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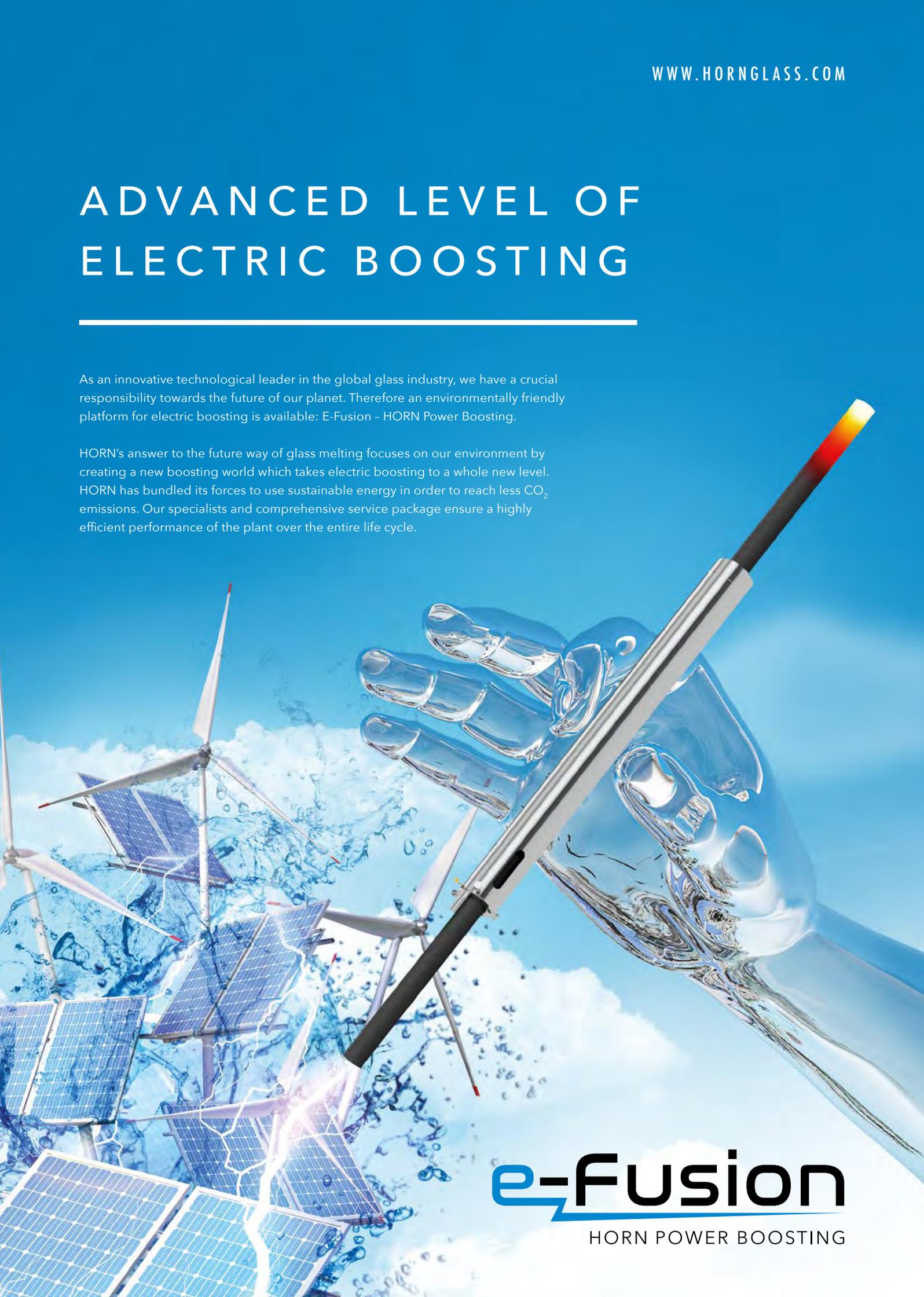
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A futuristic glass hand holding a glowing rod against a background of renewable energy. The background features a collage of solar panels, wind turbines, and water splashes, all set against a bright blue sky. The glass hand is highly detailed and reflective, holding a black rod that glows with a yellow and orange light at its tip. The overall composition is dynamic and emphasizes sustainable technology.

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Welcome



Welcome to our first issue in 2022, the UN International Year of Glass!

Progress towards carbon-neutral glass manufacturing has been core to *Glass Worldwide's* editorial content in recent times. The theme continues in this issue with coverage of the latest developments in melting technology being adopted by glassmakers in conjunction with their technology suppliers and collaborative industry bodies.

But it should be remembered that technological advances in numerous other areas of the manufacturing process are also vital to glass being recognised as the sustainable material of choice in all its applications. This issue features the first of two comprehensive Buyers Guides devoted to the important subject of process control and inspection, with specially written contributions from leading authorities in the business. Complemented by a diverse selection of Technology articles, glassmakers and processors can find practical solutions to the everyday issues they face on their hollow, flat and speciality glass production lines.

Glass Worldwide articles throughout 2022 will continue to assist our international readership with improving productivity, efficiency, quality and profitability so if you don't already receive your own personal copy then please visit www.glassworldwide.co.uk to order your subscription. Visitors to the website can also find the latest Hot Topics news, Virtual Marketplace showcase, latest events listings and a digital archive of current and back issues.

In addition to a series of market reports devoted to the glass industries in India, South Korea, Spain and the USA, this issue boasts exclusive interviews with industry figureheads including Ajit Jhunjhunwala (Managing Director of La Opala), Rick Zoulek (Executive Vice President of Guardian Glass Americas), Aston Fuller (General Manager of Glass Futures) and Gerry Wilkins (Senior Director for Sales & Marketing at Gerresheimer in the USA and Canada). As official journal of the AFGM, we are also pleased to announce Harris Hendraka as the federation's new chairman and we look forward to continuing to promote developments throughout the ASEAN region during his tenure.

Finally, we were very sad to hear last month of the passing of Mr B L Kheruka, Executive Chairman of Borosil, whose

contribution to the glass industry in India and beyond over many decades cannot be overstated. *Glass Worldwide* was proud to support the All India Glass Manufacturers' Federation in awarding Mr Kheruka the prestigious C K Somany Award for Innovation and Technology in 2019 and we send sincere condolences to his family, friends and colleagues.

The Glass Worldwide Team
www.glassworldwide.co.uk



B L Kheruka



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Contents

News

6 Round-up of the latest news and appointments in the glass industry

Associations

20 AFGM Chairmanship switches to Indonesia

On The Spot

22 Aston Fuller, General Manager of Glass Futures

Spotlight

24 277th Master Glass Seller installation
 36 How the Armstrong Partnership helped Encirc to promote its sustainability credentials
 40 Recycling in the glass packaging industry – part 1

Focus USA

S3 Gerresheimer is driving innovation across America and beyond
 S6 On The Spot with Rick Zoulek, Executive Vice President of Guardian Glass Americas
 S10 GPI's review of 2021
 S12 Report on activities in the US glass industry
 S18 America's glass container industry
 S24 PaneraTech recommends responding to emergencies two years in advance

Focus India

25 Expansion at La Opala is sowing the seeds for success
 30 Overview of the Indian glass industry

Technology

46 Melting – In favour of state-of-the-art fining technology
 48 Melting – Improved energy performance from a Stara Glass hybrid furnace

Supplier Focus

56 From hot to cold, all under one roof with Grenzbach



Focus Spain

60 Optimism for the Spanish glass industry

Focus South Korea

64 Overview of the South Korean glass industry

Buyers Guide • Process Control & Inspection (part one)

70 CelSian heralds a new era of furnace control
 72 Siemens' comprehensive approach to energy management
 76 End to end process control from Eurotherm
 80 AGR's findings from a study on applying ceramic labels to glass
 86 Reducing held ware with digital re-sorting from XPAR Vision
 88 How Pro-Sight Vision's quality control systems can help with compliance requirements

90 Vertech's complete production management system for glassmakers
 92 Advanced container inspection with Heye's SmartLine 2
 94 Inspection modules for all purposes from Dr Günther





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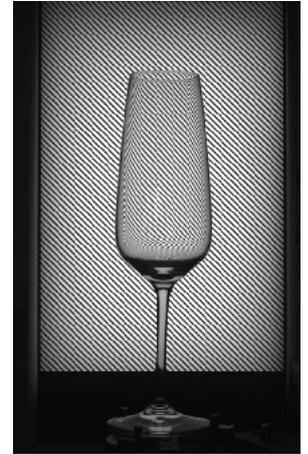


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News For the latest news, visit the Hot Topics section at www.glassworldwide.co.uk

Air Products' donation supports future ceramic and glass workforce

Industrial gas company Air Products' charitable giving and philanthropy-orientated Air Products Foundation has announced that it will donate \$15,000 to the Ceramic and Glass Industry Foundation (CGIF) and Glass Manufacturing Industry Council (GMIC), both located in Columbus, Ohio, to foster innovation by the next generation of ceramic and glass professionals.

"Air Products has been committed to helping the ceramic and glass industries for many decades, developing innovative combustion and industrial gas-based technologies for lower operating costs, higher quality and a reduced environmental footprint," said Mike Pires, Director of Strategy, Marketing and Technology-Americas at Air Products. "These donations to CGIF and GMIC will help achieve their goals of attracting, inspiring and training future ceramic and glass professionals, and we are proud to contribute to the industry's bright future."

"It's a testament to Air Products' vision, that they have made this commitment to helping to develop the workforce that will take the glass manufacturing industry forward into the next generation," said GMIC's Executive Director Bob Lipetz. "We are grateful that progressive companies like Air Products support the Glass Manufacturing Industry Council's efforts through their generous grants."

The Ceramic and Glass Industry Foundation was created in 2014 by the American Ceramic Society; it has developed and manages several programmes in the areas of K-12 student outreach, university-industry networks, student travel grants and exchanges and student leadership development programmes.

The Glass Manufacturing Industry Council was founded in 1998 to facilitate, organise and promote the interests, economic growth and sustainability of the glass industry through education and cooperation in the areas of technology, productivity, innovation and the environment.

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Air Products' has donated \$15,000 to help the careers of future ceramic and glass professionals.

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'Design of the year – flat' award was presented to Sanmukh Bawa of The Glass Company by Graham Lovell of Glass Worldwide (award sponsor).



Recipients of the Glass Focus Awards 2021.

Glass Focus Awards winners

This winners of the 2021 Glass Focus Awards were revealed at Hotel Brooklyn in Manchester, UK last November. Businesses from across the glass supply chain came together to celebrate the many achievements of the industry over the previous 12 months.

For the second year in a row Encirc was crowned 'Company of the year' and also took home the 'Innovative solution' and 'Strengthening business through people' awards, while Saint-Gobain Glass won three awards including 'Rising Star', 'Health and safety action' and 'Sustainable Practice' alongside

Morley Glass & Glazing. Other winners on the night included Allied Glass, The Armstrong Partnership and The Glass Company.

The full list of winners from the Glass Focus Awards 2021 were:

- **Design of the year – container (sponsored by Rockfield):** Clean T by Allied Glass
- **Design of the year – flat (sponsored by Glass Worldwide):** Ubiquitous Energy by The Glass Company
- **Innovative solution (sponsored by Glass Technology Services):** The world's most sustainable glass bottle by Encirc
- **Health and safety action (sponsored by Arco):** Onsite defibrillators by Saint-Gobain Glass
- **Strengthening business through people (sponsored by Glass Futures):** Ignite programme by Encirc
- **Rising Star (sponsored by the Worshipful Company of**

Glass Sellers): Will Ruane at Saint-Gobain Glass

- **Marketing Impact (sponsored by Friends of Glass):** Encirc: Big 5 by The Armstrong Partnership
- **Sustainable Practice (sponsored by Glass International):** GreenVision Fund by Saint-Gobain Glass and Morley Glass & Glazing
- **British Glass Company of the Year:** Encirc

www.britglass.org.uk/glass-focus-2021

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HOT TOPICS

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Norse mythology inspires winner of O-I Design Awards

The 2021 O-I : EXPRESSIONS DESIGN AWARDS challenged young designers to tackle a very real issue faced by spirits owners: how to convey both premium brand cues and enhanced sustainability. For her winning entry, British designer Rebecca Edwards created a drinks brand called Ommr (Old Norse for snake) derived from the story of the giant serpent Jörmungandr that grows so large that it encircles the world. Ms Edwards' packaging design explored the tactile capabilities of O-I : EXPRESSIONS, utilising the potential for complex, detailed relief printing to offer a unique texture on the snakeskin.

"The judges were entranced by the creativity of Rebecca's design, in which the 360° depiction of the serpent captured the essence of the circular economy – in which glass plays such a vital role," commented Melianthe Leeman, O-I's Global Category Director, Wine and Spirits.

"As a designer at Hunter Luxury, I work predominantly on secondary packaging, so it was fun to work on a primary packaging project," said Ms Edwards, revealing that the inspiration for the Old Norse influence in the design came from a personal family link. "The combination of this inspiration from old mythology, paired with a modern innovative manufacturing process, was a really interesting concept to explore," she added.

The other finalists were (in alphabetical order): Diana Moreira – 'Waste Spectrum', playing with the contradiction between luxury and garbage; Rita Pires – 'Genius of London', drawing on iconic London

landmarks to highlight the threat of rising water levels; Joao Vieira – 'Bright Future', offering the buyer a doorway into a more positive world; and Rodrigo Villalba – 'Cherish', using tropical plants and flowers to remind consumers to protect the planet and its beauty.

The five finalists had their entries printed onto LUX bottles from O-I's new Contemporary Spirits Collection. All five bottles were displayed at the Packaging Innovations Show (1–2 December 2021) at London Olympia, where Ms Edwards was presented with her award.

Judges for the competition were Jean-Dominique Andreu – international expert on marketing and product development in the luxury drinks market; Josh Brooks – Marketing & Community Director Packaging, Easyfairs; David Gamage – Managing Director, Earth Island Publishing; Melianthe Leeman – Global Category Manager, Wine and Spirits, O-I; Elaine Logan – UK Country Group NPD & NBD Leader, O-I; Rosie Milsom – Head of NPD and Packaging, Atom Brands; Adam Ryan – Head of Pentawards.

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British designer Rebecca Edwards captured the essence of premium sustainability with her winning entry inspired by Norse legends.

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Kerbside collection trumps DRS

An independent report published by the consulting team at Reconomy Group company, Valpak for British Glass has shown that recycling glass packaging through an improved, consistent kerbside scheme already planned for 2023 is better for the environment than a deposit return scheme (DRS).

According to the report, a good kerbside recycling model for glass packaging will deliver 11% more carbon savings than including glass in a DRS – equating to over two million tonnes of CO₂ saved by 2035. An improved, consistent kerbside scheme would lead to “a collection rate of close to 90% of [all] glass packaging placed on the market across both drinks containers and all other types of glass packaging” (compared with DRS which anticipates a collection rate of just 85% but is limited to drinks containers only).

The UK Government’s own data suggests that the implementation of a DRS for drinks bottles is likely “to reduce the collection rate at the kerbside for the remaining glass [food] packaging”, such as jam jars and condiment bottles that make up nearly a third of all glass packaging.

Responding to the publication of the report, British Glass’ Chief Executive Dave Dalton underlined that, “Including glass bottles in a DRS will lead to over two million more tonnes of CO₂ in our atmosphere. Perversely, we have a situation where we could have a green policy that is actually worse for the environment and a system that would split glass food and beverage packaging into two waste streams, to the detriment of both. Not only would this reduce the amount and the quality of recycled material available to be used again in new glass containers and bottles, it would also, as international evidence has shown, lead to more plastic packaging on the market.”

The solution, stated Dr. Dalton, is to have “more glass recycled through enhanced household collections under extended producer responsibility and consistent collections – achieving a 90% recycling rate. Only this will create a truly circular economy for glass packaging.”

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Ardagh agrees acquisition of Consol for \$1 billion

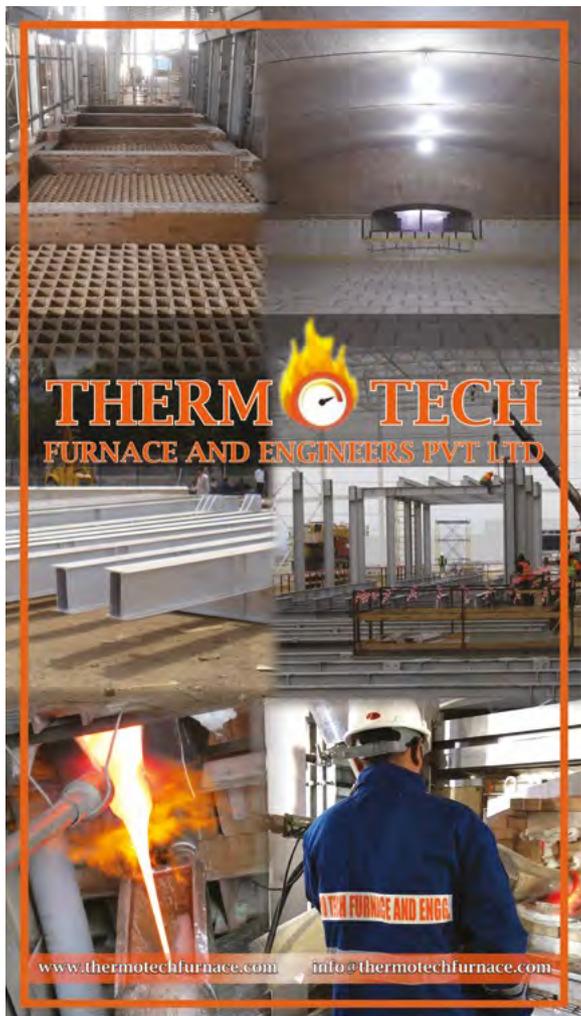
Ardagh Group has agreed to acquire Consol Holdings, the leading producer of glass packaging on the African continent, for an equity value of ZAR10.1 billion (\$635 million). Headquartered in Johannesburg, and founded in 1946, Consol operates four glass production facilities in South Africa, serving a broad range of international, regional and domestic customers, principally in the beer, wine, spirits, food and non-alcoholic beverage sectors.

Ardagh expects to finance the acquisition through a combination of its own cash resources and the assumption of ZAR5.7 billion (\$358 million) existing net debt at Consol. Completion of the acquisition is subject to certain conditions, including regulatory approvals that are expected to be obtained in the second quarter of 2022.

“We are very pleased to expand our European and North America presence in glass packaging into Africa with the acquisition of Consol, a high-quality business, led by an excellent management team,” said Paul Coulson, Ardagh’s Chairman. “Consol is a market leader in the region, with great relationships across a diversified domestic and multinational customer base. Virtually all of Consol’s multinational customers are also customers of Ardagh. We look forward to welcoming Consol to the Ardagh family and to investing in the long-term growth of the African market.”

Commenting on Consol’s business success and “established reputation for delivering quality products to a growing customer base,” Bruce MacRobert, Chairman of Consol agreed that, “Ardagh’s long-term presence in, and commitment to, glass packaging, makes it the ideal owner to continue this progress.”

www.ardaghgroup.com



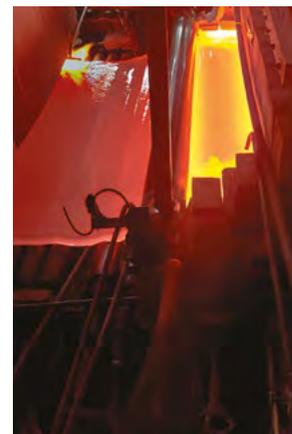
German businesses team up for Triveni Renewables’ solar plans

Indian glass manufacturer Triveni Renewables has contracted SORG, EME and Grenzebach to supply technologies and solutions for its new solar glass plant with a melting capacity of 240tpd. Construction of the facility in India will help the company take advantage of the growing domestic solar glass market through its subsidiary, Triveni Renewables Pvt Ltd.

EME will provide the batch plant and cullet return system, SORG is responsible for the melting furnace and Grenzebach will deliver the annealing lehr and the cutting line.

A statement from SORG reported that it has “been closely working with Grenzebach in the flat glass sector for a long time. Together, we can jointly provide a complete technological line for flat glass production. The partnership allows customers to benefit from the technological leadership of both companies.”

www.sorg.de



SORG, EME and Grenzebach will supply Triveni Renewables with a 240tpd solar glass manufacturing plant.

AGC transfers shares of Schott Gemtron

In early December AGC Inc transferred all of the shares of Schott Gemtron Corporation and its subsidiaries held by its subsidiary, AGC Flat Glass North America and [another company, to SSW Advanced Technology LLC – a portfolio company of Trive Capital Management LLC. The parties agreed not to publish any transaction details. The impact of this transaction on AGC’s consolidated business results will be minimal.

Schott Gemtron specialises in the production and sale of glass products mainly for the home appliance industry in North America. The AGC Group had owned 49% of the company’s outstanding shares in the Building & Industrial glass business.

Under the AGC plus-2023 medium-term management plan announced in February 2021, AGC has strived for improvements of the profitability and asset efficiency of its Building & Industrial glass business, which have been designated as one of the AGC Group’s priority issues. The transfer deal was conducted as part of these improvement measures.

www.agc.com

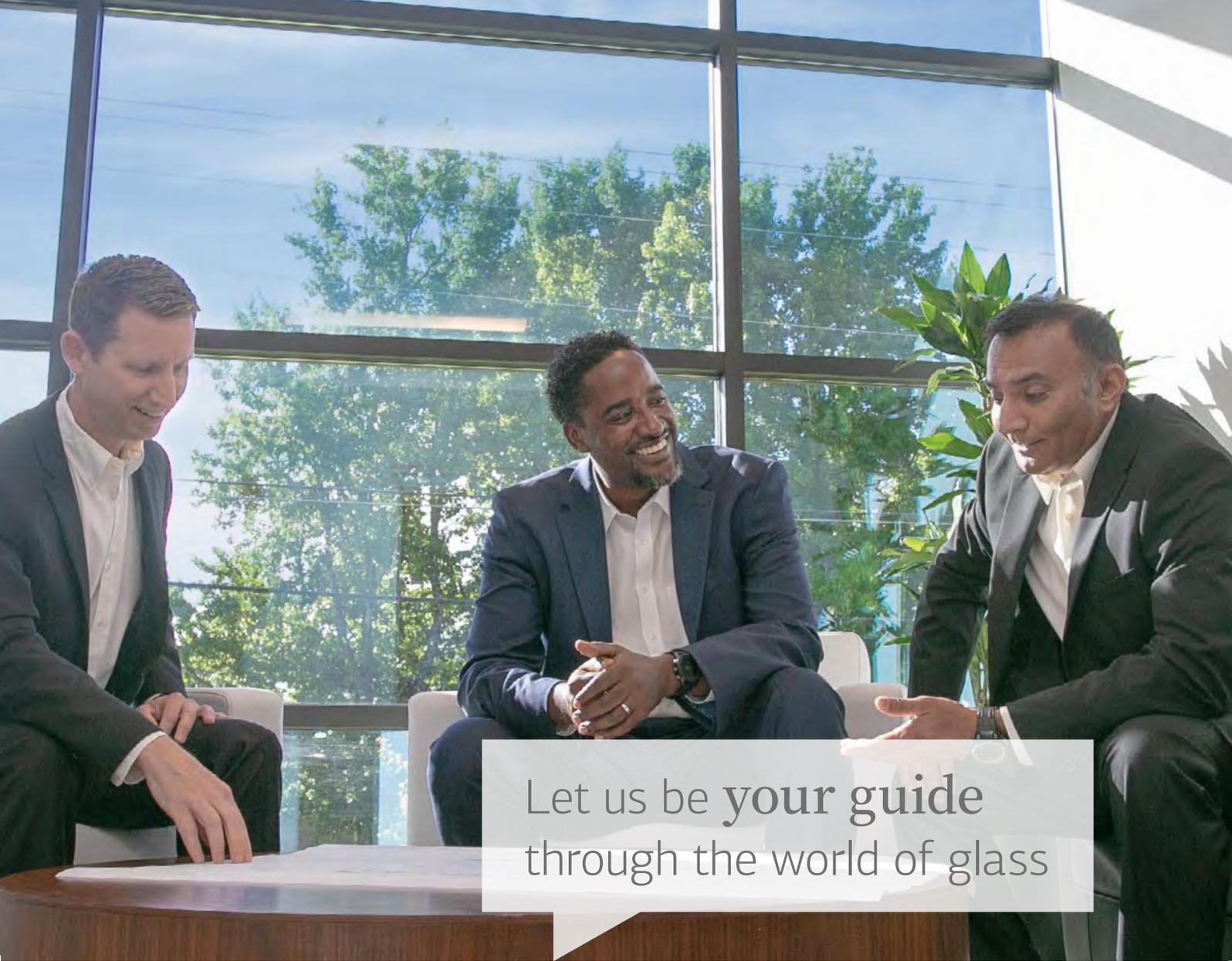
2,000th lehr for Antonini

Manufacturer of annealing and decorating lehrs Antonini Srl has made its 2,000th lehr, which will be delivered to one of its main customers, Cristalchile. Starting as a small company to supply to nearby glass factories, Antonini is now a leading producer of annealing and decorating lehrs for hollow glass. Lehr number 1,000 was reached in 2008 and by 2021 this figure had doubled, due to the firm’s flexibility, skilled workers, its quick and efficient service group and sales department, according to the company. Today, Antonini is led by Barbara Antonini and Francesca Antonini, the third generation of the family business.

www.antoninisrl.com



Italian manufacturer Antonini made its 2,000th lehr in 2021.



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Anne-Marie Aitchison.

DSF team leader promoted to purchasing manager

Long-term employee of DSF Refractories & Minerals Anne-Marie Aitchison has been appointed Purchasing Manager for the UK refractory producer.

Ms Aitchison joined DSF 25 years ago as Commercial Assistant and progressed in the sales team to her most recent post of Commercial Office Team Leader. She has a wealth of experience in international trade as well as a thorough understanding of DSF's business and markets. Ms Aitchison started her new role on 1 November 2021. www.dsf.co.uk



Nadine Ferber.

New business development manager for glass at Precitec Optronik

In October 2021 Nadine Ferber joined Precitec Optronik as the laser technology and optical metrology specialist's new business development manager for its glass measuring division.

Ms Ferber has a strong background in optical metrology and broad job experience in the glass industry. Prior to joining Precitec Optronik, she held a position of similar responsibility with a leading glass manufacturer.

As business development manager, Ms Ferber will be responsible for identifying new market trends, promoting Precitec Optronik's sensors and optical probes, and supporting the company's global sales team and customers.

"It's a great opportunity to work in an innovative, technology-leading company," said Ms Ferber. "I find glass one of the most fascinating materials. This unique combination of beneficial factors and the pleasant working ambience of a motivated and inspiring team convinced me in an instant to join Precitec Optronik."

www.precitec.com

HEGLA expands executive team



L-R: Dr Heinrich Ostendarp (CTO), Bernhard Hötger (CEO), Jochen H. Hesselbach (Managing Director) and Ingolf Ripberger (COO).

Appointing an additional managing director and authorised signatories, HEGLA Group has expanded and restructured its leadership team to support its

sustainable growth strategy.

On 1 December Ingolf Ripberger joined current Executive Board members Jochen Hesselbach, Bernhard Hötger and Dr. Heinrich Ostendarp to take on oversight responsibility for the Production, Technology, Supply Chain & Human Resources departments. Mr Ripberger joins HEGLA after 25 years working in a technical and commercial management role for the Saint-Gobain Group.

Mr Hötger, who has held various positions at HEGLA since 1984, is now CEO of the HEGLA Group. He will continue to be responsible for Sales and Marketing, and will supervise the operation of the international subsidiaries and sales agencies.

Dr. Ostendarp will focus on strategic and operational product development, as well as the integration and further development of the subsidiaries and the product areas of tempering furnaces for safety glass (HEGLA-TaiFin), laser applications (HEGLA boraident) and software and automation (HEGLA-HANIC).

Mr Hesselbach will remain a member of the Executive Board of the HEGLA Group but will focus more intensively on his role as CEO of the 100% parent LEWAG Holding AG and forge ahead with the strategic alignment and assessment of new shareholdings or subsidiaries and potential collaborative partnerships.

To adapt the structures of the HEGLA below Board level to the growth of the company, two further senior members of staff have been appointed as authorised signatories. Josef Kusserow (Head of Production) and Georg Dressler (Head of Strategic Purchasing) are now authorised to represent the HEGLA site in Beverungen, Germany.

www.hegla.de



Nancy Easterbrook.

HWI appoints recycling director to support environmental goals

Refractory products supplier HarbisonWalker International (HWI) has appointed

Nancy Easterbrook as Director of Recycled Materials to develop and commercialise the American company's offerings related to recycled refractory materials. Ms Easterbrook will lead HWI's Recycled Materials function, leveraging customer-driven solution initiatives and third-party partnerships to create operating recycling streams for material technologies.

Prior to joining HWI, Ms Easterbrook was Strategic Marketing Lead for the Water Division of Buckman Laboratories International, Inc.

"We are thrilled to welcome Nancy as a key member of our HWI Research and Development team. Her skills and proven track record as an innovator, visionary leader and growth expert are an ideal fit for creating our recycling platform," said Dr. Martha Collins, Chief Technology Officer, HarbisonWalker International. "Nancy and her new role reflect our commitment to drive improvement as an innovative and sustainable company while leading recycling solutions for our customers and the refractory industry."

Ms Easterbrook will be based in Pittsburgh, USA at HWI's Advanced Technology and Research Centre.

www.thinkhwi.com



Erika Ferrari.



Tiago Sörensen.



Christopher Tonk.

Implementing change at XPAR

Following a strategic review in 2019/2020 and the decision to utilise the market trends of digitalisation and carbon footprint reduction, XPAR Vision started a process of change to move from 'nice to have' to 'must-have'. In line with this strategy, the company's sales team is now focusing more on customers' forming process ▶



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performance than on products and in 2021 the sales team's capabilities were greatly extended; extra staff were hired in the USA, Latin America and also Europe. Bringing with them extensive experience in the world of container glass making, the new employees will help XPAR Vision to focus on forming process performance

Erika Ferrari joins XPAR Vision as Business Development Manager. This role will see her work to enhance customers' forming process improvement programmes and supporting their execution, with the aim of reducing forming process variation and improving production line performance. Ms Ferrari will focus on XPAR Vision's sensors and robotics, their technical state and utilisation, including customers' organisation around the technology and related services. Ms Ferrari is joined by Tiago Sørensen, Business Development Manager for Latin America, and Christopher Tonk, Business Development Manager for the USA, both of whom will share the same responsibilities in their respective locations.

Ms Ferrari previously worked as a sales executive for BDF Industries Spa, where she focused on sales of IS machines and related equipment, and furnace and melting equipment. For the last 15 years Mr Sørensen has worked in the international container glass industry as a consultant and project manager. Prior to his appointment at XPAR Vision, Mr Tonk spent 25 years at O-I, in roles of line production leader, plant superintendent and plant manager.

Alongside Erika Ferrari, Tiago Sørensen and Christopher Tonk, XPAR Vision's business development team also includes Paul Schreuders and Jeroen Vincent.

www.xparvision.com ●

Change of leadership at Croxsons

Glass packaging company Croxsons has made changes to its leadership structure as part of

its succession plans. Tim Croxson, formerly Chief Operations Officer, has been appointed CEO in place of his father, James Croxson, who steps aside to concentrate more on developing Croxsons' international concerns. James and Tim represent fourth and fifth generations of the Croxsons family, respectively, and the change of ownership follows a period of significant growth for the firm, which celebrates its 150th anniversary this year.

"As is the norm in a fast growing SME, I have done every role and have built a great team over the past 50 years, who have been a joy to direct and lead," said James Croxson, who turned 70 in 2021. "My main focuses going forward are international sales, continuing to build our international sales teams and giving the next generation some inevitable pearls of wisdom. And like Tim, I look forward to the next chapter in Croxsons' illustrious history."

"Moving into the CEO seat at Croxsons is really a natural progression for both James and I," responded Tim Croxson. "Our combined strengths and the team we have built around us have helped put the company into an incredibly strong position. Alongside the board, we've both worked hard to future-proof our offering and be clear on our purpose, thereby ensuring we continue to be relevant for the next 150 years."

www.croxsons.com ●



Ueli Utzinger.

Gerresheimer appoints communication & marketing expert

Ueli Utzinger has become Gerresheimer

AG's new Group Senior Director Communication & Marketing. He succeeds Jens Kürten, who is pursuing new opportunities after 12 years of marketing and communication work for the pharma packaging giant.

For the past 30 years Mr Utzinger has developed and implemented marketing and communication concepts for international industrial and pharmaceutical companies, as well as financial service providers.

"Ueli Utzinger has supported our strategy process every step of the way and actively shaped its development," enthused Dietmar Siemssen, Chief Executive Officer of Gerresheimer. "He has shown himself to be a dynamic high performer and a source of valuable input. He will ensure that our customers, partners, investors, stakeholders and employees can see and experience our transformation process through active and creative communication activities."

www.gerresheimer.com ●



Neil Syder.

New managing director for Pilkington UK

Neil Syder has been appointed Managing Director of Pilkington UK to lead the glass manufacturer as it adapts to an age of decarbonisation and targets new opportunities.

Mr Syder brings over 30 years' experience within the company to the post, most recently as head of operations. He began working at Pilkington in R&D in the 1980s, building extensive experience over four decades in specialist glass coatings, running production lines and operational planning.

Having served as Pilkington UK's Managing Director for more than a decade, Matt Buckley is taking retirement after spending 30 years with the business.

www.pilkington.com ●



Michel Giannuzzi.

Verallia's Michel Giannuzzi hands over CEO responsibility

Recognising the wishes of Michel Giannuzzi to see an evolution of his responsibilities within the Verallia Group after approximately five years as both Chairman and Chief Executive Officer, effective from

May 2022 Mr Giannuzzi will remain Chairman of the Board of Directors and Patrice Lucas will be appointed Chief Executive Officer.

Mr Lucas will join Verallia in February 2022 as Deputy Chief Executive Officer. As Chairman, Mr Giannuzzi will provide the Board and Mr Lucas with the benefit of his knowledge of strategic issues and his recognised experience in the industry, particularly in glass containers, as well as his experience in governance matters.

"These years as Chairman and CEO have been extremely exciting and intense," stated Mr Giannuzzi. "Verallia has an inspiring purpose, experienced teams and is very well positioned to continue its strategy of profitable growth, whilst accelerating its investments in sustainability. I look forward to continuing my commitment to the leadership of the Group and will confidently hand over the CEO responsibility to Patrice Lucas. With his strong industry and international experience, Patrice Lucas will unite and lead all Verallia teams to further success."

Mr Lucas joins Verallia after a 30-year career in the automotive sector, most recently as Deputy Chief Engineering Officer of the Stellantis Group.

www.verallia.com ● ▶



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People & posts (continued)



Vetropack appoints new chief supply chain officer

The Board of Directors of Vetropack Holding Ltd has appointed Stephen Rayment group-wide Chief Supply Chain Officer. Mr Rayment started his new role on 1 December 2021, also becoming a member of group

management. He succeeds Michela Argirò, who left the Group after a short period for personal reasons on 7 November 2021.

Over the last 20 years Mr Rayment has built and managed international supply chain organisations on behalf of multiple Novartis companies. For the last three years, he has been the Leader of Global Sales & Operations Planning (S&OP), for a leading Speciality Chemical company

headquartered in Switzerland.

Bringing extensive experience and strong knowledge across industries and supply chain functionalities to Vetropack, Mr Rayment's ability to design an optimal supply chain and simplify/standardise processes stands to benefit the glass packaging company.

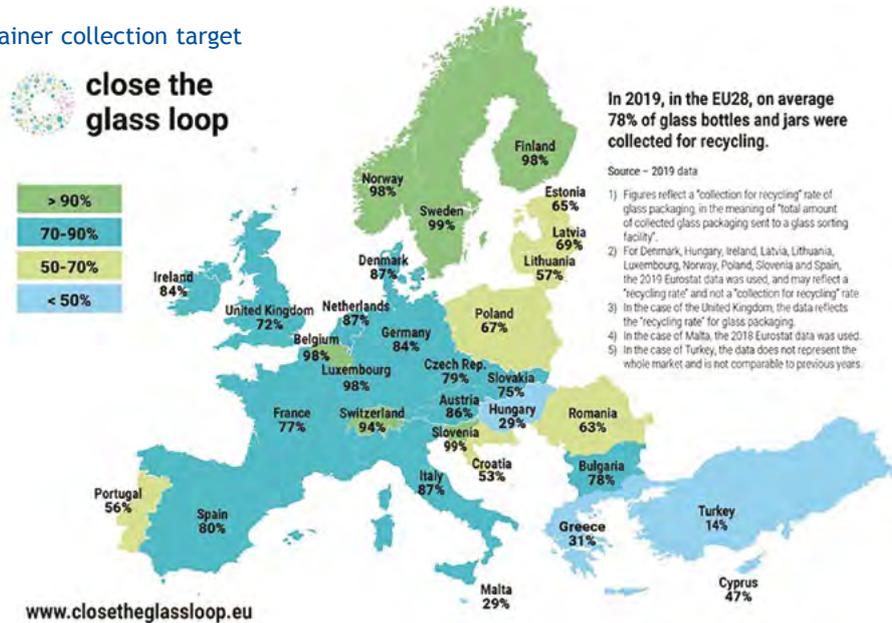
An Engineering & Manufacturing graduate from Southampton Technical College and Solent University, Mr Rayment is currently studying for a BSc (Hons) in Environmental Science with The Open University.

www.vetropack.com

Confidence boost for 2030 glass container collection target

Latest value chain data published by Close the Glass Loop shows that the EU28 average collection for recycling rate for glass packaging grew to 78% in 2019 – a growth of 2% compared to 2018. The multi-stakeholder stewardship partnership Close the Glass Loop aims to achieve a post-consumer glass container collection target of 90% by 2030, and to ensure that this is recycled into the container glass production loop.

“The record high glass collection for recycling rate of 78% shows that our ambitious Close the Glass Loop targets can be achieved with close cooperation between all players in the value chain, sharing best practices on innovative and tailored collection models, high quality sorting and recycling and communication campaigns for consumers,” said Joachim Quoden, Managing Director of EXPRA (Extended Producer Responsibility Alliance), on behalf of Close the



In 2019, in the EU28, on average 78% of glass bottles and jars were collected for recycling.

Source – 2019 data

- 1) Figures reflect a "collection for recycling" rate of glass packaging, in the meaning of "total amount of collected glass packaging sent to a glass sorting facility".
- 2) For Denmark, Hungary, Ireland, Latvia, Lithuania, Luxembourg, Norway, Poland, Slovenia and Spain, the 2019 Eurostat data was used, and may reflect a "recycling rate" and not a "collection for recycling" rate.
- 3) In the case of the United Kingdom, the data reflects the "recycling rate" for glass packaging.
- 4) In the case of Malta, the 2018 Eurostat data was used.
- 5) In the case of Turkey, the data does not represent the whole market and is not comparable to previous years.

Container glass collection for recycling in Europe.

Glass Loop partners.

“The more glass is selectively collected, the better its quality for more recycled glass that can be produced and incorporated in the production

of new glass packaging,” added Marine Ronquetti, Secretary General of FERVER (European Federation of Glass Recyclers), on behalf of Close the Glass Loop partners.

www.feve.org

Glass for Europe responds to recast Energy Efficiency Directive

In response to the public consultation on the recasting of the EU's Energy Efficiency Directive (EED), Glass for Europe has emphasised the need for drastic reductions in buildings' energy consumption to achieve a 55% CO₂ emissions cut by 2030.

As the trade association for Europe's flat glass sector, Glass for Europe supports the increased focus on building renovation in the EED recast and welcomes the proposal to extend the 3% renovation requirements to all public buildings. The association believes that high-tech glazing plays a crucial role in making buildings more energy

efficient, but flat glass technologies are also essential to the clean mobility transition and to renewable solar energy production. According to Glass for Europe, to deliver on Renovation Wave objectives, massive investment is required from the public sector for the renovation of public buildings to the highest performance standards.

The association considers that upgrading the ambition of the energy efficiency target and making it binding at EU level will be instrumental to reach the 55% emissions cut by 2030. To bring predictability to the industry and ensure accountability of Member

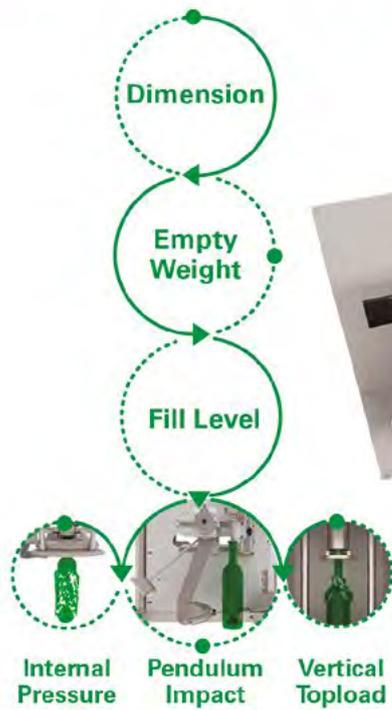


Renovation Wave objectives require public sector funds, according to Glass for Europe.

States, Glass for Europe believes that national energy efficiency targets should also be made mandatory.

www.glassforeurope.com

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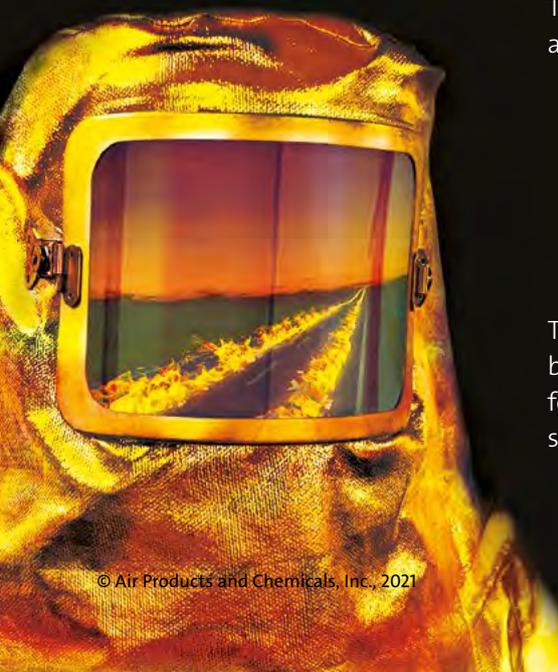
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AFGM Chairmanship switches to Indonesia



During a recent online plenary session, the ASEAN Federation of Glass Manufacturers (AFGM) announced that Harris Hendraka of the Indonesian Glass Manufacturers Association (IGMA) has been elected as Chairman for the next two years, succeeding Trans Quoc Thai from the Vietnam Glass Association (Vieglass). *Glass Worldwide*, exclusive official AFGM journal, reports on the handover.



Harris Hendraka of the IGMA has been elected Chairman of the AFGM for the next two years.



New AFGM Chairman Harris Hendraka with fellow IGMA committee members Henry T Susanto, Sanjaya Susanto (AFGM Secretary General) and Dr Johan Dharmawan.

Quoc Thai expressed his gratitude to the AFGM committee for its support during his term, and his honour on behalf of Vieglass in handing over the AFGM Chairmanship to IGMA. The AFGM committee in turn thanked Mr Thai and Mr Thang for their continuous efforts since 2018 and Mr Hendraka also acknowledged Henry Susanto, IGMA Chairman, for giving him the opportunity to become AFGM Chairman.

IGMA is a member of the AFGM, now in its 45th year as a regional industry association composed of glass manufacturers in South East Asia. Fellow member associations include the Glass Manufacturers Association of Malaysia (GMAM), Glass Manufacturers' Association of the Philippines (GMAPI), Glass Manufacturers Industry Club, The Federation of Thai Industries (GMFTI) and Vieglass.

Future plans

Originally scheduled for 2020 in Thailand with the GMFTI as hosts, the 44th ASEAN Glass Conference was postponed due to the global Covid-19 pandemic and the AFGM conveyed to *Glass Worldwide* that all possibilities of hosting the conference in 2022 are being evaluated. Plans will be clarified in spring 2022 with dates and further information to be announced in a future issue of *Glass Worldwide*. The ASEAN Glass Conference was last staged in Thailand in 2016 in Hua Hin and the most recent conference took place in 2019 in Cebu, the Philippines.

Harris Hendraka commented: "The AFGM is blessed to have a lot of supporters, one of the most important being *Glass Worldwide* as the official journal of the AFGM. It provides the AFGM with a platform to inform everyone in the glass industry about every year's event from the preparation phase until the post event, as well as the papers presented during the event. I am sure I speak for everyone in the AFGM that we are very grateful to have this partnership with *Glass Worldwide* throughout the years."

In the AFGM online library of articles on *Glass Worldwide's* website, over 60 articles previously published in the magazine are available for free download, including market reports covering Indonesia, Malaysia, Philippines, Thailand and Vietnam as well as exclusive interviews with leading players in the region such as Asahimas Flat Glass, Asia Brewery, Bangkok Glass, BJC, PT Culletprima Setia, The First National Glassware, Guardian, Kemasindo Ampuh, L Lighting Glass, Muliaglass, Myanmar Golden Eagle, O-I, PT Culletprima Setia, San Miguel, Siam Fiberglass, Siam Glass Industry, Thai Glass Industries and Thai Malaya Glass. ●

The AFGM's new Chairman Harris Hendraka is COO of Kemasindo Ampuh (trading with the brand name Kaema Glass), a key player in the Indonesian glass tableware business and was also the Organising Committee Chairman of the 37th ASEAN Glass Conference in Bali in 2013 and the 42nd ASEAN Glass

Conference in 2018 in Yogyakarta.

Sanjaya Susanto, Manager of the Safety Glass Division at Muliaglass, was announced as the successor to Nguyen Huy Thang as AFGM Secretary General. Muliaglass is a leading Indonesian glass manufacturer serving the float glass, glass block, glass container and automotive safety glass sectors.

Outgoing AFGM Chairman Trans



IGMA staged the 42nd ASEAN Glass Conference in Yogyakarta, Indonesia in 2018.

Further information:

web: www.aseanglass.org
www.glassworldwide.co.uk/afgm-articles



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www.hotwork.ag



On the Spot... Aston Fuller

At COP26 in Glasgow last November, Glass Futures exhibited glass products made with 90% less carbon, the result of a revolutionary trial funded by the UK's Department for Business, Energy and Industrial Strategy (BEIS) Energy Innovation Programme and led by Encirc in collaboration with Diageo and HEINEKEN. Speaking exclusively to preferred media partner *Glass Worldwide*, Glass Futures General Manager Aston Fuller reflected on the achievement of this collaborative climate action.

GW: How did Glass Futures' presence at COP26 come about?

Like many others who applied to exhibit at COP26 we hoped to present at this exhibition to showcase challenge and demonstrate the action we are taking to lower carbon emissions. Fifteen to twenty permanent exhibits were successfully selected from thousands of applications.

In collaboration with industry and a major customer-facing consumer, the proposition we put forward was a publicly funded trial that has never been done before and reduced the carbon content of a product by 90% [see *Glass Worldwide* November/December 2021 p.72 for an interview with Diageo about the partnership with Glass Futures and Encirc to create the most sustainable Scotch whisky bottles ever produced].

I believe our selection was a recognition of the urgent need to collaborate effectively to achieve climate goals being set and in my opinion our project exemplifies what a really positive collaboration can actually achieve... not just as a long term target but demonstrable in the here and now. We successfully conveyed a message of collaboration and that this is an industry that can work together with public and private sectors.



Getting the message across at COP26.



"The display was impactful because it showed action and physical things that have actually happened" – Aston Fuller.

GW: What was displayed on Glass Futures stand at COP26?

There was a simple concept of 'spot the difference' using four bottles: a Diageo Black & White Scotch whisky bottle and a Heineken bottle made using the typical manufacturing process, against two identical bottles that were manufactured using 90% lower carbon. We encouraged the public to examine the bottles and comment on any visible differences in the quality and appearance, with the point being that the consumer cannot notice a difference because these products are exactly the same. We demonstrated that we can change the industry and the way products are made without affecting how the consumer interacts with them in the marketplace.

We feel the display was impactful because it showed action and physical things that have actually happened and that's why we took the Diageo Black & White bottles and the Heineken bottles [see *Glass Worldwide* March/April 2021 p.6 for details on the biofuels trial] to show samples of innovations in the marketplace that were manufactured with significantly lower carbon than similar products.

GW: With UKRI (UK Research and Innovation) having already invested £15 million to support the development of Glass Futures' pilot R&D facility in St Helens, how did you partner with them during COP26?

As well as exhibiting with a podium demonstrating the collaboration between Glass Futures and Diageo, UKRI displayed a large LED glass façade designed by Sanmukh Bawa of The Glass Company working with G-Smatt that offered a visual presentation very prominently in the middle of the event. A key driving force in making it happen, Diageo sponsored the display which, after consultation with all our members, provided an opportunity for our key industrial partner members such as Siemens, Encirc, O-I, Guardian and NSG to collaboratively put out simple but excellently presented messages on a global stage; different glassmakers were able to have a common platform to talk about what they are doing for sustainability and demonstrate that the glass industry is working towards a common goal.

The screen is due to be sited at Johnnie Walker Princes Street in Edinburgh and is intended to travel



Glass Futures' COP26 stand challenged the public to 'spot the difference' between bottles made using a typical manufacturing process and those produced with 90% less carbon.

around the world as part of the International Year of Glass 2022 so that the same messages from COP26 are promoted to as wide an audience as possible. We welcome location suggestions and requests from *Glass Worldwide's* readers. The longer term plan is for the screen to then be displayed prominently at the innovation centre in St Helens.

GW: Is it fair to say that Glass Futures' presence at COP26 demonstrated that the glass sector is at the forefront of addressing sustainable manufacturing in comparison to other heavy industries?

There is mounting pressure from consumers for sustainable packaging, especially in the container glass sector. Glass Futures is working to revolutionise glass manufacture and the technologies we develop can be transferred across other industries. There are comparable activities going on in other industries currently but I get the impression we stand out because of our approach of getting the entire supply chain together and by working in collaboration we can demonstrate change quicker.

GW: How would you summarise what was achieved at COP26 and how will it benefit the Glass Futures cause?

Personal interaction was very beneficial. A breakfast meeting attended by key partners and supporters finally gave us the chance to sit down for discussions; we have been working so hard over the last couple of years to bring about this bold and ambitious project but the challenge has been that we haven't been able to meet people face to face.

At COP26 we were able remind everyone about the importance of glass, which is more often than not massively overlooked everywhere yet it is absolutely [a] foundation of civilisation and everywhere around us. At an event like that, we were able put glass as a material at the forefront of people's minds.

It was a real benefit to be able to communicate that what we are doing is unique and can help catalyse the changes that the world needs. There was a recognition at COP26 that Glass Futures is happening and is not a theoretical conversation; it's real and has received a huge amount of public

and private support. COP26 was a very good opportunity to get out and show it on the public stage where it deserves to be – not only to talk within our industry but to put it to people from all over the world. I also hope it will inspire other groups in other industries to start thinking with the same bold and ambitious mindset.

GW: How would you summarise the achievements of Glass Futures during your two years as General Manager?

It's been a very unusual and challenging time to bring together a team and a culture in the current working conditions... but we're reaching milestones already. To actually step back and evaluate what we have achieved in a short period of time with a new team is almost overwhelming; it's really humbling to see a group of people working so hard to achieve something that's never been done before. The complexity of the Global Centre of Excellence at St Helens [alone] is enough to keep a business busy for many years, but we've done that in parallel to building relationships and an

operational business with an accelerative growth path.

The contracts are signed for St Helens and by the end of 2021 we'd already carried out two hugely successful trials, with another set planned early in the new year to manufacture the lowest carbon float glass in the world.

This is only the beginning but COP26 was a very good opportunity to show the world our intent. ●

Further information:

email: info@glass-futures.org
web: www.glass-futures.org

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277th Master Glass Seller installation

Barbara Beadman was installed Master of the Worshipful Company of Glass Sellers of London at a well-attended Common Hall & Installation Dinner, staged at the Grocers' Hall in London on 7 December 2021.

glass
WORLDWIDE
Official
journal of the
Glass Sellers

The occasion attracted an impressive audience including liverymen from leading industry bodies such as British Glass and Glass Futures, glass manufacturers including Nazeing Glass Works and O-I, as well as glass artisans and a wide spectrum of industry personalities.

Outlining her plans for 2022, Barbara Beadman stated: "We have the first UN designated International Year of Glass occurring. It is our intention to influence the City in their approach to climate change, glass recycling and alternative ways to minimise the effect on the planet. Our industry is at the forefront of innovation in fuel, materials, production and research. COP26 saw Glass Futures CEO and Past Master Richard Katz flying the flag for us all."

Other appointments included Maria Chanmugam (Chair of the Glass Committee) as Prime Warden, David Wilkinson as Renter Warden, James Armitage as Master's Assistant, *Glass Worldwide's* Dave Fordham as Assistant to the Court and Mark Holford as Lay Assistant to the Court. Mr Holford has also taken over as the Glass Sellers representative on the Glass Futures' Membership Council following the previous five years' representation by Ms Chanmugam.

Ms Beadman, a member of the British Glass board, detailed a multitude of activities supported by the Glass Sellers in the different glass sectors, including the work of the Company's own charity which has supported over 15,000 schools. "We are talking to the glass industry to enable them to give greater support to their local schools... We are about to engage in the largest national project that will study glass in primary schools," she enthused.

Barbara Beadman is the third female Master of the Glass Sellers, which received its Charter in 1664. Initially founded to regulate the Glass Selling and Pot-Making industries within the City of London, the role of the livery company today is to maintain cordial relationships within the Company, the City and the wider glass industry; to stimulate interest in glass in all its aspects; carry out charitable works, with special emphasis on education; maintain the Company's traditions, values and customs; provide pastoral care for members in distress and support the Lord Mayor & the Corporation of the City of London. ●

Further information:

The Worshipful Company of Glass Sellers of London
email: info@glass-sellers.co.uk
web: www.glass-sellers.co.uk



Barbara Beadman (centre) was installed as Master, with Maria Chanmugam as Prime Warden and David Wilkinson as Renter Warden.



Left to right: Richard Katz (Glass Futures CEO), Matthew Demmon (British Glass President) and Dave Fordham (Glass Worldwide Publisher).



Members of the *Glass Worldwide* team were present at the Common Hall & Installation Dinner with their partners.

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1	111208	101.978	10.790	8.102	25.613	10.964	23.086	33.227	21.821		
1	111208	101.980	10.791	8.103	25.614	10.965	23.087	33.228	21.822		
1	111208	101.979	10.790	8.102	25.613	10.964	23.086	33.227	21.821		
1	111208	101.981	10.792	8.103	25.614	10.965	23.087	33.228	21.822		
1	111208	101.979	10.790	8.102	25.613	10.964	23.086	33.227	21.821		
1	111208	101.980	10.791	8.103	25.614	10.965	23.087	33.228	21.822		
1	111208	101.978	10.790	8.102	25.613	10.964	23.086	33.227	21.821		
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International manufacturer of moulded and tubular glass Gerresheimer offers an extensive product range for pharmaceutical and cosmetic packaging and drug delivery devices. In an exclusive *Glass Worldwide* interview, Gerry Wilkins, Senior Director for Sales & Marketing in USA and Canada, discusses the company's strategy for staying current and meeting customers' glass needs.

A globally integrated company with production sites and locations in 15 countries spread across three continents, Gerresheimer has developed a far-reaching international network with numerous innovation and production centres in Europe, America and Asia, utilising its reach and expertise to support customers across the world. The company is one of the leading suppliers for primary pharmaceutical vials/containers and cosmetics and healthcare packaging in the USA glass sector. Gerresheimer currently employs around 1,600 people in America, where it has facilities in Georgia, Illinois, Ohio, New Jersey and North Carolina.

Vital part of the vaccine effort

Over the last 18 months that the world has been battling waves of the Covid-19 coronavirus, Gerresheimer has focused heavily on its products for the pharmaceutical packaging sector and continues to make substantial investments in capacity to support increased vial needs for delivering vaccines.

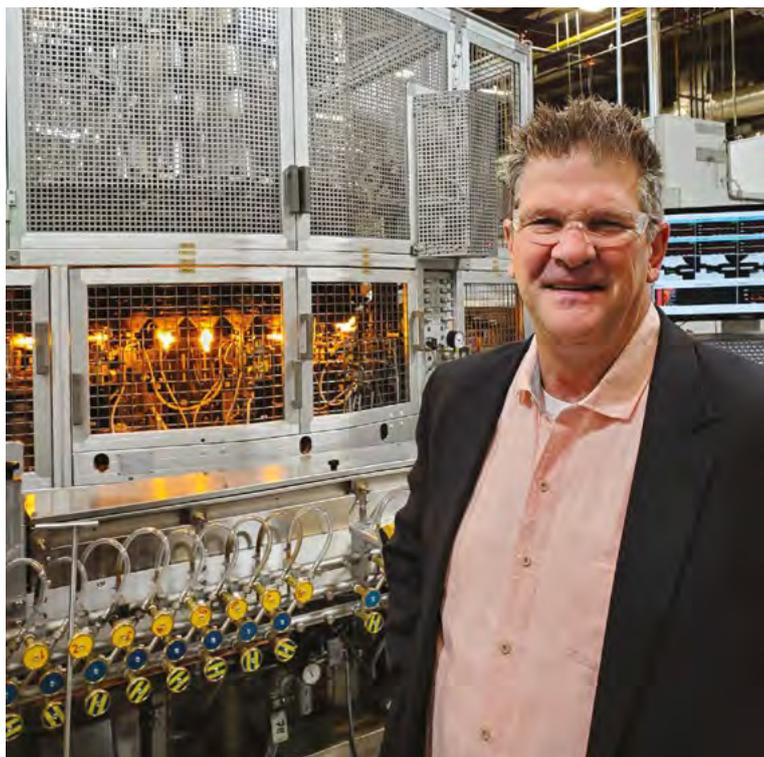
"Gerresheimer is one of the largest suppliers of pharmaceutical packaging globally as well as in America and we have taken a strong commitment to support the pandemic cause by working closely with our filling partners to ensure supply and increasing our investments in both capacity and technology," explains Gerry Wilkins, Gerresheimer's Senior Director of Sales & Marketing for USA & Canada. "We are a leading supplier of the primary containers for the Covid vaccine in America, along with other life-saving drugs."

Supporting the healthcare industry

To enhance the quality and performance of its offerings to the healthcare industry, Gerresheimer is investing at every site in America, not only for primary [glass] containers but also in pharmaceutical plastic packaging and medical devices. Funding is allocated to strategic expansions as well as for developing new technology platforms and providing technical and laboratory support to customers. Recently, Gerresheimer has significantly increased capacity in ready-to-fill (RTF), vials, syringes and specialty vials at its American plants.

"We have multiple plants that can produce a complete product portfolio in order to service the pharmaceutical industry (e.g. vials, cartridges, syringes, ampoules, RTF, drug delivery devices, diagnostic, specialty products...)," says Mr Wilkins.

"With the continued increase in biological products, we have developed a team to focus on this growing sector to ensure we are providing the technology and know-how to support this sector," he continues. "Our Biological Solutions

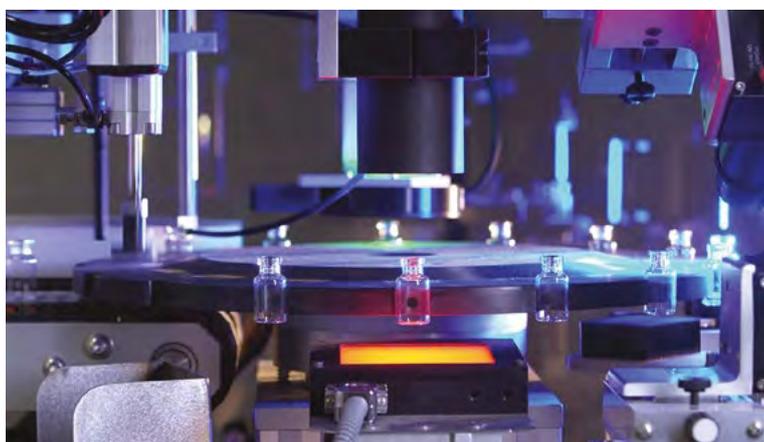


Gerry Wilkins is Gerresheimer's Senior Director for Sales & Marketing in USA and Canada.

team continues to experience high demand for this market sector.

"We are expanding our technical support as well as our laboratory services area in our Centre of

Excellence in New Jersey," reveals Mr Wilkins. "We continue to focus on several digitisation projects to further enhance process control and driving quality to new levels." ▶



Dental and pharmaceutical cartridges, including insulin pen cartridges, are produced by Gerresheimer in Vineland, New Jersey.



Gx Glass Innovation and Technology Centre

In 2019 Gerresheimer opened its Gx Glass Innovation and Technology Centre in Vineland, New Jersey to drive innovation in pharmaceutical glass, primary packaging glass products, technologies and digitised processes. The facility continues to support the development of new and innovative products and processes as well as providing laboratory testing capabilities. "It also allows us to interact with our customers with our state-of-the-art technology and develop solutions around the challenges," adds Mr Wilkins.

Along with the benefits of interactive collaboration, the centre enables Gerresheimer to dig deep into quality control by supporting CAPA [Corrective Action, Preventive Action] processes through critical appraisal of internal and external complaints. It has also helped the company to refine its offline inspection systems: to develop improved inspection methods and to perform analysis on customer-specific requirements or problems.

At the time of writing, Gerresheimer is "in the process of purchasing and installing lab equipment required to perform testing and characterisation," reports Mr Wilkins. "Ninety percent of the equipment has been purchased and installed. Utilisation of the lab services [will] support factories and customers in resolving complaints or product concerns."

Investments and future plans

At the American plants Gerresheimer places significant importance on its role in sustaining the environment, according to Mr Wilkins. Actions to improve the sustainability footprint of the plants include "reduction in electrical consumption, improved water utilisation and reduction in oil consumption."

The popularity of Gerresheimer's RTF vials has fuelled investment in this product range to boost quality and turnover. "We continue to see strong demand for our Elite ready-to-fill product in vials, which offer additional strength and increased line speed on customers' filling lines," says Mr Wilkins. "We will continue to invest in the RTF platform. We continue to experience increase demand in providing a solution approach towards the customer's product life cycle."

Investments have also been made in the development of forming



CEO Dietmar Siemssen (centre), CFO Dr. Bernd Metzner (right) and Gary Waller (left), President of Gerresheimer Glass Inc., opening the Gx Glass Innovation and Technology Centre in 2019.

processes and inspection to improve automation and process repeatability.

"We are excited about continued expansion in the cosmetic sector," notes Mr Wilkins. "Investments are being made to offer complete solutions made of glass/plastic/caps/seals/droppers and decoration to support our global partners.

"We coordinate efforts across business units and work together with customers to provide the best solution."

The company is currently engaged in collaborative projects with healthcare and pharma partners to define products for the future – "for example, wearable

devices with a digital platform; bio solution application and disease management focus," reveals Mr Wilkins.

Plans for Gerresheimer's American business going into 2022 reflect the confidence of a glass manufacturer with a healthy customer base and the resources and expertise to continue to expand its business. "We have adhered to a strong growth plan since 2019, targeting double digit increases across America business units," confirms Mr Wilkins. ●

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Vial production at the Forest Grove Plant in Vineland.

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On the Spot... Rick Zoulek

Operating since 1996, Guardian Glass' float glass plant in DeWitt, North America received Energy Star certification from the US Environmental Protection Agency (EPA) last year. Rick Zoulek, Executive Vice President of Guardian Glass Americas, spoke exclusively to *Glass Worldwide* to explain how a major capital project to expand glass production and add the latest environmental control technologies contributed to the company's enviable energy rating.

GW: What activities are undertaken at the Guardian plant in DeWitt?

The Guardian Glass float glass plant in DeWitt, Iowa produces float glass and coated glass for commercial and residential construction, as well as mirror glass and oven door glass.

GW: How does the plant fit within Guardian's American glassmaking activities and what is its market focus?

Guardian DeWitt, one of six float glass plants in North America, is strategically located for a number of customers in the central US seeking Guardian SunGuard coated glass for commercial and Guardian ClimaGuard coated glass for residential construction, as well as our Guardian HB+ coated glass for oven doors.

As with the other US float plants, about 75% of DeWitt's production stays within its region, however, the plant also supports the other plants as product demand requires. The plant ships from Western Canada to the Eastern United States.

GW: What are the prevailing market conditions for architectural glass in your region?

While residential glass demand has flattened, we still see coated glass opportunities with our residential customers within their product offerings. Commercial opportunities remain strong.

GW: What did it mean to the plant to earn the US Environmental Protection Agency's (EPA) Energy Star certification?

In March 2021, Guardian DeWitt earned the US Environmental Protection Agency's (EPA) ENERGY STAR certification, which signifies that the plant performs in the top 25% of similar facilities nationwide for energy efficiency and meets strict energy efficiency performance levels set by the EPA. Our Energy Star certification



The Guardian Glass float glass plant in DeWitt, Iowa, USA.

is a source of pride within the plant that extends into the community. We're proud that as part of Koch Industries' Stewardship Framework, our efforts at DeWitt bring value to our neighbours.

GW: What were the highlights of the major capital project in 2017 and the determining factors for Guardian's investment at that time?

The complete furnace rebuild included installation of emissions control equipment and additional improvements ▶



The DeWitt team is proud to have launched the Guardian SunGuard triple silver, or SNX, coated glass product collection in the US and continues to produce SunGuard SNX coated glass. The Forsyth County Central Library features both Guardian SunGuard SNX 51/23 coated glass and 62/27 coated glass. Photo credit: photographie: fourseven



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that contributed to our ENERGY STAR certification.

As is standard in float glass plants, the furnace at Guardian DeWitt had been operating non-stop since the plant started up in 1996. This was standard maintenance that allowed us to capitalise on the downtime to make some additional improvements.

DeWitt's Energy Star certification on the heels of the furnace rebuild are great successes that have positioned the plant to make great strides, including successfully implementing the digital investments and pilot programmes in place. We're excited about our team members' opportunities to take on more ownership and building new skillsets.

GW: What are the highlights of recent investments since 2017?

We've made a number of improvements that together help us continue to be a preferred partner to our customers by supporting their evolving demands with better efficiencies and improved quality. Some examples include:

- New inspection system on vacuum coater line
- Upgraded HVAC system throughout the plant
- Improved lighting throughout the plant
- New power factor monitor to clean energy coming into the plant

GW: How do you partner with technology suppliers to assist with investments?

The new power factor monitor is a good example of partnering with technology suppliers, and we're constantly looking for opportunities to do more of this. When we're able to identify partnerships to create programmes for one plant like DeWitt, we look to scale and apply that technology across our plants around the globe to maximise the benefits for Guardian and our partners.

GW: Are any other major investments planned at the site during 2022 or in the foreseeable future?

We will increase our ability to service our customers by replacing a cutting line that will include adding an inventory yard.

GW: What strategy is the plant adopting for increased digitalisation?

Guardian Glass has many global, scalable pilot programmes in different stages of development testing across multiple plants. The DeWitt team is leading asset management programmes that include:

- Remote monitoring utilising vibration sensors
- Expanded operator ownership of equipment maintenance and operation
- A new enterprise asset management software system

GW: How many people are employed at the DeWitt site and how important is investing in the workforce to achieve the plant's goals?

As of November 2021, Guardian DeWitt employs approximately 230 people. Like all major employers, Guardian is fighting labour challenges at every level during the pandemic. DeWitt in particular has done a great job of transforming by improving the culture to create an environment that encourages self-actualisation, a component of our Market-Based Management framework that encourages employees to be lifelong learners, develop aptitudes into skills that create value and help them realise their potential, which is essential for fulfilment. As you become increasingly self-actualised, you will better deal with reality, face the unknown, creatively solve problems and help others succeed. The team has successfully reduced employee turnover and improved productivity.

GW: Are you particularly pleased with any recent product launches?

The DeWitt team is proud to have launched the Guardian SunGuard triple silver, or SNX, coated glass product collection in the US and continues to produce SunGuard SNX coated glass along with several other high performance architectural coatings and interior mirror glass. Most recently, the plant started producing Guardian HB+, the company's coated glass product for consumer oven doors.

GW: What are your hopes and expectations for the DeWitt plant in the short, medium and long-term?

It's our intention to continue to transform how each of us work day-to-day. Today's digital investment and improved equipment will help individuals evolve their responsibilities from manual tasks to digitally monitoring and managing with expanded decision rights.

One of the most important benefits, even more so than helping our employees grow, is removing them from potential hazards. The safety of our employees is our top priority. Allowing equipment to do the work and our people to contribute at a higher level and develop new skills means we have a safer environment and greater employee fulfilment, which helps us in our goal to be a preferred employer by creating greater value in our production and therefore for our customers.

GW: What are the main challenges and opportunities you face in DeWitt?

DeWitt, Guardian Glass and the US glass industry is not alone in fighting inflationary pressure in a tough labour market and looking for ways to manage supply chain disruption. DeWitt and every Guardian plant is doing a terrific job of identifying and addressing inefficiencies and leveraging knowledge, but we must continue to accelerate transformation.

We're proud of our achievements at DeWitt, and we're inspired and motivated by the work of our colleagues at Guardian Glass and throughout the Koch Industries family of companies. We look forward to future opportunities to transform and to create new virtuous cycles of mutual benefit for our customers. ●

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2021 North American year in review

Last year brought a number of new opportunities and developments to the North American glass container manufacturing industry, with the Glass Packaging Institute (GPI) and its member companies redoubling their focus to promote the benefits of glass to policymakers, stakeholders, communities and businesses, explains GPI President Scott DeFife.



Scott DeFife, GPI President.

event, covering everything from current supply chain scenarios, achievements in glass recycling programmes, glass container statistics, as well as current marketing and communications programmes and initiatives. We are planning our in-person meeting for spring 2022, scheduled to be held in Washington, DC.

Domestic shipment numbers

Shipment categories in 2021 (through the third quarter) spotlight a few changes from 2020, with more on-premise establishments that serve alcoholic beverages re-opening, alongside changes to grocery store shopping by consumers.

Shipment and production data collected and aggregated by Precision Consulting show US glass container industry shipments trending slightly down for the year (~2–3%). While shipments of glass jars for food is down 4% year to date (YTD), the spirits category is up just over 3%. Flavoured alcoholic beverages continued its strong growth from 2020, up nearly 19% through the third quarter of the year.

Beer continues to be the largest market segment, representing 46% of the glass container industry's shipment



GPI has taken the 'next step' towards achieving 50% nationwide glass recycling.

A highlight of 2021 – and a return to normal for the Glass Packaging Institute – was our first in-person Annual Meeting since the pandemic began. The two-day event was held in Atlanta, Georgia in October. We were pleased to host over 50 GPI members, representing 19 glass container manufacturing and supply chain companies at the meeting.

Attendees enjoyed the ability to connect in-person, network and meet representatives from several new member companies. Numerous presentations were given during the

volume. The food category again accounted for 23% of the industry's volume, followed by non-alcoholic beverages (10%), wine (9%) with spirits and flavoured alcoholic beverages at 6% each.

Imports and supply chain disruption

GPI spotted a number of trends in 2021 with respect to imports of empty, unfilled, glass containers.

While a 25% tariff remained in effect in 2021 on Chinese glass container imports, for the first time in nearly two years, imports of Chinese glass containers for all food and beverages rose nearly 7% YTD (through September). Interestingly, imports of Chinese glass bottles in the 750ml sized category (key for wine and spirits customers) decreased by roughly 25% in that same timeframe.

Outside of China, Mexico recorded the largest number of 750ml bottle imports through September, up 14% YTD or about 68 million bottles. This increase tied into the overall imports of 750ml bottles, with all countries combined shipping in more than 158 million bottles, an increase of 13% YTD. All countries' glass container imports (of all sizes) increased nearly 12% through September of this year, highlighting US consumers' continuing demand for food and beverages packaged in glass.

This growth, and the demand for glass containers, have run into localised supply chain challenges over the past year. Delayed unloading of vessels at the ports, alongside connected intermodal and truck deliveries led to some rather exaggerated media reports of a 'glass bottle' shortage in North America. GPI countered that narrative in several national publications, the *Wall Street Journal* among them, to more accurately describe the challenges being



Winning entries at the Clear Choice Awards 2021 included Anchor Glass Container Corp., Ardagh Glass Packaging-North America, O-I Glass and Saverglass.



experienced by smaller producers as being tied to their specific supply chain agreements. Often, they were unaware that their bottles were not being made in North America and were instead coming in through the ports, adding to their challenges.

Return of GPI's Clear Choice Awards

The association was delighted to have the Clear Choice Awards (CCA) programme return in 2021 (see *Glass Worldwide* November/December 2021 pp151-152). Coming off a pandemic-delayed hiatus, over three dozen entries from roughly two dozen brands took part in this prestigious event, which for over 20 years has recognised excellence in packaging in the primary food and beverage categories.

Among the winners, a highlight from 2021 was a new Innovation category to provide recognition to other aspects of bottle production than bottle design. The winner of that category was Horse Soldier Bourbon Whiskey from the American Freedom Distillery company which recognised the bravery of US soldiers

in Afghanistan in the days following 9/11. Anchor Glass Container's innovative use of steel reclaimed from the World Trade Centre buildings was incorporated into the mould design for the bottle and was indicative of the goal of the category.

Given the tremendous response and participation, GPI plans to continue the programme and contest in 2022. To view pictures and descriptions of all the winning entries, please visit: www.gpi.org/2021-clear-choice-awards

Other association activity in 2021

GPI and its members took the 'next step' towards achieving its 50% nationwide glass recycling goal, acting upon recommendations included in the association-commissioned 'A Circular Future for Glass' report.

In 2021, the association partnered with the Glass Recycling Foundation (GRF), member companies, brands, and local businesses to launch 'Don't Trash Glass', a dedicated glass recycling programme. The initial results from the two inaugural cities (Phoenix, Arizona and Chicago, Illinois), demonstrated an increase in measurable, quality recycled glass, along with a number of bars, restaurants and similar establishments wanting to participate. These programmes will continue into 2022.

Aims for 2022

With the passage and approval of two landmark Extended Producer Responsibility (EPR) bills in 2020 (in the US states of Oregon and Maine), GPI will continue its work with policymakers, their staff and other stakeholders to ensure that glass is fairly treated and positioned as the regulations

are put in place. Many brands and consumers already understand the circular nature of glass, recycled content and recyclability, alongside its established domestic end markets. We will look to further strengthen our standing in these, and other policy proposals, that will be considered in 2022. ●



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The glass industry in the USA

Trade tariffs, continued consolidation, the rollout of enhanced technologies and recycling efforts all were elements of the glass industry in the United States of America in 2021. Richard McDonough reports on industry activities in one of the most important glass markets globally.

Change is one of the constants in the American economy, and the glass industry is no exception. Among the changes that have occurred at some of the largest businesses active in the glass industry include acquisitions and the rollout of enhanced technologies.

In early 2021, Anheuser-Busch (A-B) announced an agreement to sell its Houston-based Longhorn Glass manufacturing facility to Ardagh Group. According to A-B, the Longhorn facility supplies bottles to A-B's Houston brewery.

"As we consistently work to structure our organisation and network for long-term success, we are excited to further strengthen our longstanding partnership with Ardagh by transitioning our Longhorn facility," said Dave Taylor, US Chief Supply Officer at Anheuser-Busch, in a news release dated 29 January 2021. "It was important for us to find a partner with a clear vision for this facility and its workforce. That, coupled with Ardagh's expertise in the glass manufacturing space, makes them the perfect collaborator on this agreement."

"This agreement with Anheuser-Busch further strengthens the longstanding and highly collaborative relationship between our companies, across both glass and metal packaging," stated Paul Coulson, Chairman and Chief Executive Officer of Ardagh Group. "Ardagh is committed to the long-term future of Longhorn and looks forward to welcoming Anheuser-Busch employees in Houston to the Ardagh team to continue to serve demand for sustainable glass packaging."

The sale of Piramal Glass Ltd, a major glass packaging company with operations in the USA as well as in India and Sri Lanka, to the Blackstone Group for US \$1 billion was finalised on 31 March 2021. The firm has now been rebranded as 'PGP Glass.'

In a news release dated 28 September 2021, O-I Glass, Inc. announced an investor presentation to highlight "its business plan to accelerate the company's



A solar array nearing completion at the NSG Group facility in Rossford, Ohio. The 1.4MW solar array installation, using NSG Group's solar energy glass products, is being constructed by AEP OnSite Partners, an affiliate of American Electric Power. According to the NSG Group, the solar array will supply about 2.5 million kWh of renewable energy annually. Photograph courtesy of NSG Group, 20 October 2021.

transformation and increase value for all stakeholders."

In particular, O-I Glass detailed that its "MAGMA (Modular Advanced Glass Manufacturing Asset) reimagines the glassmaking process. A flexible, modular, standardised glass production line will enable rapid mobile capacity expansion in smaller increments. This transformation uniquely positions us to help customer brands better capitalise on market opportunities, opening up a new world of possibilities."

According to a statement from O-I Glass, the firm has both a prototype and pilot programme operating with this technology. The firm indicated that it expected to have "... scaled commercial viability by 2023."

"To meet the packaging market's evolving needs, we will continue to transform the company, and with our MAGMA solution, O-I will redefine the glass production process for decades to come," said Andres Lopez, Chief Executive Officer of O-I Glass. "MAGMA will further enhance our capabilities to support many of these categories and expand in the highly differentiated product segments, which are aligned to changing consumer

preferences. MAGMA also is more flexible and scalable and further improves glass' position as the most sustainable packaging material available. With MAGMA, we can quickly add capacity in smaller increments, closer to our customers, and at lower capital intensity. This new capability will increase O-I's right to win in the more differentiated markets. It will enable the company to grow in existing markets and enter new markets with greater flexibility. We are ready to deploy MAGMA, achieve the full potential of glass, and enable profitable growth."

Labor in the glass industry

"The United Steelworkers (USW) represents about 25,000 members in all segments of the glass industry in the USA, including glass container, architectural glass, automotive glass, specialty glass, scientific glass, pharmaceutical glass, glass fibre, optical glass fibre, consumer ware, tableware and light covers," stated Rob Witherell, Co-ordinator of the Glass Industry Conference for the United Steelworkers.

He indicated that almost 11,000 USW members work for glass container companies (O-I, Ardagh Glass, Anchor Glass Container, Gallo Glass, and others), 2,500 work for architectural and automotive glass businesses (NSG Pilkington, Fuyao, and Asahi), 3,700 work for specialty glass companies (Corning, Gerresheimer and Nipro), 3,600 work for glass fibre firms (O-I, Johns Manville, Knauff, and CertainTeed) and 3,000 USW members work for companies manufacturing tableware, bakeware and consumer ware (Libbey, Corelle and Oneida).

"The USW continues to advocate for our members and the work they do in the glass industry, including a tour of infrastructure events backing the passage of billions of ▶



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dollars of investments in related glass sectors: fibre optic cable used in broadband expansion, float glass used for solar panels, glass fibre and float glass for windows to improve energy efficiency, light cover glass for roads and highways, and more,” stated Mr Witherell.

Tariffs

“In 2019, we also supported an International Trade Commission petition by USA glass container companies (including Ardagh and Anchor Glass),” said Mr Witherell, “for relief on unfair imports, resulting on tariffs being applied.”

“The Chinese tariffs on empty glass bottles and jars remained at 25% in 2021,” explained Scott DeFife, President of the Glass Packaging Institute (GPI). “Whilst overall shipments of Chinese glass container imports are up about 6% year-to-date (the first increase in over two years, that began a few months ago), the 750ml-sized category remains down for the year, by about 4%.

“Of note, this is the primary category to package wine and spirits products, and where we have also seen anecdotal reports of ‘glass container shortages,” Mr DeFife continued. “What we have found in researching claims of glass shortages is the vast majority of customers are not using North American made bottles, and are instead reliant on larger, distribution import companies to supply their packaging. These customers often do not know that their bottles for fill are being made outside of the country, and are on vessels waiting to be unloaded and distributed from the overcrowded ports of entry. GPI member companies are actively working with brands and other end markets to supply their container needs when these, and other supply issues arise.”

“The tariffs on glass container imports have slowed the growth of imports from China, now making Mexico the number one source of glass container imports,” stated Mr Witherell.

Architectural glass

Guardian Glass and NSG Group are among the largest architectural glass businesses globally. Guardian is headquartered in the USA and NSG Group has large operations in the country.

“Our architectural business in the USA focuses on both the domestic and international markets,” stated Stephen Weidner, Head of Architectural Glass North America at NSG Group. He is responsible for the company’s North American architectural business as well as global solar activities. “NSG Group, operating under the Pilkington brand, manufactures and markets glass and glazing products for the architectural,

automotive and specialty flat glass markets with an increased focus on value-added products and services.”

Results for operations of NSG Group in the USA are included in the results overall for the Americas; this region includes both North and South America. The firm released its Fiscal Year Quarter 2 results in early November of 2021.

Among the details reported was that the architectural sector in the Americas represents 28% of NSG Group’s architectural sales with, “revenues and profits [...] ahead of the previous year. Volumes rebounded from the previous year although they were constrained to some extent by low levels of inventory due to a planned cold repair, and also shortages of transportation capacity. Sales of glass for solar energy continued to be positive.”

As for the automotive sector, the Americas represents 35% of NSG Group’s automotive sales overall with “cumulative revenues and profits also increased strongly from the previous year. The positive impact of removing Covid-19 restrictions was partly offset by the impact on vehicle production of computer-chip component shortages.”

Sustainability

“The glass manufacturing process itself produces very little waste material,” stated Mr Weidner of NSG Group. “All trimmed glass (cullet) from the manufacturing process is reused as one of the raw materials in the melting process. Other glass not used in processing for automotive or architectural glazing is provided to external glass recycling partners to be used for other purposes. It is also important to note the remelting of glass cullet significantly helps to reduce energy consumption and related CO₂ emissions.”

“Sustainability is one of the most important topics not only regionally but around the world,” Mr Weidner continued. “The NSG Group is fully committed to maximising the reuse, recycling or recovery of resources and minimising the production of waste involved in glass manufacturing, processing, packaging and delivery.”

A variety of glass products are collected and processed for recycling in the Kansas City Metropolitan Area and the Midwest of the USA through Ripple Glass.

“After the glass is collected through our collection programme in Kansas City and from the surrounding

states we work with, the glass is brought to our processing facility in Kansas City where it is processed into furnace-ready cullet and bottle cullet,” stated Lydia Gibson, Director of Sourcing at Ripple Glass. “Most of the glass products we receive are food and beverage containers, but we also receive post-industrial plate glass. After the cullet is processed, it is sent to a glass fibre insulation manufacturer and a bottle manufacturer.”

These recycling efforts in the Midwest operate through a metro-wide collection network established by Ripple Glass to obtain glass from residents in Kansas City and nearby communities: “We set out over 100 purple bins in convenient locations like grocery store or liquor store parking lots,” stated Ms Gibson. “There, residents can drop off glass recycling for free. This source separation of containers keeps the glass clean and free of contaminants. This collection network has expanded to other cities around the Midwest.”

She explained that Ripple Glass also collects glass products directly. “In the Kansas City Metro, we have implemented a business recycling programme that recycles glass from bars, restaurants, multi-family homes/ apartments and other businesses. For a fee, we pick up glass from these businesses. We also provide an outlet for manufacturers of glass products to recycle their post-industrial waste.”

These efforts have borne fruit during the past decade: “Specific to Ripple Glass – we took the glass recycling rate in the Kansas City Metro from 3% in 2009 to 20% in 2019,” stated Ms Gibson. “We have recycled over 200,000 tonnes of glass since 2009.” She indicated that continued growth for the recycling company is projected for 2022 and beyond.

Ms Gibson explained that glass recycling has been problematic in many areas of the USA.

“We believe there are issues with glass collection and recycling across the country, primarily stemming from co-mingled collection,” Ms Gibson explained. “We observe a lack of transparency in the recovery of glass post collection. Therefore, receiving glass that is clean enough to process for end-users and markets is a persistent problem. We have approached this with transparency and source separated collection through drop-off collection.”

Among the best practices noted by Ripple Glass to encourage ▶



Glass in production at the float line of NSG Group in Ottawa, Illinois. Photograph courtesy of NSG Group, 2 May 2018.



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consumers to recycle glass products include “clear messaging and convenient access... Allowing recyclers to understand why glass is not collected kerbside with other materials and why it’s important to recycle glass... Transparency around the process and end-users also encourages and increases confidence in recycling.”

One of the selling points noted by Ripple Glass to businesses considering participation in recycling is that “glass is heavy... When they recycle glass, they are creating less waste in their trash stream, which can in turn reduce their trash bills.”

Nationally, cullet is one of the most sought-after products, especially for businesses in such industries as glass fibre.

A total of 4.1 billion pounds [1.9 billion kg] of recycled glass was used by manufacturers in the production of residential, commercial, and industrial thermal and acoustical insulation in 2019 and 2020, according to a survey of members of the North American Insulation Manufacturers Association (NAIMA). This trade association describes itself as “the association for North American manufacturers of glass fibre, rock wool and slag wool insulation products and is an authoritative resource on energy-efficiency, sustainable performance, and the application and safety of these insulation products.” In addition to cullet, NAIMA indicated that American and Canadian facilities used more than 1,333 million pounds [605 million kg] of recycled blast furnace slag in the

production of thermal and acoustical insulation in 2019 and 2020.

“Our industry is tremendously proud of the substantial use of recycled content in the production of energy-saving insulation products,” said Curt Rich, President and Chief Executive Officer of NAIMA. “These products ultimately reduce building energy use and decrease our carbon footprint. Over the long term, the glass fibre and mineral wool insulation industry expects to continue using substantial amounts of recycled content in the production of insulation products.”

Environmental efforts

A number of businesses active in the glass industry have enhanced existing products or created new products to help with aspects of the environment. One of the biggest issues facing tall buildings in the USA is when birds fly into office and residential structures. The birds mistake many types of glass for clear skies.

Both NSG Group and Guardian Glass have been active in this area.

“... NSG Group is focused on value-added products and services and targets products that make a difference to the world in general, not only [to] people but also [to] wildlife,” stated Mr Weidner of NSG Group. “Our products make a positive contribution to the quality of living and working environments. We have glass that acts as flat transparent wire, glass used in the manufacture of solar products, antimicrobial glass and bird-safe glass, to name a few.”



Ripple Glass uses this commercial truck and trailer to pick up glass from local bars, restaurants, apartments and other businesses in the Metropolitan Kansas City Area in the USA. Photograph courtesy of Ripple Glass.

In a news release dated 16 March 2021, Chris Dolan, Director of Commercial Segment and Technical Services at Guardian Glass North America, noted that

“Guardian Bird1st Etch glass gives architects greater flexibility to select the best coated glass for their project. By pairing a Bird1st Etch pattern on surface 1 and a Guardian SunGuard low-E coating on surface 2 of an insulating glass unit, the project can achieve desired energy performance whilst meeting bird-friendly standards.”

Impact of Covid-19

“Covid-19 has impacted our members working in the glass industry in different ways,” stated Mr Witherell of the United Steelworkers. “The closures of bars and restaurants early in the pandemic had a significant impact... On the other hand, a surge in demand has kept our members busy in glass container, glass fibre and consumer ware.”

Mr Weidner of NSG Group stated that “Covid-19 has had an impact on our business similar to many businesses. Logistics constraints have been a big challenge for us again similar to what I am sure all other businesses have faced. Raw materials coming in and finished goods going out have been impacted domestically by the truck driver shortage and other domestic logistics constraints. On the export side, the situation with port blockages, container and vessel constraints as well as shipping costs have had an impact as well. Labour constraints are affecting all businesses.”

For Ripple Glass, Ms Gibson noted that “Covid-19 brought unique challenges, however, due to easy access to our drop-off recycling bins, recyclers still recycled glass.”

Additional details on the glass container industry in the USA can be viewed in another news column in this edition of *Glass Worldwide* (see page S18). ●

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Third and Lenora is a 36-story office and apartment tower in Seattle, Washington State. The complex was designed by Perkins & Will of Seattle. Guardian SunGuard SuperNeutral 68 coated glass was used to help maintain the building’s climate control. This mixed-use project was honoured with a Commercial Project Award by Guardian Glass in 2021. Photograph produced by Clarity Northwest Photography and provided courtesy of Guardian Glass, August 17, 2020.

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America's glass container industry

Glass is used to contain a wide variety of products sold in the United States of America. Richard McDonough reports on how glass containers were utilised by businesses that sell beer, wine, spirits and other products in 2021. He also details efforts taken to enhance recycling in the USA.

"For 2021 (through the third quarter), the domestic glass container industry has shipped about 16.6 billion bottles and jars to customers (brands) and similar end markets," stated Scott DeFife, President of the Glass Packaging Institute (GPI). The GPI membership represents the North American glass container manufacturers and suppliers to the industry, with the majority of its member companies in the USA (see page S10 for a dedicated contribution from the GPI).

"GPI tracks shipments to customers on a quarterly basis, through a third-party aggregation effort, led by an outside firm (Precision Consulting)," Mr DeFife explained. "This is done so no company-specific data comes into the possession of the association. This is reported by companies (representing about 95% of the domestic industry) and tracked in thousands gross (units), which can be translated into individual bottles and jars. Weight translations are not available.

"Through the third quarter of 2021 vs. 2020, our data shows an additional 28 million spirits bottles have been shipped to customer end markets, and an additional 181 million bottles for the flavoured alcoholic beverages market," Mr DeFife continued. "Food shipments have declined 4% year-to-date from its 2020 pandemic-highs, beer shipments are down about 5% year-to-date and wine shipments are essentially flat. Overall shipments are down about 3% year-to-date."

To provide some perspective on the glass container industry, several individual businesses that manufacture or utilise glass are highlighted in this news column.

Diageo North America

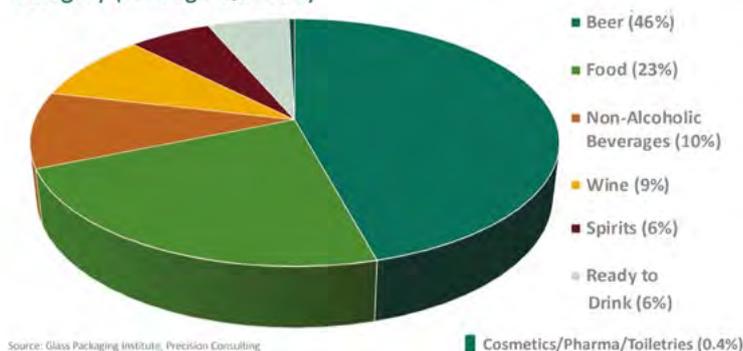
One of the largest spirits beverage companies operating in the USA is Diageo.

"Diageo is a global leader in premium drinks and one of the best-performing consumer goods company across the United States and Canada, with an outstanding collection of brands," stated Ronald Holmes, Packaging Director of Diageo North America. "According to data from our consumers and customers, we know they prefer the luxury of glass packaging for the brands they enjoy. We also want to use packaging which has the lowest environmental impact whilst protecting, delivering and presenting the quality of our brands.

"Whilst other packaging materials represent a portion of Diageo's product line, over 85% of the company's global packaging is in glass by weight," Mr Holmes continued. "As part of our 2030 ambition, Diageo continues working to reduce total packaging and increase recycled content in our packaging. Selecting the right packaging materials can have a significant effect on the overall environmental impact of our products and glass is infinitely recyclable and it's arguably one of, if not, the most recyclable packaging materials in use."

Mr Holmes explained that whilst much of the focus of packaging for Diageo products is on glass, the firm is "continuously looking for ways to work with our suppliers, customers and consumers to ensure that our packaging is effective as well as sustainable – considering both package weight and carbon emission reduction."

Share of 2021 U.S. Glass Container Shipments by Category (Through Q3 2021)



Source: Glass Packaging Institute, Precision Consulting

Image provided courtesy of the Glass Packaging Institute, 2021.

Drake's Organic Spirits

Although not as large as Diageo, Drake's Organic Spirits also operates globally. This business is headquartered in Minneapolis, Minnesota. Drake's Organic Spirits is sold in 44 states in the USA as well as in Canada, Guam, India, Japan, Puerto Rico and Venezuela. Sales have doubled each year, according to the firm, since the business started operations in 2018; the company is projecting to double sales again in 2022.

"Our spirits can be found from TGI Fridays to the Ritz Carlton, Whole Foods to Walmart, and Caesars Palace pool-side to Fashion Week in New York City," said Mark Anderson, Founder and Chief Executive Officer of Drake's Organic Spirits.

"As of today, Drake's Organic Spiced Rum, Premium White Rum and Premium Vodka are all offered in 750ml and 1l glass bottles. We use recycled glass for our spirit lines. Drake's is the first only-spirits brand that has achieved and holds all five official certifications, which are being vegan, gluten-free, non-GMO project verified, kosher and certified USDA Organic.

"Whilst our Spiked Ice pops come in plastic sleeves and our Boxtails come in bag-in-box packaging, we use glass for our pure spirits because glass is the most neutral container," explained Mr Anderson. "To really get the perfect tasting notes, it's important to use glass as the container because it will not affect the taste of the alcohol inside and

it is also more eco-friendly than plastic."

He noted that "Our glass usage has continued to double year-by-year. In 2020, we sold more than 40k 9l cases, and in 2021, we are on track to exceed 100k."

One area where the business is looking at an alternative to glass is for its planned tequila. "We are going to launch an Extra Anejo tequila that will come [in] ceramic and/or porcelain hand-painted bottles produced by a local ceramic bottle maker close to Jalisco, Mexico," noted Mr Anderson. "This is to highlight the ultra-premium quality of our upcoming tequila."

Silver Spur Corporation

"Silver Spur Corporation is a packaging supply company founded in Cerritos, California, in 1978," stated Brenda Harper, Account Manager at Silver Spur Corporation. "Since our inception, we have been best known for our amber glass bottles. However, today, with access to more than 45 furnaces, we can accommodate orders of all shapes, sizes and colours at large volumes year-round. These accommodations enable us to serve many different industries, including nutraceutical, pharmaceutical, food and beverage, cosmetics, wine, beer and liquor. We assure that our custom and stock items are manufactured to the highest quality standards and are regularly available in amber, green, flint and cobalt blue."

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customers in the United States, with its customers including distributors, manufacturers and contract fillers.

“Glass bottles and containers are manufactured worldwide and imported to the United States,” Ms Harper continued. “We are also now able to produce a new line of highly-engineered medical/lab-related products, including, but not limited to, injectable vials, pre-filled syringes and tubular products.”

Ms Harper noted that the business uses 50% or more recycled glass in its products: The firm uses glass “to be environmentally friendly,” she said. “Glass has always been our core product line.” She stated that usage of glass at Silver Spur Corporation has increased in 2021 as compared to previous years.

Ms Harper indicated that the business has experienced a 20% growth in sales in 2021 compared to previous years. For 2022 and beyond, she explained that “We expect continued growth on-trend with last year of 15-20%.”

Beyond glass products, Silver Spur Corporation also sells other types of items. “We do not have plans to replace glass,” said Ms Harper, “but we offer HDPE and PET Packers as an alternative to glass.”

Wine and beer supply

“We are an end-to-end supply and service provider for the craft beverage industry,” stated Casey Werderman, President of Wine & Beer Supply. “A winery can purchase their bottles and closures from us and then use them on our mobile bottling trucks.

“Our company is growing rapidly which includes the glass bottle segment,” Mr Werderman continued. He explained that the glass bottles use a combination of ‘new’ glass and cullet.

The business is located outside of Richmond, Virginia, and focuses its operations in the USA. He noted that customers include craft beverage producers, wineries, breweries and cideries. Mr Werderman indicated that the firm sells “a variety of packaging options including glass bottles, aluminium cans, PET single-use kegs, etc.”

Flow Cannabis Co.

In recent years, a new market developed within the glass industry in the USA – the legal marijuana market. Medical marijuana has been legal in a number of American states for years. Recreational marijuana has become more prevalent as a legal commodity in the past few years.

“Formed in 2015 with the launch of its top-selling flower line as its flagship brand (Flow Kana), Flow Cannabis Co. aims to build a more sustainable future,” said Annie Davis, Vice President of Marketing at Flow Cannabis Co. The firm is headquartered in Mendocino County, California. “Glass is used to house our flower in eighths and quarter sizes. As our products are organic and natural, we wanted to use a material that is non-toxic or [non-]harmful to the general public; glass was the best option for this. We also use glass to prevent leaching that can happen from plastics.”

She explained that the usage of glass has remained about the same in 2021 compared to previous years. “We have always used glass since our founding. We choose to use glass as we feel it is the most sustainable option; our customers love our packaging and so we see them ‘upcycle’ our jar into pots for succulents, for housing face creams or other keepsakes.” She indicated that the glass used “is 100% recyclable and the reason we picked it.”

Ms Davis explained that Flow Cannabis Co. is currently primarily focused on sales to customers in California and in other parts of the USA.

Sustainability and recycling

“At Diageo, we have always understood that for our business to be sustainable, it needs to create enduring value – for us and for those around us,” stated Mr Holmes of Diageo North America. “Through our ‘Society 2030: Spirit of Progress’ plan to help build a more sustainable future, Diageo is committed to reduc[ing] the environmental impact of its bottles. In that context, at Diageo we use a mix of recycled glass [...] and virgin glass for our packaging. The amount of cullet glass varies by supplier and their location. However, shared sustainability objectives and a desire to reduce our environmental impacts mean we partner closely with our strategic glass suppliers and we encourage them to use cullet glass as much as possible.

“As part of our 2030 ambition, we are working to ensure 100% of our packaging is widely recyclable or reusable, whilst meeting our quality and brand standards,” Mr Holmes continued. “In this context, all glass bottles used by Diageo can be recycled. You will find in many of our labels the recycling symbol or the phrase ‘Please Recycle.’ As for Diageo’s efforts, we are always working

with our glass suppliers and recycled glass processors to understand how to include recycled glass in our bottles. We are always exploring options around the supply of recycled glass, the transportation of recycled glass to glass manufacture, and the integration of recycled glass into the glass manufacturing process.

“We have made important strides across the globe in reducing our environmental impact over decades of focus on waste, recycling and packaging,” stated Mr Holmes. “As we work towards our 2030 targets, we aim to keep going until we have reduced our impact everywhere: cutting down packaging, increasing recycled content and eliminating waste. Partnerships will be critical. Initiatives such as our new Diageo Sustainable Solutions programme, which enables us to partner with innovators to share ideas for growing brands sustainably, help us work together with customers, suppliers, non-governmental organisations, research institutions and governments to help create a truly circular economy.”

Beyond individual corporate efforts, many businesses in the glass industry work together through both the GPI and the Glass Recycling Foundation (GRF).

“GPI is involved with efforts to improve glass recycling on multiple fronts,” stated Mr DeFife, President of GPI. “In 2021, GPI met with a variety of legislators, their staff, local government representatives and stakeholders and submitted testimony on legislation in California, Colorado, Connecticut, Hawaii, Maine, New Jersey, Oregon and Washington state, along with the US Environmental Protection Agency (EPA). Whilst the legislation and conversations vary (depending on what is being considered), GPI’s primary message remains the same – programmes should both capture additional amounts of recycled glass, and be designed to ensure that glass is suitable for re-use in the manufacture of bottles and jars. Glass should also be recognised as a circular package and treated fairly among competitive packaging in extended producer responsibility programmes, which were signed into law earlier this year by the Governors of Maine and Oregon.”

Mr DeFife indicated that 2021 has seen a more normal return to recycling options for consumers.

“All of the country’s 10 bottle deposit return programmes (which account for 60–70% of all recycled glass used to make new bottles and jars) re-opened their redemption options to consumers,” Mr DeFife continued. “GPI and its members spent several months in 2020 encouraging Michigan and other states to re-open temporarily shuttered return options for consumers. Most of the closed operations were housed inside grocery stores and similar ‘return to retail’ options. With these options now fully open, we’ve seen the glass recycled content rate gradually increase, returning to pre-pandemic levels (roughly 1/3 recycled content).”

A new recycling programme was implemented in Arizona ▶



Farmer’s Reserve is one of products packaged in glass containers by Flow Cannabis Co. Photograph provided by Flow Cannabis Co., 3 March 2018.



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and Illinois in 2021. According to the GPI, the rollout of the 'Don't Trash Glass' (DTG) Programme began in the Southwestern part of the USA and then expanded into the country's Midwest.

"The DTG is a dedicated glass collection effort, focused on bars and restaurants," explained Mr DeFife. "It was started in Phoenix, Arizona, with help from Crescent Crown Distributing, GlassKing, Keep Arizona Beautiful, and Strategic Materials, Inc. (SMI), the country's largest glass recycling processor (clean-up) company. GPI organised the effort, with assistance from the GRF. Dozens of bars and restaurants have signed up to participate in the programme, and [have] been provided [with] the bins for separate glass collection.

"This was followed by a similar pilot programme in Chicago, which kicked off on Memorial Day weekend," Mr DeFife continued. "Initial start-up funding for the programme came from the GRF, with additional support from Legacy Marketing, Lakeshore Recycling Systems, O-I Glass, SMI and Constellation Brands (the parent company of Corona Beer). Through this effort, Constellation Brands has enhanced Corona's 'Protect Our Beaches' programme. The glass captured through the assistance of glass from bars and restaurants is now finding its way to processing and back into the production of new bottles and jars."

He indicated that "the DTG programme is a great example of how the industry is proactively seeking local, on-the-ground ways to capture more recycled glass, absent legislative or regulatory directives.

"Recent statistics (collected internally for GPI, via-third party) showed an average post-consumer recycled glass content for glass bottles and jars made in the USA at about 30% over the past two years," said Mr DeFife. "This data represents about 95% of the glass container manufacturing plants."

Mr DeFife reported that, according to the latest statistics (from 2018) from the EPA, 39.6% of beer and soft drink bottles were recovered for recycling, 39.8% of wine and liquor bottles were recovered for recycling and 15.0% of food and other glass jars were recycled. In total, the EPA indicated that 33.1% of all glass food and beverage containers were recycled.

One of the largest single activities in glass recycling occurred in New York State and Pennsylvania in the summer of 2021. A total of 1.3 million cobalt blue glass bottles were kept out of

landfills, according to Mr DeFife. Both the GPI and GRF worked with Prism Glass Recycling, Campbell Trucking, Central Recycling Cooperative, and Ardagh Group to have 500 pallets of glass bottles moved out of a warehouse in Bath, New York; turned into cullet in Horseheads, New York; and then used for glass production at Port Allegany, Pennsylvania. "This story could be happening in other communities, and we want to make people aware that unique partnerships like this can help to recover and recycle more endlessly recyclable glass," stated Mr DeFife.

External issues

"Like many industries, 2021 has been unique on several fronts for glass container manufacturers and suppliers to the industry," said Mr DeFife. "As on-premise bars, restaurants and other dining options began to slowly open up in phases across the country, we noticed a shift in some of the end-market categories we cover. Our reports show a decrease in food shipments, which were up over 10% in 2020 versus 2019. The 2020 increase in this category was even more significant than the annual number shows, when you consider the Covid-19 shutdowns really didn't occur until the end of March, so that increase is really more tied to nine months of strong consumer-spending data, focused largely at the grocery store for glass food jars."

"The supply chain crisis impacted the glass container industry in slightly different ways than many of our customers' competitive packaging options," Mr DeFife explained. "Whilst imports and exports remain challenged and delayed at the ports of entry (particularly on the West Coast), glass has always been a primarily domestic industry by nature. Raw materials, recycled glass and other components that comprise a bottle and jar are found domestically (often locally), and are provided to customers on a routine basis.

"Glass benefits from having a single manufacturing operation layout as well: raw materials are melted, formed and often packaged in cartons – going directly to their respective customer end markets for filling," Mr DeFife continued, "in contrast to a multi-step process employed by plastics and other packaging formats."

"In 2020, with Covid-19, the biggest impacts were state-by-state restrictions affecting demos/tastings, which are slowly recovering," said Mr Anderson of Drake's Organic Spirits. "We also suffered from huge delays with



Glass is recycled in a number of communities in Alabama as well as throughout the USA. Photograph provided courtesy of the Alabama Cooperative Extension System.

the shipping crisis and struggled with inflation and currency changes as we get multiple ingredients from around the world."

Silver Spur Corporation has also been affected by supply chain issues. "Ocean freight cost increases and port congestion impact the lead-time on the product and the cost to our customers and us," explained Ms Harper of Silver Spur Corporation. She indicated that ocean freight cost increases and port congestion may continue to impact the lead-time on the products and the costs to its customers and to the business.

"Demand has remained strong through Covid-19," stated Mr Werderman of Wine & Beer Supply, "however ongoing supply chain challenges continue to be a significant pain point. We have increased our in-stock inventory, warehouse space, and built in longer lead times to avoid delays. Inventory availability and increased costs have driven prices up on all products, forcing us to further diversify our manufacturing partners."

"The last few weeks [in autumn 2021] have seen the first softening in international container rates in months that we are bullish will carry into 2022," Mr Werderman continued. "We have very aggressive growth plans ahead of us and are constantly exploring new opportunities to add products and services of value to our customers."

Governmental regulations – those that deal with Covid-19 as well as broader regulatory policies – have been affecting businesses like Flow Cannabis Co.

"As states and local governments were closing or considering closing retail operations, multiple city and state health departments affirmed that cannabis dispensaries are 'essential' businesses, like pharmacies or grocery stores, and therefore remained open," said Ms Davis. "This was a huge milestone for the industry. For now, the coronavirus pandemic has further highlighted the disconnect between Federal and state policies: under one set of laws, cannabis is a banned drug, and under the other it's a medicine deemed just as essential as any other."

Additional details on the overall glass industry in the USA can be viewed in another news column in this edition of *Glass Worldwide* – see page S12. ●

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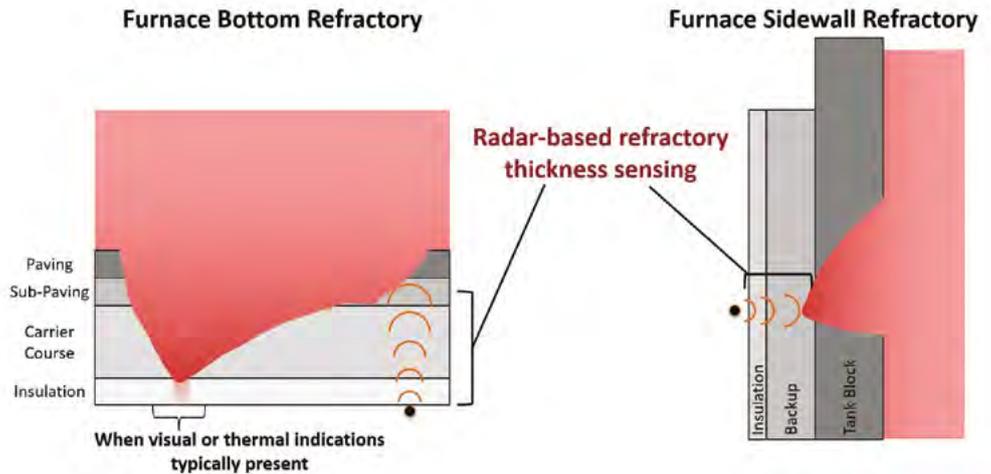


Responding to emergencies two years in advance

The introduction of radar-based refractory inspection in 2017 brought new insight into the rate of wear of the inner insulation and protection layers. Data from nearly 1 million measurements on over 300 furnaces shows that once glass infiltration begins, a furnace can continue to operate much longer than anticipated. Alex Ruege and Jon Wechsel from PaneraTech explain what they have learned.

Until recently, quantifying how long backup refractories will last before failing on operational furnaces has been a challenge for glass manufacturers. The industry has relied on techniques such as thermal sensors, test drilling, visual inspection and other indirect methods such as historical data. These techniques give an incomplete picture of the integrity of the refractories. Making matters worse, thermal or visual sensing may only respond to glass infiltration that has already compromised the containment to a point where urgent decisions must be made. The original problem that has caused the critical situation may have begun years earlier, but given the inspection techniques at the time, operators may assume that early glass penetration into insulation may lead to a major leak within days.

Our experience monitoring over 300 glass furnaces with SmartMelter radar over almost four years has shown us that the original assumptions about the rate of wear of materials like firebricks, flux and bonded AZS



General furnace bottom and sidewall refractory configuration.

were not accurate. Through SmartMelter radar mappings, once glass was discovered to have penetrated bottom and sidewall materials, continued operation was possible for much longer than originally anticipated. Guided by these radar mapping results, in some cases these furnaces have lasted two years without failing.

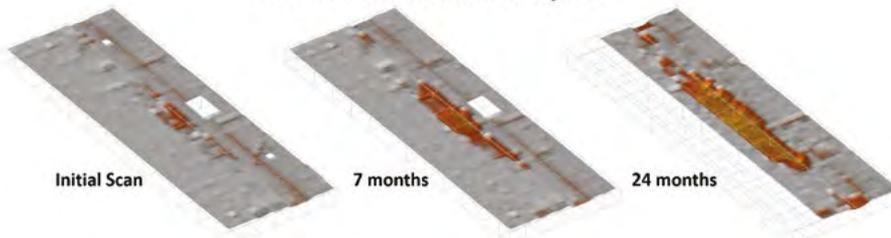
How SmartMelter monitors refractory wear

Using radar mapping, a three-dimensional map of the internal glass penetration inside of the furnace materials can be

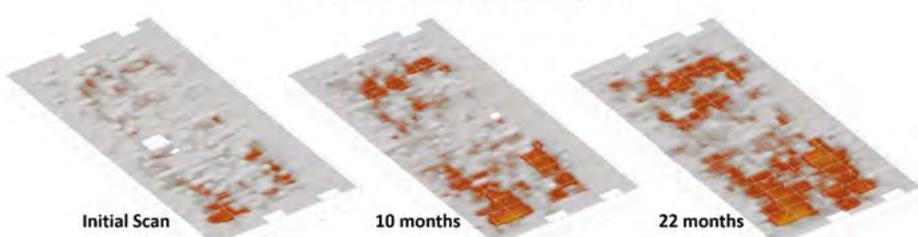
constructed. This is done by sending extremely low power radar signals into the materials at different positions and measuring those echoes that come back from the glass infiltration. Regular radar mapping will provide a timeline of information regarding the spread and depth of refractory wear.

When considering furnace bottoms and sidewall backup designs, many furnaces have a similar construction. On bottoms, the glass-contact pavers are typically followed by sub-paving layers which may consist of a variety of corrosion-resistant refractories such as zircons, castables, rams, and bonded AZS materials. Below these, the carrier courses are composed of alumina-silica fireclay materials such as superduty firebrick or sillimanite. Under the carrier courses are the highly insulating materials which are meant to thermally insulate the furnace. Because of the highly insulating nature of these materials, the outer surface temperature will increase by a measurable degree only as glass penetration makes its way into the weakest outer layers. At this point, very little time remains before glass would make its way through those insulating layers. In contrast, radar-based refractory thickness sensing ▶

Float Furnace Bottom Example 1



Float Furnace Bottom Example 2



Radar mapping of showing the progression of glass penetration into a float furnace bottom.

The 82nd Conference on Glass Problems By The Numbers

By Robert Weisenburger Lipetz, MBA – Executive Director, Glass Manufacturing Industry Council and 82nd GPC Conference Director

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5 Technical programs (2 Plenary; Refractories; Data, Chemistry, Energy; energy/Combustion, and Sensors and Energy)

2 Venues staging the conference (Greater Columbus Convention Center and Columbus Hilton Downtown)



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21

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1 Tour of the Acuity Brands glass plant for GPC students

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10 Industry experts in the GMIC symposium, Automation in Glass Manufacturing



87 Years since first conference (the conference took a hiatus during WWII)

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will reach much deeper into the furnace bottom and well beyond the outer insulation materials, providing extended time to mitigate the issue to best fit the manufacturer's schedule and plans.

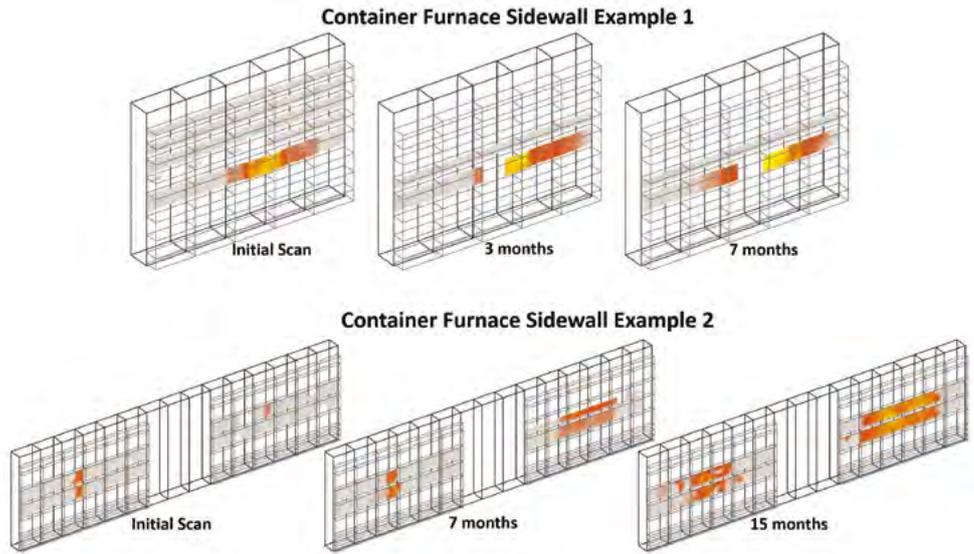
Relying on temperature alone

When manufacturers rely on temperature, they are forced to make hasty and often costly decisions. PaneraTech performed radar mapping on a container furnace where hotspots had already been observed on the bottom. Radar mapping found that 85% of the total bottom thickness was gone with glass infiltration into the outer layers. Based on the data collected, immediate repair was recommended. However, the plant had commitments to fill for six months. Operation continued for four months before a bottom leak occurred. As we can learn from this experience, temperature indications given on the furnace bottom provided very little time to react. Because of the nature of radar, which can reach much more deeply into the materials, glass penetration can be found at a much earlier stage.

Benefits of early detection

Example 1: Float furnace bottom repaired two years after glass detected

The first mapping done on this bottom indicated wear into the outer clay flux. After two years, the thickness reduced by 120mm at the worst locations on the bottom. However, we observed that the affected area spread laterally by seven times of the original area over the course of those two years. Water and air cooling was applied on the bottom surface and was gradually increased and changed as guided by the radar mappings. These mappings allowed the presence of glass infiltration to be known by the manufacturer and proper maintenance plans were set in place well in advance of the needed repair, which occurred two years after the initial mapping where glass infiltration was discovered.



Radar mapping of glass penetration progression into a container furnace sidewall.

Example 2: Float furnace bottom repaired 22 months after glass detected

As in the first example, early-stage glass penetration was found in the initial radar mapping in this float furnace's clay flux bottom layer. This glass penetration also spread significantly over a period of nearly two years. However, the thinnest area only lost 50mm of material. Air cooling was applied on the bottom surface after the initial radar mappings. Once again, the furnace was safely shut down and repaired 22 months after the initial mapping.

Example 3: Container furnace sidewall repaired 7 months after glass detected

On a container furnace sidewall, which was composed of bonded AZS, firebrick and insulation board, initial radar mappings of the area showed deep infiltration into the bonded AZS layers in front of the outer firebrick layer. Over a period of seven months, only 8mm of the bonded AZS was lost at the worst locations. The outer insulation board was removed, and cooling was applied in these concern areas. A sidewall repair of the area took place seven months after the initial discovery and furnace operations continued.

Example 4: Container furnace sidewall repaired 15 months after glass detected

On a similar container furnace sidewall, the first radar mapping of a sidewall area discovered the early stages of glass infiltration into the bonded AZS layer. After 15 months, the worst-case location only lost 10mm of the bonded AZS. However, the affected area increased dramatically, spreading from only two tank blocks to 10 blocks. The outer firebrick layer was removed, and a significant amount of air cooling was applied to the bonded surface. Soon after the last radar mapping, the furnace was safely shut down and repaired.

New data supports better decisions

Given this new knowledge, we now have a better understanding of just how well specific refractory materials perform within sidewall and bottom backup packages under many different operating conditions in the glass manufacturing industry. Identifying when and to what extent glass makes its way into the backup materials provides a data-driven assessment of the health of the asset and gives a manufacturer the confidence to either continue to operate safely or make the best-informed repair decision. ●

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Ajit Jhunjhunwala and Sushil Jhunjhunwala, Managing Director and Chairman of La Opala respectively.

Sowing the seeds for success

Specialist Indian producer of opal and 24% lead crystal tableware La Opala RG Ltd is expanding to meet demand by opening two new plants. Managing Director Ajit Jhunjhunwala exclusively discussed his company's next steps with *Glass Worldwide*, preferred international journal of the All India Glass Manufacturers' Federation.

Since 1988 La Opala has been producing opal glass – a translucent or opaque glass made by adding opacifiers to the melt – at its original glassworks in Madhupur, eastern India. In 2007 a second facility in Sitarganj in the state of Uttarakhand (formerly known as Uttaranchal) in the north of the country doubled the size of La Opala's operations and 95% of the company's current business now comes from opal.

Running two furnaces with a capacity of 75 metric tonnes and five lines, the Uttarakhand facility has become a victim of its own success...

"We are almost at saturation point with no possibilities to expand the plant any further," explains Managing Director Ajit Jhunjhunwala, son of Sushil Jhunjhunwala, the company's founder and now Chairman. "We have used almost all of the area and are at full capacity." A decision was taken to expand close to the existing site in Uttarakhand.

"We decided that we should go for a greenfield project and we thought that Sitarganj [approximately 200 miles from Delhi] is an ideal location because we already have an operation there," continues Mr Jhunjhunwala. "The place is conducive for business as there are no problems in terms

of availability of power or manpower."

The new site is 2km from the existing plant and only a 15-minute walk away. "The top management will remain the same across both plants and there will be a lot of synergies between the two locations," confirms Mr Jhunjhunwala.

Threatened by Covid

Despite incurring costs from not being able to sell during the start of the global Covid-19 pandemic, the existing plant at Sitarganj remained robust due to a healthy balance sheet and its dedicated team. However, the progress of the new plant was significantly affected during the first phase of lockdown from March–August 2020 with "practically no activities at all," recalls Mr Jhunjhunwala. "But then gradually things started settling down and people started returning ►



La Opala was the recipient of the prestigious AIGMF Balkrishna Gupta Award for Exports in 2020 following Sushil Jhunjhunwala being the recipient of the C K Somany Glass Award in 2018.



The existing plant in Uttarakhand runs two furnaces with a capacity of 75 metric tonnes and five lines.

to work and fortunately now we are at the stage that we are almost ready [despite] the delays to construction and the market uncertainties. We didn't want a situation where we started the new project and a lockdown would then shut the plant, which would have been very bad for the morale of the organisation. We wanted reassurance of the market dynamics before we started. Right now we don't see any major disruption as we are working on almost 100% capacity utilisation at our existing plants.

"Fortunately, our business has been consistently generating surplus net cash and today we have almost zero borrowings so whatever we are doing, even the money we have invested in the new plant, is entirely from internal funding. We don't have to worry about the high interest rates in India."

Manufacturing capabilities

According to Ajit Jhunjhunwala, La Opala's new facility in Sitarganj will have a 45-metric-tonne furnace with three lines: two spinning lines and one press line. Running the same technology as the existing plant, the furnace, press

and spin machines and tempering and annealing lines have all been received and installed.

"In 2008/9, we were the first Indian glassmaker to switch to electric melting," notes Mr Jhunjhunwala. "The credit goes entirely to my father Sushil who had the vision to know it would be very hard to continue to melt with fossil fuel. We were the first in the country to adopt electric melting and also the first to come out with automated process in opal technology.

"We had good experience of our existing suppliers who had all been very supportive in the past in terms of technology provision and service and that is the reason why we decided to go with the same partners. It makes life easier for all parties because we understand each other. It also

helps massively in the spare parts management. With the synergy at our existing plant, there are a lot of advantages to the new plant.

"It goes without saying that we will share expertise from the nearby plant so that the top management can look after both plants. But being a specialised industry and being a very highly technical orientated industry we do need the right people at the right place and as there are not many opal producers in the area, we have to get people from other industries and then train them. We have already started to recruit people from our new plant so they can be trained at our existing plant and once the commissioning at the new plant starts it makes it easier for them to switch.

"The machines are important but the men behind the machines are even more important," he underlines.

Expanding the opal market

The product line at the new plant will be similar to that of the existing plant, to assist with increasing demand, driven in part by a shift in consumer attitude towards glass. All of La Opala's product designs are eco-friendly and food-safe, eschewing decoration that contains any lead or cadmium.

"There is a limitation in terms of usage for opal; basically it is only used for tableware [but] we feel the market is expanding," observes Mr Jhunjhunwala. "We have seen consumers switching from plastic to glass because of obvious health reasons, and consumers are ▶



The new greenfield plant in Sitarganj, 2km from the existing plant in Uttarakhand.



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switching from steel to glass because of lifestyle changes. Consumers have aspirations to use better products, especially the younger generation who don't want to use stainless steel, so there is a shift to glass in tableware-related products. People are getting more aware of the side effects of using melamine plastic.

"Within the segment, we are coming up with lots of new ranges, different designs, different shapes and different products. We feel the demand is strong and as long as we continue innovating then meeting demand should not be a challenge.

"In opal we have 55–60% market share and still we feel the market has got a lot of potential to grow further; with the new plant in Sitarganj opening we will perhaps become one of the top three producers of opalware in the world so that really excites us. And most importantly we feel that we are able to offer consumers excellent products at a very affordable price."

New borosilicate plant

On 4 November 2021 La Opala announced plans to build a new borosilicate plant that will be situated alongside the new opal glass plant in Sitarganj.

"There is no producer of borosilicate product in India," says Mr Jhunjhunwala. "It's a natural extension to our opal products and will go through the same distribution channels. We have such a strong brand already that we will be able to leverage our branding to market borosilicate products.

"At the new plant in Sitarganj we have enough space so this plant will fit well," he continues. "We feel it is a great category of product that is growing – each and every house has these kind of products. This new borosilicate business will complement our opalware range and will be a totally new category for us.

"We have a lead crystal business in Madhupur which is hand blown and hand cut so we are not able to scale up that business because of the nature of the manufacturing process. So we decided we must venture into new areas.

"It's always fun to enter new sectors; there are challenges to developing a product from scratch but we feel we are fortunate to be part of the process," he enthuses. "We are looking forward to the next 18–24 months when we should have set up the site."

Family-run business

Glass Worldwide spoke to Sushil Jhunjhunwala for the November/December 2018 issue, the same year that Ajit took over as Managing Director. "My father is still very involved in the business, and although not in a hands on capacity, we take advantage of his great experience when making any major decisions," he reports. "We recently purchased a new building for our headquarters, still located in Kolkata [Calcutta], but slightly away from the main city. With the way the company is expanding, a new area was definitely very much needed and we moved from our previous 4,000ft² building into this 16,000ft² office. It's a brand new building with a very positive energy that is fun to work in. We can now provide a comfortable atmosphere for staff who have a good and comfortable place to work... We can already see that the efficiency has improved.

"My son Aphyubay (24) recently finished his education at Kelley School of Business in Muncie, Indiana in America and has started work in the company," continues Mr Jhunjhunwala. "We hope he will have a role in the business moving forward as the third generation. Right now I've



As the third generation, Aphyubay Jhunjhunwala recently started work at La Opala.



Sushil Jhunjhunwala is credited with La Opala's vision to pioneer electric melting technology in India.

asked him to learn about each and every area of the business, as I did when my father brought me into the company. We are giving him an overview of the business and I want him to work through every department so he can really get the feel of the business and prove his worth."

Global achievement

In 2018 Sushil Jhunjhunwala won the All India Glass Manufacturers' Federation (AIGMF)'s inaugural C K Somany Glass Award for Innovation and Technology, and in 2020 La Opala followed this up with the Balkrishna Gupta Award for Exports. "It's a great achievement for us to be awarded prestigious awards from the AIGMF, one in my father's personal capacity and the other in a La Opala capacity," acknowledges Mr Jhunjhunwala. "We feel honoured and it is a real matter of pride.

"Although I have not been able to be involved too much due to my other commitments, my father [a former President of the AIGMF] has always been very actively involved with the AIGMF as well as the zonal Eastern India Glass Manufacturers' Association (EIGMA) in Kolkata which is under the AIGMF.

"The kind of support we have received from the AIGMF can never be understated – any concern relating to the industry or regulations and the AIGMF are just a phone call away. As with his predecessor Manohar Lal, Vinit Kapur [General Secretary] has been extremely supportive to us. The AIGMF is a great solid platform for any sort of concern to its members and is a very friendly association."

Happily, Mr Jhunjhunwala also sees a positive benefit to *Glass*

Worldwide being the preferred international journal of the AIGMF (in association with Kanch).

"*Glass Worldwide* does a wonderful job," he opines. "The content is fantastic and I make sure I go through each edition which is always a pleasure. The quality of *Glass Worldwide* enriches the AIGMF and it is an excellent partnership."

Mr Jhunjhunwala also appreciates the "fantastic effort" that event organisers such as those of glasspex INDIA make to unite industry peers from across the world on one platform. "It's a great opportunity for us and anybody in the glass business to meet suppliers," he explains. "As we have also missed out on being able to go to glasstec in Germany since 2018, glasspex INDIA 2022 will be a great platform. Although we have certain suppliers we partner with, things are changing so fast and you never know when new suppliers can provide additional ideas."

At the time of this interview in November 2021, La Opala's first new Sitarganj plant is almost ready; "90% percent complete," reveals Mr Jhunjhunwala. "I am very pleased to see the progress. We have learnt from our other plants and maximised the layout and structure, keeping in mind further expansion in the future. We are currently waiting for foreign travellers to be able to visit so that the plant can open in January or February 2022." ●

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Overview of the Indian glass industry

Facing a prolonged slowdown for the last few years, over the last 12 months the Indian glass industry has experienced a major realignment and finally seen a slew of capacity expansion announcements. Sunder Singh presents an overview of major company plans and progress on the ground.

It has been a tough one-and-a-half-year period for the Indian glass industry. The start of the Covid-19 coronavirus in March 2020 forced a prolonged lockdown in the country, which had a sizable impact on the consumption of container and float glass as the end user segments – construction and alcoholic beverages – came to a complete shutdown for more than two months. Both of these segments started to pick up momentum in the last quarter of 2020.

However, the second wave in April 2021 hit the country like lightning and although production during the second wave didn't come to a screeching halt, demand from end users slowed the momentum of the glass industry. After a grinding three-month period, the Indian glass industry started to recover and demand from the end users' segment registered one of the healthiest growth rates during the August–October 2021 period.

Challenges

The Indian economy declined by a record -7.3% during the country's financial year 2020–21. This was the worst performance of India's GDP growth in any year since independence [1947].

The Indian flat glass segment, which had suffered three years of disruptions in the form of demonetisation, GST, RERA, and the NBFC crisis started to gain momentum towards the end of 2019, but the nationwide lockdown that followed in March 2020 caused turmoil in the market, bringing more pain and distress to the architectural glass sub-segment due to the complete halt in construction industry. However, once the unlocking process was initiated in the third quarter of 2020, the construction sector and architectural glass uptake started showing promising signs of revival. Automotive glass suffered a similar fate as carmakers recorded a historic decline in production and sales of automobiles during most of the 2020. However, at the time of writing (in the second half of November 2021), both the major sub-segments of flat glass are performing very well.

The container glass industry also suffered a massive decline in

production and consumption. Barring the pharmaceuticals sub-segment, all the other sub-segments registered huge declines. For example, in the spirits sector, the country's largest spirit maker United Spirits (Diageo India) registered sales of about 70.7 million cases in the 2020–21 financial year, suffering a volume decline of 11.3% compared to previous year. The country's largest brewer, United Breweries, which accounts for 52% of India's beer market suffered a massive decline of 38% in volumes compared to the previous financial year.

Container glass

The acquisition of speciality container glass producer Piramal Glass by leading investment business group Blackstone in December 2020 has been the most significant occurrence in the Indian glass industry in the last twelve months. The nearly US \$1 billion acquisition was the largest in the history of the Indian glass (also packaging) industry. The new entity has been renamed as PGP Glass (see the July/August 2021 issue of *Glass Worldwide* for an exclusive interview with PGP Vice Chairman Vijay Shah).

In the Indian container glass industry, mid and small-sized ▶



United Breweries, producer of Kingfisher beer, suffered a massive decline in volumes during the pandemic.



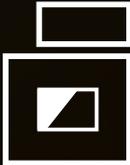
The Indian glass industry has experienced a number of capacity expansion announcements during the last twelve months.



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producers have started to gain market share at the expense of the three large size container glass producers, which is expected to intensify the competition in the container glass segment in the short and medium term. Modernisation and capacity expansions by these tier-two producers are expected to change the face of Indian container glass industry over the next few years. Smaller companies such as Haldyn Glass, Sunrise Glass and new entrant Emerging Glass are expected to pose challenges to the three established container glass producers in the coming years.

AGI glaspac - greenfield expansion

The second largest container glass producer in India, AGI glaspac is undertaking a greenfield capacity expansion at its Bhongir plant in the state of Telengana. Due to be completed by June 2022, the new production facility will have an installed capacity of 154tpd of container glass for the cosmetics & perfumery and pharmaceutical segments. The company will be spending INR 2.2 billion for this expansion.

Speaking at the company's investors' conference in July 2021, AGI glaspac's CEO Rajesh Khosla said, "We have this 154-tonne per day new furnace, which is coming up and is primarily focusing on meeting the demands of various customers on the high end side, making value-added products, the high end perfumery and pharma side. This one will be up and running during quarter one of the next financial year."

Sunrise Glass Industries

Surat, Gujarat-based Sunrise Glass Industries is in the process of installing its third furnace at its production facilities. The new furnace has an installed capacity of 240tpd container glass.

With the addition of this furnace, the company will have an installed capacity of 620 tonnes per day with the assistance of three furnaces. Currently the company operates two furnaces with a combined total installed capacity of 380tpd.

See the July/August 2021 issue of *Glass Worldwide* for an exclusive interview with Gaurav Thakker, Executive Director of Sunrise.

Haldyn Glass

Vadodra, Gujarat-based Haldyn Glass has emerged as one of the fastest growing mid-scale container glass producers in the country. The company operates a state of the art production plant with an installed capacity of 360tpd with the assistance of two furnaces (200tpd and 160tpd) and eight IS machines for the production of containers ranging from 1ml to 2,500ml.

One of the furnaces operated by Haldyn Glass was refurbished in 2011; its modernisation planned for 2021 was expected to cost about INR 197 million.

Glass containers manufactured by HGL are supplied to the liquor, cosmetics and food & beverages industries, with the company deriving the majority of its revenues from the liquor industry.

In order to diversify its product portfolio, HGL entered into a 50:50 joint venture with German speciality container glass producer HEINZ-GLAS, named Haldyn Heinz Fine Glass Private Limited. The joint venture produces glass bottles for perfumes and cosmetics for the clients based in Europe and USA. For optimum furnace utilisation the joint venture has planned to set up additional bottling line in 2021 with an outlay of INR 300 million.

Ownership transition at SCHOTT Kaisha

In August 2021 Serum Institute of India, the world's largest vaccine producer bought the 50% stake in the Indian joint venture SCHOTT Kaisha from former co-owners Kairus Dadachanji and Shapoor Mistry. The joint venture is the leading producer of container glass for pharmaceutical packaging such as vials, syringes, ampoules and cartridges used to package life-saving medications.

In a press release from SCHOTT at the time of the acquisition, Dr. Frank Heinrich, CEO of SCHOTT said, "We are looking forward to the co-operation with the new partner. As India has steadily established its position as a global pharmaceutical hub, we are delighted to strengthen our footprint within the Indian pharma supply chain. We are looking forward to strong impulses from this partnership. It is an excellent example of shifting towards new co-operation models, with greater synergies between pharma manufacturing and packaging production."

Adar Poonawalla, CEO Serum Institute of India commented, "Even the best medication can't reach the patient without the right packaging. Securing this supply chain is of strategic importance. SCHOTT is the perfect partner for us to do this because of their expertise and global network. As a long-time customer, we use their vials, ampoules and syringes to store our vaccines including Covishield. Working even closer together is in the best interest of global health."

SCHOTT Kaisha has significantly increased its production capacity in India. Over the last three years the company has invested roughly INR 6 billion to set up two new plants in Umarsadi in the state of Gujarat, and Baddi in the state of Himachal Pradesh.

Flat glass

In the last 12 months the Indian flat glass industry has witnessed an unprecedented momentum in terms of new capacity addition announcements. Saint Gobain India, Gold Plus Glass and Borosil Renewables have confirmed that they will add more than 4,000tpd of new capacity in float and solar grade float glass in the next three years. These newly announced capacity additions will take India's overall installed capacity of float and solar grade float glass to more than 11,500tpd by the end of 2024. ▶



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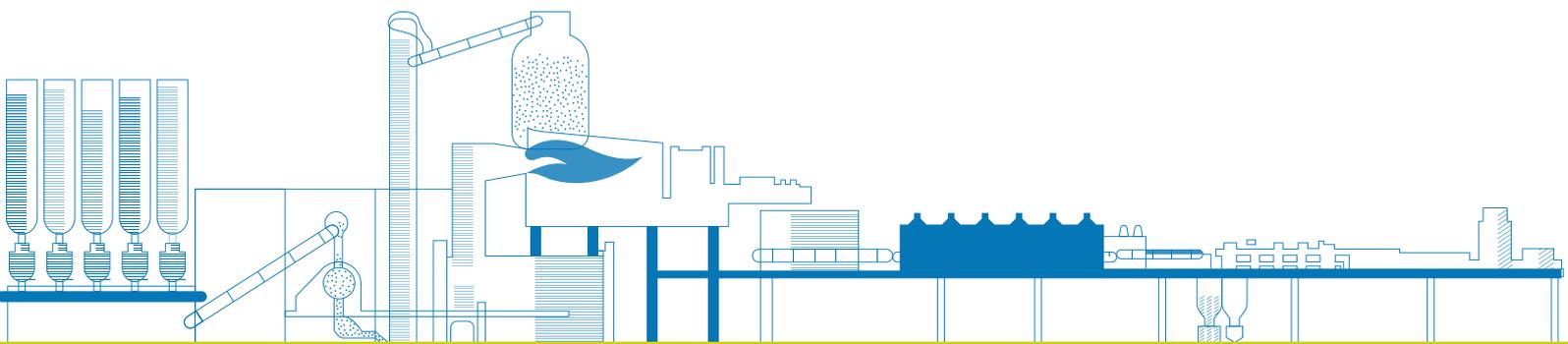
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Flat glass is witnessing unprecedented momentum. Capacity in this sector of the Indian glass industry is expected to increase by nearly 2,000 tonnes per day over the next three years.

Sixth float glass line for Saint Gobain India

India's largest producer of flat glass, Saint Gobain has committed to set up the company's sixth float glass line in the state of Rajasthan. In May 2021 the company submitted its proposal of investing US \$148 million (INR 11 billion) to the Chief Minister of the state to seek incentives and support under the state policy framework.

Speaking on the occasion, Saint Gobain Group (India) Chairman B. Santhanam said, "In line with our strategy for accelerated growth in India, Saint-Gobain will invest in a new float glass plant in our world class complex in Bhiwadi. Rajasthan is the ideal state for this investment as it has abundant raw materials for glass production and rich pool of talent. This new investment of US \$148 million [will] help us to produce advanced and value added products for the growing architectural and automotive markets in India."

With an installed capacity of 3,750 tonnes of float glass from five float glass lines, Saint Gobain India is the largest producer of float glass in the country. The company accounts for nearly 50% of the installed capacity of the Indian float glass industry.

Gold Plus Glass - massive capacity addition

As will be discussed in further detail in a dedicated interview in the next issue of *Glass Worldwide*, Gold Plus has announced it will set up two more float glass line and a solar grade float glass line in the next three years. Collectively,

those three additions are likely to culminate in an additional capacity of 1,900tpd. Total outlay for these three projects would be around INR 23 billion, which would be funded through a mix of fresh equity, incremental debt and internal accruals. Gold Plus Glass plans to raise about INR 12 billion through an initial public offer (IPO). The company has appointed nearly half a dozen investment bankers including Jeffries and Axis Capital, according to a report in Indian business newspaper *The Economic Times*. The company is set to file the Draft Red Herring Prospectus (DRHP) by December 2021 or January 2022 and the share sale may be launched early this year.

Currently, Gold Plus Glass is the second largest float glass producer in India, with an installed production capacity of 1,250tpd for float glass from its two production lines in Roorkee in the northern state of Uttarakhand. The company has a sizeable market share in the clear glass segment, especially in North and East India. Gold Plus Glass set up its first float glass manufacturing line in 2009 with an installed capacity of 470tpd, which was further augmented in 2018 with its second greenfield facility with 700tpd capacity. Line 1 was subsequently refurbished in October 2019 with an increased capacity of 550tpd.

Asahi India

AIS's greenfield production plant in Patan, Gujarat was ready in late 2019 but because of the pandemic it did not begin operating until February 2021. The new production plant is a modular, three-phase, state-of-the-art facility with all the latest technologies and equipment,

capable of making complex modern automotive glazing products. The first phase is for 0.8 million laminated windshields. Upon completion of phase three, the company will have an installed capacity of three million windshields.

Borosil Renewables - spearheading the solar glass revolution

Borosil Renewables Ltd has set ambitious targets for the production of solar grade float glass in India. Currently, the company operates two furnaces with a combined capacity of 450tpd for solar grade float glass. Borosil Renewables is in the process of installing its third furnace with an installed capacity of 500tpd. Commercial production from this furnace is expected to commence in June 2022. This will take the overall installed capacity to 950tpd.

The company has announced plans to set up two more furnaces for solar glass production, each with installed capacity of 500tpd. Furnace number four is expected to commence commercial production by June 2023, while the fifth furnace is expected to commence production during June – September 2024.

According to a statement from the company, "In view of the robust demand for domestic solar modules, the demand for solar glass is set to rise, needing around 2,300tpd of melting capacity by the year 2024." ●

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Taking command of the sustainability conversation

When glass container manufacturer Encirc began to strive for greater sustainability, its marketing agency The Armstrong Partnership proposed a 360 strategy to communicate the new business model. Daniel Owen reveals how the results of this working partnership have transformed the beverage industry.



Daniel Owen, CEO of The Armstrong Partnership.

If your business has ever worked with an external marketing agency, you may be familiar with creating a



Adrian Curry, Managing Director of Encirc.

brand proposition: the way in which you tell your brand story outside of your organisation. It's a vital

element to the success of your business, particularly if your organisation has ambitious growth objectives. Without an effective external facing narrative, your current and potential customers aren't going to easily understand the journey you are taking your company on and – perhaps more importantly – how that can benefit them. An effective brand proposition can be the difference between recognition and disregard.

The Armstrong Partnership has worked with Encirc, part of Vidrala for over seven years, helping to form a new identity, craft its brand proposition and support its external communications throughout a period of evolution as it sought to revolutionise the supply chain.

Striving for greater sustainability

Why did Encirc strive for greater sustainability and what changes were made?

Sustainability has seen a significant change of pace over the last few years. Across the board, companies have been slow to react and, historically, simply weren't doing enough to make a considerable impact.

This presented a huge gap in the market and Encirc ▶

Putting it into practice

The Armstrong Partnership's work for Encirc won the Marketing Impact category at this year's Glass Focus Awards. CEO Daniel Owen explains how the agency approached Encirc's brief and the campaign's results:

"To celebrate five key milestones over the course of 2020, we worked with Encirc to create a bold and inspiring campaign to support a series of virtual customer events.

"Encirc has always been a game-changer in its industry. Their achievements during 2020 were unseen anywhere else in the glass industry and their vision for the future has once again set the bar for the industry. What was needed was a creative direction that would match the impact of this transformation and engage their global customer base.

"Encirc had disrupted the beverages supply chain by creating a unique '360' service that transformed the route to market

for global brands selling in the UK. The innovative service is the most sustainable way to deliver to retail. With the pandemic immediately putting paid to hosting any live events, we needed to find a new way to share Encirc's ambitious future plans with customers.

"The resulting campaign was called Game Changers, and it celebrated five incredible achievements in one year. These included enjoying five successful years as part of the Vidrala Group, the completion of a massive €275m investment programme, trialling bio-diesel as a sustainable fuel alternative to achieve an ultra-low carbon bottle, installing the world's first industry 4.0 production line and building the world's largest furnace making it one of the most efficient in the world.

"We used captivating messages and impactful visuals, coupled with a series of footage and 3D videos and a bold 30-second teaser animation to bolster interest, while the Encirc team presented directly to existing and

prospective customers.

"The core messages focused on the benefits to all: how Encirc's sustainable business model is integral to achieving the ultimate goal of becoming the most sustainable beverage supply chain in the world.

"The exceptional success of Game Changers attracted interest from some of the world's highest profile brand owners, who were delighted to see such an innovative and progressive approach and a partner that was pushing the boundaries and putting sustainability first."



Representatives of Encirc and The Armstrong Partnership receiving the Marketing Impact award (sponsored by Friends of Glass) at the Glass Focus Awards 2021 in Manchester last November.

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became the only company in the sector to combine container glass manufacturing, high-speed beverage filling, bonded warehousing and automated logistics. This unique offering provides customers with speed and surety of supply and takes the headache out of the supply chain, simplifying logistics between brand owner and retailer. It's the most sustainable way to deliver drinks to retail.

By cutting multiple steps from the packaging process, Encirc saves millions of road miles every year. This has had a significant impact on sustainable logistics, as well as reducing administration and planning between brand owners and retailers.

In addition to providing a unique and sustainable supply chain, Encirc has invested heavily in all three of its manufacturing sites, built the world's largest container glass furnace – capable of making up to 900 tonnes of glass per day, successfully trialed bio-fuel, and installed the world's first industry 4.0 production line.

These substantial changes represent a new era for the business – but they're complex and difficult to

communicate succinctly. The challenge for us, as Encirc's global marketing partner, was to find new and engaging ways to explain what was happening behind-the-scenes.

The key is in communication

Unequivocal change such as this requires strategic communication; a globally understood label that customers can instantly recognise and understand. We called it '360,' to represent the full-service supply chain.

Communicating such a monumental change in business model was challenging. Our strategy focused on communicating the countless efficiency and sustainability benefits – rather than focus on the process itself. Tailored presentations, video and animations to illustrate the process were all shared with customers, supported with a new website to which to direct traffic.

Internally, we managed an exercise to align the company and ensure that all messaging coming out of Encirc was consistent. This can be an overlooked area when communicating large-scale change, but it's vital that all voices are the same when it comes to the customer's experience.

Embracing tech

Technology is key for projects such as this, both in terms of project delivery and demonstrating the impact. Ambitious change, particularly with tech, must be clearly communicated so its impact can be understood and embraced by customers. For Encirc, that meant photorealistic 3D, animations, video and CGI stills of the process and stunning print content. The results are clear. Customers and retailers responded, with Encirc logging order increases as high as 90% – as well as a significant reduction in carbon emissions each year.

Adrian Curry, MD of Encirc, said: "The 360 strategy has not only transformed our business, it's now something that retailers are demanding. It has transformed the beverage industry. With unrivalled investment from our parent company Vidrala, it is our ambition to lead the way in the UK drinks industry." ●

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Recycling in the glass packaging industry - part 1

Prof. Vincenzo M. Sglavo and Davide Armoni, Andrea Rossi, Mattia Scottini and Nicholas Paul Sentieri outline the current state of recycling in the glass packaging industry in Italy and Europe and discuss technical and economical limitations to the EU's goals for glass packaging recycling.

In the last three years the European Union has outlined the latest goals and established a standard that the glass packaging industry of all 27 EU member states must meet. By 2030, 90% of all consumed glass packaging must be collected and made available for recycling.¹ Acknowledging that not all glass packaging makes its way through all the recycling process, the EU has also set targets to recycle 70% of packaging by 2025 and 75% by 2030.¹ These values take into account losses during the recycling process and underline how proper education, techniques and procedures appropriate for each individual glass container are more important than ever before.

Figures from 2018 showed that, with a total 'collection for recycling' rate of 76.4%² (based on just under 17 million tons of consumed glass packaging over a collected recycling value of just under 13 million tons²) the EU as a whole is well on its way towards meeting the 90% goal. Relative to other EU member states,

Italy had a total collection recycling rate of 85.2% for 2018.² Finland, Sweden and Belgium boasted approximately 98% for 2018, while Portugal could only manage to collect a pitiful 49%.²

What holds back some of the member states from improving these collection efforts?

This report seeks to identify the limitations affecting the glass packaging industry in the technical, economic, social, legislative aspects, among others, through the lens of collection and processing in Italy. In addition to identifying the limitations, this work identifies potential solutions to aid in closing the gap on the EU set standards with reference and comparison to other EU members. This may prove difficult as every limitation is interconnected to another in a multitude of ways. The complete and total efforts of every citizen in every nation [must] be set at the forefront of importance if these limitations are to ever be overcome and reach, in the next decade, the EU goal. Yet, even beyond these hollow numbers lies a deeper and more meaningful benchmark of self-sufficient, closed-loop glass packaging systems. These ideas, among others, will be further detailed in the analysis below, specifically referring to the Italian situation.

Restrictive aspects of the glass recycling industry

The EU's ambitious goal of achieving 90% recycling of glass packaging by 2030 is currently held back by limitations in different sectors, not only linked to potential opportunities not exploited in the past, but also to legacies that show

enormous inertia to change. In the following sections, a brief analysis of the current situation and its effect on the recycling system are considered and commented on.

Technical limitations

The technical aspect takes into consideration the impact of technology and its development on the recycling industry. The last few years have seen a radical change in technological development, both hardware and software, with a positive impact on productivity and reduction in costs. The current configuration of the glass recycling system envisages the presence of three main entities: the private citizen who carries out separate collection, the industry that processes glass waste in cullet form and the final glass manufacturers. Various bodies can intervene and aid in linking these protagonists together, as shown in the case of CoReVe [the national glass recovery consortium] in Italy, which represents the link between waste collection and the process industry.

The collection system is managed by the municipalities, which usually choose between a centralised bottle bank or a door-to-door collection system. The collection of solely glass packaging, as well as multi-material systems (glass, plastic and metal), can be implemented; single-colour or multi-colour glass collection are additional possible choices. The application of the business model is based on various factors, such as the city structure, political moves or the consolidation of historical actions. An important effect was observed regarding the choice of collection system: the quality of the waste, assessed as the quantity of impurities present, decreases going from a collection of glass only to a multi-material collection, and from the bell-glass [collection] system to the door-to-door system.³

Sorting and purification are the ▶



The market for glass packaging recycling in Italy is very different compared to the rest of Europe.



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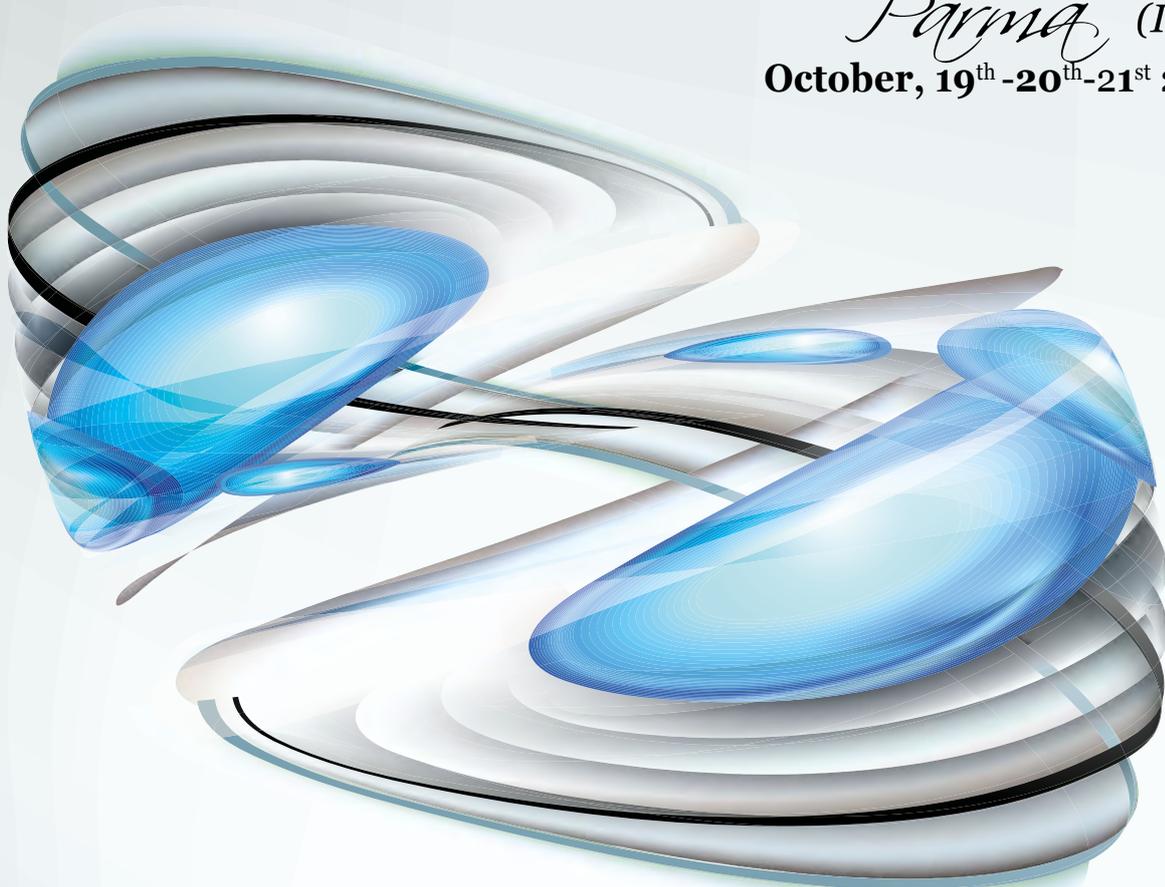


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core steps of the glass collection system: they convert waste into cullet, by removing impurities and reducing the pieces to suitable dimensions. Every high-technology production plant is unique and characterised by different machinery along the line, but in general, the process can be boiled down to several phases including the cleaning of the packaging, elimination of metallic impurities, removal of non-metallic contaminants and finally the inspection.⁴ The structure of each plant varies according to different factors, most importantly the type and purity of the average incoming waste, which changes greatly from region to region and from state to state. For example, Northern Europe produces glass waste with fewer impurities than Italy and so its plants are characterised by fewer optical detectors and a leaner structure.^{4,5}

Separating and sorting

The efficiency of cullet processing is determined by the quantity of recyclable glass that is discharged due to the removal of contaminants. The main impurities that can be recognised are metals, such as bottle caps or cans, plastics, especially plastic bags,

and ceramic materials. The latter represents the biggest problem, as porcelain and non-sodium-calcium glasses can be found in the collected product: their glass-like structure and properties make identification difficult and currently account for almost all impurities in the final cullet. Porcelain material usually appears as small particles that do not undergo substantial changes in the melting furnace and are found as inclusions in the final glass package. Lead glass danger is related to the presence of the toxic element: an ashtray contains enough lead to exceed the legislative limit of an entire batch! Glasses of other compositions vary the chemical-physical properties during the melting phase, reducing the efficiency of the melting process.

Coloured glass separation is another major role played by optical sorting. The main colours, flint, green and amber, are distinct and sold separately. Their separation is not perfect and this represents the biggest issue for the use of recycled glass, with direct impacts on the aesthetics of the final product. For this reason, the maximum recycled material rate (MRR) adopted by the glass industries

is very low in the case of flint glass, while the MRR of amber glass can reach maximum values of 90%, which is currently the technical production limit.⁶ An increase in MRR has different advantages: the most important is the reduction of energy used during final production, but a decrease in the raw material costs and equivalent CO₂ into the atmosphere can also be achieved.⁷ The drawback of MRR is that it may significantly impact the aesthetic quality, but not mechanical properties, of the final product.

Economic limitations

Regarding the economic limitation, the price of cullet is difficult to estimate, as it varies a lot depending on the timeframe and the region of collection. The first is connected to the cullet availability on the market, while the latter is determined by the cost and quality of waste collection management. Additionally, colours and purity are the two major factors for the final determination of the products final price.

As pointed out before, in the glass recycling industry, the two major types of glass collection systems used are the bottle bank and the door-to-door system. The preferred system is the bottle bank because it is cheaper, more effective and has a higher efficiency. Furthermore, a bottle bank service is one-third the cost when compared to the door-to-door system.⁵ In general, the door-to-door system is particularly favourable only in specific and isolated cases (e.g., larger producers such as bars and restaurants or in high populated areas).⁵ However, the problematic aspects of the door-to-door system are related to a partial lack of co-operation on the part of citizens or insufficient storage for waste inside homes – often this is due to inadequate collection frequency, causing glass packaging to build up over time.▶



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Industry perspective

From the perspective of industries, the major problem with glass recycling is related to the quality and quantity of cullet. These two factors are among the easiest to identify as not only does quantity have an effect on the fluctuating price of the market, but it also affects costs related to processing industries.⁴ Regarding the quality of cullet, the glass collection system plays an important role as the door-to-door system may drastically affect the quality of cullet collected. An example of potentially compromising the cullet quality is the use of plastic bags by citizens as an easier means of separating various materials. This is detrimental to the collection and processing system because these impurities lead to a slowdown in the recycling process and above all, reduce the efficiency of the entire system.⁸ In fact, during the treatment process, plastic bags containing recycled glass packaging [have to be] opened manually in order to facilitate the subsequent selection steps.⁹ It is also important to remember that a closed bag is treated as a single body, discarded, and that material within the bag is not considered in the final value of recycled glass. A consideration that has not been made up to this point is one of the coveted mono-material,⁵ which allows us to avoid problems of contamination from other materials that can lead to the worsening of cullet quality.

Cost comparisons

When considering the economic limitations of glass recycling, an analysis from the point of view of cost is very important. Specifically, a subdivision is made between raw material costs and costs related to processing the recycled material, which includes plant operational costs, waste disposal costs and transportation costs. Production costs are among the simplest to analyse, as the costs of the workers and machinery that are used can be easily parameterized and controlled. With regards to the cost of raw materials, the analysis is more complex because they are strongly influenced by market trends and fluctuations. The costs of raw materials often assume a certain importance relative to the others and can contribute between 20 to 40% of the total cost of generating a new product.^{4,6} On the other hand, industries have greater control in managing to reduce the

costs associated with the transport of raw materials and finished products, as well as the costs associated with the processing of recycled glass, with one example being an increase in furnace efficiency.⁴ Some other interesting strategies that companies can implement to reduce costs include the development of new tools and software to improve performance in the recycling process⁴ and the progression of innovative renewable energy sources systems.

Italian market

The market for glass recycling in Italy is very different from the rest of Europe. An aspect that affects the overall percentage of total recycled glass obtained can be linked to the possibility of separating the recycled glass packaging by colour. In Italy, the situation is not as simple as it would seem, especially in the case of using a door-to-door collection system, as this system is unintentionally neglectful of the disproportional use of amber and green coloured glass relative to clear flint glass within each household.⁵ Furthermore, as mentioned in the technical limitations, Italy has a higher quantity and quality of optical readers and therefore to achieve the EU 2030 target it has invested heavily in this technology. In Northern and Central Europe (e.g. Germany, Belgium, Sweden) the situation is somewhat different, and there is greater progress towards fully utilising a glass separation system based on colour. However, the main limitation of separating by colour is linked to the final cost of separating the cullet as this separation system is very expensive. The advantage of properly sorting glass packing during collection has a direct influence, not only on the cost, but also on the quality of cullet used in production. ●

This report will be concluded in the March/April 2022 issue of *Glass Worldwide*.

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In favour of state-of-the-art fining technology

Prof. Sven Wiltzsch discusses relevant technical issues for the development of new glass melting technologies.

The potential for new furnace developments and its real application in the industry is quite high today, because of customer demand for a green and CO₂-free glass. However, the chance of failure is quite high, too, as the history of new furnace technology demonstrates. In order to minimise these risks, I would like to state here three evaluation principles of glass melting technologies to demonstrate a meaningful and safe way for a new furnace technology.

(In 2014 I presented some evaluation principles to classify melting technologies and stated two arrangements of advanced melting technologies according to Figures 1 and 2, which could have specific melting rates of higher than 5 t/(m²*d) and melting temperatures of lower than 1,350°C.)

I have stated the first and the second evaluation principles as questions, which you can ask furnace operators, furnace engineers and furnace designers.

1. "Would you accept a new furnace technology that might influence the glass level during the production?"
2. "Would you accept a new furnace technology that has less ability to control glass level than a standard melting furnace?"

Behaviour of glass melt

When I attended my first commissioning of an all electrical heated furnace in Taiwan/Hsinchu as a trainee I checked out the behaviour of the glass melt level and the glass level controller, while the operator filled the glass cullet on the top of the melt. My observation can be seen during every fill melting of an electrical furnace. Firstly, inside the furnace you will see a relatively huge wave travelling from left to right on the top of the glass melt. Secondly, you will recognise the same wave roughly 20 seconds after cullet filling at the glass level meter installed in the feeder channel in the +/- range of some mm. This observation told me, that the communication of glass level changes between furnace and

feeder channel is fast if the glass furnace and the feeder channel are directly connected. There is no better way to have a direct and fast response between batch charging and glass level measurement! On the other hand, rough glass level fluctuations in the melting part can be also seen at the glass level meter in the feeder channel and therefore could negatively interact with the glass level/batch charger controller.

Now let us check out some melting technologies based on these two principles, and I think that you will come more or less to the same understanding:

- Batch melter of the P-10² → worse glass level controllability, because the direct connection of batch and melt is missing
- Submerged combustion melter³ → glass level fluctuations
- Subatmospheric fining based on P-10 technology³ → worse glass level controllability due to nozzle application for connection of sand dissolution and fining zone
- Centrifugal fining technology of the Ramar-melter⁴ → worse glass level controllability similar to the P-10 melter

Frankly speaking I personally like the macro mix melter of the Ramar-melting technology for melting batch due to several reasons, but even here I see a risk for glass level fluctuation problems.

Degassing

The third evaluation principle considers the fining of glass melts. Most engineers will define the fining process as a 'bubble removal process'. However, the practical experiences show, that fining is a 'bubble removal and a degassing process'. You can have the best bubble removal process in your furnace. However, if the degassing of the melt is not ... [carried out properly] you will have problems with bubbles in the feeder channel, forming system (especially in the float furnace) or at customer sites. The latter problem is well known in the special glass industry during post

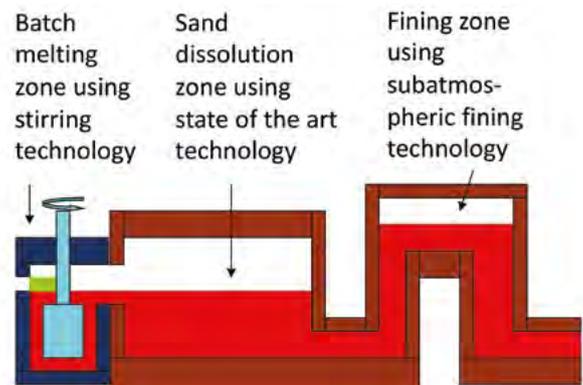


Figure 1: Advanced furnace technology using three melting zones.

forming processes of glass.

We should know that the degassing process does not work by bubble removal alone. The only way to reach a sufficient degassing of the glass melt is through bubble growth in the glass melt, which means that we 'pump the gases from the glass melt into the bubbles'. Therefore, we can state the third principle: 'A meaningful fining technology has to consider bubble growth.' If you check out the ideas of other fining technologies in comparison to the technology of using a fining agent like Na₂SO₄, then you will see that most 'physical fining technologies' do not consider bubble growth. It seems to be that the researchers in this field expect to find a technology by using physical meaning in order to abolish fining agents and decreasing the fining temperature. Both sound good, but the third evaluation principle tells us that this research is the well known 'search for the needle in a haystack'. There is only one fining technology that can reach the aim of reducing the fining temperature, 'abolish' the fining agents and bubble growth – 'subatmospheric [pressure] fining technology.'

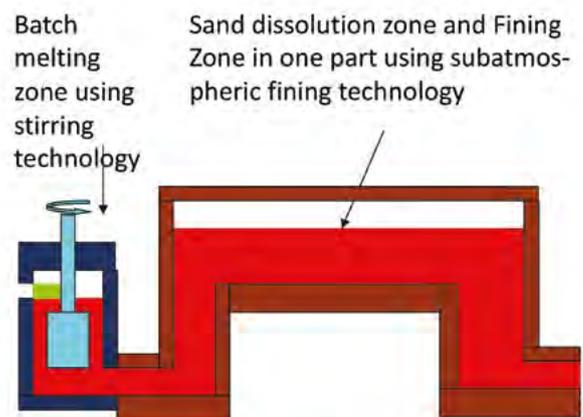


Figure 2: Advanced furnace technology using two melting zones.

Hydrogen fuel combustion

We should reflect the third evaluation principle in another way. Why do we want to use hydrogen fuel combustion in the future?

It is well known that water in the glass melt is well dissolved at high temperatures, contrary to all other gases. In contrast the glass melt would like to 'spit' the water out at cold temperatures (feeder channel and float furnace). The amount of water in the glass melt is particularly influenced in the batch melting zone and it is a function of the partial pressure of the water in the combustion atmosphere. In special glass production it is well known that water in the glass melt is a cause of oxygen bubbles in the feeder channel.

We must realise that switching our melting technology to oxygen-hydrogen combustion means that we must accept a higher risk of new bubble formation in the feeder channel or float furnace and in the worst cases at our customer's site. Why do we want to do this? The application of electric melting has roughly 50% higher efficiency and we can be sure that we will have a lower amount of water in the glass melt as Biennek showed.⁵ I would like to commend using electric energy to melt the batch and not hydrogen firing because we know that the energy for the batch melting is the highest energy part in the glass melt production (roughly 80%) and particularly in this part of the glass melting process, hydrogen firing only offers disadvantages.

Conclusion

Summarising the given information here and considering my former evaluation principles from 2014, we can conclude a rather positive view of a new glass melting technology for the near future. We can take the furnaces from Figures 1 or 2 and should change the macro mix melter for a state-of-the-art all-electric melter.

Of course, we do not have subatmospheric fining available technology today and therefore we should concentrate on developing such a technology, [or] we could instead start using a state-of-the-art fining technology now. ●

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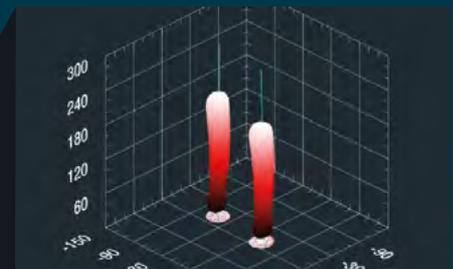
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Improved energy performance from a hybrid furnace

Carlo Cravero, Damiano Marchese, Alessandro Mola, Marco Rollini, Leonardo Spinelli and Alessandro Spoladore share the findings from an innovative heat balance project to reduce energy consumption at a glassworks in Italy.

At the O-I/Vetriere Meridionali plant in Castellana Grotte, southern Italy, the Furnace 1 is a 'Sagittario' model from Stara Glass' Centauro range.

It employs a hybrid recovery system where the exchange between the waste gasses and the combustion air is divided into two phases: the

first at high temperature in a regenerative ceramic system and the second at low temperature in a metal continuous system. The furnace also features an HEAS (high-efficiency air-staging) system to direct a flow of combustion air into the waste gas port, in order to ensure a more effective and controlled staged combustion. In addition, taking advantage of the temperature level of the waste gas, guaranteed by the passage between ceramic and metal exchangers, an SNCR (Selective Non-Catalytic Reaction) system has been installed for the thermal abatement of nitrogen oxides (NOx) by urea injection.

In essence, on this furnace, various practices have been used to overcome the limits of the structural 'rigidity' associated with traditional end-port regenerative furnaces, with important results in terms of energy and emissions.

Energy balance of the Sagittario furnace

During the heat balance detection period, the furnace produced half-white coloured glass, with an average pull of about 219tpd, corresponding to a specific pull of about three tons/m² per day. The furnace used around 873Sm³/h of natural gas and 623kW of electric boosting, approximately ▶

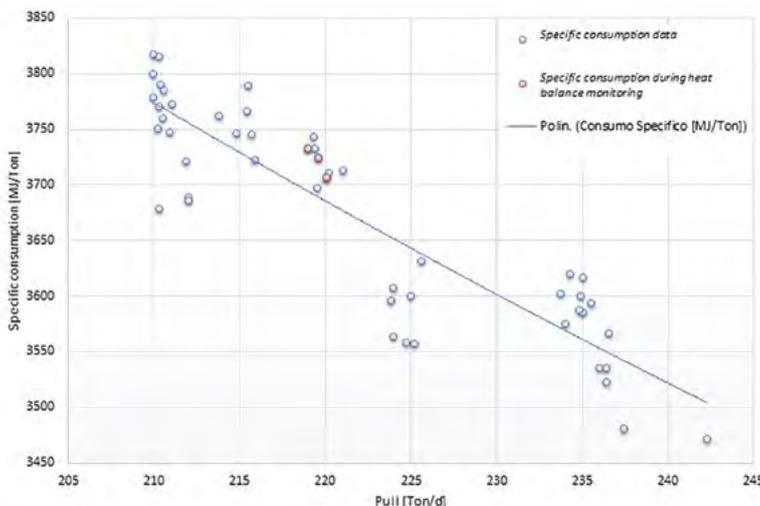


Figure 1: Energy consumption vs Pull.

ENERGY INLET

	Kcal/KG	MJ/ton	Gcal/H	%
Fuel heat	830,27	3476,17	7,60	92,78
Electric boosting heat	58,56	245,20	0,54	6,54
Inlet air heat	6,02	25,20	0,06	0,67
Total inlet energy	894,85	3746,56	8,19	100,00

ENERGY OUTLET

Glass heat	415,47	1739,49	3,80	46,43
Water evaporation heat	13,44	56,28	0,12	1,50
Reactions heat	71,47	299,22	0,65	7,99
Waste gas sensible heat	199,30	834,43	1,82	22,27
Heat released by leakages	8,21	34,39	0,08	0,92
Heat release by holes	10,46	43,78	0,10	1,17
Structural heat loss	179,26	750,53	1,64	20,03
Total outlet energy	897,61	3758,13	8,21	100,31

Pull	219,6 ton/d
Hourly Pull	9148,6 ton/h
% H2O Batch Umidity	2,04 %
% Cullet	50 %
Fuel calorific heat	8700 kcal/Nm3
Specific consumption	888,8 Kcal/Kg

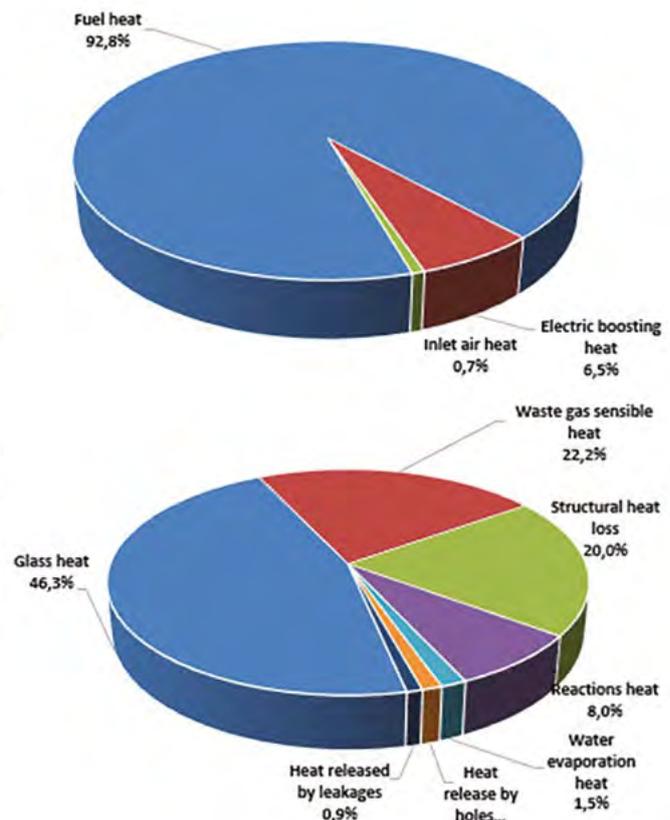


Figure 2: Sagittario heat balance.



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Figure 3: Average pressure along furnace and regenerator.

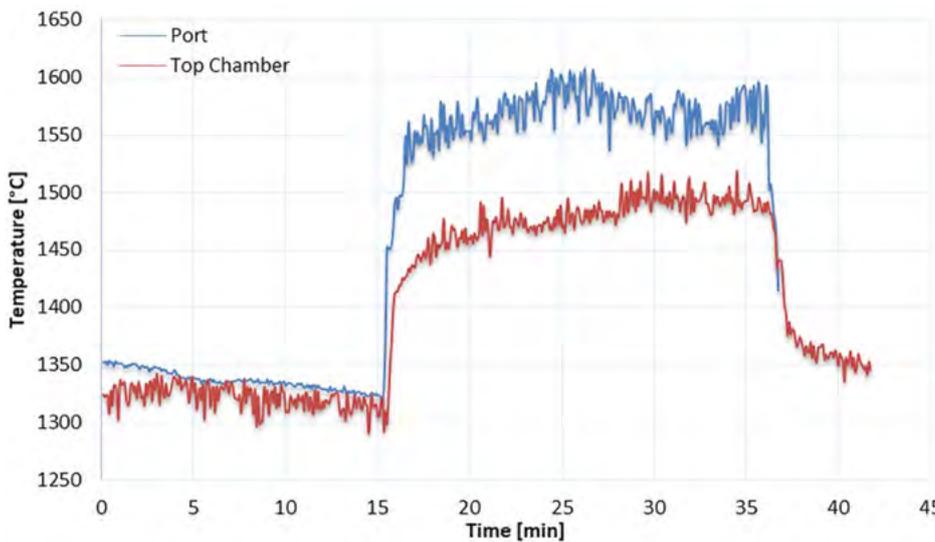


Figure 4: Temperature at the left port and top chamber.

the 6% of the total energy supplied.

Figure 1 shows the specific consumption variation with the glass

pull. The blue dots indicate the months prior to the heat balance monitoring. The red dots refer to the days of on-site monitoring – during this period the furnace was

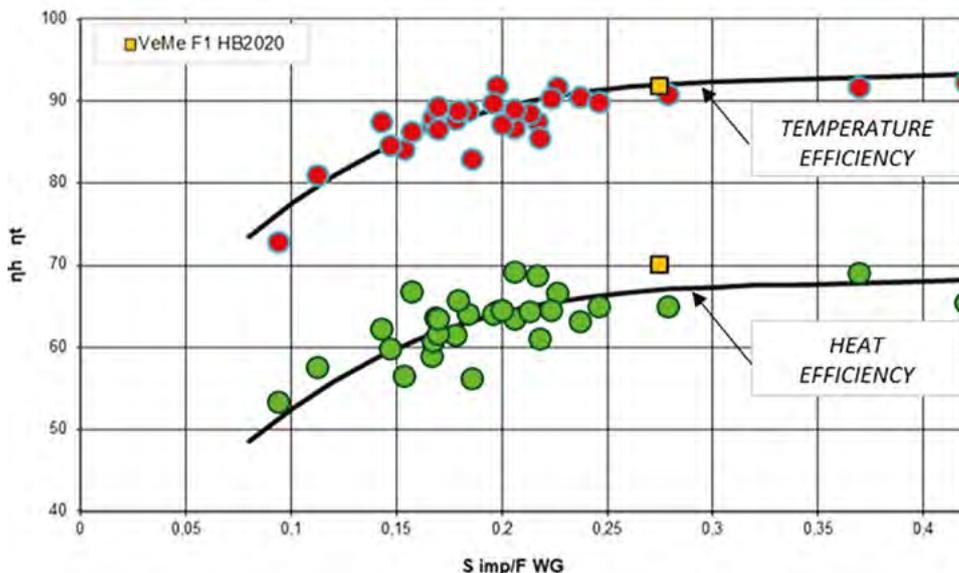


Figure 5: Regenerator temperature and heat efficiency.

managed to maintain a constant percentage of cullet and electrical boosting to ensure that energy consumption was influenced only by the pull. It can be observed that the consumption on these days is in line with measurements recorded before the project, confirming the furnace's energy and production stability.

Global thermal balance of the system

The results related to the energy balance, i.e., the incoming and outgoing heat flows, are summarised in Figure 2. In order to be able to compare the performance of the Sagittario furnace with those of any other regenerative furnace, the balance configuration must include the input of air to the system.

Natural gas provides 7,600kcal/h, equal to about 830kcal/kg, and represents 92.8% of the total input energy. The energy contribution of boosting is 530kcal/h, equal to about 58kcal/kg, and represents 6.5% of the total. The heat contained in the air entering the system at an estimated temperature of 20°C is equal to just over 60kcal/h, and represents approximately 0.7% of the total energy consumption.

Estimation of outlet energy flows

Measurements taken for the estimation of the various thermal and mass flows required for the project concerned the pressure of the furnace and of the heat recovery system, the composition of the waste gas (in particular the oxygen concentration for the estimation of infiltrations), and the temperature of combustion air and waste gases in the various significant positions of the system.

Pressure

Figure 3 shows a synthetic picture of the average pressure and its variability (standard deviation) in various positions of the melting system, both in configuration with flames on the right and with flames on the left side.

Chemical composition of the waste gases

The determination of the flue gas concentrations (O_2 , NO_x and CO) in the emissions was detected continuously in various points in the regeneration system (Table 2). The measurements taken from the top camera show a post-staging increase in the concentration of O_2 up to about 2.5–2.9%, a value completely in line ▶

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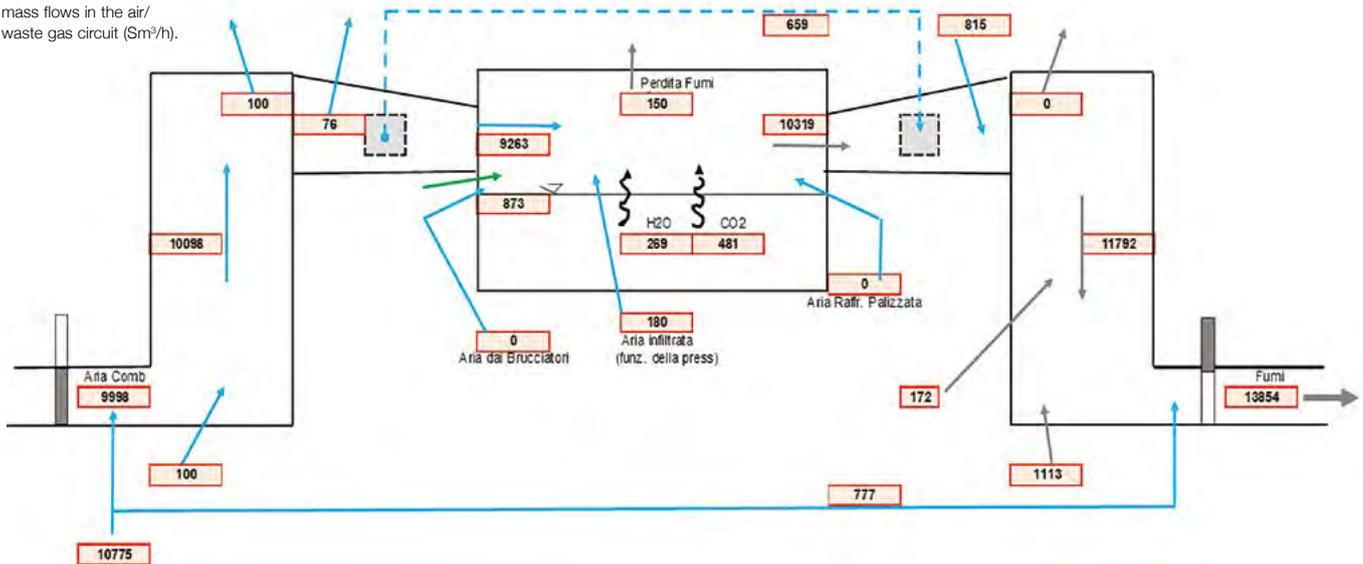
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Figure 6: Diagram of mass flows in the air/waste gas circuit (Sm³/h).



with the use of the HEAS system; this involves a strong reduction of CO, that is kept at the acceptable value of about 2,000ppm.

RIGHT REGENERATOR	CO	O ₂	NO _x
	ppm	%	mg/Nm ³ @8%
Port	2200	1.00	791
Top chamber	30	2.36	856
Base chamber	3	2.60	798
LEFT REGENERATOR	CO	O ₂	NO _x
	ppm	%	mg/Nm ³ @8%
Port	1600	1.10	806
Top chamber	9	2.60	890
Base chamber	0	2.90	848

Table 2: Waste Gas analysis

Air and waste gas temperatures

To estimate the heat entering the furnace with preheated air, and leaving with combustion waste gas, the temperature of the gaseous flows was measured at various points: in the ports and at the regenerator top and bottom.

To measure the temperature of a gas flowing in a high temperature environment, it is essential to use a suction thermocouple, specially designed to minimise the radiative heat exchange between the thermocouple and the surrounding environment, and instead maximise the convective one with the fluid of interest.

The graphs of the measurements made are shown in Figure 4, while Table 3 shows the temperatures used as a reference in the thermal balance.

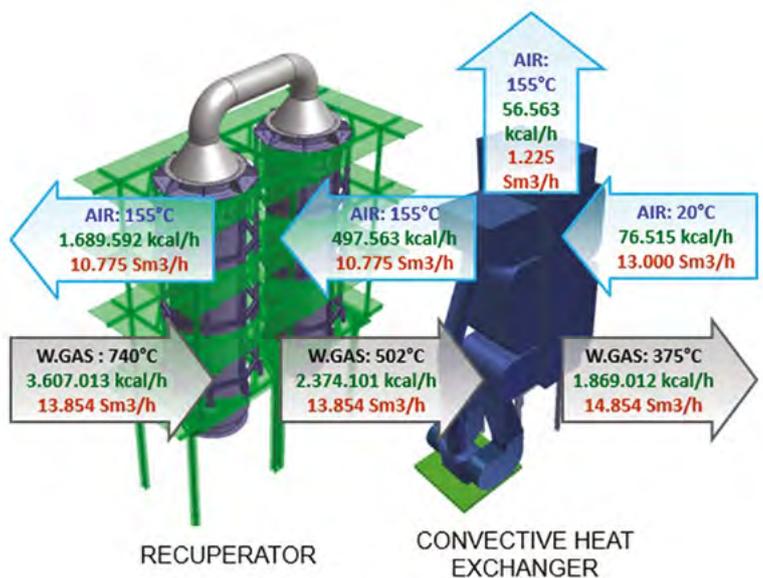


Figure 7: Energy balance of the metal heat exchange section.

Temperature [°C]	Air	WG
Port	1342	1555
Regenerator top	1322	1465
Metallic double shell – inlet flows	155*	742
Metallic double shell – outlet flows	500*	502*
Convective heat exchanger – inlet flows	20**	502*
Convective heat exchanger – outlet flows	155*	375*

Table 3: Summary of the estimated temperatures for the closure of partial balances

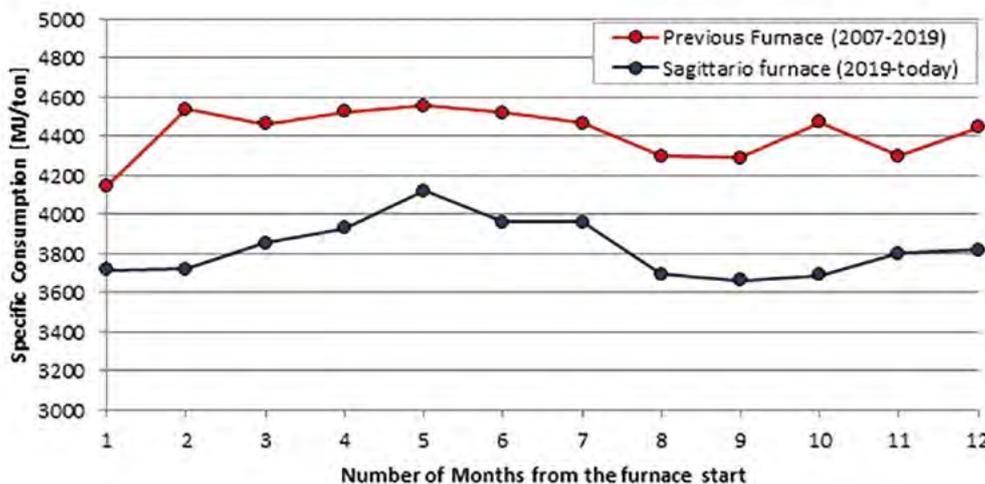


Figure 8: Previous and current furnace campaign consumption trends.

The system expresses high levels of heat recovery from the waste gas to the combustion air, which represents the premise for a containment of energy consumption and associated emissions. In particular, the recovery system shows a temperature efficiency of 91.8%, ($T_{air}[K]/T_{waste\ gas}[K]$) and a heat efficiency (Heat air/Heat waste gas) close to 70%, among the highest to date measured on regenerative furnaces with U-flames.

In the case of a hybrid furnace such as Sagittario, in which the heat exchange takes place partly ▶



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in a regenerative configuration and partly in a recuperative configuration, if the efficiency values (temperature and heat) were diagrammed as a function of the 'specific' exchange surface of the regenerator (total surface of the regenerator/flow of hot waste gases see Figure 5), a clear overestimation of the exchange performance would be obtained.

In fact, since the temperature of the air at the outlet of the metal section was measured at about 500–510°C (which becomes 530–540°C at the inlet of the regenerator, due to the regenerative effect of the refractory connection duct), it can be estimated that about 35% of the heat exchange happens in the recuperator, so, we are willing to concede that compared with the other regenerative furnaces, our 'effective' exchange surface is amplified by a factor of ≈ 1.5 .

It is interesting to underline that in the case of the Sagittario furnace, we have three levels of heat exchange to recover the heat from the waste gas towards the combustion air.

A high temperature ceramic one where the waste gas drops from 1,480 to 860°C, heating the air up to 1,320–1,340°C.

A second metal still at the radiating-heat-exchange stage constituted by a double shell recuperator, where the air is heated up to 500°C and the waste gas is cooled down to 520°C, and finally a third heat exchange, still metallic, where the waste gas comes out at 375–380°C and preheats the combustion air (and an additional quota) at 155°C.

If we look at the mass balance, we see how a partially staged combustion is managed in the furnace where a more reduced management of the combustion in the furnace is followed by a supply of preheated air directly coming from the fan.

The share of this air can be adjusted by means of an ejector that allows, on one hand, generation of a Venturi effect [whereby the velocity of a fluid increases as the cross section of its container decreases] that accompanies the flow of preheated air from the air port to the waste gas port (already naturally favoured by the physiologic pressure

difference), and on the other, facilitates the mixing of the two flows, ensuring the development of an effective post combustion. This enables the furnace NOx emissions to be contained.

Figure 6 shows that, in addition to the usual flows, in the Sagittario furnace there are also two bypass flows: one at the base of the chambers, consisting of the losses of the reversing valves; and one between the port necks (indicated by grey rectangles), consisting of the total post-combustion air flow linked to the HEAS system.

It should be noted that the Castellana plant has an electrostatic precipitator (ESP) for the two furnaces, specified for an operating temperature of 350–400°C. This limits the possibility of extracting larger quantities of heat from the waste gases but does not reduce the thermal level of the combustion air (which in the context of a substantially counter-current exchanger still reaches optimal levels), as the residual heat is recovered through the additional extra-process hot air.

In other contexts, with textile purification systems (bag filters) the thermal level of the waste gas could drop down to 160–180°C with recoveries in terms of hot (clean) air of up to 12–15% of the heat introduced into the furnace.

It is clean air because, unlike in the ceramic exchange, in the metal exchange the two streams of dirty waste gas and clean air are separated.

It is known that this excess air is energetically useful when a use outside the melting process is identified.

If we limit ourselves to the melting process, this organisation of recovery from the waste gases to the air still allows us to better maintain energy performance over time.

In fact, in a traditional regenerative furnace, three main reasons connected to the ageing of the furnace determine the increase in consumption:

1. The increase in heat loss from the structure walls, in particular from the palisade subject to a severe corrosion, in particular at the height of the glass level.
2. The increase in infiltrations due to increasingly less effective sealing over time.

3. The loss of efficiency of the air/waste gas heat exchange in the chambers depending on the condensation of sulphates and the consequent reduction of the exchange area.

While the first two effects are common to a regenerative furnace and to a hybrid furnace, the degradation of recovery is almost absent in this second type, or in any case limited.

In the metal exchange section [of a recuperative furnace] through non-invasive methods it is possible to clean the surfaces (typically every 60–90 days) which restores the starting performance; however, the ceramic section [in a hybrid furnace] works at waste gas temperatures higher than the condensation temperature of the sulphates and therefore the fouling due to the condensation is avoided in this un-cleanable zone and moved to a cleanable one.

Energy consumption comparison

Comparing the energy consumption of the Sagittario furnace in the first year of the campaign with the previous furnace in the same period (a traditional end-port furnace), we observe a consistent and continuous energy saving of around 10% under the same operating conditions in terms of pull, cullet percentage and contribution of electricity.

Figure 8 illustrates the average consumption trend during the Sagittario furnace's first months of activity compared to the previous furnace's first 12 months of operation. Levels of cullet remained similar for both periods, therefore the data is comparable. The increase in consumption detected in the new furnace during months 4–7 (March-June 2020) can be linked to the context of the situation created by the Covid-19 pandemic (in particular, cullet supply).

Conclusion: The new plant system shows an important reduction in energy consumption, confirming the expectations and premise of the project. ●

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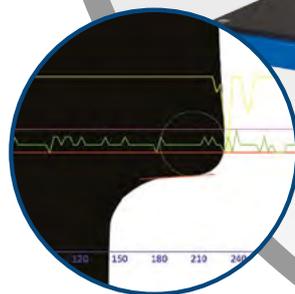


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From hot to cold, all under one roof

Since the end of 2019, CNUD EFCO GFT, a proven successful player in the field of flat glass production equipment, has been part of the Grenzebach Group. With the adoption of the Grenzebach name, the next step on the way to integration will take place at the beginning of 2022.

For decades the name CNUD EFCO GFT has been synonymous with excellent products and process know-how in tin bath, annealing lehr and utilities in float glass production. In November 2019, the Grenzebach Group took over the company – the beginning of an extensive integration process that has allowed numerous synergies and complements Grenzebach’s already comprehensive range of services. Since then, Grenzebach has offered its customers all the fundamentals of the glass production process – from tin bath to cold end – from a single source, right through to the transportation of the glass sheets to the warehouse.

An integration that makes everything easier

The next step on this path is scheduled to take place on January 1, 2022: the full integration of the glass business into the Grenzebach Group, with all of its tools and processes. Grenzebach and CNUD EFCO GFT will then finally be ‘one family,’ and customers will have only one contractual partner as of this date, namely Grenzebach – a clear, consistent solution that makes everything easier. It is also associated with the renaming of the location in Iași, Romania: the current company name, Cnud Efcu Operations, will be changed to Grenzebach Romania S.R.L. In



Another step on the way to becoming an integrated family of companies: from 1 January 2022 the production site in Iași, Romania, will be called Grenzebach Romania S.R.L. Production capacity will be expanded in 2022 with the construction of a new production hall. Source: Grenzebach.

addition, a capacity expansion is being planned at the site in Iași. A new production hall will be built in 2022.

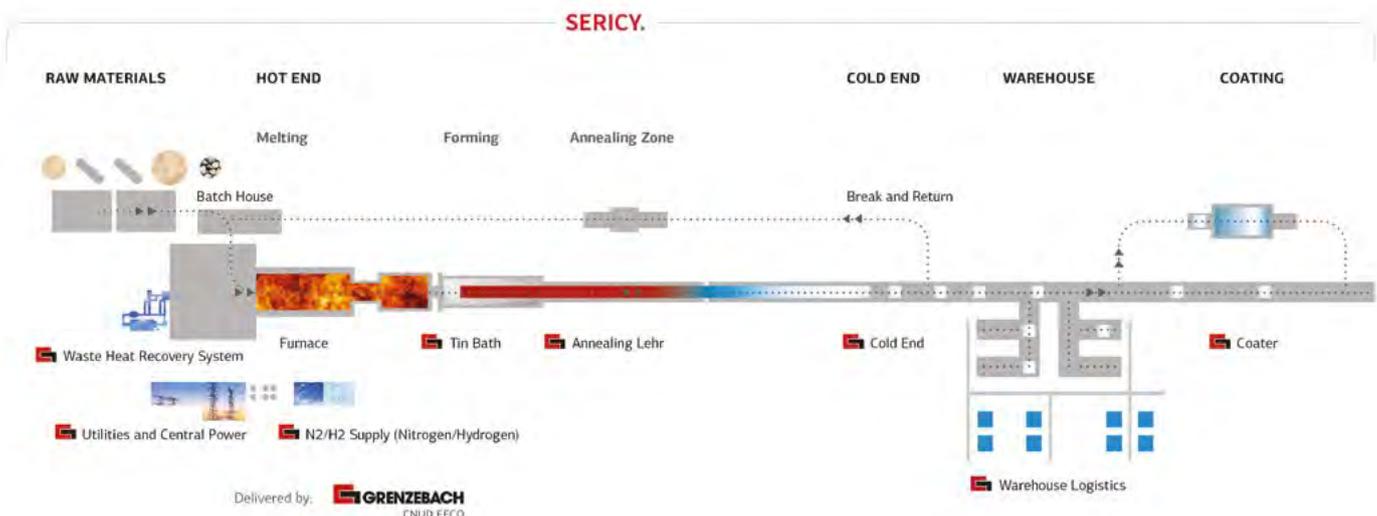
Egbert Wenninger, CCO of the Grenzebach Group, emphasises that customers can continue to rely on the performance they are used to: “The scope of services and the proven expertise will not change; the contact persons will also remain the same,” he says. The only new features as of 2022 will be the organisation structure, the company name and the e-mail addresses. This does not affect projects that are currently in progress; from now on, all new orders will be managed under the company name Grenzebach Maschinenbau GmbH, located in Hamlar, close to Augsburg, Germany.

More synergies, less effort for customers

The successful, ever closer integration of CNUD EFCO GFT into the Grenzebach Group gives customers several substantial advantages: in view of the increasing complexity of float glass production lines, solutions from a ‘one-stop shop’ are more economical and easier to calculate; they also provide more security in every respect than if solutions from different suppliers had to be combined. “The joint development and planning of integrated production lines enable glass manufacturers to implement projects smoothly, with significantly reduced coordination needs and overall costs,” says Robert Lamy, CSO of Grenzebach Belgium.

Together for better innovation

Moreover, the combined expertise is the perfect basis for joint technological developments, both new and existing, especially innovations in the digital glass industry. This possibility is represented by Grenzebach’s SERICY platform. The Industrial Internet of Things (IIoT) solution generates benefits from high data volume, reduces information silos and leverages on the ▶



Hot to cold, that’s the mission: with technologies from CNUD EFCO GFT, Grenzebach has covered the majority of float glass production since the end of 2019 – from tin bath to annealing lehr to cold end, from coating to transporting the end product to the warehouse. Source: Grenzebach.



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Grenzebach and CNUD EFCO GFT - a history of successful mergers

We shouldn't forget that CNUD EFCO GFT itself was born of a merger between three pioneering companies – CNUD, EFCO and GFT:

- CNUD, an expert in annealing lehrs, has spearheaded the annealing lehr production process since the dawn of float line history.
- EFCO has delivered ground-breaking work in tin bath development, with a special focus on the tin bath roof.
- GFT has also developed expertise in tin bath production since 2005.

Since the end of 2019, CNUD EFCO GFT has been a member of the international Grenzebach Group. With Grenzebach, a global player, CNUD EFCO GFT has been able to access an enormous wealth of knowledge and provide even more comprehensive solutions and services for the glass production industry.

latest technology. It merges information from the hot and cold sections, allowing users to achieve even better quality, higher output and reduced resource consumption. In addition, both companies have a common focus on energy efficiency and sustainability – an aspect that is becoming increasingly important, especially in today's world.

This year, Grenzebach's glass experts are looking forward to seeing customers again: in 2022, numerous trade



Egbert Wenninger, COO at Grenzebach, and Robert Lamy, CSO at Grenzebach Belgium, share the same goal: to create even more added value for their glass production customers in the future by capitalising on synergies and joint expertise. Source: Grenzebach.

fairs are on the schedule, including glasspex India, China Glass, Mir Stekla and glasstec. This means excellent opportunities to hold face-to-face discussions again and to see the latest solutions demonstrated first-hand. ●

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Optimism for the Spanish glass industry

Taking into account the ongoing recovery of the Spanish national economy from the Covid-19 pandemic and maintaining a stable demand for glass in the local market, the Spanish glass industry is optimistic about the future, reports Eugene Gerden.

While Spain was the European economy hit hardest by Covid-19 and its recovery has been slower than those of its European rivals, the current growth rates in the glass sector of the country remains generally higher than in the majority of other segments of industrial production. Positive dynamics in the glass sector of the country have been recently confirmed by some leading local glass producers as well as analysts in the field of glass business. According to them, of the entire industry, probably the highest growth is currently observed in the segment of glass containers.

Comment from ANFEVI

In an exclusive interview, Karen Davies, Secretary General of the Spanish National Association of Producers of Glass Containers (ANFEVI) has confirmed that the Association currently observes a peak of demand for glass containers in Spain.

Ms Davies commented: "This is mainly due to main reasons: the reopening of the HoReCa [hotel/restaurant/café] sector which has caused a transitory high and less orderly demand (mostly from wines and spirits); and the hoarding of glass packaging in case our product is affected by the global price

increases of raw material, industrial packaging, transport or energy. In this respect, and to avoid such increase, our industry has called for the Government's immediate support to address energy prices, which only aggravates the present circumstances, endangering the return to normality."

According to Ms Davies, during lockdown glassmaking was considered essential, and "regarding the raw material shortage that some industries are currently suffering, this has not been the case for glass packaging."

As Ms Davies added, both situations have enabled stable production throughout the year, producing around 19,000,000 bottles and jars per day, and even though exports increased during lockdown, levels are now back to normal with 80% of production allocated to the national market.

Guardian Glass

The generally good situation with Covid-19 during the period of August–November 2021 and relatively low number of new cases in the country has contributed to the fact that most of Spanish glassmaking factories operated with almost maximum utilisation. At the same time, the importance of the Spanish glass market has been recently confirmed by representatives of some

global glass producers, operating in the local market.

One such company is Guardian Glass, which has confirmed its plans for a further expansion in the market of Spain.

As Guus Boekhoudt Executive Vice President, Guardian Glass revealed in an exclusive interview for this report, Guardian Glass considers the Spanish glass market to be an important part of the business, being one of the largest glass suppliers in the country, with plants in Llodio and Tudela.

"Every crisis presents opportunities to transform, to take drastic action and become stronger at the end of the crisis," noted Mr Boekhoudt. "Guardian Glass has taken circumstances that have arisen from the pandemic to invest in our plants and work on our customer relationships in Spain. The divestiture of our automotive business in 2020 is allowing us to fully focus our attention on providing glass for commercial and residential use in the region."

According to Mr Boekhoudt, due to recent improvements in the efficiency of the lamination line production in Tudela, Guardian has been able to supply an additional 3.5% of laminated glass to the region. This year the company plans to provide an additional 3.5%, in comparison with 2021, also evaluating investing in a second lamination line.

Mr Boekhoudt expects that despite headwinds from supply chain issues, energy pricing, freight costs and other factors, the Spanish glass business will continue its growth.

"The bottom line is that individuals will always desire a comfortable space in which to live and work, and daylight ▶



Further expansion in the Spanish flat glass sector is expected.



ANFEVI has observed increasing demand for glass containers in Spain.



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will continue to be associated with improved mood, enhanced morale, less fatigue and better performance and productivity,” he concluded.

Verallia Iberia

In the meantime, representatives of Verallia Iberia, another leading local player, spoke about the company’s plans to focus on the development of its existing glassmaking assets in Spain as well as Portugal. Verallia Iberia is based in Madrid (Spain) and Figueria da Foz (Portugal), and has 1,300 employees.

According to the company’s spokesperson, Verallia Iberia maintains a strong presence on the entire Iberian Peninsula, where it operates six factories located in Azuqueca de Henares, Burgos, Montblanc, Seville, Zaragoza and Mondego (Portugal). It also has a manufacturing plant in the Canary Islands and two product development centres.

The company’s plans include further investment in their development in Spain in years to come, while, so far, major investments have already been allocated in its Spanish glassmaking activities.

An official spokesperson for Verallia commented: “Verallia has invested nearly €228 million over the last five years in modernising its production centres. Over the past few years, the Group notably invested in its plant Azuqueca, in the province of Guadalajara, and in Burgos, in the province of Castile and Leon.”

According to Verallia’s spokesperson, the company is particularly focused on the further development of its local Azuqueca plant, which was commissioned last year. In 2021 the company launched a second furnace at the plant, aimed to serve the growing domestic demand.

Verallia is also ready for the development of its Burgos plant – another flagship factory in Spain. The €33 million facility was launched in 2019 and following its reconstruction, its furnace has become one of the largest in Europe.

“By combining the capacities of its two furnaces on the site, the plant produces 600 million glass bottles each year, mainly for the wine and spirits markets,” reported Verallia’s spokesperson. “These investments demonstrate the importance of the Spanish Market for the Group and the strong perspectives it has there in the long term.”

AGC Glass Europe

Finally, the biggest hopes of AGC Glass Europe in Spain are related to the ongoing recovery of the Spanish building market. Niels Schreuder, a spokesman of Architectural Glass AGC Glass Europe has confirmed that the Spanish building market is slightly improving after the “pandemic year 2020”.

Mr Schreuder commented: “It seems that the residential sector will grow next year and this will be our challenge for [2022] from a sales and production point of view. In terms of non-residential construction, the growth is not so clear due to delays in investments and the developments of projects. We will see. AGC will increase the introduction and development of the BIPV products

including some investments in new partners for it. This can be a new business to be developed. Energy efficiency and sustainability will be our next objective for special products promotion.”

Building on growth

During 2021 many leading local players completed modernisation of their Spanish production facilities. For example, Guardian Glass completed installation of automation solutions and digital and data-driven technologies at its local Tudela and Llodio plants, thereby significantly increasing operational efficiencies.

Most of the producers and analysts interviewed expect further growth of the Spanish glass market in 2022.

According to a spokesperson for Verallia, an earlier survey by McKinsey Company identified an ever growing demand for sustainable packaging both in Spain and some other EU markets:

“In most of Verallia’s markets, if not all of its markets in Europe, glass packaging was seen as the most sustainable packaging. And more interestingly, the consumers are even prepared to pay more for a sustainable packaging.”

Glass is the preferred packaging material, according to another study conducted by the European federations of glass industry.

Analysts expect additional growth impetus for the Spanish glass sector to come from EU financing for energy efficient building renovations. This may contribute to the launch of new projects in existing residential and commercial buildings that, without such support, may not have been considered for retrofit.

In addition, most analysts and producers expect demand for coated glass to grow in Spain, while 40% of the double-glazed insulated glass units in this region still use only plain float glass. Due to this forecast, many local producers and global majors plan to increase the supplies of plain float glass to the local market. For example, Guardian Glass has recently confirmed its plan to increase the float availability in the region by around 10% by 2023 in comparison with 2021, while coated product availability will rise by 15% by 2023. ●

About the author:

Eugene Gerden is a freelance correspondent



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Overview of the South Korean glass industry

While vibrant construction and automotive sectors have contributed to the growth of South Korea's flat glass industry, a high per capita consumption of beverages (both alcoholic and non-alcoholic) and a burgeoning cosmetics industry has propelled the growth of country's container glass industry, explains Sunder Singh.

Catered for by two large scale flat glass and four mid and small-sized container glass producers, the South Korean glass industry has been through a number of churns in the past two years.

Saint Gobain's divestment from Hankuk Glass Industries, KCC Glass' spin-off from parent company KCC Corporation in the flat glass sector, and the acquisition of cosmetics glass producer Pacific Glass by leading European container glass producer Verescence have been some of the key developments in the country's glass industry during the last 24 months.

Company	Segment	Plant location	Installed capacity
Techpack Solutions	Container glass	Gunsan	260,000 tonnes per annum
Samkwang Glass	Container glass	Nosan and Cheonan	600 tonnes per day
Kumbi Corporation	Container glass	Icheon and Onyang	450 tonnes per day
Pacific Glass	Container glass	Jhanghang	80 tonnes per day
KCC Glass	Flat glass	Yeoju	3,700 tonnes per day
Hankuk Glass	Flat glass	Gunsan and Busan	2,240 tonnes per day

Flat and container glass producers in South Korea

Encouraging numbers from the economic side are expected to result in healthy gains for South Korea's glass producers. Asia's fourth-largest economy is expected to have a GDP growth rate of 4.0% for 2021, a sharp rebound after the economy shrank 1.0% in 2020 – its first contraction in over two decades, according to the news agency Reuters. But growth is expected to ease to 3.0% in 2022 and then to 2.6% in 2023.

Flat glass

Comprising of two float glass producers – KCC Glass and Hankuk Glass – the South Korean float glass industry has registered steady growth rates during the past few years. Cumulatively, the two float glass producers have an installed capacity of 5,940tpd of float glass. Domestic production meets about 80% of the total flat glass demand in the country; the rest is imported from South East Asian countries and China. Both the major sub-segments – architectural and automotive – have contributed to this growth.

Architectural Glass

Steady growth in the construction sector has been the mainstay of the South Korean architectural glass industry. In 2020, the South Korean construction industry, including public and private infrastructure and civil engineering services, recorded double-digit growth of 16.9%. The industry-generated revenue reached \$164 billion (KRW194 trillion) despite the Covid-19 pandemic. The Construction Association of Korea (CAK) predicted that the number of strong construction orders in 2021 will stimulate the economy. According to the Government, it is the first time in history that the Korean construction market has exceeded \$142 billion (KRW166 trillion).



Steady growth in the construction sector has been the mainstay of the South Korean architectural glass industry.

Automotive Glass

The automotive sector is a big contributor to flat glass consumption in South Korea. The country's automobile industry is now the fifth largest producer of passenger cars in the world. The automobile industry accounts for 13% of manufacturing output, generates 12% of value added, and is a very important industrial area that contributes to about 12% of total employment in South Korea.

The last three years have not been best of the times for South Korean automotive producers. In 2020 production was deeply impacted by Covid 19 and South Korea's domestic auto production fell 11% to 3.5 million vehicles, with a historic drop in exports. However, total South Korean car output for 2021 is expected to increase by 4.4% to 3.66 million units.

Final figures for 2021 sales at home are projected to fall by 3.5% to around 1.84 million units due to production disruption from chip shortage. According to the Korean Automobile Manufacturers Association, sales of domestic cars are projected to drop 5.8% to 1.51 million units due to lacklustre new releases amid chip shortage. Auto exports are expected to climb by 14% to 2.15

million units on a sign of recovery in major markets such as the US and European Union, and emerging markets.

From January to July 2021, the number of cars produced from South Korea amounted to 2.11 million units, up 7.0% from a year earlier. Outbound shipments soared 23.1% to 1.24 million units, while domestic sales fell 3.2% to 1.06 million units.

Despite the decline of the last three years, automotive glass is expected to remain an important factor in the growth of South Korea's flat glass industry.

KCC Glass

KCC Glass is the largest flat glass producer in South Korea. A subsidiary of KCC Corporation, which was spun off from the parent company in January 2020 to ensure stable supply and demand of glass and developing high-performance glasses including head-up display (HUD) glass, lightweight laminated glass, solar cell roof and heating glass, KCC Glass has an installed capacity to produce 3,700 tonnes of float glass through five float glass lines.

The last capacity expansion in 2018, when KCC Glass commenced ▶



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production from a double width line specifically for automotive grade glass took the overall installed capacity of the company to 3,700tpd. Three years prior to this line, the company installed one of the largest float glass lines in the Asian Pacific region, with an installed capacity to produce 1,200 tonnes of float glass.

The company also has capability to produce approximately 17 million square metres of coated glass per year through two lines.

In December 2020, KCC Glass merged with Korea Autoglass Corp – producer of automotive glass for domestic and export markets. The automotive safety glass division accounted for about 90% of South Korea's total sales in 2020. It is a major supplier to domestic automakers such as Hyundai Motor, Kia Motors, and GM, while maintaining 70% of the market share through exports.

Speaking at the time of merger, Korea Autoglass CEO Woo Jong-chul said, "The merger will bolster efficiency and strengthen overall competitiveness by solidifying the process of producing architectural and automotive glass under a single roof. By working

together, more effort can be made in research and development that can further lead to growth."

KCC Glass's parent company KCC Corporation is one of the largest business conglomerates in South Korea. Established in 1958, KCC Corporation has led the national construction industry by supplying architectural and industrial materials. KCC Corporation is owned by chairman and CEO Chung Mong-Jin and his family. Mr Mong-Jin is the nephew of the late Hyundai Group founder Chung Ju-young.

Hankuk Glass Industries

Established in 1957, Hankuk Glass solely led the South Korean flat glass market until KCC entered the flat glass arena in 1987. A subsidiary of Saint Gobain until 2019, Hankuk Glass is the smaller of the two flat glass producers in South Korea.

The company operates a total of four float glass lines at two locations: Gunsan and Busan in South Korea. The Gunsan facility houses three state-of-the-art float-glass production lines, while the Busan plant operates one float glass line and one patterned-glass production line. These four float

lines have a total installed capacity of 2,240tpd.

The company's automotive glass division, Hankuk Sekurit Limited was first the automotive glass producer in the country when it commenced operations in 1970. A large automotive production base has enabled it to supply some of the major automotive producers in the country. Hankuk Sekurit currently operates two plants at Gajwa and Iksan and has an annual installed capacity to produce 2.3 million car sets.

Hankuk Processed Glass Industry Co, Ltd. (formerly Hankuk Pair Glass Industry Co., Ltd.), another subsidiary of Hankuk Glass produces added-value glass products such as insulating, reflective, tempered and specialty glasses.

In December 2019, Korea Glass Holdings Co., Ltd., an SPC (segregated portfolio company) established by Korean private equity firm Glenwood PE acquired a 100% stake in Hankuk Glass Industries, Inc. for approximately KRW 330 billion (about 240 million euros), from Saint-Gobain Korea Holdings Co., Ltd.

Container glass

South Korean demand for container glass was estimated at 654,000¹ tonnes at the end of 2019. Catered for by four producers, the country's container glass industry is among the most modern on the Asian continent.

Alcoholic beverages (beer, soju and hard spirits) have been the largest contributors to the growth of the South Korean container glass industry. With a current per capita consumption of over 39 litres, the country's beer industry has been one of the pillars for the growth for container glass. In 2019, South Korea was the 18th largest consumer of beer globally, with a total consumption of 20.22 million ▶

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hectolitres of beer. In the same year, beer accounted for nearly 40% of the total alcoholic beverage sales in the country.

Soju (a clear distilled liquor made from rice, barley or wheat) is the second most popular alcoholic beverage and the second largest demand driver for the South Korean container glass industry. Dominated by the company Hite Jinro, the South Korean soju industry has made rapid progress in domestic and export markets during the last decade. In 2020, Hite Jinro sold around 95.3 million soju cases, almost threefold the amount sold by the world's No. 2 distilled spirit brand, the Philippines' Ginebra, which sold around 31.2 million cases during the same period. This is a stunning performance considering that the global distilled spirits market has been sluggish due to the global pandemic which led alcohol consumption to drop by 9% in 2020 compared to the previous year. Despite the downward trend, Jinro soju logged a 10% growth in sales volume in 2020 compared to the previous year.

Techpack Solutions

With an installed capacity of 260,000 tonnes per year, Techpack Solutions is the largest container glass producer in South Korea. The company operates four furnaces and supplies container glass to leading beverage producers such as OB Beer, The Coca-Cola Company, Woongjin Foods and Lotte Chilsung.

Techpack Solutions has been operating in container glass industry since 1956. It diversified into alternate forms of packaging such as PET and metal cans in the late 1980s. In 2014, leading business conglomerate in South Korea, Dongwon Systems acquired a 56% stake in Techpack Solutions for US \$243 million (250 billion won). Dongwon Group company Star Kist and a private equity firm EQ Partners hold 24% and 20% stakes in the company.

In 2020, Techpack Solutions signed a contract with industrial gas supplier Air Products to convert its third furnace from air-fuel to oxy-fuel for enhanced sustainability and competitiveness.

"With Air Products' support, we have successfully converted two furnaces from air-fuel to oxy-fuel combustion and achieved remarkable improvements in NOx emission reductions, energy efficiency and

productivity. We are confident in Air Products' innovative technologies, in-depth expertise and professional team, and are pleased to continue working with them on our third furnace," said Young-Min Kim, Technical Team General Manager of Techpack Solutions at the time of signing the contract.

Verescence acquires Pacific Glas

In one of the most significant developments in South Korean glass industry, in early 2021 France-based speciality container glass producer Verescence acquired a majority stake in cosmetics & perfumery container glass producer Pacificglas, a subsidiary of Korean cosmetics company Amorepacific.

An expert in luxury glass packaging for the perfumery & cosmetics industries, Verescence produces 500 million bottles per year from its three glass production sites and its four decoration sites in Europe and North America. In 2019, the company achieved sales revenue of 309 million euros.

For the purpose of this article, Verescence CEO, Thomas Riou provided some more information on the acquisition:

Sunder Singh: What is the rationale behind the Pacificglas acquisition by your company?

Thomas Riou: We did not have an industrial base in this part of the world. Thanks to this acquisition, Verescence will establish itself in the Korean and Asian market. It's important to know that Asian brands source their glass or their components in Asia. We will therefore be able to gain access to new, very prestigious customers, starting with Amorepacific which becomes one of Verescence's biggest customers. In addition, this new position of Verescence in Asia will allow our large international customers to benefit from unparalleled global service as Asia joins Europe and the United States.

SS: Could you share some tentative details about any planned expansion in South Korea?

TR: The Verescence Pacific factory has one furnace with a capacity of 80 tons, four production lines and has extensive decorating capabilities. The size of the production unit is equivalent to what we have in the United States. More importantly, there is space to be able to double the production capacity. Our acquisition of a stake in Pacificglas, now Verescence Pacific, is only one step in our development strategy in this region of the world.

SS: South Korea has a big cosmetics market sector, but wouldn't an acquisition in one of the South East Asian countries have been better for Verescence, given the lower production cost and proximity of ASEAN markets?

TR: Our presence in Asia must correspond to our strategy of being a major player in the premium market, and it takes a long time to build this culture. We also have a very high CSR requirement: South Korea and Amorepacific have a level of requirement in this area at least equal to what we know in Europe.

SGC Solutions Co. Ltd. (formerly Samkwang Glass)

Supplying container glass products to prestigious South Korean food, beverage and pharmaceutical producers such as Oriental Brewery, Lotte Chilsung, Deahan Pharm Co., Ltd, Hite Jinro, Sajo, zeitgeist seals, Dong-A Socio Holdings and Ilwha Co., Ltd, SGC Solutions Company Limited is the second largest container glass producer in South Korea with an installed capacity of 600tpd for container glass products from two production facilities at Nonsan and Cheonan. The company operates a total of three furnaces.

SGC's Nonsan plant has an installed capacity of 200tpd



Alcoholic beverages (beer, soju and hard spirits) have been the largest contributors to the growth of the South Korean container glass industry.

for container glass products. The Cheonan production facility has an installed capacity to produce 400tpd of glass containers through two furnaces.

Established in 1967, the company changed its name from Samkwang Glass Co. Ltd to SGC Company Solutions Limited in 2020.

Kumbi Corporation

A fixture of the container glass industry since 1957, Kumbi Corporation operates two plants located in Onyang and Icheon with a total installed capacity for 450tpd of container glass with seven IS machines.

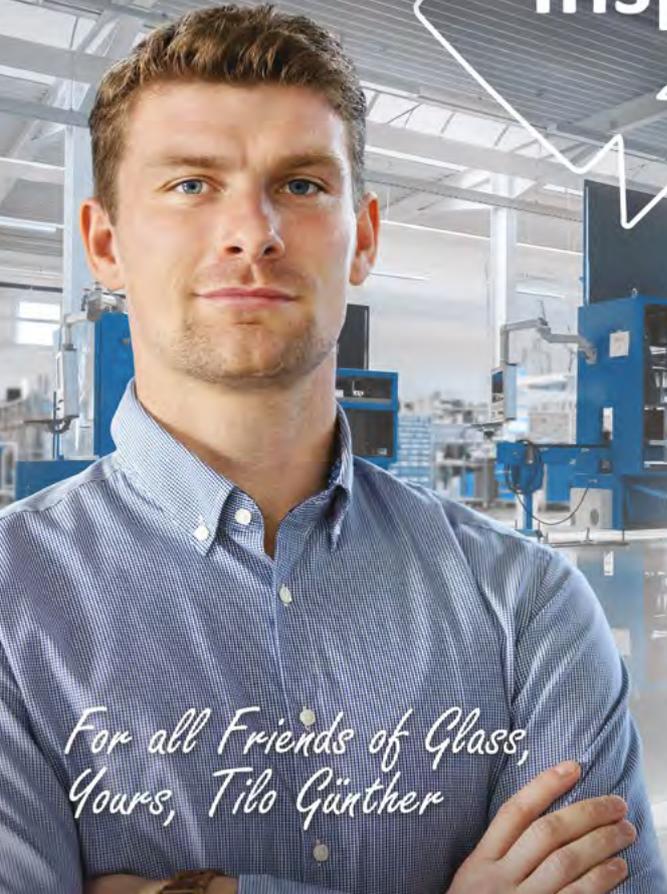
The company offers flint and emerald green glass bottles in various shapes, narrow neck pressed bottles and small bottles that are widely used for alcoholic and non-alcoholic beverages, foods and pharmaceuticals. ●

1 Figures are based on the 2020 Sustainability Report of Dongwon Industries, parent company of TechPack Solutions – page 50: [https://www.dongwon.com/upload/attachment/vision/Dongwongroup_CSR_report\(EN\)_2020.pdf](https://www.dongwon.com/upload/attachment/vision/Dongwongroup_CSR_report(EN)_2020.pdf)

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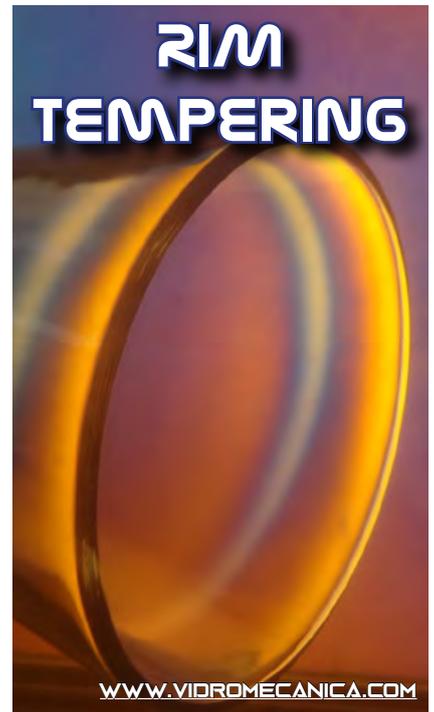


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Rigorous model predictive control

René Meuleman looks at the evolution of advanced glass process control and explains why CelSian's latest technology heralds a new era of furnace control.

Rigorous model-based model predictive control is becoming the new standard of glass furnace advanced control. How MPC (model predictive control) works is already difficult to explain. Does it become more complex by adding 'rigorous' to the equation? Perhaps not. In the first of a series of articles, let's dive into it by starting with some history.

"As complexity rises, precise statements lose meaning and meaningful statements lose precision" – Lotfi A. Zadeh.

It is almost 30 years since one of the speakers at a Fuzzy Logic conference came from TNO, the institute which later became CelSian. In those late 1992 days Fuzzy Logic became a big thing in industry almost 27 years after the scientist Lotfi Zadeh introduced his thoughts on the fuzzy set theory. You may ask yourself why it took so long for the industry to pick up this technology. The explanation is quite simple: there were no process control systems available to support it and once they became available the 'fuzzy' image wasn't working in favour of it. Perhaps you remember that washing machines with Fuzzy Logic control had become available and not many glass companies wanted to run their furnaces with what they perceived as 'washing machine technology'. It shows how bad gut feelings can work against very smart ideas but nevertheless, the first 'smart' glass furnace control systems that became available were based on Lotfi's theories. You can still find those strategies running in some plants today.

Conventional MPC vs rMPC

The next new development in advanced glass process control was published in 2008. It described the 'rigorous model-based model predictive control of a glass melter and feeder'. Notice that 'rigorous' is underlined as there is a distinct difference between conventional MPC and rMPC. Let's explain by going back to a 13-year-old publication.¹

'Conventional MPC controllers apply models that are determined by means of step tests on the actual

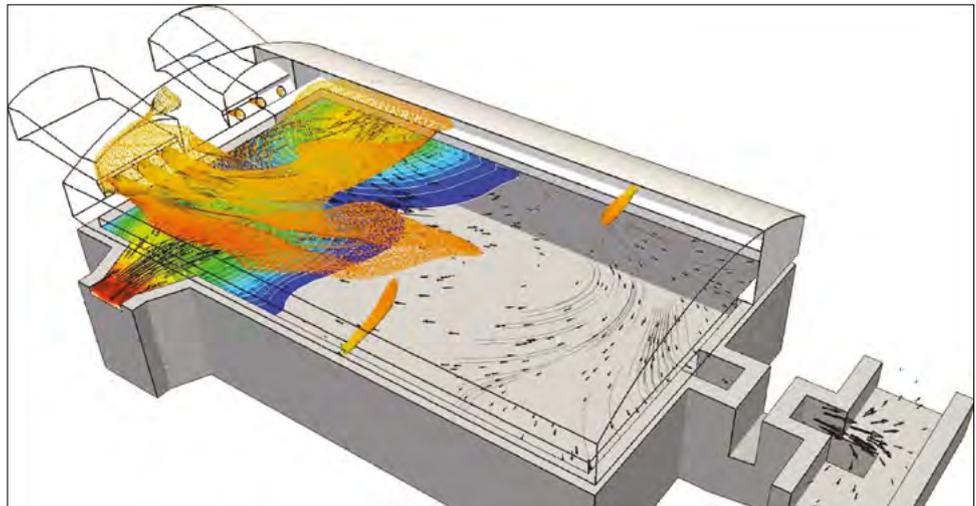


Figure 1: CelSian's GTM-X models are used to build the rMPC controller.

running furnace in which the inputs (i.e. fuel distribution, boosting, and load) are changed in a stepwise fashion. The output response of the furnace is measured, and data is stored. To minimise the risk of production losses during testing, many small steps are taken, and measurements continue for several days or even up

to weeks to enable modelling of the melting tank dynamics. A model is derived from the measurement data that relates the observed variations of the measured outputs to the manipulations applied to the input signals at the working point (set of process settings: pull, total fuel consumption, required electrical boosting power) for which the tests were performed.'

In other words, tests are made on furnaces which are in operation and the size of those steps are limited so as not to

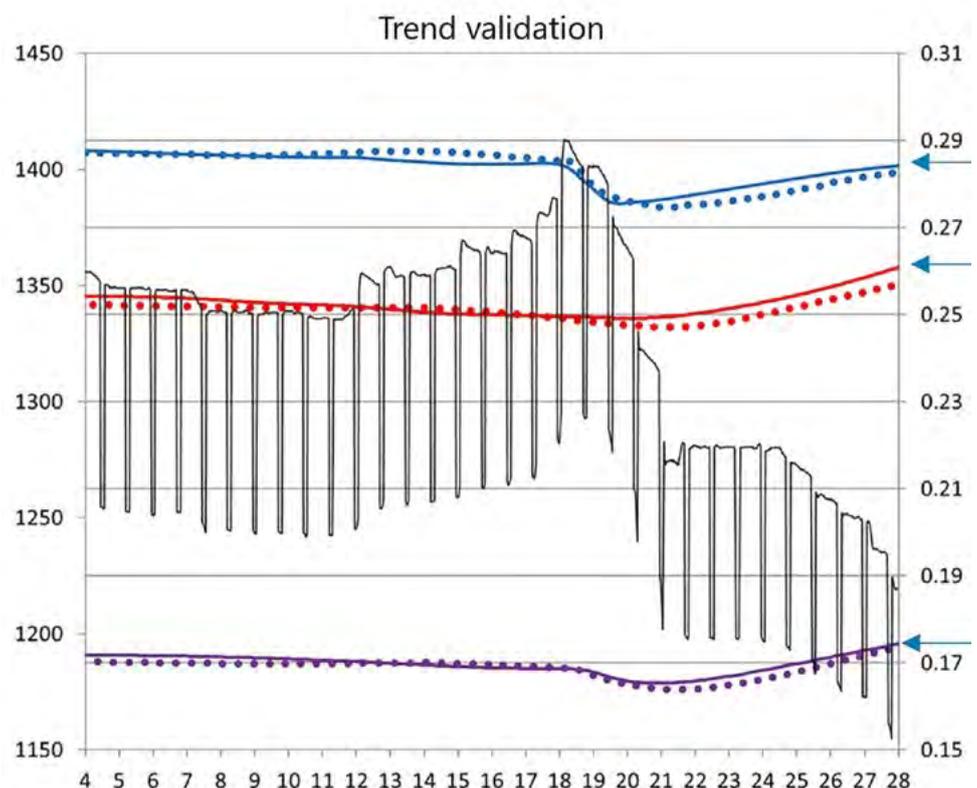


Figure 2: Measured versus modelled temperatures underlines precision.

disturb daily operation. The response of the furnace is likely to be unclear due to the disturbances and gathering the data can take weeks. Therefore, the data coming out of that exercise is questionable and collecting it takes a lot of time.

New approach

'CelSian has developed a totally new approach for the determination of control models. In a first step, a rigorous, fast 3D detailed model (derived from CelSian's state of the art GMT-X software) furnace is set up and validated. GTM-X describes the dynamic behaviour of the process (the furnace) sufficiently accurately, and therefore the rigorous 3D CFD (Computational Fluid Dynamics) model can be applied as control system design without any concerns.'

CelSian takes its vast GTM-X mathematical furnace models instead of the actual running furnace to perform the steps responses and capture the derived data to build the rMPC controller. The advantages are that it doesn't impact daily production, much bigger steps can be applied to the model getting a much better

response in return, and no unwanted or unknown disturbances influence the results. Next to that, the model is applicable as soon as the furnace is operational, representing a huge advantage in these times where new, reduced CO₂ emission furnace designs are arriving.

rMPC becomes established technology

'First applications have been completed and these have demonstrated the benefits of the use of rigorous process models for process control. RMPC is applied to increase furnace and feeder stability and to improve transition behaviour (e.g. load changes, glass composition/colour changes, recovery from major process upsets etc.). Stability of temperature distribution and flow pattern is essential for production at the highest possible yield.'

We have travelled a long way at CelSian with the development of rMPC whilst the industry is facing new furnace designs, moving away from fossil fuel firing, and trying to squeeze out the final energy efficiency of their traditional designs. Today rMPC has

become an established technology with a proven track record outperforming other advanced control systems.

At CelSian we sometimes do things differently because we believe we can do better for you and the industry. Therefore we specifically called our MPC control 'rigorous' because the adjective's synonyms are: *'meticulous, punctilious, conscientious, careful, diligent, attentive, ultra-careful, exact, precise, accurate, correct.'* If you consider trusting your furnace process to an advanced controller, you should consider CelSian's model predictive control.

Finally, we are heading for the ultimate solution which we cannot reveal yet, but we will keep you posted. Curious? Give us a call or send us an email and we will explain. Once you understand, your choice will be obvious. To be continued! ●

- 1 "Rigorous model-based model predictive control of a glass melter and feeder", Backx, Ton; Huisman, Leo; Op den Camp, Olaf; Verheijen, Oscar. *Glass Technology – European Journal of Glass Science and Technology Part A*, Volume 49, Number 3, June 2008, pp.139-144.

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A comprehensive approach to managing energy

To optimise its energy consumption and energy costs, packaging glass manufacturer Vetropack Group believed it was necessary link all disciplines involved, from production and engineering to procurement. Rudolf Traxler explains why the long-time Siemens customer has chosen the Simatic Energy Manager PRO software solution for its energy management requirements.

Vetropack Group is one of Europe's leading manufacturers of packaging glass for the food and beverage industry in Europe. With roughly 4,000 employees, it currently operates eight glass factories in Switzerland, Austria, Czechia, Croatia, Slovakia, Ukraine, Italy and Moldova.

In a challenging environment impacted by the pandemic in 2020 and beyond, the Vetropack Group generated an EBIT margin of 11.5% in 2020 (2019: 12.5%). Consolidated net revenues amounted to CHF 662.6 million (2019: 714.9 million). In late 2020, the Group acquired a glass factory in Moldova, financing the acquisition with its own funds.



One of Europe's leading manufacturers of packaging glass for the food and beverage industry in Europe, Vetropack Group currently operates eight glass factories and is building a ninth. Image source: Vetropack.

In October 2021 Vetropack began construction of a new production site in the town of Boffalora sopra Ticino in Italy.

Energy management and procurement

The Vetropack Group is taking strategic and economic as well as technical factors into account for its energy management and procurement. In doing so, it is relying on external consulting expertise and using the energy management system Simatic Energy Manager PRO, including add-ons for structured energy procurement. The goal is to comprehensively manage energy throughout the Vetropack Group, from planning and strategic procurement to monitoring consumption and invoice verification. The goals of the Swiss packaging glass manufacturer will be achieved after the rollout [of the energy management system] in all nine of its international factories.

Permanent reduction in costs and consumption

Given the well-known fact that glass production is extremely energy- and cost-intensive, many adjustments need to be made in order to achieve improvements in both areas. This would be impossible without the use of professional software tools, especially in light of Vetropack's goal of ensuring uniform energy management across all its locations. Another challenge is the definition, harmonisation and uniform reporting from energy measurement points.

A comprehensive approach

What's special about Vetropack's approach is that a core project team is devoted to the task of tackling energy management from the perspective of both commercial and technical factors as an integral part of the company's digitalisation strategy. The project was initiated and is led by Strategic Procurement. The packaging glass manufacturer believes that the best and only way to optimise energy consumption and energy costs at the Group level – and thus make the necessary contribution to improving the company's CO₂ footprint – is to link all disciplines involved, from production and engineering to procurement. After a phase of evaluating and piloting different systems, the long-time Siemens customer chose the Simatic Energy Manager PRO software solution. To this end, Siemens developed and programmed a new module for integrating procurement on the basis of extensive specifications. After the project began in 2017, Siemens and Vetropack piloted the system in Vetropack's Austrian factory in Kremsmünster in 2019 before systematically embedding it into the existing Simatic PCS 7 and IT infrastructure in all the other glass factories, beginning with Vetropack Straža in Croatia. ►

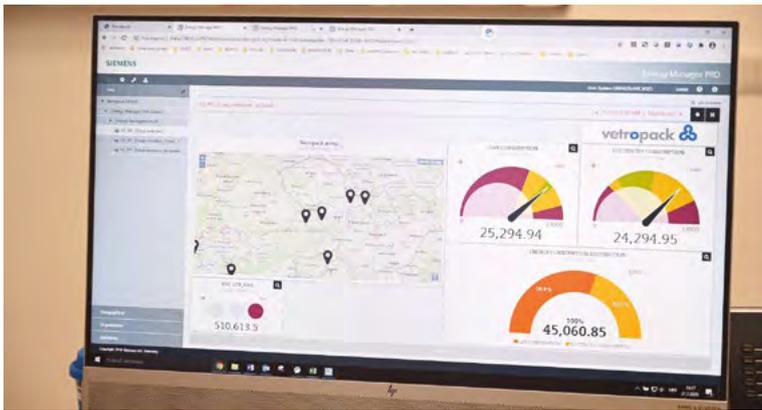


Vetropack Straža produces, sells and distributes glass packaging to the Croatian domestic market as well as to the neighbouring markets in Slovenia, Italy, Hungary, Bosnia, Serbia and other countries in south-eastern Europe. Image source: Vetropack.

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Siemens' Simatic Energy Manager PRO software solution enables Vetropack to manage energy throughout the Group. Image source: Vetropack.

Linkage of operations and energy data

When the Group-wide rollout is completed in one to two years, Vetropack will have complete transparency across all relevant energy and media consumption values and corresponding costs (primarily gas, power, water and compressed air), CO₂ emissions on various aggregation levels, and uniformly allocated cost centres.

A crucial element of this goal is a master metering plan to set uniform measurement standards. Up to 200 measurement points per factory will be integrated into the energy management system. "On this basis, harmonised Group-wide energy indicators can be purposefully defined, analysed, displayed on dashboards and applied as the basis for energy efficiency measures," explained Bozo Dragoslavic, Energy Manager for the Vetropack Group. Best practices will be systematically transferred to the other production facilities. Thanks to the ISO 50001-conformant software support from Siemens, Vetropack will save considerable time on data entry and will therefore be able to focus more on drawing inferences from the data and making decisions about energy efficiency

measures such as adding more photovoltaic systems in a given factory.

Smart energy procurement with real-time price display

Vetropack could well be the first company to link an energy management system with a fully integrated energy procurement tool. As a result of these measures, Vetropack can connect all market data in real time to the newly developed add-on of Simatic Energy Manager PRO and represent its entire procurement strategy and the implementation of that strategy in the module. The system will be connected to both the Group-wide ERP system and to various other systems.

Features of the Simatic Energy Manager PRO include:

- Recording and graphic display of all market data, procurement schedules and procurement quantities. Consumption values are likewise integrated graphically.
- The graphic display follows the established procurement strategy. The status quo of all factories can be seen at a glance.
- The tool manages energy package purchases for the purpose of structured procurement in line with



In orange hi-vis, L-R: Kurt Hagenberger, Bozo Dragoslavic, Ulrich Ruberg. Image source: Vetropack.

the strategy. Setting target prices triggers notifications in the form of action recommendations whenever the price targets are approached; alternatively, target prices can be agreed on directly with the energy supplier.

- Purchase quality is monitored graphically relative to self-defined benchmarks.
- Budget calculations and subsequent refinements on the basis of periodic forecasts are supported and quasi-automated by the system.
- All energy procurement contracts are administered in the system. Bids submitted in tenders are simulated using the relevant contract criteria. This allows the lowest-cost variant for implementing the strategy to be identified quickly.
- CO₂ emissions from energy consumption and batch formulation, including Scope 2 CO₂ emissions, can be calculated in this tool. The necessary certificates and their acquisition are likewise integrated into the tool.
- Thanks to the display of real-time prices (both hedging and spot prices), the decision to change and optimise the energy mix (electricity vs. gas) can be made at any time.

Customer value overview

Full-range provider Siemens has provided comprehensive support to Vetropack since the project began and has covered all phases, from advice and analysis in joint workshops to installation, commissioning and project planning of energy management software solutions. Siemens also handles the turnkey implementation of field devices such as energy measurement devices, flow meters and automation components, as well as assembly and connection to the process control system Simatic PCS 7, which is used in all eight factories.

"As we see it, Siemens plays a pioneering role in comprehensive energy management solutions," says Kurt Hagenberger, Lead Buyer Energy at Vetropack Austria. "In addition, we've been very impressed with the company's expertise in the glass industry. On top of that, their team is highly experienced, and the same team has supported us for many years and is always very flexible." ●



Vetropack could be the first company to link an energy management system with a fully integrated energy procurement tool. Image source: Vetropack.

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Process and power control for hybrid and all-electric furnaces

As the glass industry considers more sustainable melting technologies, it's important to consider the process control from end to end, believes Mikael Le Guern.

Currently around 75 to 85% of CO₂ emitted in glass production comes from fuel combustion in the melting process. Although alternative technologies such as hydrogen and biogas are currently being assessed, Eurotherm by Schneider Electric believes that in terms of technology readiness and availability, electrical melting solutions, including hybrid melting (using 50% to 90% electrical energy) make the most sense to address decarbonisation into the future. After all, electrical melting is already a proven and commonly used technology, suitable for scaling up for larger electrical melting systems.

With a long history in supplying advanced process and power control systems and services for electric melting/boosting applications, particularly for glass fibre, container and float glass furnaces, Eurotherm has the expertise



Eurotherm T2750 PAC provides high availability dual redundant process control, ideal for high efficiency glass manufacturing applications.



Eurotherm power supply solutions are based on the EPower SCR power controller.

and knowledge to support the glass industry with its transformation to greener glass production.

Data is key

To achieve the balance between sustainability and profitability, an important part of this transformation is to treat the process as a whole. Batch house, hot-end, forming, cold-end, quality, packaging, and warehouse can no longer be considered as separate systems, as they interact with each other and have an impact on the overall outcome. Controlling all parts of the process at the same time from end-to-end can improve the whole process. With the right infrastructure and actionable data, sustainability can be embedded in the entire production cycle, from supply chain management and glass manufacturing quality control to energy consumption and recycling.

Advanced process control strategies in Eurotherm T2750 PAC (programmable automation controller) together with AVEVA System Platform offer a scalable distributed control system (DCS) with built in redundancy and data acquisition, ideally suited to the glass industry's continuous processes. The T2750 PAC I/O is 'hot swappable', so new or replacement modules can be plugged in without process interruption for easier

maintenance. For predominantly digital applications such as batch house and cold end processes, the Schneider Electric IoT-ready Modicon PLC range can be utilised, also offering enhanced protection against new vulnerabilities across connected assets or in the cloud.

Digitalisation applies at all levels of a modern glass plant, offering real-time data analytics for effective decision making from the shop floor to the global enterprise. Schneider Electric's IoT-enabled, open and interoperable architecture platform EcoStruxure, offers collaborative environments for connecting the field level to the enterprise level. From smart sensors, to DCS and SCADA, through to software/analytics and services, the EcoStruxure platform allows IoT-enabled solutions to seamlessly connect, collect, analyse, and act on data in real-time. Power distribution devices can also be connected to help improve asset utilization, minimise maintenance costs, and reduce unplanned downtime.

The traditional complexity of multiple data acquisition systems can result in inconsistent TAG names, time synchronisation and formatting problems. Therefore, Eurotherm considers the database to be one of the most important aspects of the whole manufacturing automation plant. ▶



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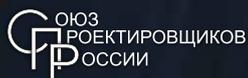
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As a solution, it offers a single collection, storage and analytics system to cover all processes, helping to simplify analytics for benchmarking and process quality enhancements.

With advanced control becoming more widespread in glass production to improve the performance of complex melting, fining, and conditioning processes, Eurotherm can provide model-based predictive control (MPC) from CelSian or GLASS SERVICE as part of its DCS. The build of these operational models does not usually require interruption of on-site processes. Integrating the results from MPC directly into the control process makes mathematical modelling knowledge accessible at the daily operational level, providing improved understanding, reliability and operational efficiency of glass processes.

Considering cybersecurity

Through its electrification and digitalisation services Schneider Electric provides cybersecurity solutions and ongoing services for industrial control systems. The T2750 PAC has Achilles Level 1 certification for communication robustness, helping to protect industrial processes from being compromised by cyber-attacks as part of a defence in depth strategy. Features include, password-controlled user access enhancements, and algorithms that can detect excessive network activity as well as help to ensure that a device's resources are prioritised on the essential functions of the control and/or recording strategy.

Industrial cybersecurity services offered by Eurotherm include risk assessments, system architecture design based on a defence in depth approach, network monitoring, software/operating system patching and more.

Optimising power control

For electric-melting and -boosting applications, Eurotherm has developed water-cooled power supply boxes for controlling one or two pairs of electrodes (typically from 100kVA to over 1MVA). The compact design means these packaged power supplies can be located very close to the furnace to reduce line current and heat losses. As a result, smaller cables can be used leading to significant CapEx savings. For flexibility, multiple power supply boxes can be connected together to provide a scalable power supply with sufficient power redundancy to help enable continuous and reliable operation.

These power supplies as well as the distribution system can be optimised through modelling and simulation of their digital twin equivalents using software such as ETAP, which is now part of the Schneider portfolio. Renewables, microgrids, fuel cells and battery storage technologies can also be integrated into the power grid. Employing this 'grid to glass' design approach can result in CapEx savings of up to 20% and help to improve power grid resiliency and decarbonisation of energy transport and generation.

As a 'one stop shop' for control, Eurotherm by Schneider Electric offers comprehensive process control solutions that support the transition to environmentally friendly glass production, covering high efficiency power control and distribution, precision process control, redundant hardware configurations, consistent data storage, standardised operator interfaces, Model Predictive Control (MPC) and analytic tools, and most importantly, a global team that understands the electrification of glass processes. ●

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Applying ceramic labels to glass

Wenke Hu and Gary Smay present findings from a study to define the stresses that are generated when an applied ceramic label is fused onto a soda-lime-silica glass surface, and explore how this can affect the performance of the decorated item.

Using conventional methods, the source material for an applied ceramic label (ACL), consisting of a glassy frit, colourant and dispersion media, is applied onto the surface of room temperature bottles, which are then heated to about 625°C. At this temperature, the ACL melts, is fused to and becomes an integral part of the glass surface.^{1,2} The labelled bottles are then cooled to room temperature at a rate that is consistent with normal annealing practices.

The suitability of using a ceramic label on either refillable or non-refillable glass containers depends primarily on the coefficient of thermal expansion (CTE) of the ACL relative to the glass substrate. If the CTE of the ACL and glass exactly match, no residual stress will be generated in either the ACL or the underlying glass surface. However, this ideal situation is seldom realised in normal commercial practice. Therefore, since some degree of mismatch routinely exists, it is imperative that the CTE of the ACL is less than that of the glass so that a compressive stress will be present in the ACL.²⁻⁶

It has been stated in the literature that under these conditions, the CTE difference can be relatively large with no adverse effects on the performance of the decorated glass article.⁴ This assertion was initially troubling because it was assumed that with large differences in the CTE, high magnitude tensile stresses would be generated in the surface of the glass immediately beneath the ACL. It was postulated that the presence of high tensile stresses could adversely affect the performance of the decorated item.⁷ This concern was the genesis of the current study.

Experimental procedure

A finite element computer stress analysis (FEA) model was utilised to determine the magnitude of the stress that is created in both the glass and the ACL when the CTE of the ACL and glass are different. The model consisted of a two-dimensional solid beam with a thin ACL layer situated on the surface of a much thicker glass substrate. The boundary conditions consisted of a fixed support on both ends of the beam. The mesh size ranged from 5.1 microns to 10.2 microns, values that provided an accurate assessment of the stresses throughout the ACL thickness and the underlying glass substrate.

ACL thicknesses of 25.4 microns, 38.1 microns and 50.8 microns were used, which are comparable to typical commercial values. Glass substrate thicknesses were 2.29mm and 1.27mm, representative of the sidewall thickness of refillable and non-refillable glass containers, respectively. The CTE of the glass was 88, 90 and 92 ($\times 10^{-7} \text{C}^{-1}$), typical of current soda-limesilicate glass container compositions. The CTE of the ACL ranged from 86 to 102 ($\times 10^{-7} \text{C}^{-1}$), which provided both positive and negative 'fits' relative to the CTE of the glass substrate.

It was assumed that the CTE for both the glass and the ACL were linear from the 'lower critical point or transformation point'² of the ACL to room temperature. It was further assumed that both the ACL and glass substrates were fully elastic below the ACL 'transformation

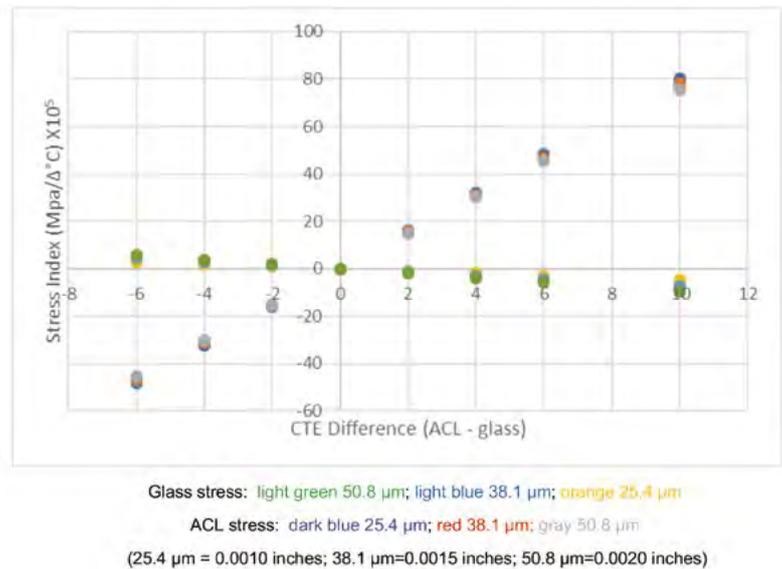


Figure 1: ACL and glass stresses for different ACL thicknesses (glass thickness = 2.29mm).

point' and that the elastic modulus of the ACL was equal to that of soda-lime-silica glass. This latter assumption was necessary because of the absence of data for the elastic modulus of typical ACL materials in the published literature.

The output of the FEA models provided a stress index in units of $\text{MPa}/\Delta^\circ\text{C}$, the difference in temperature being the value from the transformation point to room temperature. Stress magnitudes can be calculated by multiplying the stress

indices by the total temperature interval from the ACL transformation point to room temperature. However, in this paper, only the stress indices will be discussed as the temperature range could vary in actual commercial practice depending on the operation of the decorating Lehr.

Results

The results of the FEA calculations are summarised in Tables I, II and III for ACL thicknesses of 25.4 microns, 38.1 microns and 50.8 microns, ►

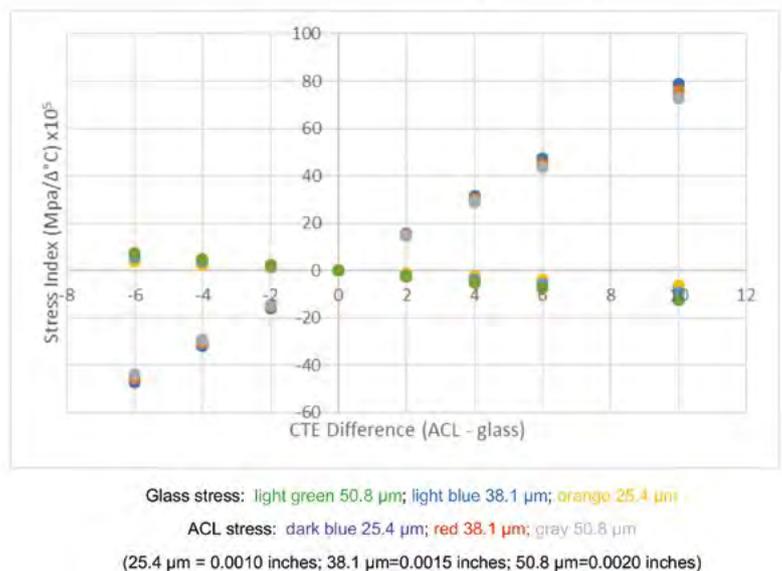


Figure 2: ACL and glass stresses for different ACL thicknesses (glass thickness = 1.27mm).

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respectively. In each of these tables, the data are grouped into three sub-sections according to the CTE of the glass. When the CTE of the ACL and glass were equal, the results are highlighted in yellow.

As shown by the data in Table I, the overall magnitude of both the glass and ACL stress indices increased with increases in the difference between the CTE of the ACL and glass. This was consistent with previous studies.^{10,11}

The ACL stress indices were slightly lower for a glass thickness of 1.27mm compared to a glass thickness of 2.29mm. The glass stress indices showed the opposite trend. Similar results were obtained for ACL thicknesses of 38.1 microns and 50.8 microns, as shown in Table II and Table III, respectively. Also, as noted in Tables I, II and III, as the ACL thickness increased, the ACL stress indices decreased while the glass stress indices increased. All of these results are consistent with the thin layer theory of Hutchinson, et al.¹⁰ which states that stress in a thin layer increases when the thickness ratio of the thin layer and substrate decreases (a decrease in this ratio was observed in this study when either the ACL thickness decreased or the glass thickness increased).

Finally, the absolute magnitudes of the ACL stress indices were much greater compared to the stress indices of the glass. For a glass thickness of 2.29mm, the ACL stress indices were approximately 8 to 16 times greater compared to the stress indices in the glass. This difference was approximately 6 to 12 times for a glass thickness of 1.27mm. These differences were attributed to the response of the relatively thin ACL layer compared to the much thicker glass substrate when an equivalent strain is placed on the decorated surface.

The data in Tables I, II and III are graphically shown in Figure 1 and Figure 2 for glass thicknesses of 2.29 mm and 1.27 mm, respectively. The large differences in the ACL and glass stress indices are clearly seen. In addition, the nearly identical results for both the ACL and glass stress indices for various ACL thicknesses are also evident.

Discussion

The type and magnitude of stress that is generated in a glass substrate due to the presence of an ACL is

easily and conveniently analysed by use of suitable optical retardation instruments.^{8,9} It is normal practice to assume that the stress type in the ACL is opposite of that which is observed in the glass. Such an assumption is justified based on the differences in the CTE of the ACL and glass and how these two components contract when cooled from the ACL transformation point to room temperature.

The magnitude of the stress in the ACL, however, is an entirely different matter. Historically, it has been assumed that the magnitude of the stress in the ACL would be at least equal to and, since the ACL is much thinner compared to the thickness of the glass substrate, most likely numerically greater than the magnitude of the stress in the glass. Unfortunately, this assumption cannot be directly verified by polariscope observations due to the opaque nature of the ACL. In the current FEA study, it was confirmed that the absolute magnitude of the ACL stress was numerically greater compared to the stress created in the glass. While this comparison has never been presented in the published literature, it is consistent with comments made by previous investigators who suggested that significant differences existed although no direct calculations or measurements were given.^{4,10,11}

The discovery of this stress

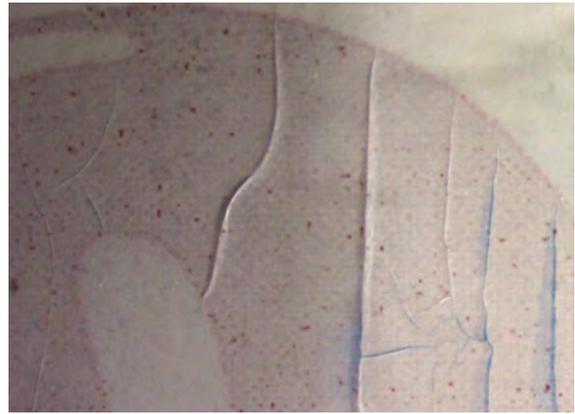


Figure 3: View from inside surface of the glass showing microcracks in an ACL decoration.

difference has two significant implications. First, these results confirm that large differences in the CTE of the glass and ACL can be tolerated with no adverse effects, provided the CTE of the ACL is less than that of the glass.⁴ Even if a large magnitude of compressive stress is present in the ACL, a much lower tensile stress will be generated in the underlying glass substrate. It is anticipated that the presence of only minor tensile stresses in the glass would have very little, if any, effect on the overall performance of the decorated item contrary to our initial concern.

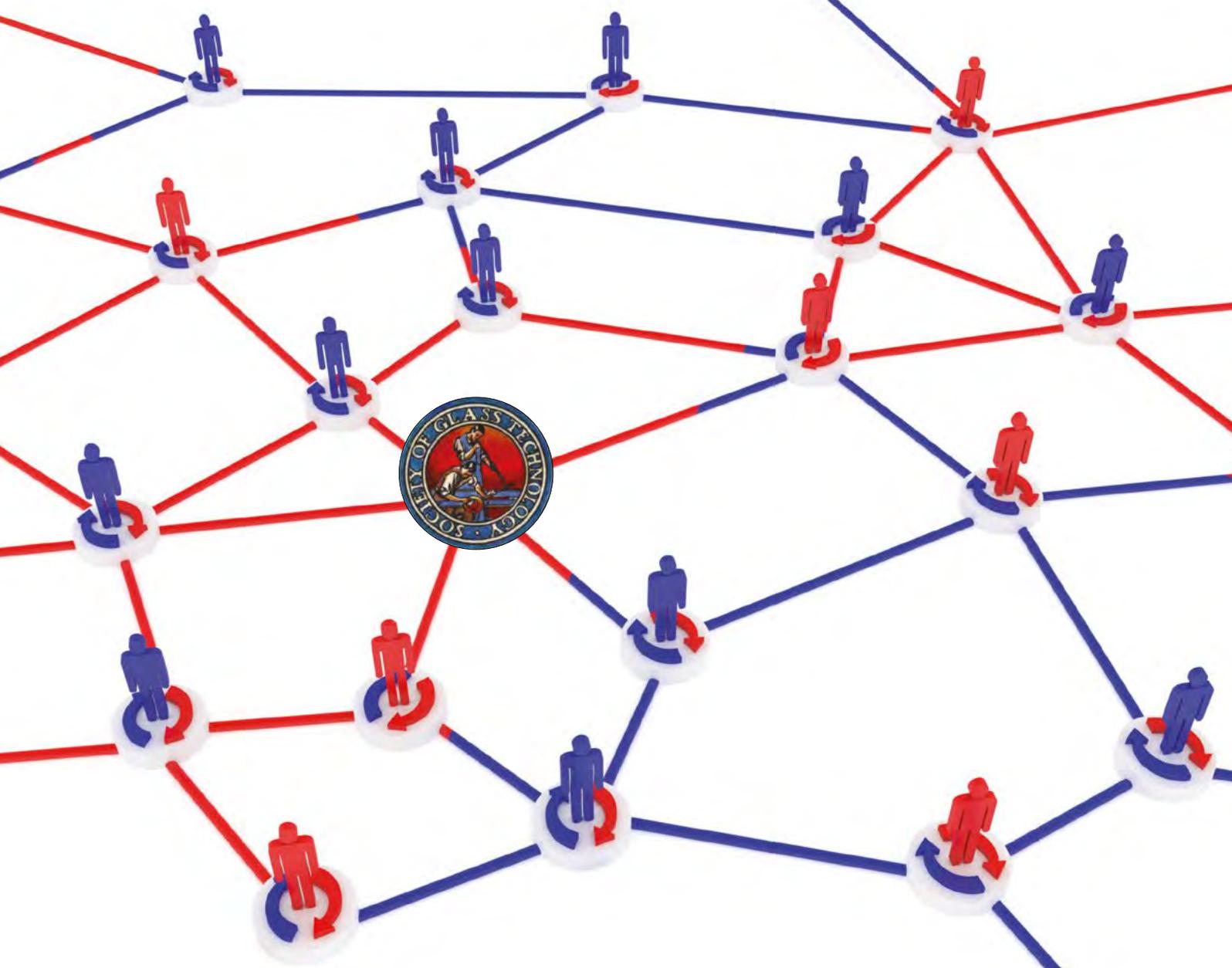
Second, if the CTE of the ACL is greater compared to the glass, then relatively large tensile stresses will be generated in the ACL even though the magnitude of the compressive stresses that would be observed in the glass will be of moderate or even low magnitude. Such a condition could potentially cause breakage even though the magnitude of the measured stresses in the glass would not be alarming, as inferred by Andrews.⁴

A recent breakage problem is representative of this latter situation. A decorated, non-refillable bottle had failed ▶

ACL and Glass Substrate Stresses
(ACL thickness = 25.4 mm; glass thicknesses = 2.29 mm and 1.27 mm)

ACL Thickness (µm)	ACL CTE (°C) ⁻¹	ACL Stress Index [Mpa/Δ°C]		Glass Stress Index [Mpa/Δ°C]	
		t = 2.29 mm	t = 1.27 mm	t = 2.29 mm	t = 1.27
25.4	8.60E-06	-0.00032	-0.00032	0.00002	0.00003
	8.80E-06	-0.00016	-0.00016	0.00001	0.00001
	9.00E-06	0.00000	0.00000	0.00000	0.00000
	9.20E-06	0.00016	0.00016	-0.00001	-0.00001
	9.40E-06	0.00032	0.00032	-0.00002	-0.00003
	1.00E-05	0.00080	0.00079	-0.00005	-0.00006
25.4	8.60E-06	-0.00016	-0.00016	0.00001	0.00001
	8.80E-06	0.00000	0.00000	0.00000	0.00000
	9.00E-06	0.00016	0.00016	-0.00001	-0.00001
	9.20E-06	0.00032	0.00032	-0.00002	-0.00003
	9.40E-06	0.00048	0.00047	-0.00003	-0.00004
	9.80E-06	0.00080	0.00079	-0.00005	-0.00006
25.4	8.60E-06	-0.00048	-0.00047	0.00003	0.00004
	8.80E-06	-0.00032	-0.00032	0.00002	0.00003
	9.00E-06	-0.00016	-0.00016	0.00001	0.00001
	9.20E-06	0.00000	0.00000	0.00000	0.00000
	9.40E-06	0.00016	0.00016	-0.00001	-0.00001
	1.02E-05	0.00080	0.00079	-0.00005	-0.00006
CTE of glass and ACL are equal					

Table 1: ACL and glass substrate stresses (ACL thickness = 50.8mm; glass thicknesses = 2.29mm and 1.27mm).



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at a very low level of applied force. Inspection of the fracture origins revealed that dwell marks were present indicative of the presence of micro-cracks in the decorated glass surface. These micro-cracks had significantly weakened the glass surface and were the sole cause of the breakage problem. Further examination of unbroken exemplar bottles revealed that the micro-cracks were present in the ACL on the as-produced bottles (see Figure 3).

Polariscopic analysis revealed the presence of a compressive stress in the glass with a magnitude of 28kg/cm² (400psi). Using the assumption that the tensile stress in the ACL was approximately the same magnitude, then it was difficult to fathom how 28kg/cm² (400psi) of tension would cause the ACL to spontaneously crack. However, applying the factors shown in the current FEA analyses, the tensile stress in the ACL would actually have been on the order of 168kg/cm² (2,400psi) to as much as 336kg/cm² (4,800psi) in magnitude. Such high tensile stresses are definitely sufficient to spontaneously cause micro-cracks to develop in the ACL layer as was observed in the breakage problem. ●

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ACL Thickness (μm)	ACL CTE (α) ⁻¹	ACL Stress Index [Mpa/Δ°C]		Glass Stress Index [Mpa/Δ°C]	
		t = 2.29 mm	t = 1.27 mm	t = 2.29 mm	t = 1.27
38.1	8.60E-06	-0.00031	-0.00030	0.00003	0.00004
	8.80E-06	-0.00016	-0.00015	0.00001	0.00002
	9.00E-06	0.00000	0.00000	0.00000	0.00000
	9.20E-06	0.00016	0.00015	-0.00001	-0.00002
	9.40E-06	0.00031	0.00030	-0.00003	-0.00004
	1.00E-05	0.00078	0.00076	-0.00007	-0.00009
38.1	8.60E-06	-0.00016	-0.00015	0.00001	0.00002
	8.80E-06	0.00000	0.00000	0.00000	0.00000
	9.00E-06	0.00016	0.00015	-0.00001	-0.00002
	9.20E-06	0.00031	0.00030	-0.00003	-0.00004
	9.40E-06	0.00047	0.00045	-0.00004	-0.00006
	9.80E-06	0.00078	0.00076	-0.00007	-0.00009
38.1	8.60E-06	-0.00047	-0.00045	0.00004	0.00006
	8.80E-06	-0.00031	-0.00030	0.00003	0.00004
	9.00E-06	-0.00016	-0.00015	0.00001	0.00002
	9.20E-06	0.00000	0.00000	0.00000	0.00000
	9.40E-06	0.00016	0.00015	-0.00001	-0.00002
	1.02E-05	0.00078	0.00076	-0.00007	-0.00009
CTE of glass and ACL are equal					

Table 2: ACL and glass substrate stresses (ACL thickness = 38.1mm).

ACL Thickness (μm)	ACL CTE (α) ⁻¹	ACL Stress Index [Mpa/Δ°C]		Glass Stress Index [Mpa/Δ°C]	
		t = 2.29 mm	t = 1.27 mm	t = 2.29 mm	t = 1.27
50.8	8.60E-06	-0.00030	-0.00029	0.00004	0.00005
	8.80E-06	-0.00015	-0.00015	0.00002	0.00002
	9.00E-06	0.00000	0.00000	0.00000	0.00000
	9.20E-06	0.00015	0.00015	-0.00002	-0.00002
	9.40E-06	0.00030	0.00029	-0.00004	-0.00005
	1.00E-05	0.00076	0.00073	-0.00010	-0.00012
50.8	8.60E-06	-0.00015	-0.00015	0.00002	0.00002
	8.80E-06	0.00000	0.00000	0.00000	0.00000
	9.00E-06	0.00015	0.00015	-0.00002	-0.00002
	9.20E-06	0.00030	0.00029	-0.00004	-0.00005
	9.40E-06	0.00045	0.00044	-0.00006	-0.00007
	9.80E-06	0.00075	0.00073	-0.00010	-0.00012
50.8	8.60E-06	-0.00045	-0.00044	0.00006	0.00007
	8.80E-06	-0.00030	-0.00029	0.00004	0.00005
	9.00E-06	-0.00015	-0.00015	0.00002	0.00002
	9.20E-06	0.00000	0.00000	0.00000	0.00000
	9.40E-06	0.00015	0.00015	-0.00002	-0.00002
	1.02E-05	0.00076	0.00073	-0.00010	-0.00012
CTE of glass and ACL are equal					

Table 3: ACL and glass substrate stresses (ACL thickness = 50.8mm).

8. ASTM C978, Photoelastic Determination of Residual Stress in a Transparent Glass Matrix Using a Polarizing Microscope and Optical Retardation Compensation Procedures
9. Glass Container Association, Polariscopic Examination of Glass Container Sections, J. Am. Cer. Soc., Vol 27, No 3, 1944, p. 85
10. John W. Hutchinson, Stresses and Failure Modes in Thin Films and Multilayers, Notes from a DCAMM Course, Oct. 1996
11. A. G. Evans and J. W. Hutchinson, The Thermomechanical Integrity of Thin Films and Multilayers, Acta. metall. mater., Vol 43, No 7, 1995, p. 2507

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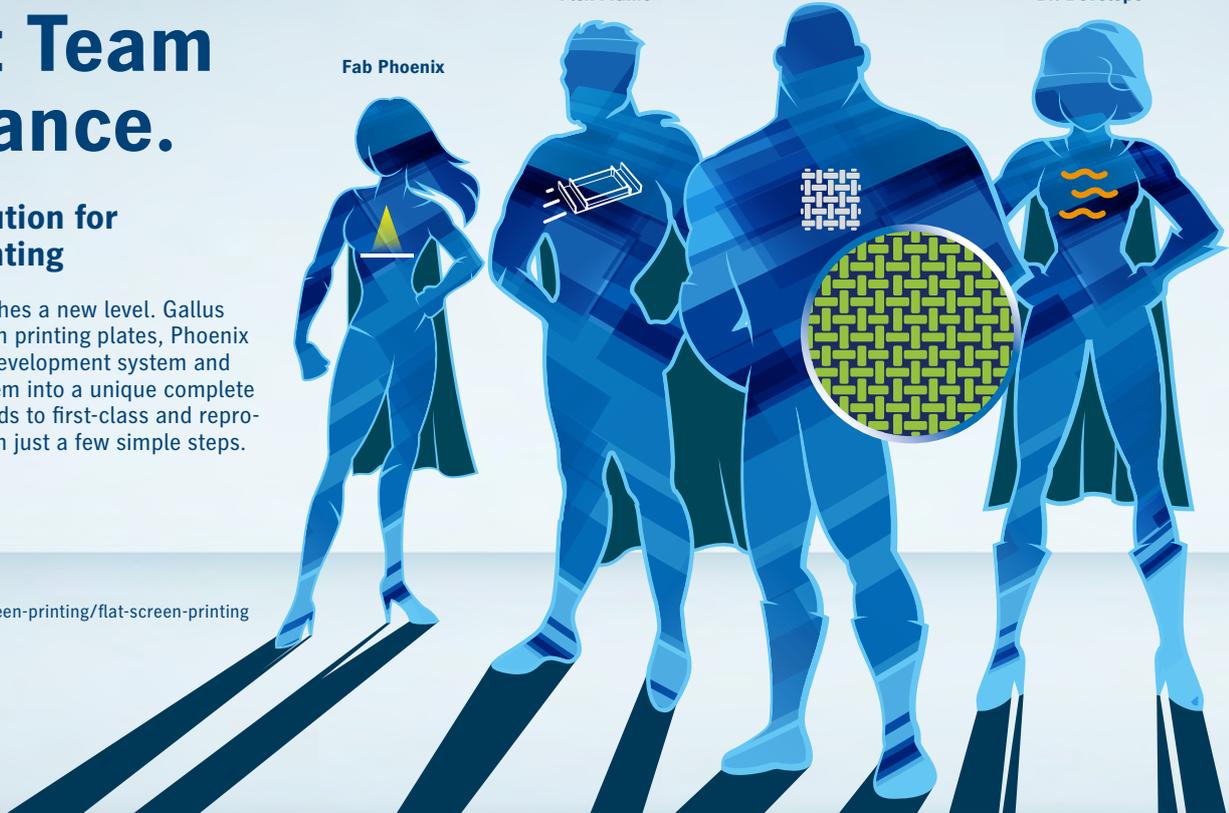


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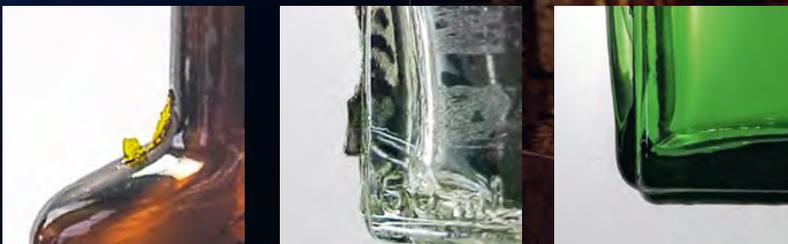
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Reducing held ware with digital re-sorting

Held ware is a huge driver of increased costs in container glass factories and re-sorting can be a nuisance for companies keen to optimise efficiency. Paul Schreuders explains how Long Term Image Storage from Netherlands-based specialist in advanced sensor and robot technology XPAR Vision can diminish these problems.

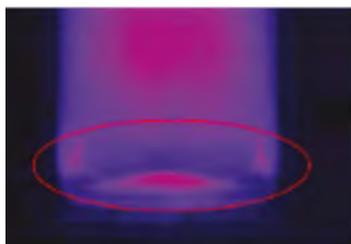
When poor quality is suspected or critical defects are identified, pallets of bottles or jars are set aside for the purpose of re-inspection. In the majority of cases, this re-inspection is carried out by manually unloading pallets at the cold end, re-inspecting all the containers and then palletising again. This process of re-sorting is costly, inefficient and disruptive for the normal production process. As a result, re-sorting activities are often postponed to 'a better time', which can lead to a backlog of blocked pallets.

Held ware is a huge driver of increased costs. A high number of blocked pallets take up valuable warehouse space, hold captive packaging material (pallets, tier sheets, etc.), can delay customer delivery times and increase employee headcount.

While held ware is a major key performance indicator (KPI) in glass factories, costs associated with held ware don't always show up in factories' major metrics and can therefore be overlooked. Furthermore, if held ware continues to increase and reaches unmanageable levels, often the only feasible options remaining are even more costly: dumping and scrapping of the ware.

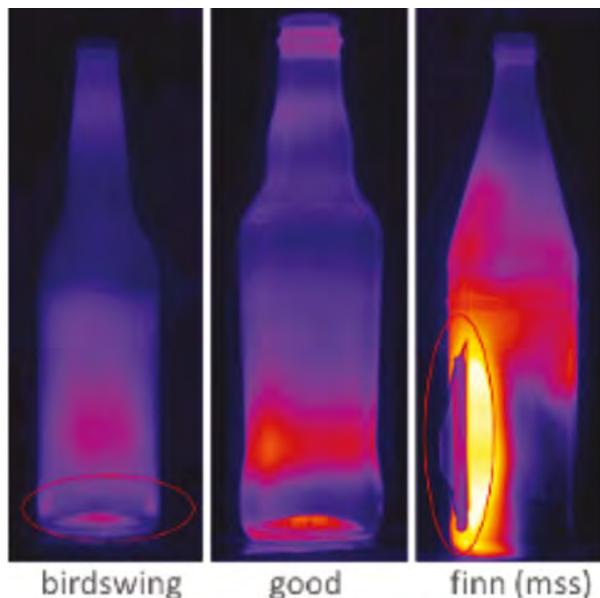
Long Term Image Storage

With XPAR Vision's Long Term Image Storage (LTIS), thermal images of all individual containers collected by the hot end infrared camera system are stored, including images of both good and rejected containers. Depending on customer choice, image storage can take place on local hard disks or in the Cloud, for as long as the customer wants – potentially enabling an 'unlimited' number of images to be logged.



birdswing

Container images presented in colour.

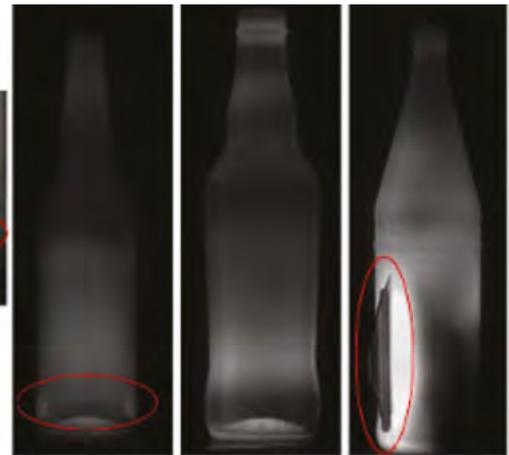


birdswing good finn (mss)



birdswing

Container images presented in grayscale.



birdswing good finn (mss)

Using XPAR Viewer, the stored images are simple to retrieve and the data is easy to analyse. Images are presented in grey scale or colour.

Digital re-sorting

The basic principle of LTIS is that images can be reviewed at all times, allowing the user to go back and verify if and when poor quality or critical defects have been produced, and on which cavity or section. As a result, related pallets can

be identified precisely, while preventing critical defects from being sent to the customer. By using LTIS, the inefficient and costly process of physical re-sorting is, to a great extent, replaced by a digital re-sorting.

For internal traceability, the availability of all images (including their time stamps) enables accurate determination of minimum quantities of held ware, and thus re-sorting costs. According to feedback from LTIS users, held ware and re-sorting is dramatically reduced.

Similarly, LTIS benefits external traceability by allowing precise identification of contaminated pallets as well as recording proof for the intended end user. As such, potential damage (customer complaints, financial claims, recalls, reputational damage) can be managed and limited. ●

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Offline quality control systems

Graeme Reid introduces a new development in Pro-Sight Vision's range of offline quality control systems that is designed to help glass container manufacturers meet stringent compliance requirements.

As a result of the success of its Finish Inspection System (Tuck Under Measurement), glass container manufacturers have told Pro-Sight that it is also becoming more important for them to have the ability to inspect, measure and record more of the critical dimensions of a container finish in order to quantify and meet compliance requirements.

Pro-Sight has responded to this customer-driven need and developed its Universal Finish Inspection System. This is a powerful offline quality control machine which is able to measure a wide range of critical dimensions and angles from the neck line up to the sealing surface, along with the new, additional feature of guide plate seam defect inspection and measurement. The system is applicable to all types of glass container finish.

Description and operation

Pro-Sight's latest Universal Finish Inspection System is of similar construction to its earlier Tuck Under Angle and Full Finish Inspection machines, in that it is again an offline system where the user places a container onto a turntable for the measurements to be taken. It can be located either on the shop floor at the cold end, typically by the QC bench or in a laboratory environment. It is also possible to use the machine in the hot end with suitably cooled samples from the IS machine conveyor.

The unit is supplied as a mobile system on a compact frame with a self-contained process control unit, a large high definition touchscreen interface and a drive unit to rotate the sample in front of the camera and lens.

Once a container is placed on the machine, it is rotated whilst the Ultra High Definition camera scans the bottle, capturing 120 images (one every three degrees of rotation). The results are recorded by the on-board processor and are then displayed on the large touchscreen display, with multi-language capability.

Connecting the machine to a factory network is achieved through a LAN ethernet port or by Wi-Fi to enable the possibility of exporting and saving

result data to any network location.

This connection can also provide remote access for Pro-Sight engineers to carry out software updates, training and customer support.

Setting system parameters

As with the previous version of machine, the Universal Finish Inspection System can be configured to measure the dimensions selected by the customer, including:-

- E dimension – Diameter of the finish at the thread root
- T dimension – Diameter of the finish at the thread peak
- U dimension – The thread height over its entire helical length
- S dimension – The distance from the sealing surface to the start of the thread
- H dimension – The height from the sealing surface to the end point of the thread
- F dimension – The distance from the sealing surface to the Tuck Under
- L dimension – The diameter of the finish at the Tuck Under
- N dimension – The diameter of the ring at its mating point with the container neck
- Tuck Under Angle
- Tuck Under Radius

In addition to the above, as part of the inspection routine the new Universal

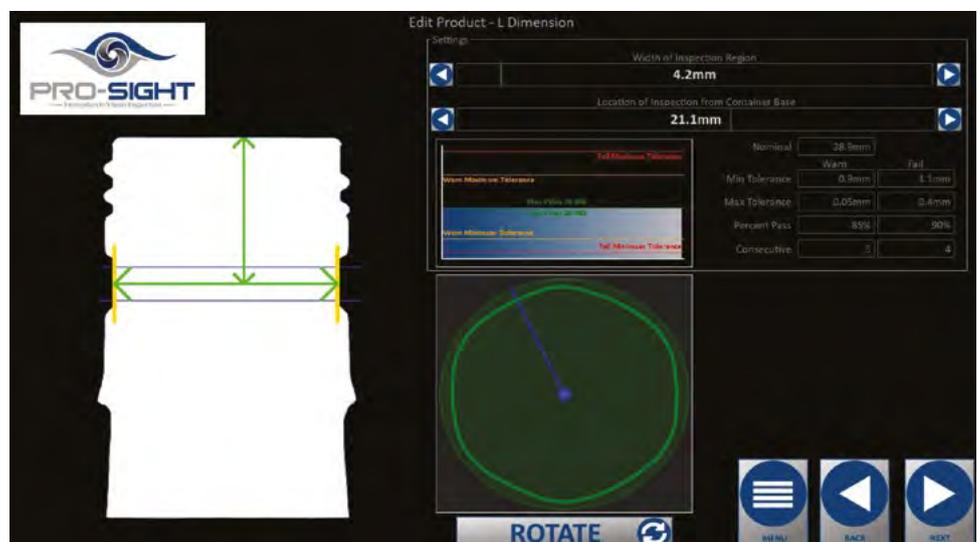
The Pro-Sight Universal Finish Inspector.



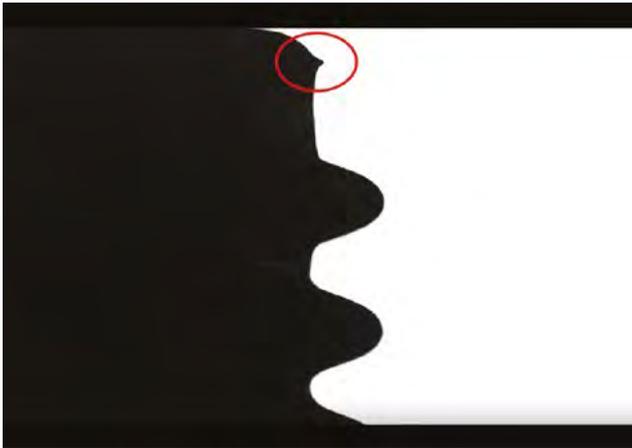
Finish Inspection System will also inspect the container for and measure the following guide plate seam defects:

- Flange Finish
- Knock Out

Each parameter can have minimum and maximum allowable tolerances set, with any measurements outside of these limits being highlighted to the user.



One of the inspection screens.



Example of a guide plate seam defect that the system can detect and accurately measure.

As a standard unit, the system will inspect finishes up to 48mm, with an 'XL' version to cater for wide mouth finishes. The system has modes for measuring a single bottle, doing a full cavity set with Mould plus Section Number traceability.

User-friendly operation

The Universal Finish Inspection System's touchscreen interface provides a step-by-step guide for the operator and is used to set the date, time, job number, IS machine section number and cavity numbers. These are stored, together with the dimensional data, as a job file in the system software. The operator is prompted to place a sample on the chuck, following which the measurements are taken.

At a glance, the visual display allows the QC operator or the IS machine operator to see whether the container is within or outside the specified limits and immediate action can be taken to change any ring mould equipment that has become out of specification through being dirty or damaged.

An 'Audit Mode' feature has been added to the new machine for top tier or full pallet audits. In this mode, the operator is asked to enter the job number, the date of manufacture and the pallet number, after which the mould number can be entered as each bottle is placed onto the turntable. The results from each bottle are displayed individually during the Audit, with all the data being collated and summarised in a single report when the tier or the full pallet Audit is complete.

Every bottle inspection result is stored in a local database. At any time, be that immediately after a batch of bottles has been inspected or going back to any previously captured results, the data can be searched by date of inspection and job reference number to be reviewed and if required exported. Data exports are in Microsoft Excel format and can be saved to any location on the factory network (LAN cable connection or Wi-Fi) or to a USB Flash Drive that can be plugged into the easy to access USB socket on the front of the machine. The exported data includes all the readings taken, allowing for comprehensive analysis.

For further information on this system, or to develop a solution for a specific container inspection requirement, please contact Pro-Sight Vision. ●

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A complete production management system for glassmakers

By monitoring key performance indicators and maintaining full traceability for an entire glass plant, production rates improve, losses decrease and customer risks are reduced. A pioneer in online supervision, Vertech's SIL production management system provides glassmakers with accurate, real time supervision across the entire plant.

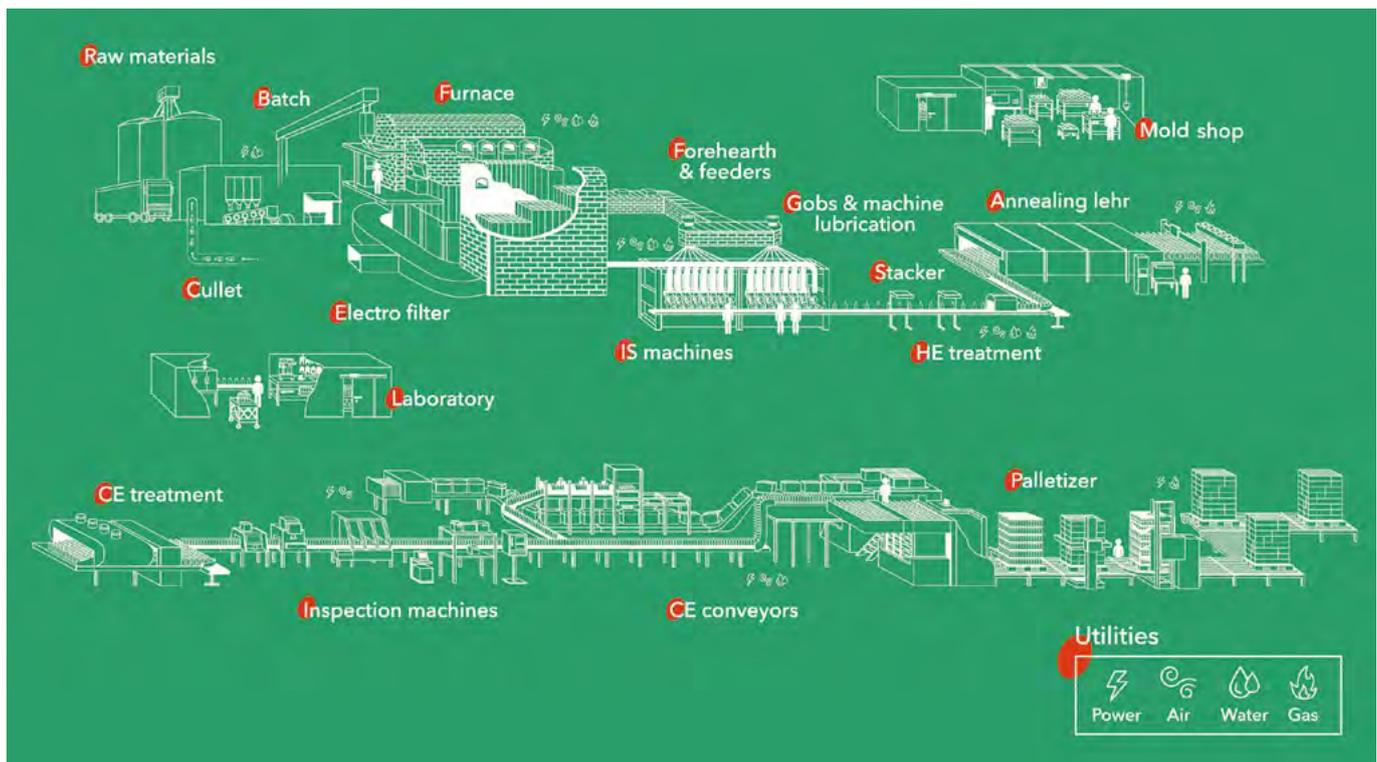
For more than 25 years French software specialist Vertech' has been honing its SIL supervision system for glassmakers producing hollowware, tableware and tubes or decorating glass. The sophisticated management execution system (M.E.S.) can be installed at the hot end and cold end, as well as in the mould shop, palletiser and quality labs.

Gathering together all existing features, SIL has been streamlined and restructured into five modules: SILProd, SIL4.0, SILXQual, SILXMold and SILXManager.

- **SILProd** ensures the data acquisition on production lines from gob cut to palletiser. Data is stored in the common DataBase and then displayed in real time. This user-friendly module is customised in order to provide operators and managers with



SIL has been streamlined and restructured into five modules: SILProd, SIL4.0, SILXQual, SILXMold and SILXManager.



With SIL, Vertech' strives to provide a user-friendly solution to facilitate the digitalisation of processes across the entire glass plant.

relevant lines information.

- **SIL4.0** is a module which allows the digitalisation of the full plant: sensors, machines, utilities data acquisition. The interface is customisable and adaptable. This state-of-art module can also analyse the past to anticipate the future.
- **SILXQual**, which is dedicated to quality control records, is an essential module for full traceability, permitting the recording of all controls from raw materials to pallets.
- **SILXMold** allows users to track each mould independently and record all of its details to improve quality and reduce defects.
- **SILXManager** is designed for managers and ensures the extraction and restitution of data in order to perform analysis with its reporting tools.

With its latest range of modules, SIL is constantly evolving and is adapted to all glassmakers' needs.

Latest updates

Now with an improved interface, SILProd allows manufacturers to follow up the manufacturing change time. A comment can be entered and a difficulty rating can be given. New time indicators have been created for challenging machine tracking, first good pallets, and line emptying. This update is designed to provide better traceability on the job change for faster decision making.

The latest improvement for downtime follow-up is another SILXProd innovation which is used to monitor machines stops. With this function, the availability of the machines can be followed. Now it is also possible to manually declare machine shutdowns.

A major improvement for parts follow-up is the SILXMaint option, which allows the monitoring of equipment assembly time, assembly place, repairs, dimensional measurements in order to get a unit traceability. With this SIL improvement, repair times are tracked and moulds assembly time and location are defined. Operators can choose the parts to track and then record this in the DataBase.

One of the most used interfaces, the SILProd history page F4 has been totally redesigned. Previously it was only possible to access history up to 96 hours. With the F4 upgrade, history is now unlimited which allows a more detailed overview for more accurate analyses. The new page is configurable, allowing operators to add or remove information to suit their needs.

With the SILXManager web interface, data can be managed, analysed and extracted. Formerly available as a desktop programme, SILXManager is now available online. The new platform offers online access to three distinct spaces: data management, quality and moulds. SILQual Manager is now integrated into SILXManager. Plant managers can configure SILProd, SILXQual and SILXMold with just one module.

Vertech' strives to provide a user-friendly solution to facilitate the digitalisation of processes in different departments of the plant. The company's aim is to satisfy customers by better adapting the SIL system to their needs and their environment to deliver the most versatile solution for daily usage; that's why SIL is continuously optimised. ●

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Digitalisation drives innovations in glass inspection

Hans Renders explains how digitalisation of container inspection, as embodied in Heye's SmartLine 2 inspection machine, continues to advance, bringing increased speed, accuracy and efficiency to glass manufacture.

Pressures on customers' businesses drive innovation in glass manufacture. Heye's development of new inspection equipment responds to these market demands, which are currently dominated by two trends: premiumisation and the journey to net zero.

Premiumisation and customisation – as brand owners seek further differentiation through packaging design – make inspection more challenging. Glass manufacturers have to meet demand for more non-round, complex shapes and more mini-ware (as sampling and tasting become ever more important ways to launch new ranges in the drinks industry). Special operations like mini-ware and non-round containers are standard with Heye's SmartLine 2.

Simultaneously, the packaging industry must also meet the need to restrict emissions throughout the supply chain. Heye constantly updates its inspection technology to deal with these challenges because increasing inspection efficiency reduces false positive ejection and energy consumption and keeps costs down



Heye's most up-to-date SmartLine 2 inspection machine features extensive non-contact enhancements such as bore gauge, diameter and ovality inspection and wall thickness.

for customers. Digitalisation and AI contribute strongly to the development.

Automated production driven by smart technology makes machine-powered processes more efficient, ultimately reducing raw material use, energy consumption and CO₂ emissions.

Heye uses AI extensively in the new software to train machines to read and react to different faults but also to understand when what may previously have been thought a fault is actually a design feature of the new container. This is explicitly demonstrated by the new AI-enabled Mould Number Reader KSL3.



Up to six inspection stations can be configured from a wide menu according to users' needs.

Hi-tech inspection tools

At the heart of Heye's operation is the HiSHIELD SmartLine 2 which integrates the newest technology combined with robust electrics and an electronic control system. Working at speeds of up to 400 articles per minute, up to six inspection stations can be configured from a wide menu according to users' needs.

The application of servo technology results in a high degree of flexibility. Fast and easy changes to an item's indexing positions and optimal use of the servo torque for up to four rotation stations are possible. Optimised motion sequences allow faster reactions to changing process parameters. The equipment's innovative design and its large

and easy-to-open hood provide more working space between the inspection stations. Job changes become much easier.

The most up-to-date SmartLine 2 features extensive non-contact enhancements which include bore gauge, diameter and ovality inspection and wall thickness. One major advantage is that Heye uses the superior chromatic-confocal method, which is much more precise than other solutions. These non-contact features are available for retrofitting onto original SmartLine 2 machines.

Check detection is one of the most important quality inspections conducted during the production of glass containers. Heye's HiSHIELD Ranger 2 enables manufacturers to fulfil the quality expectations of their customers when it comes to eliminating critical defects. It has proved time and again to detect more than 99.8% of all critical defects.

Ranger 2 is now able to inspect pharmaceutical mini-ware. With this evolution the system can fulfil all customer requirements relating to container sizes and shapes.

AI inspires latest developments

The latest addition to the glass manufacturer's arsenal of inspection technology is Heye's new Mould Number Reader KSL 3. This innovation is at the forefront of digital, non-contact inspection, utilising AI (machine learning) to improve its own performance during operation.

It has two aims. Step One is the systematic ejection of ware from faulty moulds at the cold end, by scanning mould numbers even where they are not especially well defined. Step Two is the correlation of detected defects to repeating mould numbers and communicating this to the hot end.

Older mould number readers sometimes struggle to recognise poorly defined numbers. These are typically caused by faulty or worn embossing in the moulds. KSL 3 features a new evaluation algorithm, based on artificial intelligence which it uses to train itself to learn shape number deviations. These technologies allow the system to be set up faster and mould numbers that were previously not readable can now be read. The result is that the KSL 3 increases the correct reading rate to over 99% of mould numbers.

It also extends the equipment's ability to recognise standard digital mould and alpha numeric codes that are available on the market. The simplified and intuitive Graphical User Interface (GUI) speeds up identification and enables more effective record keeping and this data feeds all aspects of the production process. PlantPilot Information Management connects the cold end and hot end and enables sifter rectification of identified problems within individual mould sections. The system collects and aggregates data from different sources and shares information on the spot. Tracking and tracing as well as the possibility of creating user-specific analysis are additional components, allowing continuous improvement processes to increase productivity.

On SmartLine 2 we constantly reduce mechanical elements and enhance the non-contact, digitised components of the inspection system. Powered by Industry 4.0, the new mould number reader augments Heye's HiSHIELD suite of digital and non-contact inspection equipment to create a cutting-edge cold end system to remove defective articles. ●

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Standard for variety: inspection modules for all purposes

Variety and design are key competitive advantages for glass compared to other packaging materials. Apart from product-specific requirements, glass plants face the challenge of integrating an existing mix of equipment with the need to implement new technologies and, on the other hand, limiting financial investment budgets. Supporting the management of this variety intelligently and simply is the clear strategic focus of family-owned company Dr. Günther Inspections, writes Mark Ziegler.

In general, cold end container glass inspection lines consist of three types of machine: a camera inspection machine for the body (sidewall), then a second camera inspection machine for the base/finish, and one at the end of a starwheel machine. Family-owned company Dr. Günther Inspections specialises in the automatic inspection and sorting of container glass, focusing on non-contact camera inspection machines. The German firm's R&D team has developed a clear concept to differentiate its standard inspection equipment from an advanced version by adding a number of inspection modules, thereby broadening its product portfolio to suit the needs of any glass plant investing in new technology.

CSWI machine

The standard version of Dr. Günther's camera sidewall inspection machine (CSWI) has six cameras in six positions to detect body defects, planity and dimensions. This configuration is suitable for many customers, especially when articles are more or less in the standard range or the client has a limited budget. Of particular note is the symmetrical camera/light source concept, which uses one light source for each camera position. Consequently, the



Recognition of low contrast defects using a special light source.

inspection result is independent from the container orientation. This permits a more precise execution of different detection tasks – with fewer shadows, for example. Detection of the outside contour or the ovality also becomes possible.

In addition to the standard configuration CSWI, different modules are available for specific requirements.

Module 1: Shoulder camera and thread + mouth crack inspection

Many customers use the module with shoulder cameras. This allows defects in the neck-, thread- and mouth-area to be picked up with specifically arranged cameras. This module serves also to detect cracks in the mouth area. The 360° thread inspection covers broken or unfilled ▶

HIGHLY MODULAR inspection machines

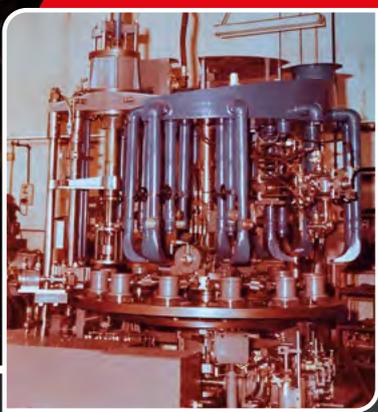


The modular structure of Dr. Günther Inspections machines allows glass plants to integrate existing equipment with new technologies.



YEAR 1980

YEAR 2000



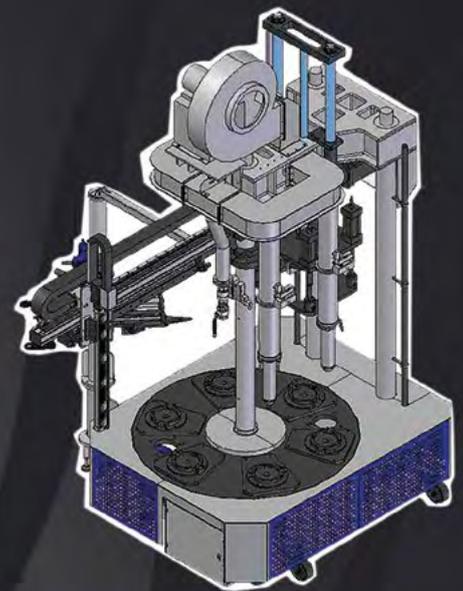
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Dr. Günther Inspections offers optical inspection systems for the automatic inspection and sorting of round and moulded articles made of clear, coloured and opal glass.

threads, bubbles and inclusions in or between the thread turn. Automatic seam masking is included, as well as recognition of logos and engravings. For bottles and especially for jars, dip/saddle detection replaces the mechanical vacuum test in the starwheel machine. This camera-based variant is extremely precise up to very high inspection speeds.

Module 2: Stress inspection

Stress in the body of the container can lead to a potentially dangerous collapse. With module 2, using polarised light, glass stress can easily be detected.

Module 3: Low contrast

Dr. Günther's R&D team has developed 'smart lighting', a special low contrast detection system combining multi-image illumination technology with high-speed algorithms. As a result, very small cosmetic defects can be detected.

Module 4: Flacons

This module comprises multi-image illumination for premium cosmetics products. Tilo Günther, Head of R&D and Project Management, is proud of this advanced solution package for this sector: "Smart lighting is a key component. For this reason, specific R&D investments have been made by the team. A special image processing module in the software makes even the smallest cosmetic defects visible. Checking washboards and folds of flacons is just as easy as checking for symmetry of the overall shape and the inner bottom contour." High class flacons must not have cosmetic defects. "The packaging is a fundamental component of the brand perception by the consumer and not only among females," says his sister Linda, the company's Commercial Manager, with a smile.

Base and finish inspection machine

The standard set-up of Dr. Günther's base and finish machine inspects the mouth rim to detect a damaged mouth or open blisters and cracks, and to carry out the so-called LOF (line over finish) test. A special software feature can find defects on or near the mould seam and differentiate between knurling and real defects on or near the knurling.

Module 1: Wire edge and overpress

Among the most critical defects in glass container production are overpress and wire edge, particularly for narrow neck press and blow (NNPB) producers. An overpress is located on the inner rim of the sealing surface, like a fin of glass extending above the sealing surface. Wire edge is also a fin of glass but it is located under the inner ring of the sealing surface. The reasons for both defects lie in a too-high gob weight or in problems related to the plunger movement. Both defect types can easily be detected by this module, based on the combination of precise cameras and innovative software architecture. Dr. Friedrich Günther, founder of the company, is proud to have been among the first to offer a technology solution for these critical defects in high-speed NNPB productions.

Module 2: Unfilled shoulder

According to Dr. Günther, with one of the company's self-built light sources, it is possible to inspect the article shoulder from above. "Shape deviations in the shoulder of cream jars, for example, are very hard to detect by standard camera inspections. With our custom-made solution, we have a precise detection for these defect types. The consistently good feedback shows us the high level of functionality in practice."

Module 3: Mould number reader

The mould number reader can be used regardless of the orientation of the bottle. Dot code and alphanumeric codes can both be read. In this module, the camera is mounted on top of the bottle, with the light source underneath the bottom. In conjunction with the sidewall inspection machine, rejection of defect bottles is guaranteed.

Module 4: Inner bore diameter

Inner bore measurements for containers and ampoules are among the important requirements because the filling nozzle always has to fit precisely into the ampoule. Dr. Günther R&D experts have developed an accurate camera set-up that replaces existing mechanical systems in the starwheel machine. The inspection unit consists of a camera above the bottle and a light source mounted below the bottle. In addition to the inner bore diameter, spikes and ovality problems are also detected.

Module 5: Bottom inspection for flacons

Flacons typically have much higher quality requirements. Special shapes or a different glass structure, such as greater glass thickness, mean that defect detection is significantly more challenging than with standard beer bottles, for example. Further required test criteria concern the measurement of the bottom height, which is important to ensure the break resistance. In addition, image processing of the container bottom, especially bottom notch recognition, is another criterion.

Module 6: Stress in the bottom

This module uses a set-up with polarised light and can detect stress problems in the bottom. Stress in this area is very critical, as it can lead to a large break with big pieces, which can be dangerous for the consumer.

Technologic differentiation

The cornerstone of technologic differentiation is superior optical precision and image processing technology, which can increase the financial performance of a glass plant. Dr. Günther's sidewall machines use one light source per camera position, permitting more opportunities for the detection of different defects. Another important feature is a new machine learning algorithm, combined with a multi-image processing engine. This allows greater precision for different inspection tasks over a wide range of articles. As a result, many of the starwheel machine's mechanical inspection units can be performed by Dr. Günther's camera machines, such as checks in the most critical areas, planity and tightness, inner bore diameter, container height or dimension and ovality.

Positive lookout

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About the author:
Mark Ziegler is a representative for Dr. Günther Inspections

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Avacon SA	47
BDF Industries SpA	41
Bock Energietechnik GmbH	62
Bottero Glass Technologies	11
Bucher Emhart Glass	49
CelSian Glass & Solar BV	53
Cortex Glass BV	73
CTA Division Delta Thermique	71
Dr Günther Inspections GbR	69
Dukhiram Maurya Engineering & Refractory Works India Pvt Ltd	35
Dura Temp Corporation	USA S11
Electroglass Ltd	27
EME GmbH	57
Eurotherm by Schneider Electric	77
Excelsius Global Services GmbH	1
Famor Engineering Srl	95
Ferro Corporation	79
FIC (UK) Ltd	USA S8 & S15, 63
Fosbel	USA S13
Furnotherm Glass Projects India Pvt Ltd	32
futronic GmbH	85
Gallus Ferd Rüesch AG	85
Glass Global	87
Glass Service Srl	45
Glaston	S7
Global Combustion Systems Ltd	61
Grafotec Spray Systems GmbH	66
Grenzebach Maschinenbau GmbH ...	13
Grünig-Interscreen AG	59
Henry F Teichmann Inc	USA S27
Heye International GmbH	51
HORN Glass Industries AG	Inside Front Cover
Hotwork International AG	21
Hotwork USA	USA S21
Hunprencio	17
IPRO Tec GmbH	5
IRIS Inspection machines ...	Front Cover
Earpiece & Outside Back Cover JADCO Manufacturing Inc	USA S19
Koenig & Bauer Kammann GmbH ...	81
Linde	USA S17
Lüscher Technologies AG	61
Mir Stekla	78
NOVAXION	89
OCMI-OTG SpA	USA S5
Olivotto Glass Technologies	29
PaneraTech Inc	67
Parkinson-Spencer Refractories Ltd .	65
Penico Gauges Ltd	8
Ernst Pennenkamp GmbH & Co oHG ..	39
Pennine Industrial Equipment Ltd	37
Precitec GmbH & Co KG	87
Pro-Sight Vision	55
Quantum Engineered Products Inc	USA S28
Ramsey Products Corp	USA S19
REFMON Co Ltd	55
Refractories Experience Srl	43
Shamvik Glasstech Private Limited ...	33
Shanghai Precision Dosing and Weighing System Co Ltd	USA S9
Sheppee International	Insert 8-9
Siemens	23
Socabelec SA	91
Society of Glass Technology	83
Somex Ltd	19
Nikolaus Sorg GmbH & Co KG	Front Cover
Strutz International Inc	Inside Back Cover
TECO Group	USA S1
THERMO TECH FURNACE & ENGINEERS PVT LTD	12
Total Specialities USA Inc	USA S23
Vertech'	53
Vidromecanica Lda	69
VMA GmbH	10
D Widmann GmbH	9
XPAR Vision BV	15
ZIPPE Industrieanlagen GmbH	75

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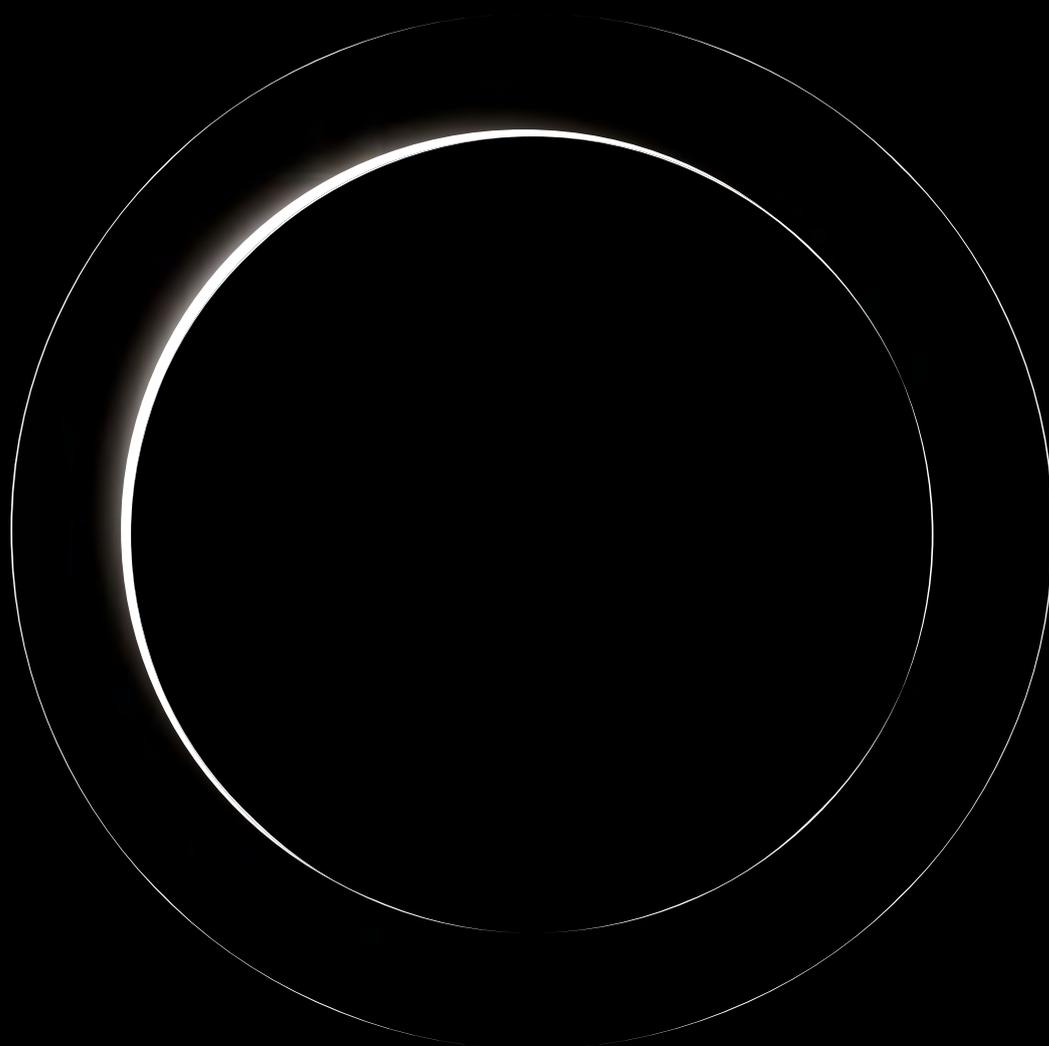
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