our Vice President Mario Taddeo. Mario has been an excellent support in the role of VP and I wish Mario well in his coming tenure.

Kindest regards

Mark Prince
Brisbane, Queensland, Australia



Events Diary

Upcoming events to be added as dates in your diary

12-16 June 2023

GIFA, METEC, THERMPROCESS, NEWCAST

Foundry, metallurgy and thermal processing trade fairs and meetings

Venue: Messe Centre, Dusseldorf (Germany)

Contact: www.gifa.com

28-29 June 2023

The Advanced Materials Show

Exhibition and conference

Venue: NEC, Birmingham (UK)

Contact: www.advancedmaterialsshow.com

9 August 2023

International Conference on Refractory Materials and Alloys (ICRMA) 2023

Venue: New York (USA)

Contact: www.waset.org

26-29 September 2023

Unified International Technical Conference on Refractories (UNITECR)

Venue: Kap Europa, Frankfurt (Germany)

Contact: www.unitecr2023.org

15 November 2023

IRE Annual Conference

Venue: The Mowbray, Kelham Island, Sheffield (UK)

Contact: secretary@ireng.org

23-24 April 2024

Ceramitec 2024

Venue: Messe Munchen Exhibition Center, Munchen (Germany)

Contact: www.ceramitec.com

14-19 July 2024

International Congress on Ceramics

Venue: Hotel Bonaventure, Montreal (Canada)

Contact: www.ceramics.org/event

Institute of Refractories Engineers

Annual Conference 2023

15 November 2023

The Mowbray, Kelham Island, Sheffield, UK

SAVE THE DATE

Following the success of the IRE Annual Conference in 2022, we are pleased to announce that we will be holding the 2023 IRE Annual Conference at the same venue – The Mowbray in Kelham Island, Sheffield (UK) on 15 November 2023.

The conference offers the chance to come together to listen to industry experts impart their knowledge and is an ideal networking opportunity. We will be seeking contributions for the event in the coming weeks and suggest you check out the website for updates. At this stage we ask you to save the date to ensure you don't miss out.

More detailed information on the IRE Annual Conference will be published in the next issue of *The Refractories Engineer*, for now remember to save the dates in your diaries.



World-leader looking to recruit

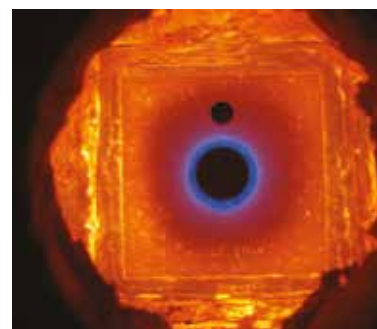
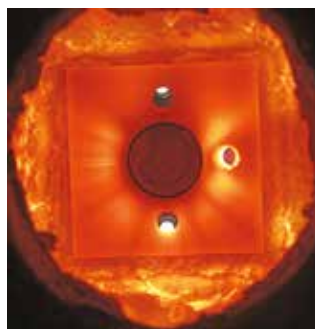
Zeeco is the world leader in combustion and environmental solutions, employing 1,600+ people across 25+ global locations. Since 1979, Zeeco has completed 50,000+ projects helping industries meet global safety and environmental regulations.

The company's dedicated team of refractory engineers understands the demands placed on combustion products; thus the company's ready shape pre-cast works are producing all shapes and sizes of process and power burner tiles. Zeeco's global refractory manufacturing facilities are certified to meet the industry standards laid out under ASTM, BS, DIN, and EN specifications. Combined with its research and testing facility, Zeeco is able to test to destruction to ensure longevity and product selection suitability.

Attention to detail, careful and correct raw material sourcing, and the utilisation of highly qualified refractory engineers ensures that the service life performance of the company's products exceed industry expectations.

The message from Zeeco: join our team of expert engineers and redefine your career with Zeeco.

Refer to page 39 for more information.



The
**Refractories
Engineer**

Calderys becomes a standalone company

Formerly the High Temperature Solutions (HTS) business area of Imerys, Calderys becomes an independent company owned by Platinum Equity, a global investment firm operating companies in a broad range of business markets.

Known globally for its advanced refractory products and services, Calderys becomes an independent company encompassing the full scope of high temperature solutions business (HTS) area formerly under Imerys. The new company is owned by US-based Platinum Equity following the successful completion of regulatory approvals and customary closing conditions.

Calderys specialises in thermal protection for industrial equipment with a wide range of refractory products and advanced solutions to enhance steel casting, metallurgical fluxes and moulding processes. With a global network of experts and 36 industrial sites in 16 countries, Calderys leverages over a century of experience, a global reach and a truly diverse team, to continuously innovate and offer a best-in-class, end-to-end solution tailored to customers' needs.

Michel Cornelissen has been instrumental in positioning Calderys as a global leader and will continue to serve as its president and chief executive officer, he said: "This is a key milestone in our development. As a standalone company, we expect to be even more agile, improving our ability to deliver solutions that help our customers meet the demands of tomorrow, especially in terms of energy transition. Platinum Equity is committed to the future of Calderys, supporting our customers and growing our business, notably through acquisitions."

"We are happy to welcome Calderys in our portfolio of companies and are excited to work with Calderys' leadership team and all of the talented employees to develop the company and unlock its growth potential," said Platinum Equity partner Louis Samson and Platinum Equity managing director Malik Vorderwuelbecke in a joint statement.

The private equity company announced in December 2022 that it will acquire HarbisonWalker International (HWI) with the aim of combining Calderys and HWI into a global business with increased reach and scale.

"Calderys and HWI will be a great fit together, with complementary footprints and product portfolios," added Samson and Vorderwuelbecke. "We expect the combination to create exciting growth opportunities for both businesses."

Platinum Equity said it will continue to seek more opportunities to help the combined business grow both organically and through additional acquisitions in key product areas and geographies.

Calderys is a leading global provider for industries operating in high temperature conditions. The group specialises in thermal protection for industrial equipment with a wide range of refractory products and advanced solutions to enhance steel casting, metallurgical fluxes and moulding processes. The international network of experts ensures an end-to-end offer with tailored services. Drawing on over 100 years of experience, the group supports customers in their energy transition needs. Calderys reported revenues of €981 million in 2022 and utilises more than 5,000 people, including 2,000 contractors, in over 30 countries. www.calderys.com

Refractories company highlights a 'GOLD STANDARD' approach to sustainability

In December 2022 Trent Refractories Ltd received a gold standard award from EcoVadis placing them in the top five per cent of companies of comparable size and industry committed to sustainability, they have now further strengthened this commitment following another assessment from EcoVadis.

Tens of thousands of companies partner with EcoVadis to collaborate on sustainability with a common platform, universal scorecard, benchmarks and performance improvement tools.

Katy Moss, managing director of Trent Refractories and immediate past president of IRE said: "This framework is very much part of our environmental, social, and corporate governance (ESG) management and at the very heart of our business."

To drive global supply chain sustainability, large multinational corporations partner with EcoVadis, leveraging the influence of spend as a 'force for good' to push trading partners beyond compliance. The rated company can see how their score compares to the benchmark in their industry. Combining the scorecard results with improvement areas results in a 'race to the top,' in which whole industries compete to achieve global best practice. Through the *enterprise subscription* and associated services, EcoVadis provides an outsourced sustainability management platform that helps large organisations to invite their trading partners to be rated; to manage trading partners' performance; and to drive continuous improvement.

Purchasing organisations easily integrate EcoVadis Scorecards into their day-to-day business practices (such as vendor registration, compliance, sourcing, and supplier performance and relationship management), driving their organisation to make more sustainable procurement decisions, while positively incentivising trading partners that align with their sustainability practices. To date, EcoVadis has rated over 75,000 trading partners worldwide, mitigating risk for some of the world's largest organisations, while positively impacting the environment, fostering transparency and driving innovation.

The achievement is part of Trent's commitment to being a responsible manufacturer committed to global sustainability.

Induction melting technology centre launched in India

In February 2023, Saint-Gobain launched a new induction melting technology centre at the company's performance ceramics and refractories plant in Bangalore, India.

The centre will reinforce services to customers and enable the company to customise its solutions and accelerate developments and R&D projects.

The company says it will also offer energy saving solutions and recycling programs to enable a greener foundry industry and to contribute to reducing customers' carbon footprints.

An opening was marked by the visit of vice-president Reinaldo Valu and the executive director of SEFPRO and Saint-Gobain Performance Ceramics & Refractories India Shekar, K.

Intensifying Indian presence with renewed partnership

With the recent acquisition of Dalmia OCL by RHI Magnesita, the joint venture between Seven Refractories and Dalmia OCL will now be operating under the name RHI Magnesita Seven and will continue to supply the thriving Indian iron, steel and cement industries with the most advanced refractory monolithics.

Customers will keep on relying on outstanding finished goods and services, its further development, and an increasing focus on environmental-friendly products manufactured on site.

The successful story started at the end of 2016 when Seven Refractories entered into an agreement with Dalmia Bharat Group to develop and supply a wide range of monolithic refractories for the Indian market.

In 2018, both partners saw the need of having local production and committed to set up a modern monolithic production site, which was launched in 2019 in Katni (in the state of Madhya Pradesh).

"Establishing the activities in India was one of the best decisions we have made so far. We're speaking of one of the most vibrant and expansive markets that still holds tremendous promises," said Erik Zobec, group CEO of Seven Refractories.

Dalmia Seven joint venture has already proven to be a highly successful company with a unique, advanced and modern production plant in India, centrally located in Katni, offering several logistic advantages due to its favourable location. The presence of the nearby airport of Jabalpur, the strategic location in the centre of India, ensures flexible and cost-effective transportation to clients in both Eastern and Western India. The region is also rich in natural raw materials, which contributes to a favourable ecological footprint.

"We are very excited by the Dalmia OCL acquisition, and we are deeply convinced that we have found a perfect business partner in Seven Refractories. We are fully confident that with our modern production line we are able to satisfy and even delight all current and potential customers," says Parmod Sagar, CEO of RHI Magnesita India.

"Joining forces with RHI Magnesita for the first time is another highly important milestone. There is an incredible potential in combining our production technology and product development with additional expertise and a powerful sales network of the largest refractory company in the world", summarises Erik Zobec. "And the best is certainly yet to come – the Indian growth story is unrivalled, and we are proud to be a part of it."



ADVERTORIAL

Door to door logistics support

SB Global Logistics Ltd is a specialist exhibition/events and time sensitive logistics company.

With offices in Surrey and Frankfurt, experienced official agents in multiple countries and onsite at venues around the world can look after collection from premises, using dedicated UK fleet vehicles with experienced UK drivers, air freight, sea freight FCL and LCL.

The SB Global Logistics onsite team will deliver direct to stand any time or day of the week, and also collect from stand/site on breakdown and ensure safe lifting/handling back to the return destination.

The company can move anything from a delicate precision model/instrument(s) to full size foundry machines and equipment. Also, providing full customs clearance with CARNETS for temporary exhibition and events movements and permanent import/exports.

The company is specialising in helping FESA (Foundry Equipment & Supplies Association) members going to GIFA/ METEC/ THERMOPROCESS and NEWCAST in June 2023 at Dusseldorf Messe Centre, Germany.

Contact: SB Global Logistics Ltd,
Tel: +44 1428 746378, +44 7779 349 917,
email: scott@sblogistics.co.uk

Monocon International Refractories Ltd acquires Sheffield Refractories Ltd

IFGL Refractories Ltd's wholly owned subsidiary in the UK, Monocon International Refractories Ltd, has completed the acquisition of one hundred per cent shareholding of Sheffield Refractories Ltd.

SRL is a manufacturer and installer of monolithic refractory products with a specific interest in blast furnace cast house products, shotcreting materials and an extensive range of other specialist monolithic products for use in the iron and steel, cement, incineration and waste to energy industries.

Outside of India, the company has manufacturing facilities in China, Germany, the UK and USA.

In a statement, the company said the acquisition of SRL is an important milestone and forms part of an overall strategy that will see the group grow both organically and inorganically. There is a substantial focus on developing a broader range of technology, products and markets. SRL's revenue from operations during the twelve months ending on 30th September 2022 was more than £17.5m. SRL's product range will provide a significant boost to the group, not least in India where an increased Capex has been allocated to the 2023 fiscal budget, specifically to assist with the development of sales within the growing iron and steel market.

Managing director, James McIntosh said: "Sheffield Refractories is a strategically important acquisition for the IFGL Group, which significantly expands our UK presence whilst also initiating a process of strategic acquisitions designed to expand our operational markets within the iron and steel industry. The tremendous technology package and experience of Sheffield Refractories in the blast furnace cast house brings our group compelling new growth opportunities, especially in the Indian market. We look forward to welcoming our new colleagues onboard and working with the Sheffield Refractories team."

Elkem expands production capacity for carbon solutions in Brazil

Elkem is to invest approximately NOK 200 million to increase its production capacity in Brazil for pitch, a raw material for electrode paste to industrial smelters.

The investment is based on well-known technology and constitutes an expansion of a running Elkem facility, thereby further improving productivity and profitability. The increased production of high-quality products will be supplied to a major customer on a long-term contract. Elkem will also have options to sell additional supply to others. The investment will increase the production capacity by up to 40 per cent from 2024 and is expected to generate additional annual sales in excess of NOK 300 million.

"This investment is an example of how Elkem is committed to delivering the potential of our customers. In a situation where demand is higher than supply, we are stepping up our production capacity. Elkem's unique position, both as producer and user of electrode paste and raw materials, has enabled us to define the standard for electrode paste performance and optimal electrode operation. For many years, our customers have benefited from our long tradition of technology development, and we are delighted that they continue to do so," says Elkem's senior vice president for carbon solutions, Luiz Simão.

Pitch is produced based on byproducts from the steel industry. It is both a raw material in Elkem's electrode paste production and an end-product that is sold in the external market, mainly to the aluminium industry. Carbon solutions support the production of the metals that the world needs.

The investment will expand the Elkem Carboderivados plant established in Brazil in 1987, contributing to secure local jobs and ripple effects in greater Vitoria, State of Espírito Santo. The flexible production setup of the facility allows it to meet the market needs quickly and deliver tailor-made products to its customers. The plant also has an integrated management system for quality, safety and environment. Brazil largely relies on hydropower for its electricity generation.

www.elkem.com

Raw material company opens office in India

Cremer Erzkontor, the international raw material management company from Germany, recently opened a new subsidiary in Asia, in Chennai, India. This move gives the company a new point of contact from which it can improve upon the service to Indian customers and suppliers in the future. In addition to expanding the trading business locally, the office will help with accessing new raw materials and sources.

"As a global player it's important for us to closely follow the latest market developments. With our new subsidiary in India we're ensuring that we can quickly respond to demand from our customers," said Nicol Tomaschewski, head of region Asia at Cremer Erzkontor. "Subsidiary director Ananthanarayana Nonavinakere will take care of supplying our Indian customers with raw materials and expanding our customer roster. This step is part and parcel of our business expansion strategy in Asia." After Hong Kong, Dalian and Beijing, Chennai is now the fourth location for the company in Asia, underlining the important role that Asia plays in international raw material supply.

Ananthanarayana Nonavinakere has more than 25 years of experience in the fireproof minerals business, and already worked for Erzkontor in the 2000s. As an expert for the Indian raw materials market, he has a wide network in the industry.

The Possehl Erzkontor Group, founded in 1915 and today Cremer Erzkontor, has been part of the Peter Cremer Holding company since 2014. Its offices on five continents co-ordinate international trade, processing, recycling and logistics in raw materials and chemicals, with the sales focus on all European countries, North and South America, Africa, and Asia. The company is headquartered in Lübeck, Germany.

Survey and training solutions for manufacturers to SAVE COSTS AND IMPROVE QUALITY

Adhesives and sealants specialist Henkel is extending its support to manufacturers and MRO teams through a comprehensive range of survey and training services, with the aim of helping them reduce costs and improve quality through the use of Henkel products, including the world-famous LOCTITE® brand.

Rising energy costs, raw material shortages and fluctuating currency markets have posed significant challenges for manufacturers, impacting their bottom lines. To address this, manufacturers are seeking ways to maintain and improve the performance of products and machinery, while contending with changing consumer demands, supply chain disruptions and increased competition.

Innovation and agility are essential for keeping a competitive edge. Henkel's line of LOCTITE® adhesives, sealants and equipment offer cost-effective solutions to improve quality and increase efficiency, helping manufacturers meet these challenges.

To help businesses make informed choices, Henkel provides detailed surveys of manufacturing plants and processes to identify potential cost-savings and improvements. This involves a tour of production lines and sub-assembly areas to document cost reduction opportunities, as well as potential challenges in maintenance, repair and overhaul (MRO).

Using the findings from these surveys, Henkel can then deliver tailored seminars at manufacturers' sites, covering topics such as bonding, sealing, dispensing and curing equipment. Attendees are encouraged to bring parts and specific design challenges to the workshop.

Henkel's industry specific application training helps manufacturers in selecting the proper adhesive and equipment for their assembly challenges. The training incorporates technical guides, application information and case histories. Upon completion of a survey, manufacturers receive a detailed audit of their operations, recommendations for process improvements, a report of cost-saving opportunities, as well as a cost analysis.

Gavin Jackson, applications engineering manager at Henkel, said: "We're dedicated to providing solutions that help our customers save costs and improve quality. We understand that manufacturers face a multitude of challenges, and our team is committed to working closely with them to address their specific needs and give tailored solutions."

To schedule a LOCTITE Cost Reduction Line Survey visit: <https://www.henkel-adhesives.com/dz/en/services/resources/consulting-and-training.html>



Multi-furnace heat treat project for major steel forger

Between May and December 2023, Nutec Bickley will manufacture and install five completely new furnaces, along with fully modernised combustion system, for a leading US manufacturer of high-quality alloy steel and carbon steel closed-die forgings. Onsite work will be completed by Nutec Bickley's expert team one furnace at a time, so that in any given month no more than one furnace will be out of operation, to help the customer keep its production schedules fully on track.

This highly prestigious contract involves five new lift-up furnaces – two for tempering and three for austenitising. Each furnace will be fitted with a comprehensively modernised combustion system (including replacement fans), latest control systems, complete fibre flues, and new exhaust and pressure control system, plus freshly insulated casings.

Each of these state-of-the-art combustion packages will be fully compliant with NFPA 86 standards, and the installations will comprise the complete supply of materials and instrumentation required to operate the furnace combustion systems, plus new sets of air and gas piping.

Operation will be based on a fuel-only control system (fixed air modulating gas) to allow maximum temperature uniformity potential for all cycles. The retrofitted furnaces will benefit from the incorporation of high-velocity nozzle mixing burners fitted with high-temperature burner blocks. These burners fire with a constant air volume while the control system regulates the gas input by modulating an impulse-bleed valve.

Meanwhile, the combustion systems will be equipped with an automatic air control valve on the main air manifold that will provide the means to adjust the



maximum air volume the system can use, and to lower the air supply to the burners to ensure proper burner ignition conditions.

All controls and instrumentation are mounted in a NEMA 12 rated console, ergonomically arranged for simple and logical operation. Appropriate alarms will be supplied for burner flame failure, loss of air, loss of fuel, and over temperature. The control panel will be installed next to the existing furnace panels and will be prewired and positioned before the furnace replacements begin. They will be wired across the quench pit to the local furnace areas prior to the first furnace being converted. This system will be designed in accordance with the NFPA 70 standard.

To achieve a completely co-ordinated command structure, a master PLC will be supplied to integrate the five furnaces

and communication with the two existing quench tanks, manipulator/charging machine, the two panel views, the SCADA system, two recording units, and the central hydraulic system. The master PLC will be mounted in a separate NEMA 12 rated cabinet.

When complete, the newly lined units (23cm thick ceramic fibre modules) will work to operational temperature ranges of 480°C-1065°C for the austenitising furnaces, and 450°C-1065°C for the tempering furnaces. Installed thermal capacities will be eight million Btu/h (2345kW) for the austenitising furnaces, and 5.5 million Btu/h (1612kW) for the tempering furnaces.

As with all projects of this type, especially given the exacting timescales involved, carefully planned teamwork between customer and supplier will be a key factor in successful delivery and highest quality outcomes. Rodrigo González, VP metals at Nutec Bickley, said: "We have long recognised the value of this approach, and we are committed to constant communication and status updates with our customers. In turn, they reciprocate with the same level of engagement in the process, resulting in a dynamic and mutually beneficial project result. We are always determined to make this work, and our observation over many years in this sort of undertaking is that the closer the co-operation and the better the flow of information, then the nearer one can get to the optimum progress levels."



UK ceramics trade body announces its first female vice president

The trade association for the ceramics industry will welcome its first female vice president onto its board later this year, who brings with her a wealth of industry experience.

Hannah Ault, managing director of Stoke-on-Trent-based Valentine Clays Ltd, has agreed to take up the role on the British Ceramic Confederation (BCC) board of directors.

The BCC is the trade association for the UK ceramic manufacturing industry, representing all sectors of the industry. Its member companies cover the full spectrum of ceramic manufacturing, including the supply of materials, and comprise more than 90 per cent of the industry's manufacturing capacity.

Rob Ffello, chief executive of the British Ceramic Confederation, said: "We are delighted that Hannah has agreed to take on the role of vice president. Her background, knowledge and passion for the ceramics sector has already strengthened the board, and we look forward to what the future will bring as we continue to raise awareness of the UK ceramic industry's needs."

"Being the first female vice president is a quite an accolade in this forward-thinking industry, especially as she will become the board's president in two years' time. It is a significant milestone for an organisation that has been supporting the UK ceramics industry for nearly one hundred years."

Ault, who has grown up within the ceramics industry and is a third-generation leader in clay manufacturing, said her mission was to grow awareness of the sector and increase nationwide support via education and skills.

She added: "I feel hugely honoured to be asked to represent an industry that I am extremely proud to be a part of and one that impacts all aspects of our lives."

"Without the ceramics industry, we wouldn't be using mobile phones, driving cars, or flying into outer space. It's an industry that forms a significant part of our economy and heritage, which is why I am making it my mission to do whatever I can to raise its awareness. We need the future generation to realise that we are an industry of choice, that we have all levels of great opportunities for career development, that we are more than just tableware and hospitality too."



When the bi-annual board rotation occurs in the summer, current BCC president Edward Naylor, chief executive Naylor Industries Plc, will become the deputy president, with Alan McLelland, vice president of technology at Morgan Advanced Materials, stepping into the president's role.

Naylor said: "Hannah has a real passion for the ceramic industry, and I think she will, in due course, be an absolutely fabulous president."

Naylor's roles within the local community also include board director of the Staffordshire Chamber of Commerce, most recently a director of Stoke-on-Trent & Staffordshire's Local Enterprise Partnership, as well as chair of Staffordshire County Council's *We Are Staffordshire Place* campaign.

The impact of recession and geopolitical tensions on the CONSTRUCTION INDUSTRY

Last year was not kind to the construction industry, with many companies reporting a significant drop in profits. It is difficult to predict the exact impact on profits for construction companies in 2023, but there is likely to be continued uncertainty and potential challenges ahead. Companies may need to adjust their strategies and find ways to minimise costs and increase efficiency to maintain profitability, says Elisabeth Lodin of Swedish ground screw supplier StopDigging.

The construction industry is an essential component of the global economy, providing employment and infrastructure for societies around the world. However, like many other sectors, it has been hit hard by the economic recession that began early in 2022 and by the ongoing political tensions and conflicts around the world. In addition, the war in Ukraine has had a significant impact on the industry, causing disruption to supply chains and increasing costs for construction materials.

The recession that began in 2022 has had a profound effect on the construction industry, with many projects cancelled or delayed as a result of reduced demand and financing difficulties. As the global economy struggles to recover, the construction industry also faces increased competition from emerging markets and a shift towards more sustainable building practices. While the industry has shown signs of recovery since the pandemic, it continues to face challenges such as rising material costs and a shortage of skilled labour.

The situation in Ukraine has also had a significant impact on the construction industry. With the conflict ongoing, many construction projects have been disrupted by the closure of supply chains and the increased costs of transportation and materials. In addition, the instability in the region has made it more difficult for construction

companies to secure financing and insurance, leading to further delays and cancellations of projects.

The construction industry has always been volatile, and fluctuations in the economy can have a significant impact on profits. The Covid-19 pandemic caused a significant drop in construction activity in 2020, with many projects being put on hold or cancelled. While some recovery was seen in 2021, the ongoing global supply chain issues and rising material costs have continued to impact the industry.

Potential solutions

Despite these challenges, the construction industry has shown resilience and adaptability in the face of adversity. Companies have sought to diversify their operations, explore new markets and embrace new technologies to remain competitive. In addition, the industry has recognised the importance of sustainability. It has begun to embrace more eco-friendly practices, such as the use of renewable energy sources and the adoption of green building standards.

Overall, it is important for construction companies to remain flexible and adaptable in the face of economic challenges. By staying informed and proactive, companies can take steps to minimise the impact of economic downturns and emerge stronger on the other side.

As the world continues to grapple with economic and political uncertainty, the construction industry will play a crucial role in driving growth and providing essential infrastructure for societies around the world.

StopDigging is Sweden's largest supplier of cost-effective ground anchoring via ground screws. The company operates globally in the European market, North America, Australia, and New Zealand.

New LD converter (BOF) boosts productivity

In Autumn 2022, Bosnian steel producer ArcelorMittal Zenica started up a new 125-ton LD converter (BOF), supplied by Primetals Technologies, at its plant in Zenica, Bosnia Herzegovina.

As part of the project, engineers at Primetals Technologies have optimised the vessel shape, resulting in an increase in converter reaction volume by almost 30 per cent. The new technology has also reduced the tap-to-tap time, which has led to a higher capacity for the production line. At the same time, ArcelorMittal Zenica is now able to produce a wider array of steel grades.

"This is a very successful project – everything went smoothly and within the expected timeframe. Thanks to the new solution, the converter reaction volume has increased, and this vessel has shorter tap-to-tap times. These are strong benefits for us," says Adnan Topalovic, head of the CAPEX and projects department at ArcelorMittal Zenica.

A converter vessel, a trunnion ring, and Vaicon Link 2.0, the maintenance-free suspension system, were the key equipment included in Primetals Technologies' scope of supply. Primetals Technologies was responsible for engineering, project management and quality assurance, and provided advisory services for



The new 125-ton LD converter (BOF) at ArcelorMittal Zenica's steel plant ensures increased productivity and has eliminated a sloping issue

construction work and implementation together with its consortium partner.

The suspension system was one of the main reasons why ArcelorMittal Zenica chose Primetals Technologies as its supplier: "We had lots of issues with the suspension system on the former converter. We investigated the best possible option and had the choice between a common lamella type and Primetals Technologies' suspension system. Feedback from other steel producers told us that Vaicon Link 2.0 is the one with the best ratings," says Topalovic.

The new converter technology implemented at ArcelorMittal's plant in Zenica has resulted in further benefits for the steel producer. Slopping, i.e. slag flowing over the converter, was a common issue with the old equipment. Thanks to the optimised shape of the new vessel, this problem no longer exists. Therefore, a higher percentage of the yield is generated, which also contributes to greater productivity.

The project had a tight schedule and was heavily impacted by Covid-19 restrictions. Nevertheless, all the milestones were achieved on time. The teams from ArcelorMittal Zenica and Primetals Technologies partnered up for weekly follow-up meetings, and the communication was characterised by fast response times. In this way, potential issues were quickly resolved.

ArcelorMittal is one of the world's leading steel and mining companies with some 168,000 employees in more than 60 countries.

The ArcelorMittal Zenica plant, founded in 1892 and operated by ArcelorMittal since 2004, is in the centre of Bosnia and Herzegovina. 2,300 employees make it the largest producer of long steel products in the Balkans, with an annual production capacity of almost one million tons. The product range includes rebar (in bars and coils), wire rod, mesh, and lattice girders.

European Foundry Industry: Crisis Cancelled?

The European Foundry Industry Sentiment Indicator (FISI) records a significant upward correction with a plus of 2.76 index points in February, says the European Foundry Association, CAEF. The positive trend thus continues for the fourth consecutive month, bringing the index to a value of 105.9 points. The main driver of this encouraging momentum has recently been iron foundries. Overall, the assessment of the current business situation and expectations are brightening across all materials. Meanwhile, the latter, coming from a low base, show the strongest increase.

Although incoming orders have been declining for months, casting production remains stable due to sufficient stocks. While debates on economic policy are predominantly about large industrial corporations that are increasingly sceptical of Europe as a business location in favour of North America, the disadvantages of high energy prices will hit the European industrial sector progressively, if politicians do not bring about an effective adjustment of the framework conditions. The fact that a fatal production collapse in the manufacturing sector has so far been avoided despite dramatic cuts in the chemical industry and

aluminium smelters, and that it is not to be expected to the same extent in the near future as it was in the autumn of last year, should nevertheless not be seen as a general all-clear.

Meanwhile the *Business Climate Indicator (BCI)* held its level in February. The increase of 0.02 points brings the index to 0.72 points. Overall, the production trend of the past months has been more positive than expected, while the selling price expectations for the month ahead are dropping significantly.

The *FISI – European Foundry Industry Sentiment Indicator* – is the earliest available composite indicator providing information on the European foundry industry performance. It is published by CAEF every month and is based on survey responses of the European foundry industry. CAEF members are asked to give their assessment of the current business situation in the foundry sector and their expectations for the next six months.

The *BCI – Business Climate Indicator* – is an indicator published by the European Commission. The BCI evaluates development conditions of the manufacturing sector in the euro area every month and uses five balances of opinion from industry survey: production trends, order books, export order books, stocks and production expectations.

www.caef.eu

Scientists develop a 'cosmic concrete' that is twice as strong as regular concrete

Manchester scientists have created a new material, dubbed 'StarCrete' which is made from extra-terrestrial dust, potato starch, and a pinch of salt and could be used to build homes on Mars.

Building infrastructure in space is currently prohibitively expensive and difficult to achieve. Future space construction will need to rely on simple materials that are easily available to astronauts, StarCrete offers one possible solution. The scientists behind the invention used simulated Martian soil mixed with potato starch and a pinch of salt to create the material that is twice as strong as ordinary concrete and is perfectly suited for construction work in extra-terrestrial environments.

In an article published in the journal *Open Engineering*⁽¹⁾, the research team demonstrated that ordinary potato starch can act as a binder when mixed

with simulated Mars dust to produce a concrete-like material. When tested, StarCrete had a compressive strength of 72 Megapascals (MPa), which is over twice as strong as the 32MPa seen in ordinary concrete. Starcrete made from moon dust was even stronger at over 91MPa.

This work improves on previous work from the same team where they used astronauts' blood and urine as a binding agent. While the resulting material had a compressive strength of around 40MPa, which is better than normal concrete, the process had the drawback of requiring blood on a regular basis. When operating in an environment as hostile as space, this option was seen as less feasible than using potato starch.

"Since we will be producing starch as food for astronauts, it made sense to look at that as a binding agent rather than human blood. Also, current building technologies still need many years of development and require considerable energy and additional heavy processing equipment which all adds cost and complexity to a mission. StarCrete doesn't need any of this and so it simplifies the mission and makes it cheaper and more feasible.

"And anyway, astronauts probably don't want to be living in houses made from scabs and urine," said Dr Aled

Roberts, research fellow at the Future Biomanufacturing Research Hub, and lead researcher for this project.

The team calculate that a sack (25kg) of dehydrated potatoes (crisps) contains enough starch to produce almost half a tonne of StarCrete, which is equivalent to over 213 brick's worth of material. For comparison, a three-bedroom house takes roughly 7,500 bricks to build. Additionally, they discovered that a common salt – magnesium chloride – obtainable from the Martian surface or from the tears of astronauts, significantly improved the strength of StarCrete.

The next stages of this project are to translate StarCrete from the lab to application. Dr Roberts and his team have recently launched a start-up company, DeakinBio, which is exploring ways to improve StarCrete so that it could also be used in a terrestrial setting.

If used on earth, StarCrete could offer a greener alternative to traditional concrete. Cement and concrete account for about eight per cent of global CO₂ emissions as the process by which they are made requires very high firing temperatures and amounts of energy. StarCrete, on the other hand, can be made in an ordinary oven or microwave at normal 'home baking' temperatures, therefore offering reduced energy costs for production.

1. The paper, 'StarCrete: a starch-based biocomposite for off-world construction', is published in journal *Open Engineering*.
<https://doi.org/10.1515/eng-2022-0390>



Image source: Aled Roberts

Ceramics trade body chief executive takes up board appointments for sector organisations

The Chief Executive of the trade association for the UK ceramics manufacturing industry will use his expertise to support two major industry bodies after being asked to join their boards.

Rob Ffello, of the British Ceramic Confederation (BCC), has been asked to sit on the board of the Construction Products Association, as well as join the advisory board for the *Advanced Ceramics Show* and *The Advanced Materials Show*.

He said he was delighted to have been asked by the CPA as it continues to champion construction product manufacturers and suppliers.

Ffello, who joined BCC in February 2022 as its chief executive, added: "The values and aims of the BCC and CPA are closely aligned as we represent sectors of the UK manufacturing industry that are vital to a strong and stable economy through construction.

"I am looking forward to working closely with other members of the board in continuing to highlight the essential nature of our industry."

The *Advanced Ceramics Show* and *The Advanced Materials*

Show, which will take place at the NEC in Birmingham (UK), will bring together industry, academia and commercial R&D involved in the latest technical ceramic solutions, on 28-29 June. Co-located with the *Battery Cells & Systems Expo*, and *Vehicle Electrification Expo*, the four shows will welcome hundreds of exhibitors and thousands of visitors.

Ffello said: "I am enjoying working with the advisory board to highlight how essential UK technical ceramics are to modern life.

"Ceramics touch everything from automotive to aerospace, from construction to space technology, from renewable energy to medical applications. The list goes on.

"Members of the British Ceramic Confederation are innovative and forward thinking with immense expertise, and I aim to harness their values and ambitions within my advisory role and firmly put the spotlight on UK ceramics."

The British Ceramic Confederation represents the common and collective interests of all sectors of the industry. Its member companies cover the full spectrum of UK ceramic manufacturing, including the supply of materials, and comprise more than 90 per cent of the industry's manufacturing capacity.

Global cement producer achieves multi-site digitalisation

One of the world's largest cement producers reports enhanced productivity, streamlined processes, reduced maintenance and energy savings through Industry 4.0 solutions.

ABB has delivered advanced automation and digital technologies to global building materials and sustainable solutions company Votorantim Cimentos, as it embraces Industry 4.0 in cement to simultaneously optimise production and decarbonise operations.

Industrial companies, including Votorantim Cimentos Europe, Asia and Africa Region (VCEAA) – which has the worldwide capacity to produce 55.7 million tons of cement per annum, are ramping up their efforts to ensure lower emissions as governments and international organisations push for net-zero emissions by 2030.

Digital solutions ABB Ability™ Expert Optimizer and ABB Ability™ Knowledge Manager have recently been installed in the customer's plants in Spain, Turkey, Tunisia and Morocco with proven impacts for enhanced productivity, streamlined processes, reduced maintenance and energy savings. Expert Optimizer, deployed in Votorantim plants since

the 1990s, ensures optimisation of the complete process and reduces emissions significantly while Knowledge Manager helps in standardising and ensuring consistency in collecting and analysing laboratory data across the plants.

ABB says Expert Optimizer will minimise energy costs while maximising the use of alternative fuels and at the same time maintain and improve the quality of the product. Working closely with Votorantim in engineering and project management, ABB has also provided the Expert Optimizer RMP module to the raw mix to enhance the quality of raw material products going to the kiln. Regarding cement, discrete lab data is combined with continuous process data to optimise production while maintaining cement quality.

"Votorantim Cimentos has committed to a substantial reduction in CO₂ emissions by 2030," said Juan Antonio Gimenez Soriano, VCEAA maintenance and sustaining capex manager. "We are increasing our efforts to drive energy efficiency to meet our emissions targets. With the recent ABB installations showing better than expected results, our other plants are also pushing for the implementation of the ABB solutions."

"ABB has proven for many years to be a reliable partner in developing one of our strategical pillars, to be the best-in-class in operations," said Jose Maria Hidalgo, VCEAA process manager. "This, together with the ability of their managers and technicians to understand the cement process challenges and needs, has made us decide to continue with them in the current projects on digitalisation and decarbonisation."

"Votorantim Cimentos is placing more focus on running an intelligent plant and this will ensure less impacts on the environment," said Marie O'Grady-Hills, global sales manager, process industries, ABB. "We are working with a forward-thinking and modern company focused on productivity but also on contributing to building a sustainable and safe planet. We look forward to supporting Votorantim in future digital endeavours while ensuring their operations remain economically viable."

The variability of the feed and fuel will be optimised with the main aim to save money for the plant. During all this, the emissions will be controlled and reduced making the process more environmentally friendly.

Road towards a fossil fuel-free steel industry presented at the Green Steel World Expo

At the Green Steel World Expo, Kanthal presented the benefits of electric heating to the world's leading experts, decision makers and companies currently working to decarbonise the steel industry.

Collectively the steel industry is one of the world's biggest sources of CO₂ emissions and it is clear that changes need to be made. However, the challenge facing many manufacturers is knowing where and how to make reductions.

"The good news is that electric heating can play a significant role when it comes to carbon reductions," says Robert Stål, CEO of Kanthal. "By replacing conventional gas heating in heat treatment processes with electric, manufacturers can make significant savings in energy consumption and emissions. In fact, with the solutions available today, electric heating represents one of the fastest ways steel manufacturers can have a meaningful impact on their carbon footprints."

At the Green Steel World Expo that was held in Essen in Germany on 4-5th April 2023, Dilip Chandrasekaran, business development manager at Kanthal, gave a presentation on the benefits and advantages of electric heating. This included an outline of some of the technical challenges and how they can be overcome, as well as some tangible examples of companies that have successfully switched from gas heating to electric. He also addressed some of the misconceptions about electric heating.

"There is still a widespread belief that electric heating cannot

deliver the power output and temperatures required for steel production, but we have already proven time and time again that our electric heating solutions have no problems with this," says Dilip Chandrasekaran. "There are a lot of processes within steel manufacturing that can already be electrified today and are successfully being done. And there are other processes that are close to being electrified with just some additional development work. We're ready to work together with manufacturers to help develop bespoke solutions to suit their needs."



Roller hearth is one furnace type in steel manufacturing that can be electrified to reduce CO₂ emissions

Alleima inaugurates a new manufacturing facility in India

Alleima, a global manufacturer and supplier of advanced stainless steels, special alloys, and heating systems, has inaugurated its new hydraulic and instrumentation tubing factory at its Mehsana Mill in Gujarat, western India. The investment that Alleima made in 2021 has now concluded and is part of a larger growth initiative that the company started in 2017. The new factory will meet the increasing demand for locally manufactured products in India.

In 1983, Alleima established its first operation in Pune, India. Since then, the company's activities in the country have expanded. Today, India is one of Alleima's key geographical areas, and the Mehsana manufacturing facility has since grown in importance. Having been successively expanded and modernised, the factory has increased production and availability of high quality seamless stainless steel and high alloy tubes to strengthen service in the region.

"As part of our strategy to invest capacity and capability in growth markets, the new hydraulic and instrumentation tubing manufacturing facility will enable us to serve our customers locally with premium products in India," says Göran Björkman, president and CEO at Alleima. "The investment aims to capture growth opportunities in the chemical and petrochemical segment. There is also a change towards increased natural gas in the energy mix and a shift towards alternative clean fuels, which present further growth opportunities. The Mehsana Mill is an important facility in our journey towards strengthening our footprint in Asia."

The first phase of this growth initiative commenced in 2017. It was completed in 2020 when Alleima added a new cold finishing tube manufacturing line mainly for heat exchanger tubing and other demanding industrial applications. This time, the investment has been divided into two parts – a new hydraulic and instrumentation tubing factory and a heat exchanger (HX) cold finish tube capacity that will be fully completed and operational in 2023.

"For the past few years, we have been focusing on boosting capacity, adding new products, and constantly improving our capabilities to meet the highest global quality standards and customer specifications. The new

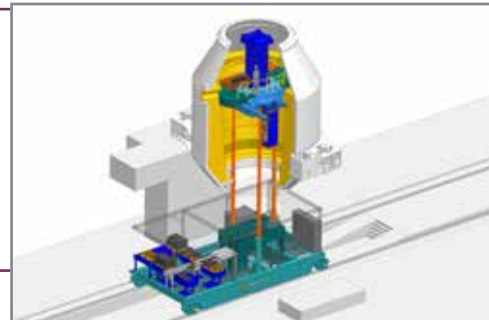


factory will expand the hydraulic and instrumentation tube capacity to meet the growing market for infrastructure around natural gas. This move will also enable the transition towards cleaner alternative fuels and meet the increased demand from growth in the chemical and petrochemical segment in India," says Sharath Satish, president, business unit tube APAC, Alleima. "We look forward to ramping up our production to cater to the increasing demand for locally manufactured products in India while aligning with the government of India's 'Make in India' and 'Atma Nirbhar Bharat' program for self-reliance. Through this investment, we also look forward to enabling further export and swifter delivery times to customers across the region."

The Mehsana is a high-tech tube mill situated in Gujarat, western India, that produces advanced corrosion resistant tubes, pipe for heat exchangers and process equipment across a wide range of industries. www.alleima.com

German steel producer orders customised relining machine

German steel producer Hüttenwerke Krupp Mannesmann (HKM) has ordered an LD converter (BOF) relining machine from Primetals Technologies as a tailor-made solution to increase safety and improve occupational health. It will replace a 30-year-old and outdated machine at HKM's steel plant in Duisburg, Germany. Startup is scheduled for June 2024. HKM's decision to award the contract to Primetals Technologies was based mainly on the tailor-made design, which is optimised for HKM's needs, and successful recent relining machine projects with features such as staff elevators and tailor-made solutions for brick logistics. Primetals Technologies will engineer, manufacture, implement, and provide advisory services for the installation and startup of the new relining machine.



HKM's new relining machine from Primetals Technologies, with an automated solution for brick handling

A comprehensive study was undertaken to find the best relining solution for HKM, one that would meet their needs in terms of state-of-the-art ergonomics, staff access via a separate elevator, and an automated working platform.

As part of the solution, personnel working inside the converter vessel will no longer need to lift the bricks. This is thanks to a semi-automatic system in which two magazine lifts transport the bricks from the depalletising station and into the converter. A brick manipulator, which is an arm-like robotic device for handling materials, will then automatically discharge the bricks from the magazine lifts onto an extendable roller table. With this logistics concept, the bricks are pushed into their final position without the workers having to lift them. Additionally, a staff elevator ensures that the personnel have easy access to the relining platform.

A detailed safety concept will increase occupational safety during the relining procedure. As an example, a solution for emergency rescue in case of technical issues with the staff elevator will be implemented.

Also, Primetals Technologies will install an emergency power unit for use in the event of a power failure.

The new machine will be used for the relining of HKM's movable converters. The relining procedure is executed on a separate relining stand. When the converter is in place, the relining machine is inserted through the detachable bottom. After the relining procedure is completed, the machine fully retracts and can then easily be moved into its parking position.

The engineering and testing phases will take place in Austria in partnership with leading suppliers and partners. Once manufacturing has completed, the machine will be pre-assembled and tested at the workshop before being transported to Germany.

HKM produces four million tons of liquid steel annually and employs some 3,000 people. The steel producer operates an integrated plant in Duisburg and produces intermediate products for the processing industry. HKM is owned by Salzgitter, Thyssenkrupp, and Vallourec.

This is the second part of an article which focuses on worker exposure to respirable crystalline silica in the refractories industry, writes Phil Walls of Hitech Materials Pty Ltd. Part 1 was published in The Refractories Engineer 2023: Issue 1 – March.

Quartz Crystals
Image source: Shutterstock



RESPIRABLE CRYSTALLINE SILICA in the refractories industry – part 2

Worker exposure to respirable crystalline silica (RCS) has been highlighted in the media recently in Australia, with unions calling for a blanket ban. It has mainly been due to its generation during cutting of stone-based materials including synthetic kitchen benches (mixtures of polymer resin containing silica-based gravel).

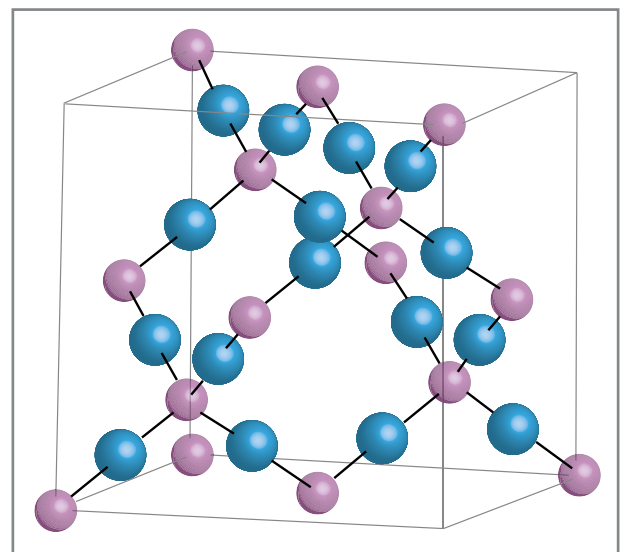
In the refractories sector, silica containing products are a mainstay of the industry due to their thermal resilience.

Part one of this article covered information on RCS sources and protection of workers' health and safety. Part two looks at what the ISO refractories committee is doing to help identify this form of silica and how to quantify it in refractories.

RCS covers all crystalline forms of silica. The three main forms in refractories are quartz, cristobalite, and tridymite.

A technique called XRD (x-ray diffraction) analysis can be used to differentiate between all three types of silica. There are varying effects of operational temperature and compositional impurities (iron and aluminium) on the relative proportions of tridymite and cristobalite in the original material and after exposure to operational conditions. This is one issue that the technical committee is exploring as we work to produce useable test methods for identifying RCS in refractory materials.

Currently some 'round robin' testing is being carried out in several countries. Those results will also be discussed at the ISO TC 33 working group on RCS at the next meeting in September 2023 at the UNITECR 2023 conference in Frankfurt.



Structure of Cristobalite – blue= silicon, purple = oxygen
Image source: Shutterstock

Author contact: Dr Philip Walls, director of Hitech Materials Pty Ltd, email: philip.walls@hitechmaterials.com.au

Image Source: Messe Düsseldorf/
ctillmann



The Bright World of Metals is the slogan for the joint staging of the four technology trade fairs: **GIFA** (15th International Foundry Trade Fair with Technical Forum), **METEC** (11th International Metallurgical Trade Fair with Congresses), **THERMPROCESS** (13th International Trade Fair and Symposium for Thermo Process Technology) and **NEWCAST** (6th International Trade Fair for Castings with NEWCAST Forum). Organised by Messe Düsseldorf GmbH.

The Bright World of Metals

DATES AND OPENING HOURS: Monday, 12th to Thursday 15th June 2023, open daily from 10.00am to 6.00pm, Friday 16th June 2023: 10.00am to 4.00pm

HALLS OCCUPIED:

GIFA: Halls 10-13 and 15-17.

METEC: Halls 1, 4-5.

THERMPROCESS: Halls 9 and 10.

NEWCAST: Halls 13 and 14.

SIDE EVENTS AND SPECIAL SHOWS

ecoMetals 2023: Sustainability campaign of Messe Düsseldorf's metal portfolio – highlighting outstanding innovations in the field of energy and resource efficiency.
metals4you: Programme for school children and students.

GIFA

GIFA has a long tradition in the Düsseldorf trade fair portfolio and offers a vast international range in the areas of foundry and melting plants, refractory technology, plants and machinery for mould and core production, moulding materials and moulding supplies, model and mould making, control technology and automation, environmental protection and waste disposal as well as information technologies. The trade show is accompanied by a diverse supporting program with numerous seminars, international congresses, symposia and lecture series as follows:

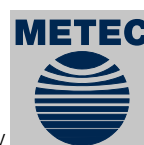
- ❑ **GIFA Forums**, 12-13th June 2023 (Hall 13, Stand D07).
- ❑ **Gießler-Treff (Foundrymen's Meeting Point)**, 12-16th June 2023 (Hall 13, Stand C39).
- ❑ **Young Talents' Programme with show foundry**, – 16th June 2023 (Hall 13, Stands E50 and F52).
- ❑ **Instituteschau (Institutes' show)**, 12-16th June 2023 (Hall 13, Stand C17).



METEC – International Metallurgical Trade Fairs with ESTAD Congress

METEC is the world's leading trade fair for metallurgical technology. It consistently focuses on reflecting challenges to identify demands for the future. The world's leading experts in the metallurgical industry meet at METEC to exchange ideas and experiences.

METEC forms an integral part of the trade fair quartet. Equipment for iron, steel or non-ferrous metal production will be presented alongside lines for casting or forming steel, equipment and components for metallurgical plants and rolling mills or steel mills. With over 17,820 visitors (66 per cent of international origin) and 618 exhibitors from 39 countries, METEC 2019 posted record results.



Growth engine metallurgy – to design the future

- ❑ Plants and equipment: for iron production, for steel production, for non-ferrous metal production, for casting and pouring of molten steel and for shaping of steel.
- ❑ Environmental protection/disposal/gas purification.
- ❑ Electrical engineering and process control technology.
- ❑ Measurement and test technology.

The trade show is accompanied by a diverse supporting program with numerous seminars, international congresses, symposia and lecture series as follows:

- ❑ **How to combine energy efficiency, sustainability and cost reduction – Smart solutions for electric heat treatment processes**, 14th June 2023 (Hall 09, Stand D47).
- ❑ **METEC and 6th ESTAD (European Steel Technology and Application Days)** – 12-16th June 2023 (Congress Centre Düsseldorf, Germany). The largest European steel conference is focused on the transformation of the German and European steel industry towards hydrogen-based, CO₂-neutral steel production. Numerous lectures by high-ranking representatives from steel production and plant engineering companies are already scheduled on this key topic. In 2023 the Steel Institute VDEh organises the conference as part of the METEC trade fair.
- ❑ **EMC European Metallurgical Conference**, 11-14th June 2023 (CCD Congress Center, Düsseldorf)

Image Source: Messe Dusseldorf/
ctillmann



EMC – European Metallurgical Conference

This year, EMC takes place in Düsseldorf from 11th to 14th June near the trade fair grounds! This is regarded as the most important, biennial conference for non-ferrous metallurgists in Europe. More than 400 international experts, scientists and decision makers will discuss latest developments in their area of expertise, such as aluminium, copper, zinc, lead and precious metals.

EMC is dedicated to hydrogen usage in metallurgical processes, lithium as a key resource for the electrified age and greenhouse gas emission reduction.

The event is organised by GDMB.



Image Source: Messe Dusseldorf/ctillmann

The Bright World of ecoMetals

Messe Düsseldorf's *ecoMetals* campaign refers to the ecological path of the casting and metal processing industries and promotes exhibiting companies that invest in innovative, sustainable and economically competitive technologies. The *ecoMetals* brand focuses on three fields of sustainability: resources, innovation and production and/or processes.

Trade visitors can easily identify the award-winning innovations and are guided to the respective exhibitors at GIFA, METEC, THERMPROCESS and NEWCAST by way of complimentary daily guided tours – so-called *ecoMetals Trails*.

THERMPROCESS

THERMPROCESS is the world's most important platform for the presentation of highly innovative technology and environmental concepts for industrial thermal processing plants. It is the 13th *International Trade Fair and Symposium for Thermo Process Technology*.

Technology trends and solutions revolving around the production and operation of industrial furnaces, heat generation plants and thermal processes provide visitors with an ultimate degree of information. The trade fair's ranges include industrial furnaces, industrial heat treatment plants and thermal processes, equipment for special uses, components and equipment as well as other supplies, occupational safety and ergonomics. 5,923 trade visitors, over 50 per cent of whom came from abroad, and 337 exhibitors from 34 countries, were hosted in the exhibition halls at the last event in 2019.



..... continued over

THERMPROCESS Forum

In the THERMPROCESS Forum renowned exhibitors will present new developments in relevant key topics such as:

- Flexible and resilient processes and technologies for new global challenges.
- Energy-efficient, sustainable and low-pollution thermoprocessing technology for effective climate protection.
- Digitalisation of processes and plants.
- Contribution of thermoprocess technology to recycling for an integrated circular economy.
- Tapping productivity potential with innovative technical solutions.

The lecture program reflects the current challenges as well as the main development drivers for thermoprocessing companies. It spans from the pressing issues of climate protection and the circular economy to current aspects of digitalisation and the relationship between productivity and process resilience.

The lectures will be presented by experts from the exhibiting companies of the thermoprocess technology sector. Experts from universities and institutes moderate the individual blocks.

Participation in the symposium is free of charge for THERMPROCESS trade visitors. This makes it possible to make an on-site decision at short notice to find out about the latest developments in the industry.

VDMA Metallurgy is the partner of THERMPROCESS. Together with the Research Association for Industrial Furnace Engineering FOGI, it organises the *Ecometals Forum* and the *THERMPROCESS Forum 2023*. The event will be moderated by the Department for Industrial Furnaces and Heat Engineering (IOB) at RWTH Aachen University.

The trade show is accompanied by a diverse supporting program with numerous seminars, international congresses, symposia and lecture series as follows:

- ❑ **THERMPROCESS Forum**, 13-14th June (Hall 09, Stand D47).
- ❑ **Green Thermprocess technology seminar**, 12th June 2023, 11.25am to 5.30pm.

NEWCAST – all things cast

NEWCAST, the 6th International Trade Fair for Castings, has completed the Düsseldorf quartet of trade fairs since 2003. As the world's leading trade fair for castings, it proves the highlight for its industry every four years posting positive results (2019: 3,404 visitors, of these 67 per cent of international origin, 433 exhibitors from 32 countries). Applications for castings range from vehicle manufacturing, aviation and aerospace industries to machine and plant manufacturing, along with medical device technology.



Image Source: Messe Dusseldorf/ctillmann

The Bright World of Metals

DÜSSELDORF/GERMANY
12-16 JUNE 2023



Hallen/Halls
10-13
15-17



Hallen/Halls
1 + 4 + 5



Hallen/Halls
9 + 10



Hallen/Halls
13 + 14

GIFA THEMENSCHWERPUNKTE/ GIFA MAIN TOPICS



Halle/Hall 13
Additive Manufacturing/
Additive manufacturing



Halle/Hall 12
Anschnitt und Speisertechnik/
Gating and feeding



Hallen/Halls 15-17
Modell-, Form- und Kernherstellung/
Moulding, pattern and core making



Halle/Hall 12
Gießereichemie/
Chemical materials for foundries



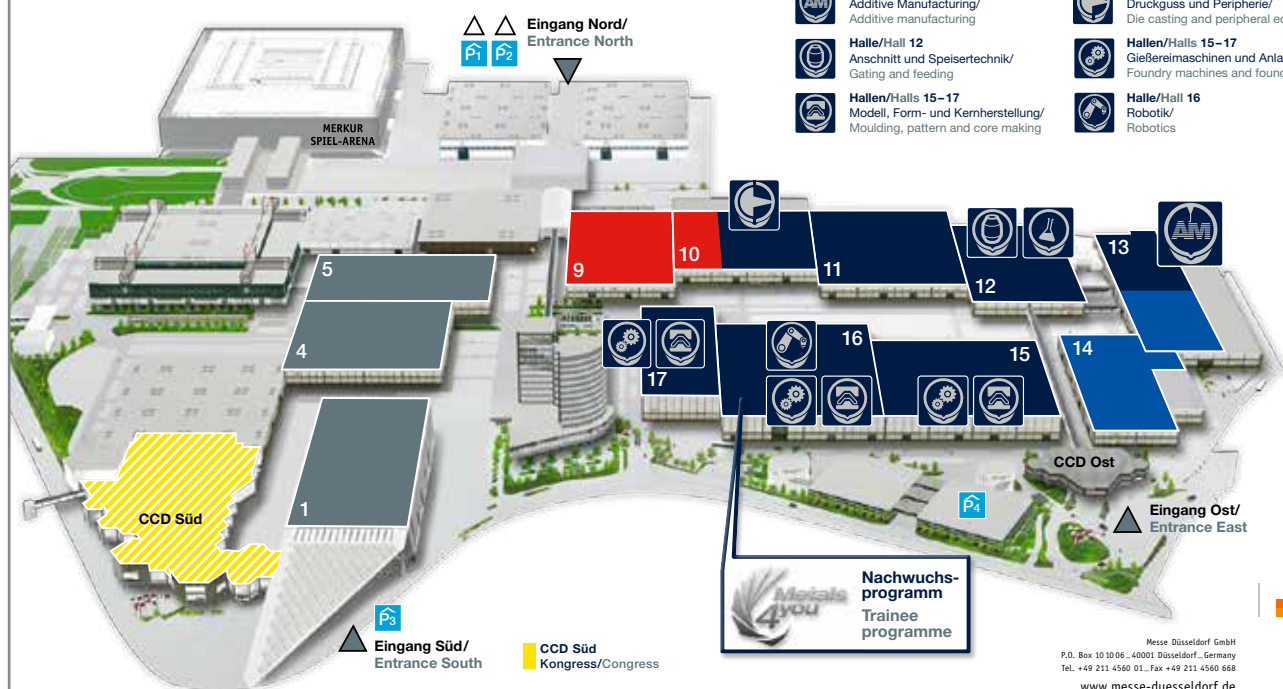
Halle/Hall 10
Druckguss und Peripherie/
Die casting and peripheral equipment



Hallen/Halls 15-17
Gießereimaschinen und Anlagen/
Foundry machines and foundry plants



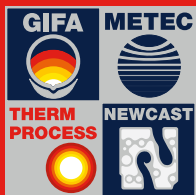
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Researchers from the University of Birmingham (UK) have designed a novel adaptation for existing iron and steel furnaces that could reduce carbon dioxide (CO₂) emissions from the steelmaking industry by nearly 90 per cent.



Novel adaptation for existing furnaces could reduce steelmaking emissions by 90 per cent

This radical reduction is achieved through a 'closed loop' carbon recycling system, which could replace 90 per cent of the coke typically used in current blast furnace-basic oxygen furnace systems and produces oxygen as a byproduct.

Devised by Professor Yulong Ding and Dr Harriet Kildahl from the University of Birmingham's School of Chemical Engineering, the system is detailed in a paper published in the *Journal of Cleaner Production*, which shows that if implemented in the UK alone, it could deliver cost savings of £1.28 billion in five years while reducing overall UK emissions by 2.9 per cent.

Professor Ding said: "Current proposals for decarbonising the steel sector rely on phasing out existing plants and introducing electric arc furnaces powered by renewable electricity. However, an electric arc furnace plant can cost over £1 billion to build, which makes this switch economically unfeasible in the time remaining to meet the Paris Climate Agreement. The system we are proposing can be retrofitted to existing plants, which reduces the risk of stranded assets, and both the reduction in CO₂, and the cost savings, are seen immediately."

The novel recycling system captures the CO₂ from the top gas and reduces it to CO using a crystalline mineral lattice

known as a 'perovskite' material. The material was chosen as the reactions take place within a range of temperatures (700-800°C) that can be powered by renewable energy sources and/or generated using heat exchangers connected to the blast furnaces.

Most of the world's steel is produced via blast furnaces which produce iron from iron ore and basic oxygen furnaces which turn that iron into steel.

The process is inherently carbon intensive, using metallurgical coke produced by destructive distillation of coal in a coke oven, which reacts with the oxygen in the hot air blast to produce carbon monoxide. This reacts with the iron ore in the furnace to produce CO₂. The top gas from the furnace contains mainly nitrogen, CO and CO₂, which is burned to raise the air blast temperature up to 1200 to 1350°C in a hot stove before blown to the furnace, with the CO₂ and N₂ (also containing NO_x) emitted to the environment.

Under a high concentration of CO₂, the perovskite splits CO₂ into oxygen, which is absorbed into the lattice, and CO, which is fed back into the blast furnace. The perovskite can be regenerated to its original form in a chemical reaction that takes place in a low oxygen environment. The oxygen produced can be used in the basic oxygen furnace to produce steel.

The new system can be retrofitted to existing furnaces, with the addition of an array of additional gas separators and heat exchangers required to support the perovskite splitter.

Iron and steelmaking is the biggest emitter of CO₂ of all foundation industrial sectors, accounting for nine per cent of global emissions. According to the International Renewable Energy Agency (IRENA), it must achieve a 90 per cent reduction in emissions by 2050 to limit global warming to 1.5°C.

University of Birmingham Enterprise has filed a patent application covering the system and its use in metal production and is looking for long-term partners to participate in pilot studies, deliver this technology to existing infrastructure, or collaborate on further research to develop the system.

For more information contact: Anna Isakova, University of Birmingham Enterprise, email: a.isakova@bham.ac.uk

Reference

Cost effective decarbonisation of blast furnace – Basic oxygen furnace steel production through thermochemical sector coupling is published in the *Journal of Cleaner Production*, and available at <https://doi.org/10.1016/j.jclepro.2023.135963>

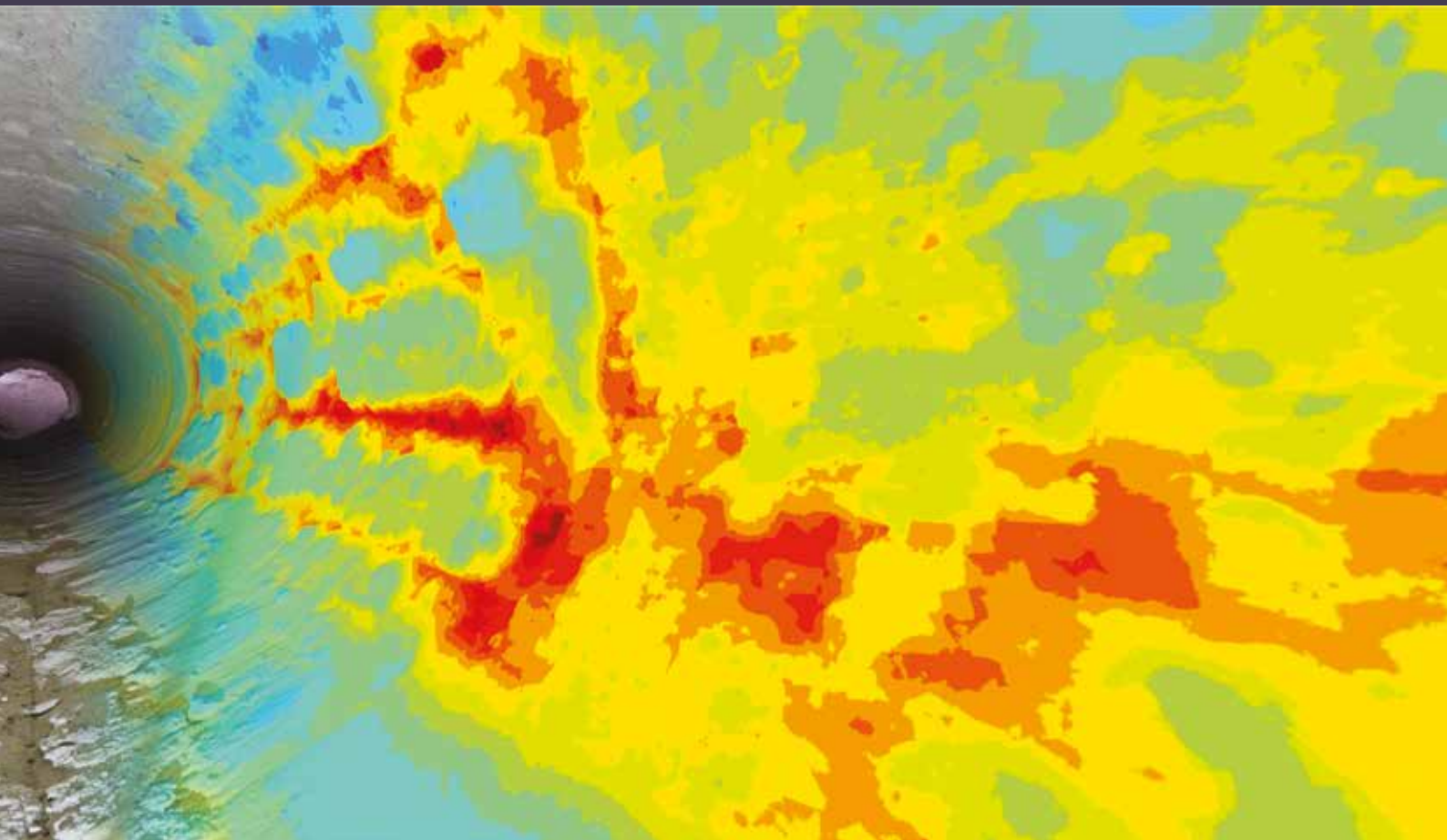


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When standard steels need to have specific characteristics, expensive alloying additions and supplementary heat treatment are generally used. Steeltec AG, a company of the Swiss Steel Group, has developed an innovative, alternative technology for this very reason.



The STEEL OF THE FUTURE

Swiss Steel Group is producing the steel of the future at the Steeltec AG mill in Düsseldorf, Germany

The company is progressive and trendsetting with its development of 'Extreme Performance Technology (XTP®)' and with high-quality technology has found a way to produce an ultra-fine-grained and tough high-grade steel which makes the need for additional alloys and special treatment obsolete thanks to a controlled thermomechanical processing phase.

Systematic temperature control and alternative forming processes produce an extremely ultra-fine-grain microstructure with grain sizes of less than 5µm. Steel produced in this way is noted for improved properties with better dynamic and mechanical characteristics, including:

- ❑ Improved tensile strength of up to 2,050MPa.
- ❑ Improved dynamic load capacity by at least 10 per cent, leading to longer service life and higher operational safety.

- ❑ Significantly improved properties despite higher tensile strength.
- ❑ Formability and machinability.
- ❑ Components can be redimensioned without losing mechanical-technical properties, making component design more flexible.
- ❑ Given the straightness of the bars, lengths of up to 8,000 (-0/+200) mm available with tolerances compliant to DIN EN ISO 286-2 *h11.
- ❑ No thermal distortion and no need for additional heat treatment.

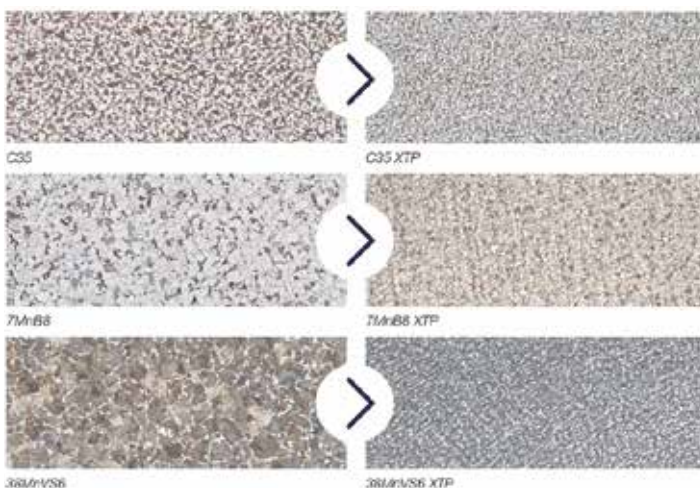
While XTP®-treated steel looks like conventional steel on the outside, its true excellence is hidden beneath the surface: the ultra-fine-grained steel microstructure provides an unprecedented level of material resistance and strength. This creates possibilities and paves the way for versatile designs and unconventional component engineering.

XTP steel withstands even difficult challenges, such as intense vibration, high internal pressure or extreme cold. Even at ultra-low temperatures of -101°C at which conventionally produced steel can become brittle and crack or break, the technically optimised steel grades have a high toughness (notched bar impact work of well over 27 joule in notched bar impact testing). Treatment with XTP technology guarantees the highest resistance to crack propagation.

Xtreme Performance Technology is the future

Thanks to consistent ongoing development of thermomechanical process phases, virtually any conventionally produced steel can undergo treatment and be considerably improved. In short, the formula is: heat+ force = ultrafine-grained steel.

When subjecting steel to induction heating, the experts of the Swiss Steel Group use austenitisation to determine material properties and grain size of the steel microstructure. The steel bar



The Swiss Steel Group is one of the world's leading suppliers of individual solutions in the area of special steel long products. In both tool steel and stainless long steel, the group is one of the leading manufacturers in the global market and one of the biggest companies in Europe for alloyed and high-alloyed engineering steel. With almost 10,000 employees and its own production and distribution companies in over 30 countries on five continents, the company ensures global support and supply for its customers and offers them a complete portfolio of production and sales and services worldwide. They benefit from the company's technological expertise, consistently high product quality worldwide, and detailed knowledge of local markets.

is then immediately cooled to the desired forming temperature and fed into the high-reduction roller unit.

The steel of the future ex works

Steels suitable for XTP® treatment are unalloyed steels, precipitation-hardened ferrite-pearlite steels, bainitic steels, quenched and tempered steels, tool steels, austenitic stainless steels, ferritic stainless steels, and high-speed steels. Steel processing companies generally stick with the steel grades they are familiar with. Using the same chemical analysis, the properties of Swiss Steel Group steels are significantly optimised from the start thanks to XTP®. The processor saves on elaborate, cost-intensive heat treatment.

The company says that XTP-treated steel opens up entirely new possibilities for the following industries and applications: spring manufacturing, hydraulics, connectors and fasteners, refrigeration systems, lifting equipment and lifting gear, cable car and aerial lift systems, wind power, the railway industry, agriculture and forestry, as well as for oil and gas extraction and recovery.

For more information contact: Helmut Freiherr von Fircks, Tel: +41 (0)41 581 4161, email: h.freherrvonfircks@ext.swisssteelgroup.com

New design guide launched to SHOWCASE the possibilities and GREEN FOOTPRINT OF CAST IRONS

Engineering designers are being urged to take advantage of a new guide that highlights the vast potential and environmental sustainability of the 'original composite material'.

The rallying cry has been made in the UK by the Cast Metals Federation as it looks to educate and persuade more professionals in industry to consider the huge range of mechanical properties of cast irons when they are designing new products.

'Cast Irons – Part 1: Materials and Properties for Design', which has been published by ISO (the International Standards Organisation) as a Technical Report, ISO/TR 10809-1:2023, provides a comprehensive yet accessible overview of design considerations, and clearly explains the potential of this hugely versatile family of metals.

The newly updated technical report includes tables to assist the designer to select, firstly, the right type of cast iron and then choose the right grade, depending upon the component criteria required.

There is also information about typical compositions, mechanical properties, and section sensitivity aspects (needed because of the effect of variations in cooling rates due to section thickness) with useful tables, images, and diagrams.

It is hoped that this influential guide will act as a bible for key design considerations, principles, limitations and opportunities associated with the use of cast irons.

Pam Murrell FICME, chief executive officer of the Cast Metals Federation and chair of ISO TC 25 (under which committee this work was organised), explained: "The metallurgical aspects of cast irons are often not well understood and cast iron is, after all, the original composite material.

"So, whilst this revised guide is not a textbook of cast iron metallurgy, I am confident that designers and engineers will find it enormously helpful in discussions with their cast component suppliers, whilst materials scientists and students of ferrous metallurgy should also find it hugely informative.

"We want people designing the next generation of products and applications to do so by having informed material choices and then hopefully they can leverage the huge versatility and power of cast irons."

The family of cast irons offers a huge range of mechanical properties to the engineering designer, yet many are unaware of the full range of iron grades available to them and the opportunities they provide in terms of castability and applicability.

Recycled Metal

In most modern economies, cast irons are readily produced using recycled metal (using steel scrap or cast iron parts at end of life) making them ideal for companies looking to reduce the carbon footprint of their supply chain.

"When most people say cast iron, more often than not they mean grey cast iron, which is a relatively low cost and easily castable material, but with excellent

machineability and good vibration damping and heat transfer properties – this makes it highly versatile. But this is to ignore the wider family of cast irons," said Murrell.

"They believe cast iron is a material that does not offer much in terms of strength and ductility – but to only consider grey cast irons is to ignore all the other types of cast iron that are available, many of which do offer ductility, wear resistance and corrosion resistance, as well as strength and castability.

"In fact, the global tonnage of cast iron components was around 74mt in 2021⁽²⁾ with parts for a huge range of applications, including machine tools, mining and agriculture, automotive, rail and freight transport. All of this demonstrates the huge range of current uses for the full family of cast irons."

The 'Cast Irons – Part 1: Materials and Properties for Design' ISO Technical Report sits alongside an accompanying technical report on the welding of cast irons (ISO/TR 10809-2:2011 Cast irons. Welding).

Many experts have contributed to the publication, including Richard Larker and Kathy Hayrynen, who led the ISO working group.

To purchase a copy of the technical report, contact the CMF, or visit: <https://knowledge.bsigroup.com/> and search for the report.

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If concrete was a country, it would have been the world's third-largest carbon dioxide emitter behind only China and the US⁽¹⁾. This is no surprise given that it is the second most used material on the globe after water, it produces roughly eight per cent of greenhouse gas emissions⁽²⁾. Decarbonisation of concrete is essential to meeting the UN net zero targets.



The race for making the \$300bn **CONCRETE MARKET GREENER** is already underway

Ali Al Suhal, Associate at DAI Magister investment bank

GCCA, an association of the key concrete producers, set a goal of achieving net zero emissions by 2050 identifying the 2020-2050 decades as the period to find new clean technologies and laying the groundwork for full deployment⁽³⁾. The industry low level of R&D has increased in recent years and venture investments into the industry has, but they still fall short of the size of the problem.

The construction industry contributes around 38 per cent of global greenhouse emissions compared to 23 per cent contributed by the transportation industry⁽⁴⁾. Yet, climate related venture investments into built environment were only \$2bn in 2022, less than a fifth of the \$12bn received by the transportation industry⁽⁵⁾. Governments are increasingly adopting policies to mandate adoption of green concrete and with the industry commitment, we see a path for investment in the industry to continue growing at double digits over the coming decade. The pursuit of a greener \$300bn concrete market is in progress.

Making concrete greener by changing its components

Cement, a key component of concrete, is available in various forms, although the most common are Portland clinker, gypsum, supplementary cementitious materials (SCMs), and fillers. Portland clinker makes up more than 98 per cent of worldwide concrete production today⁽⁶⁾. There are several reasons for this, including the fact that it is inexpensive, dependable, and creates high-quality concrete.

Process emissions released from the calcination of limestone to produce Portland clinker account for more than 50 per cent of the cement sector's emissions. A further 40 per cent stems from burning fossil fuels to heat cement

kilns to high temperatures throughout production⁽⁷⁾. Cement naturally emits CO₂ into the atmosphere as a result of cement production. This CO₂ release is a by-product of the heat required to produce the cement and an inherent part of the chemical process⁽⁸⁾.

A growing number of companies are focusing on reducing the carbon footprint of the production process by changing its components. Hoffmann Green Cement Technologies, established in France, develops, manufactures, and distributes novel clinker-free low-carbon cement with a carbon footprint six times that of standard Portland cement. The company's H-IONA cement is manufactured mainly from industrial by-products like steelworks slag to reduce waste and emissions, resulting in a decarbonate clinker.

Ecocem, which received a €22m investment from Bill Gates's climate fund in 2021, has pioneered a cement based on ground granulated blast furnace slag



(GGBS), a steel industry by-product⁽⁹⁾. With the company's low-carbon concrete product, up to 70 per cent of the cement can get replaced, reducing the overall emissions by a similar amount.

Other innovative companies are endeavouring to capture the carbon inside concrete or directly capture the CO₂ emitted during production. CarbiCrete is a Canadian company that has developed a technology for producing carbon-negative concrete through a patented process that removes more CO₂ than it emits. This process uses CO₂ from industrial sources to make a lower-carbon binder for concrete, reducing the overall carbon footprint of concrete production and creating a more sustainable product.

Some companies have created solutions to make greener aggregates used in construction. Neolithe is a French company that developed a fossilisation technology to transform waste into aggregates. This process reduces CO₂ emissions from wasted materials by grinding the un-recycled materials in a fossiliser and mixing them with a waste powder and a low-carbon binder. The result is a stone paste which is then processed into a decarbonate aggregate for use in public construction. So far, the company has sold one unit, so it will need to scale up to demonstrate its technology's benefits.

While we've seen progress in developing greener cement, considerable obstacles to broader adoption remain. Consumers

tend to be wary of less tried and tested products, which has caused resistance to the technology, particularly in a sector that prioritises safety. New technologies must also grow and scale to attract external funding. Although implementing carbon pricing could stimulate investment in low-carbon cement in its early stages, it's unlikely to reach high enough levels in major markets such as the EU, China, India, and the US any time soon. Public financing and a shift in mindset from low-tech to low-carbon cement will be required to advance the industry.

Replacing concrete with cleaner substitutes

Aside from modifying concrete components, innovative start-ups are working on creating concrete replacements or different types of concrete. Mighty Buildings is an American company that has developed a 3D printing machine that enables the creation of building structures from photopolymer resins. These polymer composites are as strong as concrete but are 30 per cent lighter and have five times tensile and flexural strength. This results in a more environmentally friendly and speedier construction process and the ability to produce sophisticated architectural designs that are impossible with traditional concrete construction.

French company XtreeE has developed large-scale 3D printing technology for sustainable building solutions. The company is agnostic regarding printable materials with its bi-component systems able to extrude various mortars, including earth-based materials, plaster and geopolymers.

COBOD printers offer automation and robotics solutions, enabling the construction industry to improve printing speed, efficiency, labour need, and material cost. The company also provides a range of materials depending on the specific project's performance standards. COBOD 3D printed Europe's first building in 2017. Subsequently, the first two and three story buildings in Europe, specifically in Belgium and Germany, were made with their technology.

While 3D printing technology is gaining momentum in the cement and construction industries, it can be more expensive than traditional manufacturing methods, especially for large-scale production. Additionally, limited materials are available for 3D printing and the strength and durability of 3D printed parts can often be lower than those made with traditional manufacturing methods. Quality control, speed, and post-processing requirements can also be challenging for 3D-printed parts.

Bio concrete based on bacteria is a technique that is still in the research and development stage but shows promise as a sustainable and low-cost alternative to traditional concrete manufacture and repair processes. Bio concrete uses naturally occurring and harmless microorganisms to form a dormant state within the material⁽¹⁰⁾. Prometheus Materials is one company using this approach, it developed a technology that uses naturally occurring microalgae to produce a bio-cement that offers an affordable, strong, and durable alternative to carbon-intensive Portland cement.

Innovating the concrete production process

Progressive start-ups and even tech behemoths are utilising artificial intelligence to optimise the process of creating concrete and cement to cut CO₂ emissions such as Meta (Facebook's parent company). The company has developed a new way of creating concrete that emits 40 per cent fewer carbon emissions than standard mixtures.

To train an AI model to find the optimal recipe, Meta researchers used a resource that lists various properties of 1,030 concrete mixtures called the *Concrete Compressive Strength Data Set*. This includes the strength of each concrete after curing for a week and a month and its carbon footprint. The AI could then analyse all possible concrete mixtures and find examples that matched a minimum given strength but also had the lowest possible emissions.

Berlin-based Alcemy is a developer of predictive analysis software designed to assist cement and concrete manufacturers. The company's software offers precise quality predictions for mixtures and their ingredients before shipping products, enabling companies to counterbalance limestone and cement fluctuations. At the same time, Alcemy enables companies to produce more concrete using recycled ingredients precisely and safely. The company claims its software can save up to 50 per cent CO₂ during production.

There are also companies like Solidia and CarbonCure using concrete to store CO₂. CarbonCure has developed a type of sustainable concrete that chemically converts CO₂

into a mineral embedded in concrete. The technology is retrofitted into concrete plants and lets producers inject captured carbon dioxide into fresh concrete during mixing. The CO₂ then gets converted into a mineral embedded in the concrete, providing climate benefits and increasing the concrete's strength.

Time is running out to develop and commercialise sustainable concrete

The coming years will be crucial for concrete usage as demand shifts from established to emerging markets. Urbanisation in developing countries such as India and Indonesia will drive increased demand for concrete worldwide.

According to UN estimates, we will create another 230 billion m² of floor area in the next 40 years, more than doubling the existing floor size of the world's buildings⁽¹¹⁾. This comes as many concrete structures are nearing the end of their lifespans, resulting in a need for renewal and removal (a particularly acute problem in China) as buildings must be torn down and either replaced or abandoned.

Given these realities, there is an intensifying need to ramp up the development and commercialisation of environmentally friendly and sustainable concrete if we are to meet net zero emissions targets.

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Kick starting a national strategy for materials innovation and commercialisation

The Henry Royce Institute is seeking to promote and support the development of a national materials innovation strategy in the UK.

The objective is to create a coherent approach across government, industry and the wider materials technology community. The strategy will identify and prioritise high-potential areas where materials innovation can make an impact in creating new and significant forms of value while addressing national priorities.

Stage one of the strategy process is the launch of a materials innovation strategy framework. The consultation document 'Materials Futures: Growing the UK's critical capabilities in materials innovation', was launched at an Advanced Materials Showcase at the House of Commons.

Royce is now seeking leaders from industry and key research organisations to become part of a materials innovation strategy group to drive the initiative. Interested parties can submit an expression of interest – final appointments will be made through an independent review process.

Materials underpins manufacturing, and the UK is one of the largest global manufacturing nations, contributing £203 billion every year to GVA and supporting five million jobs.

Professor David Knowles, Royce CEO, said: "As the UK's national institute for advanced materials Royce is pleased to facilitate this important strategy development work, which recognises that our national materials innovation capabilities are a significant asset and a strategic approach to managing them

is therefore essential in ensuring the UK is the most effective exploiter of materials innovation in the world. More than ever materials innovation has to be accelerated in the UK if it is going to deliver against the needs of major challenges such as net zero, health improvements, sustainable use of resources and, of course, underpin a robust economy.

"We know that the UK leads the way in materials R&D, however it does lag other countries in its ability to translate all that effort and commercialise new and improved materials. Today is a 'call to arms', particularly to industry leaders around the UK, to join forces with us to develop a focussed strategy designed to ensure we urgently expedite the translation of this research into new products and services."

George Freeman, Minister of State in the Department for Science, Innovation and Technology said: "This will be a challenge, as the strategy will need to be deployed into almost every manufacturing sector in the UK, as well as into emerging areas from healthcare to new sources of energy. It will need to embrace multiple stakeholders whose requirements may not immediately align – a key task of this strategy will therefore be to ensure focus and sector collaboration."

The strategy framework has been developed with the support of IfM Engage and Urban Foresight.

For more information and to submit an expression of interest, visit: <https://www.royce.ac.uk/news/national-strategy-for-materials-innovation-and-commercialisation/>

The Next Generation of Carbon Bonded Filters

Ian Andrews and Mike Lamkin – Capital Refractories Ltd (UK)

The filtration of molten metal is an established practice for many foundries around the world. Filters are used to reduce the risk of non-metallic inclusions into the casting and to modify the metal flow – essentially to reduce metal turbulence in the casting cavity.

Traditional filters are generally either foam, pressed, or extruded refractory ceramic products. Each of these filter types offer some advantages and disadvantages. The result of extensive R&D, this paper introduces a next generation filter that Capital Refractories has recently pioneered that offers most of the advantages with fewer of the disadvantages of traditional filters.

DIFFERENT TYPES OF FILTERS

There are several types of molten metal filter available to foundries. The most popular 'traditional' filters include foam, pressed and extruded. More recently, 'next generation' filters have emerged thanks to new manufacturing technologies: such as additive manufacture.

Foam filters

Foam filters are manufactured using a ceramic slurry. The slurry is usually an aqueous mixture of the main refractory powders. This aqueous slurry is then used to effectively coat reticulated polyurethane foam. After coating, the filter is dried and fired. During firing, the polyurethane foam pre-cursor will burn out and the strands of the foam filter will be hollow. This process lends itself to utilising a wide range of materials for different alloy types: such as zirconia/alumina or carbon-bonded alumina for steel, silicon carbide for iron and non-ferrous metals.

Foam filters are characterised by their sponge like reticulated structure; this makes for a tortuous path through the filter. Their porosity is expressed as 'ppi' (pores per inch) and will range from about 10ppi for coarse filters to about 30ppi for fine filters. Finer porosities are available for more specialised applications.

Pressed filters

Pressed filters are manufactured by pressing refractory powders into a complex mould. This mould contains many pins that form holes in the filter. The powders are formed around the pins, and these are then extracted to form the filter; it is then dried and fired. They are made using mullite or alumina with a clay bond.

Pressed filters are characterised by a honeycomb design with circular holes. Their porosity is usually expressed as a cell diameter: e.g. 2.5mm. Unlike foam filters, pressed filters do not create a tortuous path but a simple linear one.

Pressed filters are typically not as refractory as foam filters and are rarely used for steel but do find considerable use for grey and ductile iron.

Extruded filters

Extruded filters are manufactured by extruding a refractory dough through a die. The dough is usually an alumina-based composition with rheological additives. The extrudate emerges from the die as a continuous 'log' which is then sliced, dried and fired.

Extruded filters are again characterised by a honeycomb design with square holes. They are commonly made from alumina and their porosity is conventionally expressed in CSI (cells per square inch).

Like pressed filters, extruded filters are not normally as refractory as foam filters and are mainly used for melting iron and rarely used for steel. Their relative lack of refractoriness also gives a limit to the time of exposure to hot metal.

Next generation filters

New manufacturing techniques have created the opportunity to design filter structures in a way not possible with traditional techniques. These are made using an additive manufacturing type of process in which layers of filter material are arranged upon the previous layer in such a manner as to create an engineered structure; this can be designed to form a tortuous path of differing complexities. They are then dried and fired as per other filter types.

A next generation filter can be characterised as having a consistent and repeatable structure (like pressed and extruded filters) but combined with a

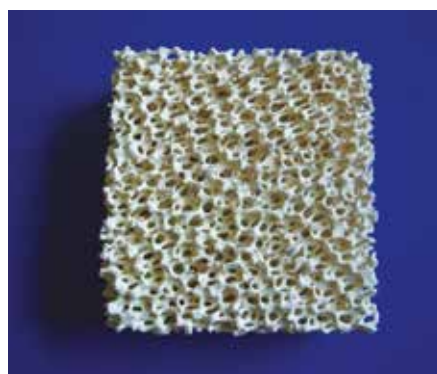


Fig.1 Foam Filter

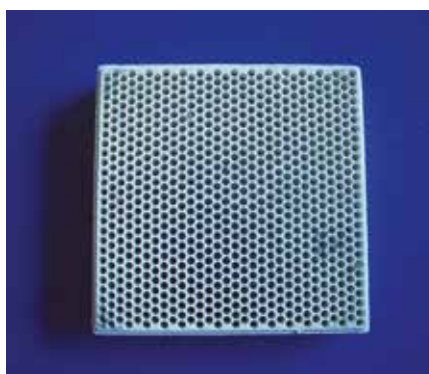


Fig.2 Pressed Filter

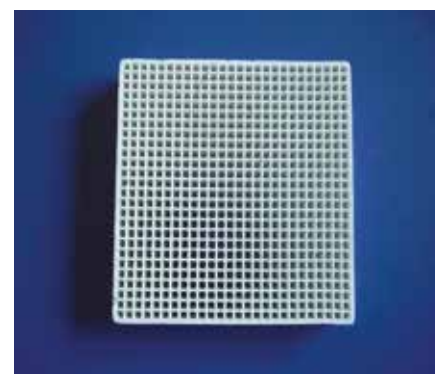


Fig.3 Extruded Filter

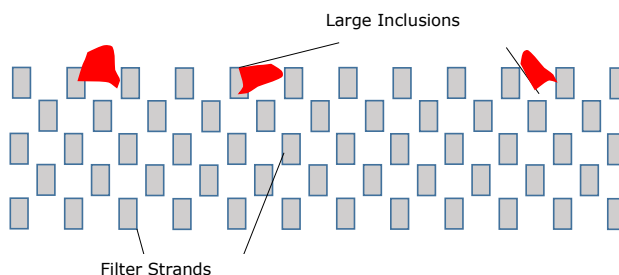
tortuous flow network (like foam). They can be made from various materials such as zirconia, alumina, and carbon bonded is also possible.

FILTRATION MECHANISMS

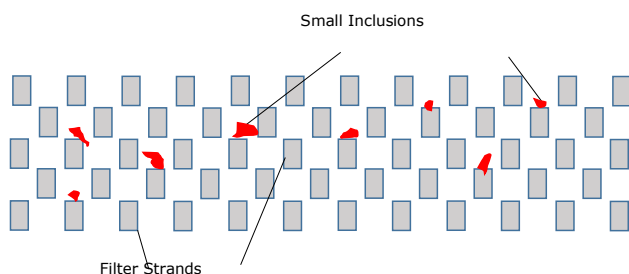
Filters prevent inclusions from occurring in the finished casting by a variety of mechanisms. These include screening, deep bed filtration and flow modification. Each of these will be explained below.

Deep bed filtration

Screening is simply the prevention of large pieces of slag or dross passing through the filter due to their physical size compared to the size of the filter cells/pores. A diagram of this mechanism can be seen below.



Essentially all types of filter offer this type of strainer filtration. Particles that are smaller than the lattice gap that are able to pass through the initial layers are eventually stopped due to the tortuosity of the internal structure. A representation of the mechanism is shown below.



This sort of filtration process is realistically only offered by filters that force the metal to take a tortuous path through them.

Flow modification

Flow modification is essentially the reduction of turbulence in the molten metal stream and is arguably the most important attribute of a filter. A reduction in the turbulence will reduce the chances of inclusions being generated from re-oxidation, the effects of mould erosion, and other flow related defects.

Desirable properties in a molten metal filter

There are many desirable traits that an ideal molten metal filter should have. Some of these properties conflict with each other. For example, a filter with a large capacity may not have a high filtration efficiency. Filters with a very consistent structure (e.g. pressed cellular filters), may not have very good flow modification properties. Ideally a filter should have the following attributes:

- Good filtration efficiency.
- High pour rate.
- High capacity.
- Consistent structure.
- Good flow modification abilities.
- High strength (hot and cold).
- Be cost effective.

Attributes of foam filters

Foam filters have excellent filtration efficiency by virtue of their structure; both screening and deep bed filtration mechanisms will be effective. Additionally, foam filters have a good flow modification effect due to their tortuous structure. This reduces the kinetic energy of the metal stream and essentially calms the flow.

The capacity of foam filters is limited by porosity.

One of the biggest issues with foam filters is their consistency. Every foam filter will have a unique structure. This results in variation in both capacity and flow rates.

Another issue with foam filters is spalling or friability. This is when small strands of the filter break off; it is possible that these ceramic pieces can end up in the casting.

In terms of hot strength, foam filters are generally good. However, as the filters get larger (200mm and above) they are more susceptible to breakage.

Attributes of pressed filters

Pressed filters usually have round holes. Unlike foam filters, they have a very repeatable and consistent structure. However, they do not have as good a filtration efficiency or flow modification effects. They are very robust and have good cold strength. Larger sizes can suffer from hot strength and creep issues.

Attributes of extruded filters

Extruded filters are similar to pressed filters except they usually have square holes and a higher open area. They also have similar filtration efficiency and flow modification effects to pressed filters. Again, larger filters can suffer from strength issues at high temperatures.

Attributes of MetCon C – next generation filter

There are now several types of 'next generation' molten metal filter available. These filters generally use a form of additive manufacture to produce a more consistent, tortuous structure that can be customisable in terms of pore size etc. Even though these filters offer an 'ideal' combination of physical properties, they are normally very expensive and can often be uneconomic to use.

MetCon C filters are produced using a unique additive manufacturing type of process to offer a cost-effective next generation filter. Whilst they may be slightly more expensive than traditional filters, the improvement in physical properties makes them cost effective. Like foam filters, they have excellent filtration efficiency due to the tortuous path, good screening and deep bed filtration, and good flow modification effects. However, unlike foam filters, their structure is consistent and repeatable. It is also possible to offer coarse porosities so very high capacity/flow rate



Fig. 4 MetCon C Filter



Fig.5 Used Filter

rates of 50 kg s⁻¹ are being achieved.

New porosities are being produced all the time. The soon to be available 300mm diameter 5G2S model should allow castings over five tonnes with flow rates up to 100 kg s⁻¹ to be achieved.

Fig.5 shows a MetCon C filter after almost three tonnes of molten steel have been poured through it. The filter is a 200mm tapered 3G2S model and the pour rate was 50 kg s⁻¹. Previously, zirconia foam filters failed due to insufficient strength.

CONCLUSIONS

Traditional molten metal filters can be effective but have some limitations on their properties. Foam filters are limited by their pore size and have issues related to consistency. Cellular filters are consistent but have issues related to filtration efficiency and flow modification. Many filters on the market suffer from hot strength issues, especially for larger sizes. New 'next generation' filters can offer the ideal combination of physical properties but are often expensive and uneconomical to use.

MetCon C filters have been designed to offer the best combination of properties in a cost-effective way. They have a consistent and repeatable structure that is engineered to give the best possible capacity and flow rate whilst retaining a good level of filtration efficiency and flow modification. They have excellent cold strength and superior hot strength, so they can withstand long pour times with very high flow rates. They are suitable for a wide variety of metals including carbon steels, manganese steels, chrome irons and ductile iron.

	Foam	Pressed	Extruded	MetCon
Filtration Efficiency	✓	✗	✗	✓
Flow Modification	✓	✗	✗	✓
Consistency	✗	✓	✓	✓
No Friability (spalling)	✗	✓	✓	✓
Cold Strength	✓	✓	✗	✓
Hot Strength	-	-	-	✓

✓ = Positive, ✗ = Negative, - = Limited (long pours)

Table 1

filters are possible. The exceptional hot strength of MetCon C filters makes it possible to make larger filters so that very large castings can be poured directly through a single filter.

The table above summarises properties of the various filters.

High capacity filters

Foam filters can be limited in their capacity by their porosity. Generally, the coarsest porosity available is 10ppi. There are occasions when a coarser porosity would be desirable such as when pouring manganese steel.

Pressed and extruded filters can have larger hole sizes to increase capacity, but the larger the hole, the more they resemble standard strainer cores – giving very little flow modification and filtration efficiency. Furthermore, large cellular filters can suffer from high temperature creep and lose strength during the pour. This gives limitations on the sizes that can be produced.

MetCon C filters are available in coarse porosities designed for very large castings and/or metals that are difficult to filter such as manganese steel. Because the hot strength is so high, they are available as large filters that can withstand very long pour times and high flow rates. The porosities that are currently available are 3G2S (3mm gap and 2mm strand) and 4G2S (4mm gap and 2mm strand).

Currently castings of 3.5 tonnes are being poured through a 200mm 4G2S filter. Flow

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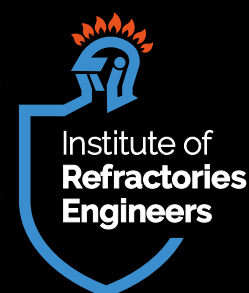
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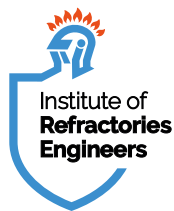
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- ❑ GIFA/THERMPROCESS Preview
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Hello from Australia

Mark Preece our President, gives the busy schedule, has requested me to write this editorial for the Refractories Engineer in Australia New Zealand. Our success in achieving our objectives is a testament to the hard work and dedication of our members and staff.

That is the theme of this editorial "Teamwork builds success".

In the first year of the Refractories Engineer, the focus of the Management Team is to continue to grow our membership base. There are many people who read the Refractories Engineer who are not members. We are keen to encourage them to join our team.

Our aim is to be a supportive environment. As an example, recently we received a letter from a member who was struggling with a technical problem. We immediately reached out to help them, and they were able to solve the problem. This is the kind of support we want to provide for all our members.

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MONOLITHIC REFRACTORIES



RHI MAGNESITA

RHI Magnesita

Kranichberggasse 6, 1120 Vienna,
Austria
Tel: +43 50213 0
Email: office@rhimagnesita.com
Website: www.rhimagnesita.com

MONOLITHIC REFRACTORIES - CASTABLE



Capital Refractories Ltd

Station Road, Clowne,
Chesterfield
S43 4AB, United Kingdom
Tel: +44 (0) 1246 811163
Fax: +44 (0) 1246 819573
Email: info@capital-refractories.com
Website: www.capital-refractories.com



ROBERT LICKLEY

Robert Lickley Refractories Ltd

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Dudley, West Midlands
DY1 2UF
Tel: (01902) 880123
Fax: (01902) 880019
Website: www.robertlickley.co.uk



Trent Refractories Ltd

Menasha Way,
Queensway Industrial Estate, Brigg Road,
Scunthorpe DN16 3RT
Tel: (01724) 858684
Fax: (01724) 281577
Email: enquiries@trentrefractories.co.uk
Website: www.trentrefractories.co.uk

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Tel: (01724) 858684
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Website: www.trentrefractories.co.uk

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Kyanite Mining Corporation

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Website: www.kyanite.com

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Fax: (01902) 880019
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Website: www.trentrefractories.co.uk

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**Quartis Ltd**

PO Box 138, Cranbrook,
Kent TN17 9AF
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Fax: (01580) 754949
Email: quartis@fccu.com
Website: www.fccu.com

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**Quartis Ltd**

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Website: www.capital-refractories.com

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Website: www.mach-int.com

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Mobile: +44 (0) 7377 212544
Email: contact@refractory-anchors.co.uk
Website: www.refractory-anchors.co.uk

**Mach One (International) Ltd**

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Fax: (0114) 276 7438
Email: anchors@mach-int.com
Website: www.mach-int.com

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Fax: (01909) 731579
Email: sales@shl-refractories.co.uk
Website: www.shl-refractories.co.uk

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Merseyside CH47 4FB
Tel: (0151) 632 6333
Fax: (0151) 632 6444
Email: info@gunform.com
Website: www.gunform.com

**Markham (Sheffield) Ltd**

Marspal House, Lawn Road Industrial
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Nottinghamshire S81 9LB
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Fax: (01909) 733584
Email: sales@markham-sheffield.co.uk
Website: www.markham-sheffield.co.uk

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**Gunform International Ltd**

33 Carsthorpe Road, Carr Lane Industrial
Estate, Hoylake, Wirral, Merseyside CH47 4FB
Tel: (0151) 632 6333
Fax: (0151) 632 6444
Email: info@gunform.com
Website: www.gunform.com

**S.H.L. Refractories (U.K.) Ltd**

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Nottinghamshire S81 9LB
Tel: (01909) 731959
Fax: (01909) 731579
Email: sales@shl-refractories.co.uk
Website: www.shl-refractories.co.uk

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**VELCO GmbH**

Haberstr. 40
42551 Velbert,
Germany
Tel. +49 (0) 2051 2087.13
Fax +49 (0) 2051 2087.20
E-mail: cwolf@velco.de
Website: www.velco.de

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**VELCO GmbH**

Haberstr. 40
42551 Velbert,
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Fax +49 (0) 2051 2087.20
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Website: www.velco.de

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Tel: +44 114 243 3141
Fax: +44 114 256 0088
Email: richmondreclaim@gmail.com

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Fax: (0151) 632 6444
Email: info@gunform.com
Website: www.gunform.com



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Tel: (01909) 730861
Fax: (01909) 733584
Email: sales@markham-sheffield.co.uk
Website: www.markham-sheffield.co.uk

SILICON METAL



Elkem Silicon Products
17 Jessops Riverside
Brightside Lane,
Sheffield S9 2RX England
Website: www.elkem.com/contact/
Tel: +44 7810 428768

SILICON METAL POWDER



S+A Blackwell Ltd
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Lancashire, FY8 5LW
Tel: +44 (0)1253 738121
Fax: +44 (0)1253 735831
Email: sb@sandablackwell.com
Website: www.sandablackwell.com

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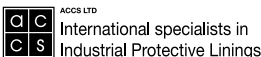
Elkem Silicon Products
17 Jessops Riverside
Brightside Lane,
Sheffield S9 2RX England
Website: www.elkem.com/contact/
Tel: +44 7810 428768

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Epinal Way, Loughborough,
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Fax: +44 (0)1509 211862
Website: www.fiberconfiber.com

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Website: www.accsLtd.co.uk

SUPERVISION/INSPECTION SERVICES



Quartis Ltd
PO Box 138, Cranbrook,
Kent TN17 9AF
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Fax: (01580) 754949
Email: quartis@fccu.com
Website: www.fccu.com

TESTING AND ANALYSIS



Seicrim Holdings Ltd
PO Box 133, Cranbrook,
Kent TN17 9AF
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Fax: (01580) 754949
Email: SHL@fccu.com

TESTING AND ANALYTICAL



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Website: www.trentrefractories.co.uk

THERMAL INSULATION



Siltherm Europe Ltd
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Sandyford Business Park,
Sandyford,
Dublin 18, D18 R9C7,
Republic of Ireland
Tel: +353 1 255 1800
Fax: +353 1 495 9201
Email: sales@siltherm.eu
Website: www.siltherm.eu

TRAINING



CHB South Africa - Third Party Inspectorate
23 Delius Street,
Vanderbijlpark,
Gauteng,
South Africa 1910
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Mob: +27 83 275 8948
Email: dcbiggs@mweb.co.za
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Institute of Refractories Engineers Corporate Packages

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 several 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.

Bronze

A Bronze Corporate Package entitles a company to:

- | | |
|--|--|
| <ul style="list-style-type: none"> □ Complimentary quarter page advert in <i>The Refractories Engineer</i> □ 2 x <i>Business Directory</i> entries □ 2 IRE individual memberships □ 1 online conference fee □ 1 online training fee | <p>Additional benefits</p> <ul style="list-style-type: none"> □ 10 per cent discount on additional advertising. □ 10 per cent discount on conference and training day attendance. □ 10 per cent discount on additional individual membership fees. |
|--|--|
- £900.00 worth of benefits for just £500.00**

Silver

A Silver Corporate Package entitles a company to:

- Complimentary half page advert in *The Refractories Engineer*
 - 4 x *Business Directory* entries
 - 2 IRE individual memberships
 - 2 online conference fees
 - 2 online training fees
- £1,434.00 worth of benefits for just £750.00**

Additional benefits

- 12.5 per cent discount on additional advertising.
- 12.5 per cent discount on conference and training day attendance.
- 12.5 per cent discount on additional individual membership fees.

Gold

A Gold Corporate Package entitles a company to:

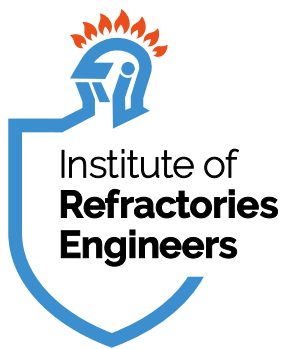
- Complimentary full page advert in *The Refractories Engineer*
 - 6 x *Business Directory* entries
 - 5 IRE individual memberships
 - 5 online conference fees
 - 5 online training fees
- £2,682.00 worth of benefits for just £1,250.00**

Additional benefits

- 15 per cent discount on additional advertising.
- 15 per cent discount on conference and training day attendance.
- 15 per cent discount on additional individual membership fees.

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.irengineers.co.uk





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Membership Application Form

Please complete the form below to apply to be a Member of the Institute of Refractories Engineers:

First Name

Last Name

Email Address

Phone Number

Company where applicable

Address Line 1

Address Line 2

Town / City

Postal / Zip Code

Country

Details of past and present employment in connection with Refractories

Training - qualifications, courses attended, or memberships of any other professional institutes, societies or associations

Comments / further information

Signature

Date

Please submit this Membership Application Form to:-
Institute of Refractories Engineers
Unit 102, 88 Queen Street, Sheffield S1 2FW, UK
Email: secretary@ireng.org

All applications are reviewed by the General Council following receipt. If you are successful in your application, you will be notified in writing by the General Secretary, and we will issue a Certificate of Membership.

To apply for Membership online, go to www.irengineers.co.uk & follow the link

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2007/09	T Staton, CEng, BTech, MIMMM, FRef Eng
2009/11	P Rooney, MSc, FRef Eng
2011/13	C Windle, BSc Hons, FRef Eng, MIM3, FSGT
2013/15	K Andrews, B Met, BSc, MSc, FRef Eng
2015/17	C Arthur, FRefEng
2017/19	J D Theron, B Tech ChemIng, FRef Eng
2019/22	Mrs K Moss, M I Ref Eng

* Deceased

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Secretary: Peter Rooney

Treasurer: Mike Lamkin

Institute of Refractories Engineers, Unit 102, 88 Queen Street, Sheffield S1 2FW, UK

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Georgina Nicol

Email: secretary@ireng.org

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Council (Elected Members):

Keith Andrews

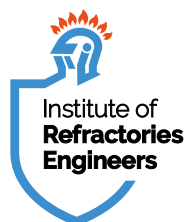
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YOUR Industry, YOUR Institute and YOUR global community

The Institute of Refractories Engineers is the heart and voice of the refractory family. Connecting people with application knowledge, sharing insights and best practice to benefit the refractories community.

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