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PENNEKAMP

glass WORLDWIDE

September/
October 2021

Extended technology section + exclusive interviews with AGC, Corning, Glass Futures / Encirc, O-I / GPI & Tariq. Hot Topics & Virtual Marketplace: glassworldwide.co.uk

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Welcome

Significant progress is being made in the glass industry's search for effective CO_2 neutral glass production solutions. Industry bodies and collaborative organisations are partnering with glassmakers and their technology suppliers to explore and advocate electro-heat, hydrogen and other innovative technologies. This bumper issue of *Glass Worldwide* sits at the heart of the topic with a Buyers Guide devoted to advances and opportunities in glass melting technology that features no less than 16 specially prepared contributions.

The theme is also prevalent throughout this issue's series of exclusive interviews with industry figureheads from glassmaking giants who are expertly positioned to evaluate the prospects for the hollow, flat and speciality glass sectors.

Now Chief Technology Officer, Marc Van Den Neste originally joined AGC as a researcher in the Melting and Refractories department. Speaking to *Glass Worldwide,* he shared his views about the main challenges related to research and innovation.

Counting membership of the ICG's TC18 committee that promotes both fundamental and applied research on phenomena connected to glass melting processes as one of his many activities, Mathieu Hubert discusses diverse glass markets in his current role as Development Associate at Corning Incorporated.

Alongside long term melting solutions, sustainability is now placed either at the top of the glassmaker's agenda or at least close to its zenith. Tim Connors, Managing Director of O-I Americas North and Chairman of the GPI speaks exclusively about the challenge of improving glass recycling in North America to meet growing consumer demand for glass packaging.

In addition, readers will discover a broad selection of technology articles to assist with all areas of processing and production, as well as a series of regional reports identifying the latest trends and developments in multiple countries from Asia, Europe, Middle East and North and South America.

Complementing this issue's special focus, comprehensive details of melting technology suppliers are featured in the listings covering all areas of production in the new 2021–22 edition of the Who's Who / Annual Review yearbook, available free of charge with subscription orders at www.glassworldwide.co.uk. Visitors to the website can also find the latest Hot Topics news, Virtual Marketplace showcase, digital archive of current and back issues and much more.

Ron Argent

We were very sorry to hear about the recent passing of glass industry stalwart Ron Argent and send sincere condolences to his family, friends and colleagues who worked with him over the past five decades and more. Ron was a keen supporter of *Glass Worldwide* and will be missed.

The Glass Worldwide Team
www.glassworldwide.co.uk

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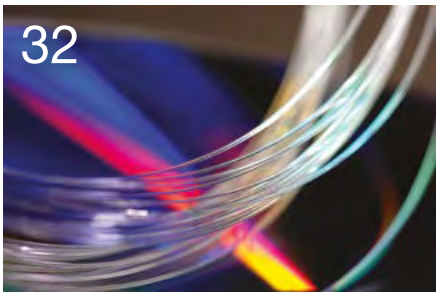

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Complementing the industry acclaimed content of *Glass Worldwide,* visit the Virtual Marketplace for a showcase of more than 150 digital presentations of the latest innovations from the following glassmakers and their suppliers. To find out how your company can be featured, email Dave Fordham: davefordham@glassworldwide.co.uk.

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

L–R: Dave Fordham (*Glass Worldwide* Publisher), Bharat Somany (AIGMF President) and Vinit Kapur (AIGMF secretary) on the joint AIGMF/*Glass Worldwide* stall at glasspex India 2019.

Glass Worldwide made honorary member of AIGMF

In recognition of decades of cooperation, *Glass Worldwide* was enrolled as an honorary member of the All India Glass Manufacturers' Federation (AIGMF) during the federation's Executive Committee meeting on 25 June 2021.

Glass Worldwide is therefore the first overseas company to become an honorary AIGMF member, joining existing honorary members in India, namely CGCRI, CDGI and BHU.

Glass Worldwide already acts as preferred international journal of the AIGMF in association with *Kanch* and the two organisations will intensify cooperation in media and event management.

Bharat Somany, AIGMF President and Executive Director of HNG and AIGMF, commented: "*Glass Worldwide* are our partners in progress and we consider them very much a part of us. It is always an absolute pleasure to work with them and find ways forward for the industry together."

"*Glass Worldwide* is honoured to officially join the AIGMF and cement our longstanding cooperation for mutual benefit. We look forward to continuing the excellent partnership and assisting the Indian sub-continent with the best possible forum for the exchange of information, as well as keeping our global readership abreast of the latest developments from the Indian market," added Dave Fordham, *Glass Worldwide* Publisher.

The AIGMF was founded in 1944 and is the sole representative body of all segments of the Indian glass Industry consisting of large, medium and small-scale manufacturers. The AIGMF recently announced the fourth AIGMF Awards for outstanding achievement in the Indian glass industry as well as a Photography Contest, themed 'Glass in our lives' and supported by ICG, IYOG and CSIR-CGCRI. Winners will be announced in the November/December 2021 issue of *Glass Worldwide*.

www.aigmf.com ●

Grünig launches new products for coating, inspection and packaging

The G-COAT 414 from Grünig is designed to close the gap between its successful 406 and 415 models and provide double-sided coating for up to medium-size screens. The G-COAT 414 is suitable for screen formats of 1000mm x 1200mm, up to 2000mm x 2000mm. For smaller sizes it is available as a 'plug & coat' system: unpack – set up – coat.

The coating machine is compatible with Industry 4.0 standard, with coating parameters that can be programmed via the touchscreen terminal, a state-of-the-art PLC control, a continuously adjustable drive unit and data exchange by means of OPC-UA architecture.

An adjustable frame profile height allows for optimal coating, along with three integrated foot-operated pedals for uncomplicated and efficient control of the screen tie-bar as well as a pneumatic screen stretching device facilitate the operation of the machine. Individual control of the coating troughs enables screens to be coated on the squeegee or print side, or simultaneous coating of both sides.

In response to growing requirements related to the QS and ISO processes in printing screen manufacture, including handling and dispatch, Grünig has developed the G-PROOF 390 inspection and packaging machine. Suitable for finished screens sized from 800mm x 800mm to 1600mm x 2700mm, integrated screen height measurement allows automatic positioning of the screen gripper and ensures that the screen is always safely held in position. Automatic high-precision lifting and turning of the printing screens is programmed via computer screen and the G-PROOF 390 can be equipped with a luminous LED wall for visual checking.

Mesh tension can be ascertained with a Tensocheck 100 (or similar checking device), allowing the 1-point or 5-point measurement to be easily recorded and saved. Mesh and coating thickness (EOM) is checked by means of a layer thickness measuring device and the screen surface's roughness (Rz values) can also be recorded.

For wrapping, the G-PROOF 390's plastic foil dispenser is equipped with an operating lever which initiates the rotating motion when it is pressed and immediately stops it as soon as it is released, allowing solo operation for wrapping even large size screens.

All data is automatically imported into a measurement log – both cabled and Bluetooth-compatible measuring devices are supported – which also provides interfaces for data import and export. Label and document printers can be connected via Cristal Report for printing measurement logs, checking documents and labelling the completed screen.

www. grunig.ch ●

Grünig's multi-tasking G-PROOF 390 combines professional final checking, logging of measured values and simplified packaging of printing screens.

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Borosil chooses EME technology for solar glass expansion

After a successful upgrade and expansion project in 2019, Indian solar glass producer Borosil Renewables is continuing its partnership with EME GmbH., supplier of batch preparation plants, cullet handling equipment and batch charging technology for the glass industry.

Borosil is increasing its low iron solar glass production capacity with an additional furnace in order to meet demand arising from the popularity of photovoltaic panels, flat plate collectors and green building concepts around the world.

The Borosil Renewables factory in Bharuch, Gujarat. Photo provided by Borosil Ltd.

EME is designing and supplying the key equipment for the raw material intake, batch plant and cullet return system. The batch plant is specially engineered with future expansion in mind and has the potential to be to the largest batch plant in India.

www.eme.de ●

British Glass calls on Government to support net zero carbon strategy

Dave Dalton, British Glass CEO

In consultation with its members, British Glass – the representative body for the UK glass sector – has published a strategy that sets out the glass industry's potential route to net zero carbon emissions.

Following the UK signing the Paris Agreement, British Glass has worked with members, industry partners and the Government to devise a strategy to achieve net zero. The strategy outlines options to enable glass manufacturers to reduce combustion and process emissions, as well as improve energy efficiency. It also sets out how glass can support other sectors to decarbonise.

Key barriers to success include financial viability due to the high costs of alternative fuels, access to alternative fuels and availability of cullet (recycled glass).

The strategy and aspirations of the industry need to be supported and protected by Government if the sector is to succeed in decarbonising. British Glass has set out policy recommendations for energy costs, energy infrastructure, decarbonisation technologies, circular economy and the use of glass products in other sectors.

Commenting on the strategy, Dave Dalton, British Glass CEO said: "This is an exciting, but challenging road ahead for UK glass manufacturers on the journey to net zero but we are committed and well placed to achieve this, provided the industry is supported with relevant policy to overcome the barriers to success.

"We are confident that the measures presented in the net zero strategy will outline the best route to both reducing and eventually eliminating carbon emissions from our industry, but it is essential that we receive the support required from Government to fulfil our ambitions."

www.britglass.co.uk ●

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Olivotto develops first rotary machine for container glass

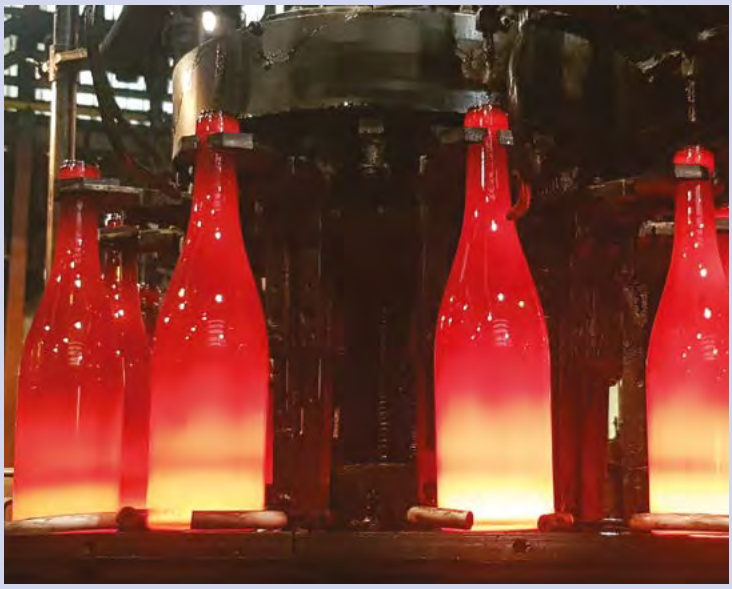
Established producer of machines and equipment for tableware, technical glass and pharma tubing Olivotto Glass Technologies (OGT) has added to its product range with a rotary machine for container glass.

The company decided to leverage its consolidated technology know-how on rotary forming machines and apply it to container glass. The pivot has resulted in a modular forming machine with ARBV (Advanced Rotary Blow Vacuum) for the new forming process.

Featuring quick job change, the new machine is suited to the needs of the producers who have a high number of different models in their production flow. It is also suitable to work with a low-medium glass pull rate capacity, offering flexibility to container glass manufacturers.

OGT's first rotary machine for container glass production, 'CGM-7', was delivered and successfully commissioned at an Italian plant for a producer of container glass at the end of 2020. Further rotary machines are currently in the process of being delivered.

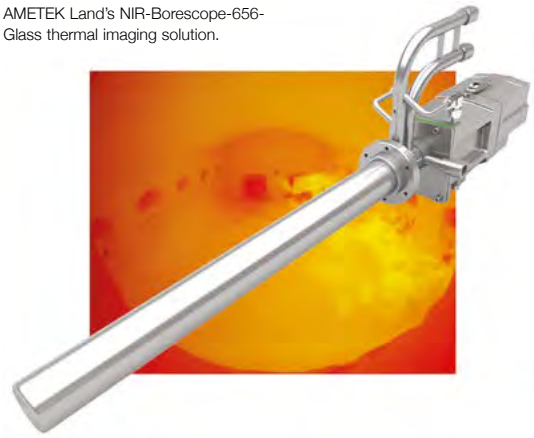
www.olivotto.it ●



Olivotto Glass Technologies is expanding into the container glass field.

Thai Glass increases product quality with AMETEK Land Thermal Imaging

AMETEK Land has enabled Thai Glass, one of the leading container glass makers in Thailand, to optimise its production quality with the installation of a high-performance temperature monitoring system.



AMETEK Land's NIR-Borescope-656-Glass thermal imaging solution.

Traditional CCTV cameras in the glass melt tanks have been replaced with a system that adds both visual and temperature measurement to its process control. AMETEK Land's NIR-Borescope-656-Glass thermal imaging solution produces high-definition thermal images and highly accurate temperature measurements in the range of 1000 to 1800°C. The new system allows Thai Glass to obtain a wider variety of temperature measurements in different locations, and can trend measurements at key points, including the crown, ports and burner blocks.

A spokesperson for Thai Glass commented: "We have seen significant advantages of using AMETEK Land's NIR-B-656-Glass in terms of process optimisation and quality control. The data obtained is invaluable in enabling us to monitor batch flow closely and to ensure optimum efficiency in the operation of the melt tank."

Phillipe Kerbois, Glass Sector Manager at AMETEK Land, said: "Glass producers worldwide are looking for more robust thermal imaging solutions that provide much more than just CCTV images. Our systems offer a truly unrivalled data-driven solution to the challenge of effective temperature measurement of glass melt tanks and increase production efficiency."

www.ametek-land.com ●

HORN to build 560tpd furnace in Turkey

Glass melting technology specialist HORN is to build a 560tpd end fired furnace for Bastürk Cam Packaging at its Malatya plant in Turkey. The new furnace is designed with six forehearths for the production of container glass. Using advanced technology the furnace will have a melting area of 185.4m² to produce flint glass. Heating of the furnace will be by natural gas or back-up diesel oil burners.

HORN's scope of supply includes the engineering of the refractory and steel structure, the combustion system, boosting system, measuring and control equipment, a new HORN HVR 600F batch charger, supervision of erection, heat-up and commissioning. Installation is planned to start in the second quarter of 2022.

HORN HVR is a registered trademark of HORN Glass Industries.

www.hornglass.com ●

Bastürk Cam is increasing production capacity with a new furnace from HORN.

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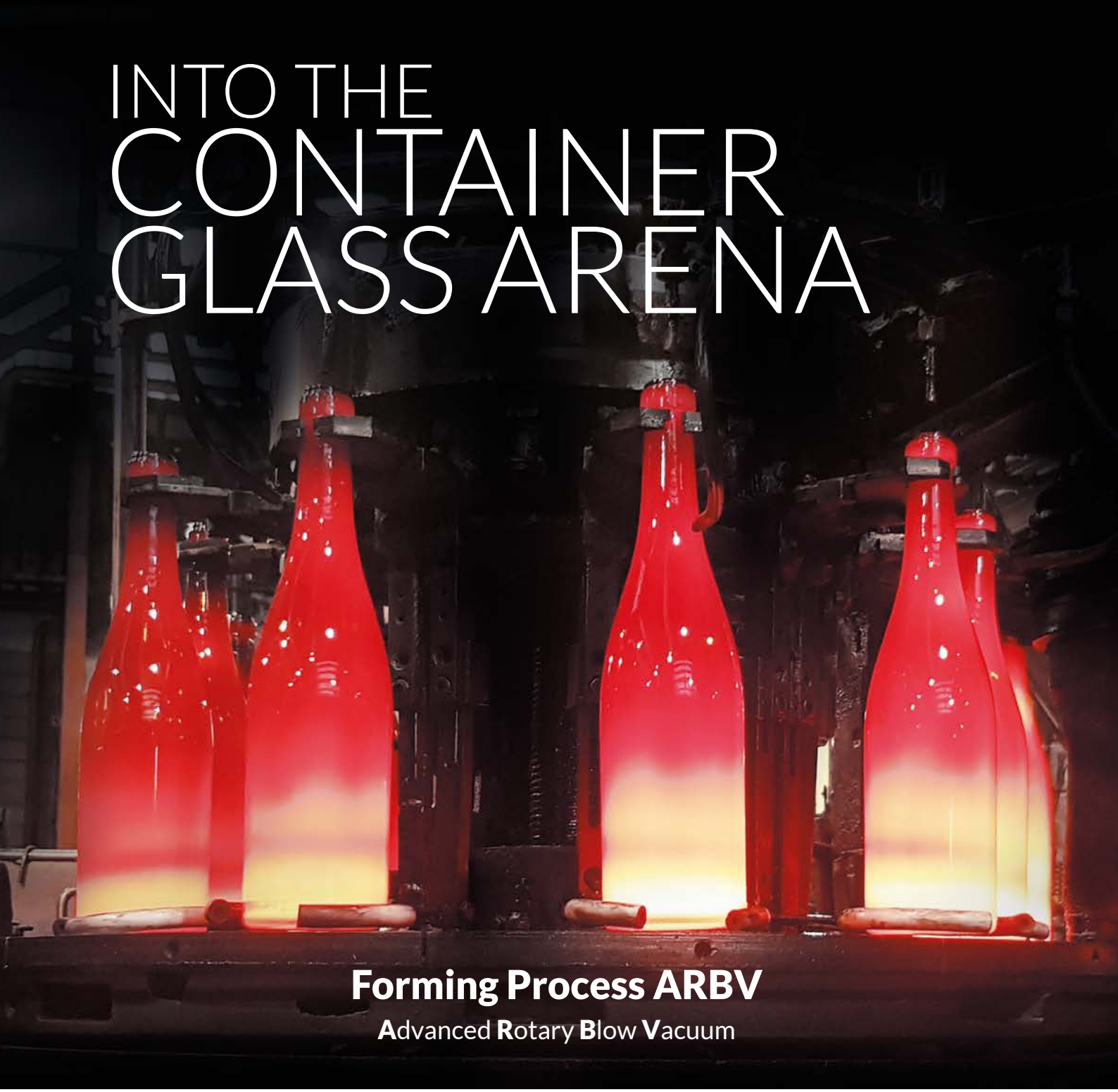

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Bormioli Pharma to triple sustainable content of its products

Pharmaceutical packaging producer Bormioli Pharma has announced its goal to use 50% sustainable raw materials for the manufacture of its products by 2025, tripling its current usage.

According to a survey conducted by Bormioli Pharma on its customer base, more than 90% of companies in the pharmaceutical sector consider the quest for new sustainable packaging solutions a priority. This focus has already translated into an increase in the sales of bottles, closures and accessories made from recycled or bio-based materials, which reached +50% in 2020 and +130% in the last three years.

"Sustainability is quickly becoming an agenda point of pharmaceutical industries around the world and, as primary packaging manufacturers, we feel the responsibility to support the industry in this transition, while sustaining the health of people and the planet," commented Andrea Lodetti, CEO of Bormioli Pharma. "We have always invested in the research and development of concrete, sustainable solutions, but today we want to make this commitment a differentiating element of our growth strategy by aligning it to medium-term objectives."

Other solutions currently being developed and tested include the creation of an innovative plastic made from carbon emissions recovery, the introduction of eco-design guidelines that encourage a lower use of virgin materials, and the simplification of components and enhanced recycling.

www.bormiolipharma.com ●

CiNER Glass creates virtual public consultation for South Wales plant

Part of CiNER Group, a major international conglomerate based in Turkey, CiNER Glass – headquartered in the UK – has held a public consultation for its Ebbw Vale plant proposal.

The company hopes to construct and operate a glass container manufacturing facility that uses recycled glass to supply glass bottles to UK food and beverage producers.

Referred to in planning documents as 'Dragon Glass Bottle Manufacturing Facility,' the plant would be located within the Rassau Industrial Estate, to the north of Ebbw Vale, Blaenau Gwent, South Wales. The intended £350m investment would create around 600 highly skilled jobs on a 21.5ha vacant plot within the Rassau Industrial Estate.

The project would also stimulate significant supply chain opportunities, with 400–500 jobs created during the construction phase and several hundred people working on site during the peak of construction.

CiNER Glass invited interested parties to view its proposals as part of a 28-day Pre-Application Consultation (PAC) process. The proposals were available to view online via CiNER's 'virtual engage' platform.

Later in the year CiNER Glass will submit a planning application to Blaenau Gwent County Borough Council, seeking permission to build its Ebbw Vale facility.

"Our vision is to build a centre of engineering excellence in glass technology in Wales, which can compete with the best in the world for generations to come," explained Didem Ciner, Executive Board Member, CiNER Glass Ltd. "South Wales is well positioned to serve the existing UK operations of our customers. Good access to road and port infrastructure and a skilled local workforce makes Wales an obvious choice for CiNER's expansion. Our intention is to get as close to our customers as possible to cut the economic and environmental costs of transporting glass," she added.

See the July/August issue of *Glass Worldwide* for an exclusive interview with Didem Ciner.

https://ciner-glass-wales.virtual-engage.com/ ●

CiNER Glass is progressing plans for its Dragon Glass manufacturing facility in South Wales.

NSG Group launches antibacterial and antiviral coated glass

In response to growing interest in antiviral materials against the backdrop of the global Covid-19 pandemic, glass and glazing systems supplier NSG Group has developed NSG Purity, an antibacterial and antiviral coated glass based on the Group's sol-gel technology.

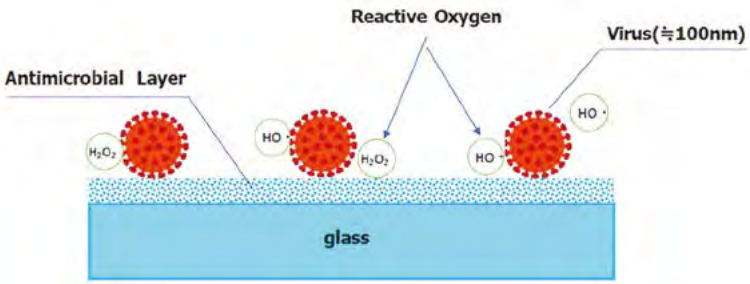
Copper contained in the NSG Purity coating layer reacts with water, oxygen and other substances in the air to generate active oxygen, which in turn inactivates bacteria and viruses by destroying their envelopes and causing lipids, protein and gene materials to decompose.

In addition to its antibacterial and antiviral performance, effective in both light and dark conditions, NSG Purity offers high durability and transparency. Potential applications may include cover glass for smart phones and tablets, touch screens for cash registers and ATMs, medical equipment, elevators and appliances used in the public places and at home.

The new glass has already been SIAA- [Society of Industrial-Technology for Antimicrobial Articles] certified for both antibacterial and antiviral properties, and a commercial production line is planned to start operation in August 2021.

Going forward, the Group intends to provide coating for various third-party glass, as well as supplying NSG Purity.

www.nsg.com ●



The antibacterial and antiviral bacterial properties of NSG Purity make it a suitable option for high contact glass that needs to be hygienic.

Italian collaboration pioneers use of hydrogen fuel

A working group comprising Snam, RINA, Bormioli Luigi, Bormioli Rocco, STARA GLASS, Università degli Studi di Genova, Stazione Sperimentale del Vetro, IFRF Italia, SGRPRO and RJC SOFT has begun a collaboration aimed at reducing emissions in the Italian glass industry through hydrogen.

The second-largest producer of glass objects in Europe, Italy manufactures over five million tonnes/year – an output that is energy-intensive and difficult to power with electricity. To this end, the 'Divina' project (Decarbonisation of the Glass Industry: Hydrogen and New Equipment), co-ordinated by Snam, RINA and Bormioli, aims to reduce emissions in the glass melting stage, which accounts for more than 50% of total energy consumption throughout the production process.

The initiative will make it possible, in the short to medium term, to assess the results of introducing an increasing proportion of hydrogen blended with natural gas into existing melting furnaces operating under regular production conditions. The project will also define and subsequently optimise the design rules for future furnaces, featuring hydrogen percentages up to 100%.

"Hydrogen will play a key role in decarbonising energy-intensive sectors such as glass production in order to meet domestic and European climate targets," explained Snam CEO Marco Alverà. "This project complements what we are already doing in the steel, rail transport and ceramics sectors."

"Following the first test with a mix of natural gas and 30% hydrogen in steel processing that we carried out in May, our expertise and laboratories are also being used for the 'Divina' project," added Ugo Salerno, President and CEO of RINA, who termed the endeavour "an important milestone towards the decarbonisation of another of the most significant sectors in the Italian economy."

Bringing together leading players in the energy sector, the glass industry and academia makes the Divina project "a sound and concrete proposal for a path to green transition and sustainability," stated Vincenzo Di Giuseppantonio, CEO of the Bormioli Luigi Group.

www.snam.it ●

futronic supplies controls and servo technology to Taiwan

As part of the Taiwan Tobacco and Liquor Corporation (TTL) glassworks modernisation project, European plant and equipment manufacturer futronic has been chosen to supply a new IS machine, control system and servo technology. The new machine is scheduled for commissioning in September.

TTL, a state-owned conglomeration which unites some of the country's biggest breweries and distilleries under one roof, is modernising one of the two production lines in its glassworks, both of which currently use EPRO control systems.

The project centres around the hot and cold ends and the line's eight-section IS machine is to be completely replaced. The order for futronic comprises the control and drive systems for IS machines with up to 24 sections: the package's core items are a FMT24S machine control system and an FDU24S servo drive. The drives for the servo take-outs (STO24S), two-axis pushers (PDU24S) and servo inverts (SIU24S) will likewise be furnished by the control system specialist and housed in a total of five control cabinets. Finally, an FMT training module will double as a supply of spare parts.

"We're very proud to have succeeded in convincing the customer of our products and our expertise", says Murat Yolaçan, Sales Engineer at futronic and the man responsible for the project. "We have an excellent reputation there. All the same, it's not every day that we can gain a competitive edge over such big players in such an extensive refurbishment project."

Installation and commissioning are scheduled for January 2022. Several representatives from the customer's organisation are due to travel to Tettnang for training at futronic, pandemic permitting. The two parties have agreed not to disclose any details regarding the order volume.

www.futronic.de ●

On its way to Taiwan: futronic's FMT24S control system, housed in a cabinet similar to this one. Photo: futronic.

Wheaton leads on biomethane

Brazilian manufacturer and decorator of glass packaging and glassware Wheaton has set out its plans to become the first glass maker in the world to use biomethane as the fuel for its glass melting furnace. In partnership with the Norwegian firm ZEG, a provider of technology for the production of clean hydrogen and electricity from hydrocarbons, the initiative is set to save around 7,000 tons/year of CO_2 emissions. Wheaton's 2020 Social and Environmental Report described the implementation of biogas as a fuel for the melting furnaces, the development of an application for the virtual personalisation of packaging and the launch of the Ecoglass refillable cosmetics containers.

www.wheaton.com.br ●

Turkish glass manufacturer chooses Quantum technology

Quantum Engineered Products Inc. has installed equipment for a 12-section machine at GCA's glass container factory in Kütahya, western Turkey.

Operating within the body of Gürok Group, GCA prioritises quality in glass packaging production by making strategic investments. The company prides itself on applying the latest technology and full automation systems to every stage of production at its factory in Kütahya.

Quantum's Tube-Within-a-Tube technology lined up for GCA's IS machine.

Successful commissioning of the first Quantum Engineered Products machine at GCA was achieved after trials and Covid-19 challenges. The equipment includes plunger mechanisms, process equipment and also a Total Forming Analysis (TFA) process controller. Quantum's Tube-Within-a-Tube was installed on all 36 cavities connected to Quantum's TFA process controller.

With its second furnace investment, which started operating in 2021, GCA nearly doubled its capacity and currently has export operations to more than 40 countries globally.

www.quantumforming.com ●

Energy efficient glass manufacturing wins funding

Following a competitive funding call, the UKRI-ISCF Transforming Foundation Industries Network+ has awarded over £270,000 in funding to six collaborative projects supporting energy efficient manufacturing across the foundation industry sectors.

Two of the projects are related to the glass industry: Improved Energy Efficiency of Float Glass Production – Dr. Peter Green (University of Liverpool) in collaboration with NSG Group; and Using Blast Furnace Waste Heat to Convert Various Wastes into New Raw Materials for Low Energy Glass – Dr. Zushu Li (University of Warwick) in collaboration with British Glass, Glass Futures, Calumite Ltd and Materials Processing Institute. A third project looks at the cold sintering of silica based shaped refractories led by Dr. Linhao Li (University of Sheffield) in collaboration with Vesuvius UK Ltd.

"The TFI Network+ has remit to help the foundation industries get ready for net-zero 2050. These projects are in key research areas that could radically alter the carbon footprint of several foundation industry sectors. We look forward to reporting their outcomes and to funding more high-quality projects in the future," said Professor Ian Reaney, Director of the Transforming Foundation Industries Network+.

All projects will begin in September, with project descriptions available on the TFI Network+ website. In July, the Network launched its second funding call, inviting proposals under the themes of resource efficiency and industrial symbiosis.

www.tfinetworkplus.org ●

People & posts

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Enrico Aureli heads up board of directors at CMS

Enrico Aureli.

On May 24, 2021 Italian manufacturer of CNC machines and systems CMS (Costruzioni Macchine Speciali) SpA appointed Enrico Aureli, Giovanni Negri and Marco Mancini to its board of directors, as President, CEO and Counsellor, respectively.

Outgoing Director Marco Aceti has left the CMS board and was thanked for his important work and for strategic help in the company's growth, particularly in Advanced Materials and Composites processing technologies.

Mr Aureli is CEO of packaging solutions specialist Aetna Group and a board member of Scm Group. As President of CMS, together with Marco Mancini and Giovanni Negri, he will be instrumental to the strategic positioning of CMS products and increasing the company's presence across all sectors and markets of reference.

www.cms.it ●

Groupe Pochet appoints new CEO

Xavier Gagey.

Effective 1 September, 2021, Xavier Gagey will assume the role of CEO at Groupe Pochet. Previously in charge of the Group's Glass Division, Mr Gagey will take over from Tristan Farabet, who has held the position since 2014 and dedicated himself to modernising the Group's organisation.

Strengthened by the fundamental progress made, along with the Group's positioning on new Industry 4.0 technologies, and enhanced value proposition, particularly in terms of CSR, the Group "can now open a new chapter in its history". Irène Gosset, Chairman and shareholder of the Groupe Pochet thanked Mr Gagey on behalf of all the shareholders "for his decisive action in the service of the Group over the past seven years and for the significant progress made. This positive momentum now enables us to look to the future with confidence and to open a new page in the Group's history with Xavier, whose proven talents will benefit the Group's activities as a whole," said Ms Gosset.

www.groupe-pochet.fr ●

New management team and premises for ISRA VISION

L–R: Enis Ersü, Dr. Johannes Giet, Tomas Lundin, Hans Jürgen Christ.

The succession planning of ISRA VISION Founder and CEO Enis Ersü, who retired from the inspection systems company at the end of June, included entering ISRA into a strategic partnership with Swedish industry group Atlas Copco. As a separate 'Machine Vision Solutions' division in Atlas Copco's Industrial Technique business area, ISRA will continue to operate from its headquarters in Darmstadt, Germany. For this purpose, the company is building new premises in the north of Darmstadt and the move-in is scheduled for the end of 2022.

ISRA VISION's new management team comprises of Executive Board members Hans Jürgen Christ and Dr. Johannes Giet and new Speaker, Tomas Lundin, who will lead the executive division as President Machine Vision Solutions. Mr Lundin joined ISRA VISION after working for the Atlas Copco Group for over 20 years in various management positions. In the last four years, he gained experience in the Asian market as General Manager Industrial Technique in China. He has already been on site at ISRA's headquarters in Darmstadt since August 2020 and is active as a member of the Management Board.

Mr Christ has been with ISRA VISION for 25 years and as CSO he contributed significantly contributed to the growth of ISRA VISION. Dr. Giet joined ISRA in 2001 via the company's acquisition of Rheinmetall Machine Vision, where he was Transaction Manager. Subsequently, he took over the management of the development of ISRA VISION worldwide.

ISRA VISION's applications focus primarily on automating the production and quality assurance of goods and products that are delivered to markets such as energy, healthcare, food, mobility and transport.

www.isravision.com ●

Verallia's executive committee reflects ESG roadmap

Mathilde Joannard

Anne-Gaëlle Bastos

Glass container manufacturer Verallia has promoted Mathilde Joannard to the position of HR Director in charge of Communication and CSR for the Verallia Group. She has also been named a member of the Group's Executive Committee. Anne-Gaëlle Bastos replaces Ms Joannard as HR Director for Verallia France.

"The appointment of two women to key positions in the Group is fully in line with the deployment of our ESG [environmental, social and governance] roadmap, and I am proud to announce that our executive committee now includes three women," said Michel Giannuzzi, Chairman and CEO of Verallia.

"I am delighted to welcome Mathilde to the Executive Committee of Verallia. Her industrial and international expertise will be an asset in the deployment of the Group's strategy. I also welcome Anne-Gaëlle to the Group. She is a renowned professional and I am convinced that her experience in the industry will be a valuable asset in consolidating our action plan for social progress in France," commented Mr Giannuzzi.

Ms Joannard was previously HR Director for Europe at Délifrance before joining Verallia France in 2018 as HR Director France. Ms Bastos's former position was HR & Organisation Director for LafargeHolcim Group in France, having worked at the company since 2014.

www.verallia.com ●

The right man for the job

Managing Director of O-I Americas North Tim Connors started his term as Chairman of GPI's Board of Trustees late last year. He talks exclusively to *Glass Worldwide,* preferred journal of GPI, about the association and the challenge of improving glass recycling in North America to meet growing consumer demand for glass packaging.

Tim Connors is Managing Director of O-I Americas North and Chairman of GPI's Board of Trustees.

Tim Connors joined O-I in 2007 as Director of Finance and Planning, North America and has gone on to establish a prestigious career at the company – the largest glass container manufacturer in North America. In 2010 Mr Connors became Vice President Strategic Planning and Business Development, North America, and then in 2011 he was made Vice President Finance of Asia Pacific. From 2014–2015 he was General Manager of O-I Australia and then went on to be President of Asia Pacific until promoted to his current position as Managing Director for O-I's Americas North operations.

Chairman of GPI

On 17 December 2020 Tim Connors began his term as Chairman of the Glass Packaging Institute (GPI)'s Board of Trustees, after receiving formal Board approval from the trade association that represents the North American glass container industry. What did he make of such an endorsement?

"It is a tremendous honour to continue a tradition of strong leadership on behalf of our industry in North America," responds Mr Connors. "GPI has made significant progress over the past 18 months under the leadership of Scott DeFife [President of GPI]. And, we are at a critical point for ensuring the benefits of glass packaging are received and comprehended.

"Over the past few years, GPI has increased its relevance and provided enhanced values to its member companies and stakeholders by increasing engagement with policymakers, staff and stakeholders at the local, state and regional levels, where many issues impacting glass are decided," Mr Connors continues. "Glass recycling programmes, plant permitting, emissions and energy policy are often determined at these levels."

Over the last year GPI has taken a more "active and hands-on" leadership role in the Glass Recycling Coalition (GRC), a not-for-profit organisation consisting of haulers, processors, recyclers and brands to improve the amount and quality of recycled glass available for purchase. "These efforts include certification of materials recovery facilities (MRF) that have installation glass sorting equipment and made other adjustments to improve the ultimate usability of glass entering their plants," says Mr Connors.

"From a broader level, Covid-19 has provided additional key opportunities for GPI to engage with federal agencies, policymakers, as well as national supply, manufacturing, consumer brands and recycling organisations," he notes. "As governments look to implement policies to reduce carbon emissions and energy use at the plant level, GPI has promoted the sustainable and circular nature of glass, its relatively lower energy-intensity in contrast to competitive packaging at numerous webinars, meetings and hearings."

Increasing benefits for members

GPI's members are "very supportive" of the association's goals, which focus on key issues in the industry, including recycling. "As members we both guide and amplify the common good for glass packaging. GPI, as with the industry, needs the people and resources to ensure clarity and understanding about the benefits of glass packaging," underlines Mr Connors.

Most of GPI's objectives (and membership benefits) run through its primary committees, Marketing

For over 30 years, food and beverage brands have participated in the GPI's Clear Choice Awards, using the programme to highlight glass packaging that tells the story of their products and to showcase stand-out, innovative designs.

and Communications (M&C) and Government Affairs, he explains. "These are tied together to provide background, materials and talking points for our members to utilise as they connect with their customers and supply chains to inform and grow their businesses.

"GPI's M&C Committee works with members to grow and expand markets for glass bottles and jars by developing communications materials, commissioning original market-based research, and providing statistical reports and information to members. These include consumer preference surveys, information on glass recycling and circular economy, supported through regular promotion of glass through earned media and original content. This year, the association restarted its well-known Clear Choice Awards, which recognises outstanding glass container design in the primary food and beverage categories."

Regarding the Government Affairs committee, GPI advocates on behalf of its member companies in a variety of industries, and Mr Connors gives several examples: "advocating for fair and transparent rail shipping policies, advancing policies that level the playing field for our domestic raw material supply companies, ensuring regulators at the local, state and federal level understand the broad range of issues related to glass recycling, or showcasing our industry's long-time and continuing efforts to reduce our carbon footprint at the plant level.

"GPI's leadership teams play a crucial role in the conception and implementation of all advocacy work in the industry," he adds. "Members of both the Board and Management Committee bring a mix of considerable experience in glass and broader manufacturing industries. This experience allows GPI to support goals to promote glass packaging and will enable progress on GPI's recycled content goals over the next year, outlined in our new plan – A Circular Future for Glass."

Spreading the word

GPI is in turn supported by this magazine, with *Glass Worldwide* serving as GPI's preferred journal, a co-operation that benefits the association by providing another platform for communication and learning. "Partnering with a glass-focused global publication recognises the many inherent and commonly held attributes shared by the entire glass container supply and customer chains," believes Mr Connors. "The partnership has provided GPI access to many different companies, increasing our knowledge by sharing experiences, either through *Glass Worldwide's* instructive webinars, or through GPI's regular industry column" – penned by Scott DeFife (see page 156).

"Glass packaging has so much to offer," concludes Mr Connors. "And, we, as an industry, have a responsibility to position it correctly in the world of sustainability and branding. For many years other substrates have been committing significant resources to gaining ground in the industry. The challenge now, and in the future, is to ensure that the real, tangible and sustainable benefits of glass are not lost in the noise of single-attribute claims and misinformation."

With this as the focus of his Chairmanship, and a leadership role at O-I where improving glass recycling in North America is high on the agenda, it is hard to imagine two positions/ambitions that dovetail more perfectly, or an individual more suited to sending the message, loud and proud, that glass is the ultimate packaging solution. ●

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AGC's Technovation Centre in Gosselies, Belgium, brings together researchers, technicians and engineers focused on improving the glassmaking processes and developing new glass products. The Centre is also a showcase for the group's glass solutions for design, thermal insulation, solar control and sustainability.

CTO challenged by carbon neutrality

Since 2016, Marc Van Den Neste has been Chief Technology Officer of the worldwide Building & Industrial* Glass Company[1] of AGC (Japan), the world's largest flat glass producer. Speaking to *Glass Worldwide* he shared his views on the main challenges related to research and innovation in his business area.

After graduating with a master's degree in engineering (specialising in materials science) in Louvain-la-Neuve (Belgium), Marc Van Den Neste started his career in 1991 as a production engineer in the iron and steel company Cockerill Sambre, now in hands of ArcelorMittal. Nine years in this 24/7 heavy industry (like glass) shaped his sense of responsibility and leadership, and saw him move away from a vision of hierarchical management.

Marc Van Den Neste is Chief Technology Officer of the worldwide Building & Industrial Glass Company of AGC (Japan).

"In this environment, workers and foremen generally know more about production than young engineers. My role was to make normal people do great things in a team and not to give lessons," explains Mr Van Den Neste.

From steel production to glass innovation

With the decline of the steel industry, he turned to glass and joined the Glaverbel Research & Development Centre (now AGC Technovation Centre) in 1999 as a researcher in the Melting and Refractories department. Moving from production to research in refractories reinforced his feeling of contribution. "In addition, I was also responsible for developing the activity of ceramic welding aimed at repairing furnaces of all industries. This is where my first contacts with clients come from, which gives you an incredible energy boost. Very exciting," confides Mr Van Den Neste. He then became head of his department in 2001 before being appointed Director of the R&D Centre two years later. From 2009 to 2015 he was Vice-President, Chief Technology Officer, of AGC Glass Europe.

Marc Van Den Neste recalls three highlights during this period as European CTO. First, it coincided with a strong will to go further in innovation and in the value chain by creating new business models. "For this, with the support of our CEO Jean-François Heris, we tripled the R&D budget and launched a programme of innovative participation throughout the company," explains Mr Van Den Neste.

Secondly, together with his Japanese counterpart, they strove to make research more global. "In a large group like ours, if we don't use the critical mass to work on common projects, we just have the disadvantages of being big, which makes research slower, less efficient, more political, more complex and leads to internal competition and double developments. Hence we launched common strategic projects, proceeded with exchange of researchers, etc."

Thirdly, AGC Glass Europe convinced its Japanese parent company to invest in a new European R&D Centre in Gosselies (Belgium) opened in 2014. "From our shareholder it was a mark of trust in our regional capacity to fully contribute to glass innovation and enhance value creation for the company," claims Mr Van Den Neste.

Optimising research and development

The cornerstone of research at AGC is the brand new Yokohama Technical Centre (Japan) inaugurated on 24 June 2021. Employing around 1,500 staff, this facility integrates product and manufacturing technology development functions that were previously in separate locations. This R&D centre serves all AGC businesses. "Maybe to a lesser extent for the glass sector," confides Mr Van Den Neste.

Indeed, the Building & Industrial Glass Company has its own network of R&D facilities to better serve its regional customers. Based on the company's historical expansion, this network is mainly spread across facilities in Europe, with around 300 employees at the Technovation Centre in Gosselies, Belgium; a unit of around 20 Interpane employees at Lauenförde, Germany, specialising in coated products and coating equipment; 40 employees at the Yokohama Technical Centre; and around 20 employees dedicated to coatings in Abingdon, Virginia, USA.[2]

In order to optimise research at AGC, distinction is made between the concepts of 'technological platform' and 'blockbuster'. "We select shared technological platforms (= one facility) on which we work in a globalised way and where 80% of the development is achieved," explains Mr Van Den Neste, who uses coatings as an example. "The point is to use our critical mass and the remaining 20% is left to regional customisation."

In contrast, the 'blockbuster' concept results from a top-down global innovation strategy, regardless of input from researchers or customers. "This is a radical innovation project, such as carbon neutral manufacturing, which may breakdown into multiple research projects and lead to new products, processes and new businesses," states Mr Van Den Neste.

Being part of a large organisation has advantages in terms of R&D, especially in a diversified group such as AGC, the only glass corporation with activities in building, automotive, display and electronics. "We can exploit our critical mass and multiple areas of expertise for faster development," says Mr Van Den Neste. "For example, we have taken advantage of 30 years of experience in automotive antennas to now transfer this technology to the building industry" [see further in article].

Fineo is an advanced high-performance insulating glass technology that deploys pioneering vacuum-insulation technology to deliver exceptional thermal control in slimline glass.

However, as developments become increasingly rapid and complex, it becomes impossible for a single company to reach the market with complete solutions. Hence the need to practise Open Innovation in partnership with customers, suppliers or even competitors.

"Our Fineo vacuum glazing, as insulating as a triple glazing but thin as a single one, results from a collaboration combining Panasonic's expertise in display-related ▸

technology with our know-how in glass processing," observes Mr Van Den Neste.

Competitive benefits

What about the correlation between research/innovation and financial performance of the company? This complex issue is constantly debated among CTOs with no real model for calculation, according to Marc Van Den Neste. "However, internally and with the help of defined rules, it is crucial to be able to quantify the impact of research that turns into innovation and success. As CTO, it's my role to convince the management to engage as far as possible in innovation on a solid basis."

Marc Van Den Neste believes that AGC owes its more than 110 years in the glass business to innovation. Without innovation, any company based on the sale of commodities is doomed to disappear. Innovation has also earned AGC technological leadership in different fields such as vacuum coatings and glass melting processes. Twenty years ago AGC used to develop a new coated glass every two or three years. "Now, thanks to realistic virtual prototyping, our Coating on Demand service allow architects to define, create and view their own tailor-made coated glass on screen under various weather conditions," says Mr Van Den Neste. "This takes place in specific plants which produce a sample of their unique creation the very same day."

Glass melting also benefits from AGC expertise in float for sectors ranging from building, automotive and display and on various advances the company has made, e.g. with its oxycombustion furnace and heat recovery system. "AGC has some of the most energy-efficient melting tools in the glass industry," claims Mr Van Den Neste.

The Technovation Centre's inside skin consists of Stopray Ultra-50 double glazing on Clearvision with a triple silver coating, offering high thermal insulation performance in winter and sun protection in the summer, reducing the building's energy consumption.

Seeking sustainability

Unsurprisingly the most powerful driver for research now at AGC is sustainability. Marc Van Den Neste cites the example of the present carbon footprint of AGC glass operations in Europe which shows a ratio of 1:8. This means that for each tonne of CO_2 emitted by AGC activities, eight tonnes of CO_2 are avoided thanks to the use of its products. However, in line with the EU Green Deal [for the EU to eliminate or completely offset its greenhouse gas emissions by 2050], AGC's commitment is to reach carbon neutrality by 2050 and bring down the first part of the ratio from 1 to 0. No more CO_2 emissions!

According to Mr Van Den Neste, energy-intensive glass manufacturing can achieve this in different ways. "Firstly through optimisation of our process, which we have been doing for long. Secondly, through electrifying with green power up to 50% of the process (a limit above which electrification can raise technical issues). Thirdly, by using green hydrogen combustion for the remaining 50% or so. A small amount of CO_2 will remain from the decomposition of the carbonates releasing CO_2. This can be treated by CO_2 capture and storage techniques that already exist in Europe."

Intense efforts will also have to be put into increasing the figure of 8, the second part of the ratio, through new high performance products. New buildings will not only have to be [consuming] zero energy but will also have to produce energy. To this end, Marc Van Den Neste strongly believes in energy-generating facade solutions which are increasingly efficient, affordable and aesthetically pleasing. In his view, glass with built-in PV cells should be widely used to cover the opaque parts of buildings: spandrels but also concrete walls, for example. Nowadays glass can be designed without the photovoltaic cells being visible to ensure there is no ▸

Marc Van Den Neste: "AGC has some of the most energy-efficient melting tools in the glass industry".

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Innovation has earned AGC technological leadership in different fields such as the glass melting process.

compromise on aesthetics.

"Based on real data, it has been demonstrated that some European cities could produce the amount of energy they need by equipping roofs with traditional PV panels and opaque facades with PV glass," insists Mr Van Den Neste. Will the same thing ever happen with transparent glass (vision glazings)? "It's underway," he reveals, "and we will one day succeed in developing transparent glass capable of producing a large amount of energy at an affordable price. It seems indeed absurd to reflect solar energy through solar-control glass instead of converting this in power. But the opaque parts of large buildings, which represent about 30% of their surface, must first be made profitable."

Another huge challenge to the EU's carbon neutrality mission is the renovation of the building stock. The Green Deal practically implies speeding up the renovation rate from the current 1% to around 3% per year. This involves a large-scale approach aimed at industrialising renovation works by groups of buildings, districts or even cities. "We can no longer afford to renovate on a case by case basis with solutions which are expensive, complicated to implement, not flexible. Glassmakers must take advantage of this momentum to come up with industrialisable and high performance glass solutions, to co-ordinate partnerships in order to meet this enormous challenge," adds Mr Van Den Neste.

Looking to the future

Next to sustainability, the other classic drivers for research remain to make glass a source of comfort, safety, appealing aesthetics, and communication through active glass.

Marc Ven Den Neste also points to a very topical issue: connectivity with the advent of 5G. With Waveattoch, AGC has developed transparent glass 4G/5G antennas to be installed indoors against the glazing. These antennas enhance network densification and improve urban coverage where extra capacity will be strongly needed. "They avoid any health issue due to their low power and do not spoil urban aesthetics while their deployment has no real technical, cost or legal limitations," he insists. This solution is now being implemented in Japan with NTT Docomo.[3] Wavethru is another development aimed at improving mobile coverage indoors also where 80% of mobile calls are made and received. Well-insulated spaces and high-frequency waves (such as 5G) are two major factors that attenuate indoor signal. By applying a laser de-coating treatment in places on existing windows on site, wave pass-through significantly improves without compromising the initial performance of the glazing.

When asked about his dream of radical innovation, Marc Van Den Neste says with a smile: "I take up my boss's idea of 15 years ago, namely inventing a glass that photosynthesises and processes CO_2 like nature does." ●

Artlite Functional Patterns designed by Alain Berteau feature on the glass partitions of the cafeteria in the AGC Technovation Centre.

References

** The 'Building & Industrial' division is set to be replaced by the 'Architectural Glass' division at AGC.*

1. The AGC Group has four in-house companies which operate worldwide: Building & Industrial Glass, Automotive, Electronics and Chemicals. The first two companies form the glass segment which accounts for around 46% of AGC sales.
2. On 15 June 2021, AGC announced its decision to sell its architectural glass business in North America to Cardinal.
3. Japan's largest telecommunications company.

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On the Spot... Dr. Ajith Appukuttan

Encirc is set to reduce its carbon output in its glass container plant in Elton, UK by more than 15.6 thousand tonnes a year by installing a new, intelligent end-to-end process control system. The company, with bid writing support from Glass Futures, has been awarded Government funding from the Department for Business, Energy and Industrial Strategy (BEIS) to begin its 'DEEP Control Project', ('Deployment of End-to-End Process control for Encirc's Elton site'). Dr. Ajith Appukuttan, Senior R&D Projects Manager at Glass Futures, exclusively described the project to *Glass Worldwide,* preferred media partner of Glass Futures.

GW: What are the main benefits of the DEEP Control Project being installed at Encirc's Elton plant?
Dr. Ajith Appukuttan: The main benefit from the DEEP Control project is the significant improvement in operational efficiency through digitalisation of end-to-end operations and reduced CO_2 emissions from the plant.

Additionally, this project paves the way towards digital transformation of their business, including supply chain operations, helping Encirc's plant move towards Industry 4.0.

GW: What is Glass Futures' role in the initiative?
Glass Futures played a significant role in identifying the funding opportunity, building project partnership with Hartree Digital Research Centre and Siemens plc, preparing and submitting the bid for the project. Glass Futures are also involved in the project as one of the partners providing programme management support and manufacturing expertise.

GW: How was the technology developed?
The project involves three stages. The first stage involves identifying different systems in the manufacturing operation from hot-end to cold-end and integrating them onto a common database stored in cloud. The second stage involves the team from Hartree analysing the production data using advanced machine learning algorithms and Siemens's visualisation tools to identify trends between various operational parameters (including environmental and operator data) and product quality. The final stage involves deploying predictive algorithms in the furnace control loop and demonstrating the benefits from this technology through production trails.

GW: How is the DEEP Control Project technology being integrated into Encirc's existing production?
The DEEP Control technology is initially deployed in Elton Furnace-1 and Line-11. Following demonstration trials on Line-11, the technology will be rolled out onto all lines in the plant.

GW: Will the DEEP Control Project complement 'Encirc's Industry 4.0 Ready' production line?
Absolutely!

GW: What has the Science and Technology Facilities Council (STFC) Hartree Centre contributed to the DEEP Control Project?
Hartree centre are world leaders on digitalisation and have extensive experience and skills in this field. As explained earlier, Hartree will provide their expertise on advanced machine learning and digitalisation to identify trends ▸

The Encirc plant in Elton.

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siemens.com/glass-processing

between production data and various inputs with an aim to produce a predictive control loop algorithm that can optimise furnace operations.

GW: And Siemens's contribution?
Siemens plc will provide support on their MindSphere platform for data integration and Mendix apps for data visualisation.

GW: How supportive have the UK government been in launching the project?
The UK Government have been very supportive from the outset as this project could help UK businesses become more competitive, allowing them to achieve one step closer towards net-zero goals.

GW: Are there already plans to replicate the Deep Control Project initiative at other plants within the Encirc/Vidrala group and/or at the facilities of other hollow glass manufacturers?
Vidrala group are also investigating another plan similar to DEEP Control to digitalise the operation.

GW: And could the technology be adapted in the future for flat, speciality and other glass melting applications?
Absolutely!

GW: In general, what is the future for the DEEP Control Project technology in the medium to long terms?
In the medium term, I see this technology evolving to incorporating other operations (i.e. supply chains) as businesses and other industries transform towards Industry 4.0 standards. In the long term, this technology will evolve to help industries respond quickly to changing trends in consumer behaviour.

GW: Following the positive biofuels trials earlier in 2021 and now the DEEP Control Project, how would you describe the collaboration between Encirc and Glass Futures?
Our relationship with Encirc is going from strength to strength as a result of these successful collaborative projects. Overall, our membership is focused on supporting the global glass supply chain and as such has seen a number of major multinational organisations participating, garnering excellent growth in the past two years.

GW: In your view, how important are such partnerships in positioning glass as the material of choice in the future and can Glass Futures be the catalyst for industry-wide collaborations?
Glass is as infinitely recyclable material, which is the primary reason for the UN proclaiming the year 2022 as the International Year of Glass.

Partnership projects with Glass Futures will help glass producers around the world move towards achieving the net zero CO_2 emissions target in their manufacturing and supply chain operations. We believe collaboration is the path to delivering technology that transforms this industry, allowing it to position glass as the material of choice amongst consumers and governments.

GW: Since joining Glass Futures earlier this year, what have been the most rewarding aspects of your role as Senior R&D Projects Manager?
I came from a technology development background in the Aerospace sector. The most rewarding aspects of my role at Glass Futures have been translating some of the lessons learnt from my previous role and ensuring projects are run at optimum efficiency for the benefit of our members and collaborators. I particularly enjoy building relationships with our members to help me identify any operational challenges preventing them from delivering on their net-zero targets, and how Glass Futures can aid the delivery of those targets.

Glass Futures' proposed centre of excellence in St Helens, UK. Planning permission was granted in May for delivery of the £54 million global glass research and innovation facility.

GW: In addition to the DEEP Control Project, do any current and/or upcoming Glass Futures R&D projects particularly excite you?
All projects at Glass Futures are challenging and exciting to various degrees. Future proofing furnace technologies to changing fuel scenarios (i.e. low carbon fuels) is particularly exciting.

GW: In your opinion, what should the glass industry be doing to support the goals of Glass Futures?
It's simple really; the glass industry should understand that Glass Futures is here to help. We are by the glass industry, for the glass industry to help decarbonise operations and offer support in the mission of positioning glass as the material of choice. Therefore, in my opinion the glass industry should work closely with Glass Futures to identify pathways for maturing technologies and responding to Governmental regulations to meet industrial goals. ●

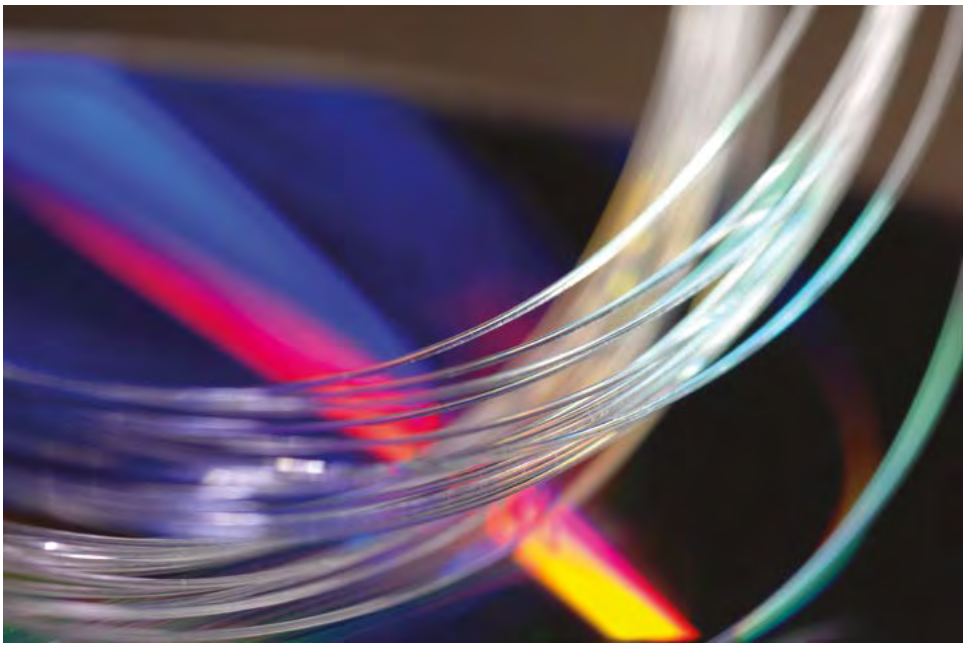
Further information:
Glass Futures
web: www.glass-futures.org

Encirc
web: www.encirc360.com

History in the making

Inspired by the ever-evolving uses for a millennia-old material, Mathieu Hubert applies his glass expertise at Corning Incorporated as a Development Associate, and has recently been made a board member of GlassTrend. Here, he speaks exclusively to *Glass Worldwide*, preferred journal of GlassTrend, about his career in the glass industry thus far and his thoughts on attracting and training the future generation of glass enthusiasts.

Mathieu Hubert is a Development Associate at Corning Incorporated.



Corning's markets include optical communications, mobile consumer electronics, display, automotive and life sciences.

Things could have turned out differently for Mathieu Hubert had he not taken a job offer whilst studying chemistry at the University of Rennes 1 in France. "I came into contact with the world of glass by chance," he explains, "when the father of a high school friend who worked in a glass and ceramics lab at a local university contacted me as he knew I was into chemistry, and I started working in his lab in 2006. I have been hooked ever since."

Mr Hubert's enduring fascination for glass is tangible, and infectious – an asset given that he now fits in teaching lectures on glass science and technology at Corning Community College, "which I really enjoy," in addition to his day job.

"Glass is a fascinating material," Mr Hubert extols. "Natural glasses, such as obsidian, have been around for millions of years. Glass has also been manufactured for thousands of years. Yet, despite being one of the oldest human-made materials, it's not an old or obsolete material. The world as we know it relies on glass and on all the possibilities it offers. So, on one hand, the glass industry is almost 5,000 years old. Yet, on the other, glass is an industry of the future – having both a rich history and virtually infinite amount of new possibilities.

"However, while glass is so critical to our everyday life, the glass industry is quite unknown to the general public. Most people will encounter glass hundreds of times a day, every single day of their life, and never know where all this material came from. Wanting to know more about the glass industry overall and all it has to offer was what got me into it."

Graduate becomes teacher

Focusing on chalcogenide glasses and glass-ceramics for infrared applications, Mathieu graduated with an MSc in Materials Chemistry and a PhD in Chemistry from the Univ. of Rennes, along with a PhD from the University of Arizona in Tucson for good measure. "Surprisingly, I did not do any work on oxide glasses, the most common glass type, until after I was done with college," he recalls.

Finishing his studies in 2012, he joined CelSian, in 2013, as a Glass Scientist/Technologist for the Netherlands-based company. "When I joined CelSian, I had a chance to work with people with a great wealth of knowledge in the industry, and from whom I learned a lot of aspects of the industrial glass-making process," he reflects. "My role revolved mostly around contract research for different facets of the glass-making world including raw materials suppliers, glass producers, and equipment suppliers. My main focus areas at CelSian were the melting, fining and redox of glass. I also joined the team of teachers for the CelSian Academy and had the opportunity to teach lectures on glass science and technology in several countries."

Tantalisingly, a lot of the areas Mathieu worked on at CelSian were "proprietary/confidential", and therefore he cannot divulge any details. However, CelSian runs GlassTrend – the worldwide consortium of glass companies and institutes that amalgamates R&D activities for better production technologies across the industry – and "I can share that I was engaged in the execution of a few GlassTrend projects," says Mr Hubert, "including a project on fining in reduced glasses, which led to some improved understanding on the behaviour of chromium in antique and olive green glasses and its interaction with the amber chromophore. One of the most successful projects I was actively engaged in while at CelSian was the development of a UK-based Glass Technology course."

The Netherlands to New York

In 2016, Mathieu accepted a position as Glass Development Scientist at American materials science technology and innovation company Corning Incorporated. Before starting work in New York, he spent a few months ▸

at the Corning European Technology Centre (CETC) in Fontainebleau, France, where he had interned in 2008 whilst studying for his master's degree. "This 'internal networking' has helped since I moved to the US," he notes, "as it's easier to communicate with your colleagues when you have spent some time together working in the same place."

At Corning, Mr Hubert's main responsibilities relate to supporting the transfer of new products and scaling from the lab to industrial-scale manufacturing. "This entails navigating between different areas such as the research labs where I'm interacting with the scientists who invent new glasses to understanding the product and its critical attributes. I also work with engineering groups to ensure compatibility with our production assets as well as plants to support production of the material, and quality/product engineering to ensure the product meets our customers' needs."

In 2020, he was promoted to Development Associate, with a broader area of responsibilities and a team of his own to manage. "There is a new challenge every day!" he enthuses. "There are always new glasses or applications being developed, and there is always a lot of exciting work to be done.

"Prior to Covid-19, I had opportunity travel to different plants to see different parts of our processes and interact with different colleagues on a regular basis which I enjoyed," he continues. "My managers at Corning also support me in remaining involved in outside activities such as conferences or participation in organisations such as GlassTrend or the International Commission on Glass."

Mathieu Hubert became an Advisory Board member of GlassTrend at the end of 2019.

Government backing and futuristic projects

Corning's markets include optical communications, mobile consumer electronics, display, automotive and life sciences. The company's products range from damage-resistant cover glass for mobile devices to precision glass for advanced displays; optical fibre, wireless technologies, and connectivity solutions for state-of-the-art communications networks.

There has understandably been a strong push on the pharmaceutical packaging sector in the last 12 months due to the Covid-19 pandemic. "With the introduction of Corning Valor Glass in 2017, Corning has prioritised pharmaceutical packaging for a number of years," says Mr Hubert. "Corning accelerated its glass vial production capacity to support pharmaceutical manufacturers with grants from the Biomedical Advanced Research and Development Authority (BARDA), under the White House's Operation Warp Speed Initiative." [To date, Corning has received $261 million from the US Government to meet escalating requirement for glass tubing and vials driven by the global demand for Covid-19 vaccines.] "Corning Pharmaceutical Technologies has thus played, and will continue to play, a key role in the distribution of Covid-19 vaccines across the world."

Corning Valor Glass is a revolutionary primary pharmaceutical glass package that enhances the storage and delivery of drugs, providing more reliable access to medicines essential to public health.

In 2017, Corning celebrated its one billionth kilometre of optical fibre delivered; "a mind-boggling number" underlines Mr Hubert. "Our world could not function as we know it without glass," he notes. "Between fibres and their critical role in 5G and telecommunications, augmented reality products, and biomaterials, the future is made out of glass and there are probably new ways that glass will enable the way we approach our everyday life that we have not discovered yet!"

Corning's goal is simple: to remain at the forefront of the glass and ceramic developments for the next 170 years.

"I believe we are headed towards a Glass Age," continues Mr Hubert. "Scientists around the world are continuing to develop new and stronger glasses. But not only that, there are also new coatings conferring windows with new optical properties as well as new technologies using glass as substrates such as augmented reality. Bioglasses are also likely to take a larger place in medical use. The development of 3D printed glass will also enable new ways to produce specialty materials or manufactured highly complex shapes for optics."

However, this progress could be hampered in the future if there is not sufficient uptake from the next generation. There is a "critical need" to sustain the talent pipelines of the glass industry, according to Mr Hubert. An academic himself, he points to the fact that "universities/institutions training people on glass are not that common. The industry is looking for the talents of tomorrow, and at all levels, there is a strong need to bring more light on the glass world, and what it has to offer." ▸

Glass furnaces

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With *Glass Worldwide* as preferred journal, the GlassTrend organisation is a consortium of worldwide operating industries and institutes working in the field of glass and glass production and its seminars are regular fixtures on the international glass events calendar.

Ambassador for GlassTrend

Mathieu became an Advisory Board member of GlassTrend (GT), now in its 20th year, at the end of 2019. "I knew GT from a participant perspective since 2013, and I am glad to be more involved in the consortium," he says. He has also recently taken on a redefined role as Speciality Glass and International Commission on Glass (ICG) Ambassador, responsible for staying in touch with GlassTrend member companies/institutes from this sector to provide an overview of the challenges specific to speciality glass. At the ICG, his ambassador duties entail "facilitating communication between the different organisations."

Knowledge sharing for the benefit of the industry is the biggest benefit of GlassTrend membership, according to Mr Hubert. "The thing that amazed me when I participated in my first GT event was how many competing companies gather and openly share challenges and understand how concerting efforts on pre-competitive areas are beneficial for everyone," he recalls. "It has provided a critical platform for knowledge sharing and promotion of new technologies."

Encompassing individuals from diverse glass sectors across several continents, the structure of GlassTrend's board "allows us to gather a lot of different opinions, interests, concerns, etc. from a wide range of perspectives, and to try to address the most pressing and relevant topics," he explains. "Many board members are engaged in several other organisations, and always try to seek possible collaborations."

Glass Trend hosts seminars and webinars (predominantly the latter during the pandemic), and Mathieu credits the "great variety in topics" for helping him to stay current on subjects closest to his line of work, "and to get more familiar with the parts of the industry that I am not typically working on as well."

Industry support and networking

Since 2017, Mathieu has been a member of the Coordination Technical Committee for the International Commission on Glass. He is also a member of the Technical Committee TC23 on Education, and TC18 on Glass Melting, and recently joined the Executive Committee for the ICG2030 project. "I was briefly part of the Melting Technical Committee of the Society of Glass Technology (SGT) and am a member of the French Union for Science and Glass Technology (USTV), the UK SGT, and the American Ceramic Society (ACerS)," he adds. "All of these associations and organisations play a critical role by bringing together different players within the glass science and glass technology worlds, and provide platforms to offer support and networking opportunities for the glass community."

A regular attendee of "extremely valuable" industry gatherings, "going to conferences is one of the best parts of the job!" according to Mr Hubert. "It's a good opportunity to meet friends and to keep learning from them. The Glass Problems Conference (GPC) is a great place to keep up to date with the latest technology updates in the glass industry," he elaborates. "The format, with plenary conferences during the day, and exhibitions in the evening, is unique and very conducive to discussions and networking.

"One thing that I particularly appreciate is the efforts of the GPC to promote the participation of students – taking them on a tour to local plants, and pairing them with a mentor during the event to help them navigate through and meet the key players in the glass industry. I didn't have a chance to participate as a student myself, but I wish I did. As a student, it tends to be much easier to navigate the glass academic world, but getting in touch with the industrial world can be a little harder and there is no better way to motivate the future talents than to bring them to a glass plant."

Mathieu Hubert in the hospitality suites at the 79th Conference on Glass Problems in 2018. With *Glass Worldwide* as official journal, GPC will take place this year on 1–4 November 2021 in Columbus, Ohio, USA (see page 158 for conference preview).

Career highlights and achievements

"I'm very fortunate in my current role at Corning that I get to work on so many interesting projects related to glass and work with some of the best glass scientists in the world," reflects Mr Hubert. "I participated in the creation of a Glass Science and Technology course at Corning Community College and have been teaching part of it for the past three years. "With other colleagues, I taught an internal Glass Course at the beginning of the Covid-19 pandemic, when most were working from home, which was a great experience.

"I also had a chance to organise or co-organise several outreach events at ICG conferences (in Istanbul in 2017, Yokohama in 2018, and 2019 in Boston), which I particularly enjoy doing.

"Finally, I had a chance to participate in the production of a video to support the ICG proposal for a United Nations International Year of Glass 2022 (see *Glass Worldwide* July/August 2021, p24), together with Julian Jones (who led that effort), Randy Youngman (Corning Incorporated), Alicia Duran (the Spanish National Research Council) and John Parker (Sheffield). I am proud to have contributed, even so slightly, to that effort. And I am now really looking forward to that IYOG 2022!" ●

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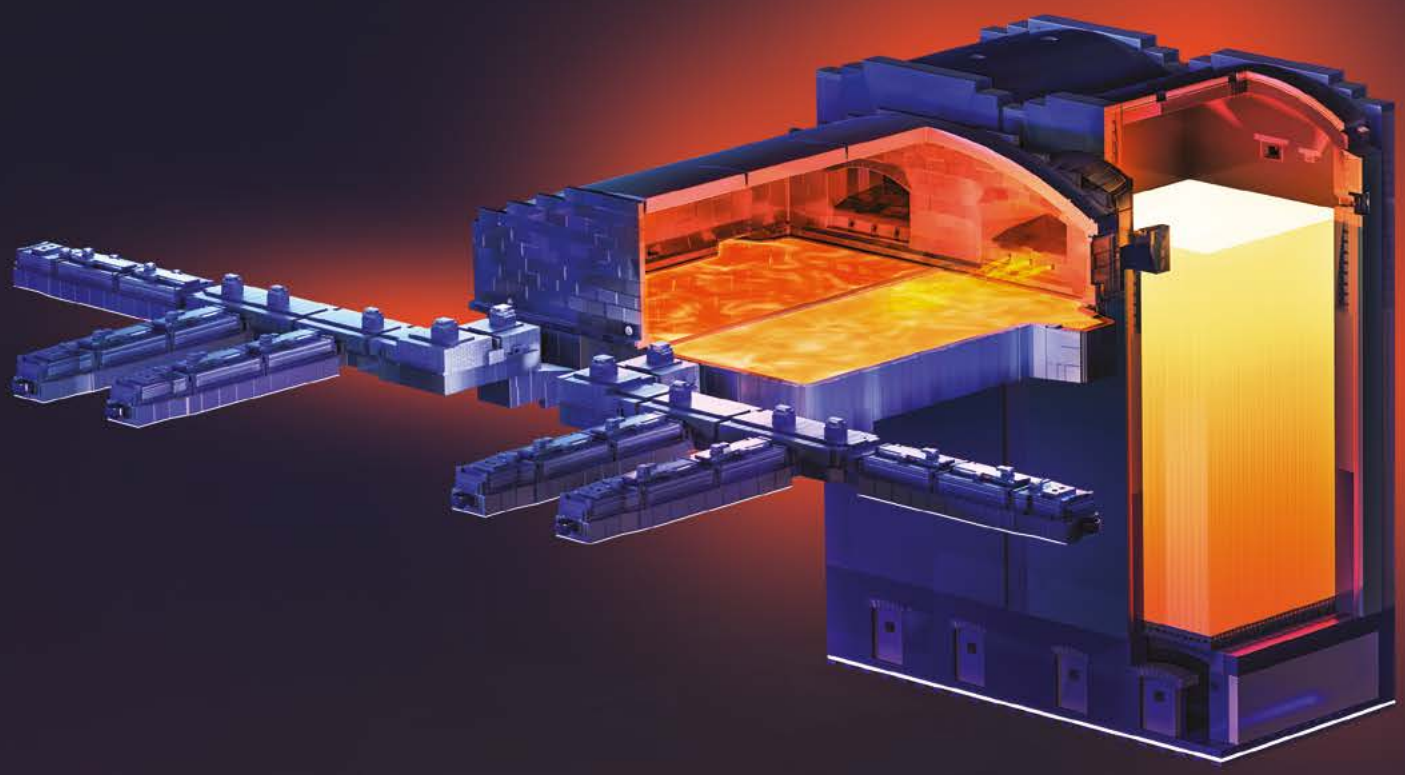

Cost of melting: 85% of the present furnaces

NO_x and CO_2 emissions: 85% of the present furnaces

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To turn the corner, we must indicate a direction

Time is ticking down for the switch to glass manufacturing without fossil fuels. René Meuleman examines the challenges and consequences for the glass industry, and those who will be running it in the future.

René Meuleman: "Solving the glass industry's future problems will become the finest hours of the youngsters, the new generation."

Everyone involved in glass manufacturing is on the edge of perhaps the biggest challenge since the production of glass manufacturing began on an industrial scale. We are facing the fact that we will have to do without the use of fossil fuels. Something that most of us have never done before, never thought of until lately, and we have only 29 years to go to succeed. Can it be done? Yes, it can (simply) because we must.

Fortunately, there is a range of alternatives from full electric melting, to hybrid and hydrogen firing, perhaps even combustion of biofuels. The first reflex most of us will have is to stick as closely as possible to any kind of combustion. It is a natural human trait to stay close to what we do today and what we ever did with fossil fuel. Be aware; don't make the mistake of putting all your eggs in one basket or all your research on one solution as it is yet not clear which of the alternative energy sources will be available and commercially viable. Most likely we will have to face different furnace designs, a mix of different energy sources, upgrades of our infrastructures and educating our operators and maintenance people to control and maintain the system smoothly after this massive changeover.

Additional hurdles

Lobbyists keep on telling us that natural gas will be replaced in the near future by hydrogen using the traditional pipelines but it seems that this is not so easy. Most probably we will have to face major changes in our internal fuel and electrical infrastructure, in addition to finding ways to manage the water content in the combustion space and perhaps even making oxygen available to avoid unwanted NOx emissions. The same can be said about electrical energy as most of our utilities and governments are struggling to get the electrical grid up to the capacity needed in near future. Within the plant it will not be different compared to hydrogen as we will have to refurbish, replace, and most probably extend the internal electrical installations as well.

As said before, the long intervals in between furnace overhauls may also work against us as there will not be that many opportunities to introduce a new melting technology before 2050, specifically for the smaller glass manufacturers. We will have to live with what we do today for at least another 10 years of furnace lifetime to come, perhaps even more. However, we are used to incremental changes per furnace campaign, a rhythm that now may need to accelerate during the energy transition.

Last but not least, most probably there will be no overall, standardised and commercially viable global solution as availability and price levels of alternative energy sources will differ from region to region. We have to act quickly as time is moving fast.

Better decision making

So is there no positive news? Yes, there is! We have a bunch of new sophisticated tools to assist us to face these challenges. One of the most important is mathematical or CFD modelling of furnaces. Thanks to the availability of today's computing power and smart people who put together tools like GTM-X, we can get a clear view of the performance of newly designed furnaces even before the first brick is laid. Extensive modelling studies are already the foundation of ruling out design errors and reducing risks, resulting in better decision making. Based on GTM-X studies, rMPC advanced control strategies of the furnaces of the future can also be integrated into process control. As a fully integrated tool these will assist our operators in managing new designs from day one of furnace operation. Supported by data collection, data storage systems and analytics, rMPC can be optimised during the first months of operation and EBM (energy balance model) will support furnace operations to keep an eye on energy consumption

and furnace performance. Lately, new sensor technologies have also arrived and today we 'look' into furnaces from a completely new perspective, being capable of sensing temperatures, analysing batch behaviour, detecting refractory wear, checking burner settings and pointing out potential NOx emission sources. Burning new green fuels can be controlled better as well, with the help of laser CO, H_2O, O_2 and temperature sensors.

Awareness has increased rapidly over the last two years and it is great to see that most suppliers to the industry are working hard to find solutions to support the demands of tomorrow. These range from new refractory material, hydrogen burner technology, electric power supplies for boosting, etc.

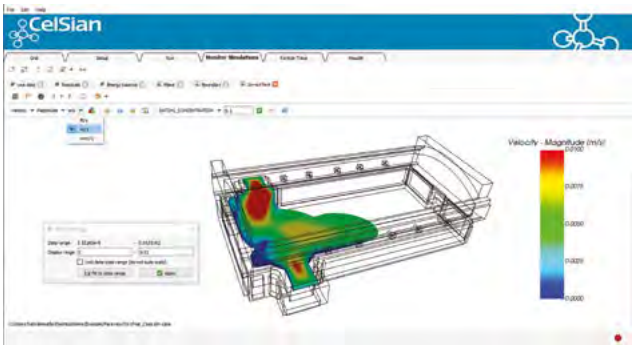
New generation of glass geeks

The biggest positive result is that it starts showing an impact on young employees as the industry is and will become much more innovatively attractive for them. Apart from meeting environmental targets, our biggest achievement most probably will be to secure a new generation which wants to become the next glass geeks. With the help of the established, experienced workforce, the new generation will make an impact by helping us to avoid tunnel vision and introducing new technologies and ways of thinking into the rather traditional glass making procedures.

The industry has already mastered a lot of challenges and those with a long history in the glass will most probably agree that overcoming the problems of introducing new technologies were perhaps their finest hours. Industry 4.0, new sophisticated modelling tools, process control systems, refractory materials, rMPC, EBM, new sensors and our ongoing dedication is key.

We at CelSian have a daily discussion on those subjects trying to find the best ways to support the industry. Our team, a combination of highly experienced people and a bunch of innovative youngsters, is working extremely hard on designing new tools and ideas to solve customers' current and future glass manufacturing problems. It shows that working on real challenges provides purpose, which is valid for old and young and also provides a lot of fun. We, at CelSian, are in the middle of it and we intend to stay in that position.

Solving the glass industry's future problems will become the finest hours of the new ones – the youngsters, the new generation, as it is clear that the world cannot do without 'green' glass, which will remain one of the most intriguing and challenging materials around. How much more can you ask for your future and from your job than being challenged?



Intent on revitalising the standard of glass furnace modelling, CelSian recently made the most significant upgrade to its GTM-X simulation software in more than a decade.

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Making adjustments for a decarbonised world

The technology exists for major advances in reduced-CO_2 glass production; hybrid and superboosted furnaces are making progress, but high electricity rates could compromise plans for all-electric vertical melters. Stuart Hakes looks at some of the issues surrounding the future of the glass industry.

Stuart Hakes.

Adverse weather conditions in New Zealand, China, USA, Canada, Belgium, Germany and Switzerland amongst many others this summer surely underline to us all that the necessity to reduce the amount of carbon dioxide going into the atmosphere is the utmost priority. The problem is, of course, that this comes with many hard decisions which have to be made.

If the glass industry is to play its part – with all of the major developments over the past few years, which have resulted in nearly 25% reduction in CO_2 emissions, we are still producing 1.5 million tons/year of CO_2 from our process.

To meet the commitments that various governments are setting, whether they be EU targets, British targets or United Nations climate change targets, requires the glass industry to make a major impact in our future CO_2 emissions, equivalent to approximately another 50% from where we are now. There are obviously financial impacts as well as technical impacts and as long as the glass industry remains ultra conservative, it is difficult to see how the correct decisions will be made.

It is not without some bright spots. The setting up of the Glass Futures furnace in the UK with an international assembly of companies in both the hollowware and flat glass fields and the Furnace For the Future container furnace (F4F) by FEVE show fantastic faith by some very able thinkers. This is to be applauded. However, the Boards of Directors who have to sign off on the results of these demonstration projects are probably a long way from being on-board, governed as they are by the necessity of delivering shareholder's returns and being ultra cautious.

How will the industry look in the future?

There is no doubt that there now is very much a consensus that hybrid furnaces are the way forward and these are described in more detail below.

We all know that for furnaces up to about 250tpd that cold top, all-electric vertical melters are by far and away the most efficient way of producing glass. The reason that cold top all-electric furnaces are so super efficient is quite obvious. There are no regenerators to heat and no superstructure as a batch blanket is established on top of the melt that effectively seals all the heat into the melt itself – the very top layer being a thick layer of batch, typically about 100mm thick followed by a reaction layer followed by a refining layer. This is clearly vertical melting and gives stunning energy efficiencies of approximately 2.6GJ/t for very small furnaces, anything between 25–80tpd.

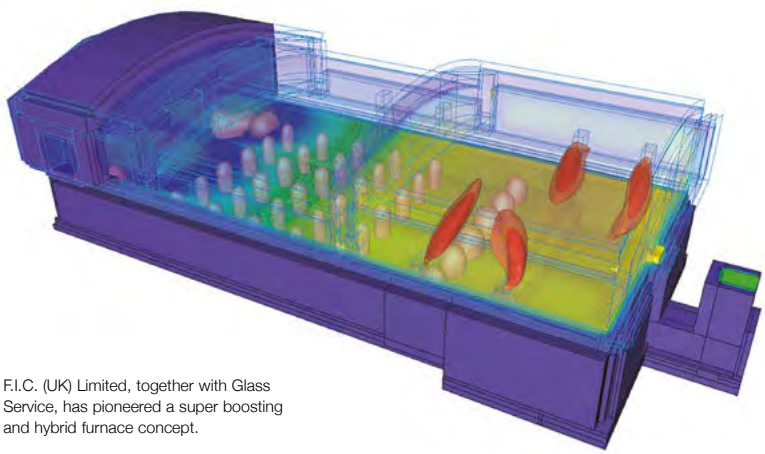
However, there are a number of negative factors, including lack of turn-down ratio (in other words the ability to go from zero pull to maximum), shorter furnace campaign lives, some perceived issues with reduced glasses such as amber, dead leaf green, etc. and the current high cost of electricity. I have argued for a long time that shorter lives should not be an issue as the rate of technology change is so great that locking ourselves into a 20-year furnace life span makes no sense. The other issue with a 20-year life span is that the furnace is very expensive in order to make it last that long.

Because we do not have to concern ourselves with regenerators, which are arguably one of the first areas to clog up, locking ourselves into a 10-year life for an electric furnace, without the expense of regenerators means that the payback in terms of building and operating an all-electric furnace for 10 years becomes much better than the older model. It is now quite common for cold top all-electric furnaces to last eight years and with the advance in technologies I am confident this can be pushed to 10 years and beyond. The issues of dealing with reduced glasses are not nearly as difficult as is believed.

The price of power

For a long time in the 1970s with the first oil shock, many all-electric furnaces were built specifically to melt amber glass and to avoid the issues they were normally operated as semi hot-top; in other words, the establishment of a thick blanket to hold the heat in was not proceeded with and by using normal screw-chargers and redesigning a superstructure, heat could escape above the surface and allow pre-heating of the batch. These hot-top and semi hot-top all-electric vertical melters made amber glass perfectly.

It remains therefore that the greatest drawback to all-electric furnaces is the cost of electricity and currently the UK has one of the highest rates of electricity pricing in Europe. This is the greatest drawback and I know much representation has been made by the high energy industries to address this anomaly and in particular its cost ▸



F.I.C. (UK) Limited, together with Glass Service, has pioneered a super boosting and hybrid furnace concept.

in relation to natural gas. How effective this will be long term really determines how the industry can respond to decarbonisation. Unless steps are taken to reduce the price of electricity the industry cannot decarbonise. It is as simple as that.

Size matters

We also know that in terms of energy efficiency, big is beautiful and that bigger furnaces are inherently more efficient. Most of the container furnaces nowadays are bigger than 250tpd and are more energy efficient than smaller furnaces but these sizes exceed the practical limit for cold top all-electric vertical melters. So, it becomes obvious that these cold top all-electric vertical melters are only a small part of the answer for the industry to decarbonise going forward.

The majority of major container manufacturers and in particular all of the flat glass industry have much bigger furnaces; typical size for a float glass furnace is between 600–800tpd and many are being built at 1000—1200tpd. Trying to set up a cold top all-electric vertical melter with the melt area suitable for a furnace of that size would require an enormous glass depth and is probably a technical advance too far. Whilst it is technically feasible, the furnace life with all the horizontal joints and the construction costs make it extremely unlikely. So the question is how do we move the industry going forward? The answer, is of course, as I intimated earlier, a horizontal hybrid electric melter.

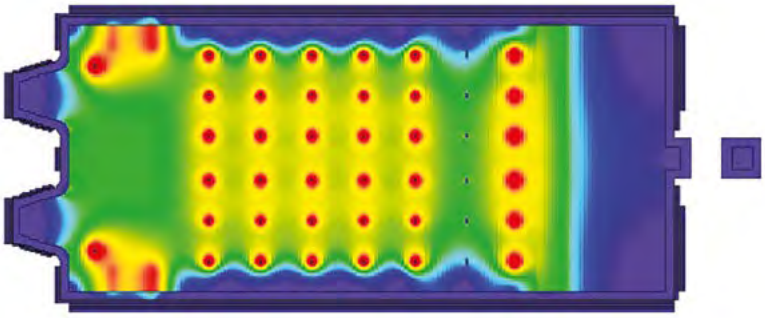
Hybrid melters

It is very encouraging to see that virtually all furnace builders and boost suppliers have now come around to a hybrid melter. This has come about because Computational Fluid Dynamic Modelling (CFD) has shown this to be the most efficient way forward. It is very interesting to see that even though there are differing CFD modelling systems being employed, they are all now converging on something very similar to each other.

So, what is a hybrid all-electric melter? Well basically this is an all-electric melter but instead of being vertical melting it is horizontal melting, meaning that the furnace size is very similar, if not identical to the footprint of the existing fossil fuel fired melter.

The in-glass electrical melting component is maximised at around 80% of the total energy. The remaining 20% of the energy has to be supplied by some top heat – either more electricity from elements or by burners. This top heat is required for controlling the glass quality.

Obviously, the furnace has to be decarbonised, which eliminates entirely any form of fossil fuel and I would also suggest eliminates bio-fuels. I think we are deluding ourselves when we believe that using bio-mass, which is a renewable resource, is saving the planet because the amount of bio-mass that we consume in a single day, and the length of time it takes to grow a tree or whatever to replace that is entirely disproportionate. Besides which we are still producing CO_2, and in global warming CO_2 is the problem. Therefore, we have to entirely eliminate any kind of bio-mass, which means that the heating is going to be either electric or hydrogen.



Stuart Hakes: "There is no doubt that there now is very much a consensus that hybrid furnaces are the way forward…"

If we are going to use hydrogen it means that we are using oxy-hydrogen fuels as anything else (such as air/hydrogen) would be many times more dangerous than possibly oxy-hydrogen would be. It also means that if we are going to eventually end up as oxy-hydrogen, we can transition initially into another oxy-fuel to give us the background and the confidence before making the change to oxy-hydrogen.

So, from the above it can be seen that the majority of the existing furnaces can go through a transition stage whereby more boost is added to the furnace, which is termed superboosting, and then at some stage change the regenerative furnace to an oxy-fired furnace and then the final step to a hybrid furnace.

Hybrid furnaces are typically envisaged to be running at a maximum of 80% in-glass heating by Joulean heat through molybdenum electrodes and around 20% by heating above the surface. All of the modelling shows that this heat is required in the refining area, which is the downstream portion of the melter. Most modellers recognise that different crown heights makes sense but we need to look at the other issues.

These are principally the refractories required if we are to burn hydrogen in the furnace but that is for another paper. There's much more to say!

In short, the technology exists for major advances in decarbonisation; the modelling proves it is safe. A small number of furnaces are already hybrid and there are also a few superboosted. Small steps on the path forward. Glass Futures and the FEVE project are tangible demonstrations but who will commit their money first and how do we tackle the future energy costs? Time will tell. ●

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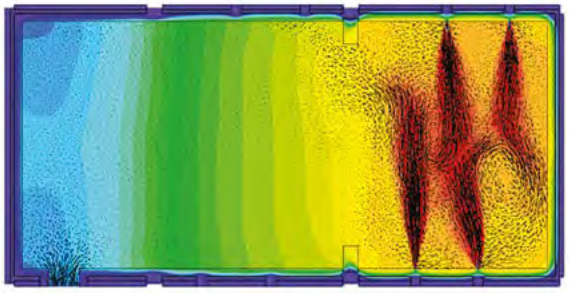

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Changing fashions in the crown jewel of the modern glass furnace

As glass manufacturers worldwide experiment with hydrogen, biofuels, electric and hybrid melting to meet sustainability targets, the full effects of these new melting techniques on existing furnace crowns are not yet understood. Fused-cast refractory supplier Monofrax is adapting to the challenges presented by these new technologies, says Valerie Weber.

While glass furnace crowns may not sparkle with the precious metals and gems of a monarch's head covering, they are impressive. There is no denying that they are marvels of chemistry, physics and engineering.

Over the years, crowns have been composed of many different refractory materials: pressed and bonded (silica, mullite, AZS, chrome-alumina) and fused cast (AZS, alumina and spinel). Chemistry, grain structure, density, furnace span and longevity all come into play. To complicate matters further, glass composition, temperature, quality and the severity of batch dusting are also variables when deciding upon the materials for a furnace crown. Silica has been a popular choice, but there is no one-size-fits-all.

Crown refractories must also exhibit sufficient mechanical strength over a range of operating temperatures and provide resistance to creep. To those unfamiliar with the term, creep resistance is the ability to withstand long-term load at high temperatures without failure. The crown span, insulation pack dimensions and density of the products used in construction determine the load. Peak loading occurs during heat-up, and the load then redistributes once the furnace reaches service temperature.

View of crown blocks set for floor inspection.

Changing crown requirements

In the 1990s, many furnaces converted from air-fuel to oxy-fuel, and crown requirements changed. Manufacturers benefited from reduced NOx and SOx emissions, reduced particulate carryover, improved glass quality and higher throughput. Existing crowns comprised of silica and mullite were exposed to more corrosive conditions, causing these crowns to experience rapid and premature deterioration and contamination of the glass product. Typical degradation included:

- Corrosion at the refractory joints
- Rat holing (formation of large voids within the blocks)
- Hot face corrosion.

This new breed of oxy-fuel furnaces produced an increased concentration of volatile, corrosive species above the glass melt. Due to their higher porosity levels, porous pressed and fired refractories degraded more than fused cast refractories. However, fused cast AZS also experienced accelerated corrosion under oxy-fuel conditions. As a result of exudation in fused AZS, ZrO_2 crystals contaminated the glass. Silica-based refractories proved to be especially vulnerable to wear due to liquid phase formation. Fortunately, there have been successes with low exudation fused AZS and fused alumina crowns.

αß-alumina

Studies show fused αβ-alumina to be the most stable crown refractory under oxy-fuel conditions, displaying superior corrosion resistance. High alkali glass melts (more than 26% Na_2O) benefit from fused β-alumina. As a result, specialty, float and container glass furnaces in North America have used fused αβ-alumina for their oxy-fuel furnace crowns for decades. At least one fused αβ-alumina crown is over 21 years old and on its second campaign.

With experience, much has been learned about the construction and behaviour of fused alumina refractories in crowns. Today, manufacturers recommend the use of void-free castings for large span crowns to eliminate the void cavity. At temperature, the area toward the cold face of the block carries most of the load. Large cold face voids result in a shortened life span and more furnace campaign interruptions.

Floor assembly

As dramatic and impressive as a crown looks when sprung, floor inspection allows for a more thorough and accurate evaluation of the blocks. Preassembly in rings on the floor results in a better fitting crown. It also proves to be more cost-effective for both the customer and the supplier.

When a preassembly is sprung, as the building progresses, minute adjustments are made to the minor faces to provide a planed surface between rings. Two objectives drive these adjustments.

1. The levelling of the block can create a slight out of plumb condition on the vertical face.
2. If one end of the block runs up the centre slightly faster than the other end, 'saw toothing' results. If this isn't taken care of immediately in preassembly, it multiplies.

The tendency is to make small adjustments to the minor face of the block to correct and create a plane surface for ring-to-ring fit. This is not the best approach.

With floor assembly, the critical plane surfaces between rings can be controlled to a much greater degree. Blocks remain square. Field construction results are improved. Building with adjusted blocks creates difficulties for the construction crew. Floor assembly results in a better-fitted crown.

Advanced coatings

In the 1990s, when glass manufacturers were converting to oxy-fuel, NASA was developing

thermal protection systems for high-speed space planes. Their research included the high emissivity coatings used as standalone replacements to the failed ceramic cladding of the space shuttle. A decade later, those coatings were made available to the glass industry through a licensing agreement. Applied to the interior of a furnace crown, products such as Emisshield resulted in significant energy savings. Over the years, high emissivity coatings have been used on various glass crowns, resulting in an average fuel savings of 7.5–10%. High emissivity coatings are currently being used on crowns for wool, container and flat glass furnaces worldwide. Now, when many in the glass industry aim to reduce their carbon footprint and their energy consumption and strive toward carbon neutrality, these coatings offer another tool for their arsenal.

Future challenges

Over the last 30 years, the glass industry has evolved to meet the demands of consumers and the planet. First came the advent of oxy-fuel. Then, manufacturers implemented high emissivity coatings. Now, glass manufacturers worldwide are experimenting with hydrogen, biofuels, electric and hybrid melting to further reduce energy consumption, operating costs and carbon production. Sustainability, both economic and environmental, is the new goal.

The effects of these new melting techniques on existing furnace crowns are not yet understood. From preliminary findings, refractories may face challenges similar to those presented by the advent of oxy-fuel. Unconsumed hydrogen appears to attack any free silica in refractories. Silica bonded with alumina seems to be less attractive to this hydrogen. Refractories in the crown and elsewhere in the furnace will need to adapt to the challenges presented by these new technologies. The future may prove to be very interesting. ●

Crown blocks sprung on steel supports for customer inspection.

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Embracing hybrid power for melting

To help glassmakers on their journey to carbon neutral production, HORN's high performance hybrid fossil end fired furnaces and hybrid fossil oxy-fuel furnaces offer an intermediary step between traditional melting and investing in the newest super hybrid facilities, explains Max Kallert.

The push towards climate neutrality is also reaching the glass industry. Besides using more sustainable fuels (like hydrogen or bio-gas), the call for the incorporation of more green electric power to reduce the carbon dioxide emissions is growing louder. An often used buzzword in this context is the 'hybrid' furnace. But what is the conception of a hybrid furnace?

The simple existence of both kinds of power in the furnace?

Equal contribution from electric and fossil sources?

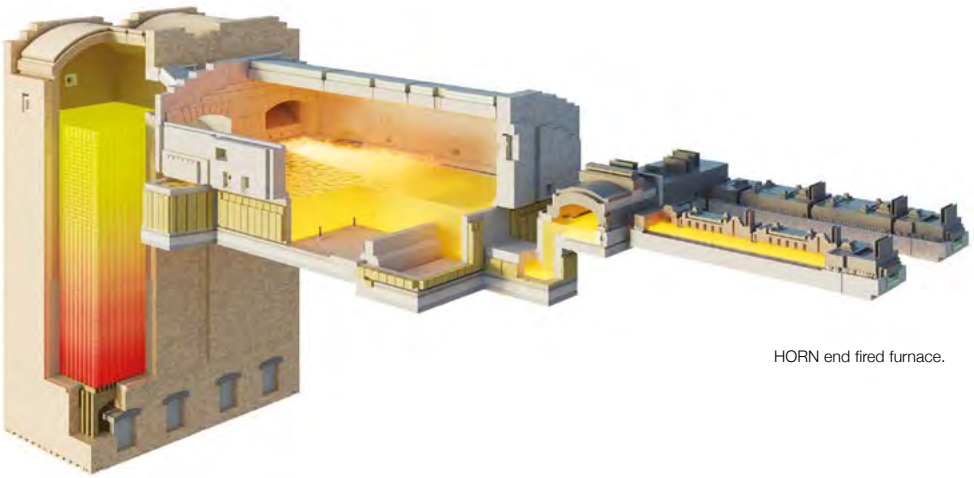
High flexibility ranging from predominantly fossil to predominantly electric contribution?

Glass melting technology specialist HORN defines a furnace as hybrid if both forms of power, electric and fossil, are needed for sufficient operating. Therefore an end fired furnace with electrical boosting up to 10–15% would not be considered a hybrid furnace, whereas a 50/50 contribution from both fossil and electric sources would clearly be a hybrid furnace.

To meet customer needs, HORN developed the following furnace categories varying in overall electric share, energy flexibility and basic principle (end fired; cross fired; oxyfuel and vertical electric melting):

- Classic fossil furnace (up to 20% electric power)
- End fired furnace
- Cross fired furnace
- Oxy-fuel furnace
- Hybrid furnace (20 to 40/50% electric power)
- Hybrid end fired furnace (Hybrid EFF)
- Hybrid oxy-fuel furnace (Hybrid OXY)
- Super hybrid furnace (20 to 80% electric power)
- Super hybrid oxy-fuel furnace (Super hybrid OXY)
- All-electric-melter (100% electric power)

The furnaces from the hybrid-fossil category represent the evolutionary step from the classic fossil furnaces in container glass towards more electric power, while the super hybrid furnaces continue this concept to an even higher electric share.



HORN end fired furnace.

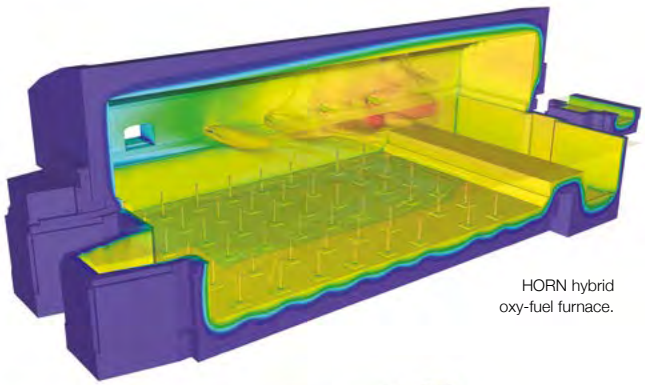
Countering the reduction of fossil power

To bring an increased amount of electric power into the glass melt, a higher number of electrodes is necessary. If these electrodes are positioned extensively over the basin bottom, it can disrupt the typical convection flow in the furnace. This is why HORN prefers a particular positioning of the electrodes to minimise the disruption and preserve the typical convection as much as possible.

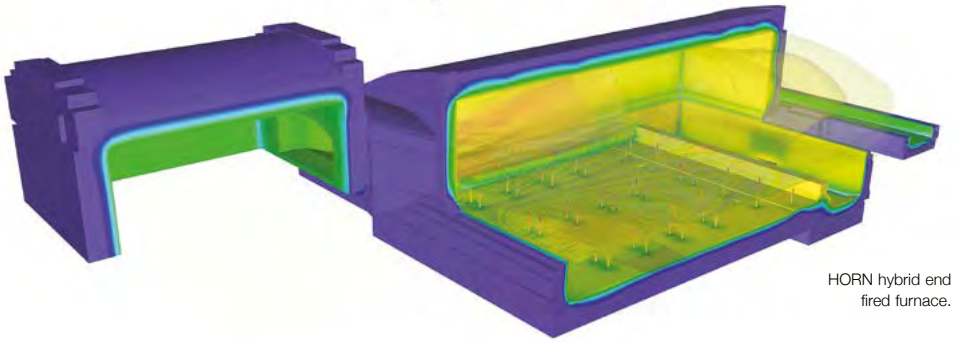
A declining share of fossil power reduces the temperature in the crown and superstructure, regardless which kind of combustion is used. Depending on the range of flexibility and the atmosphere in the combustion space, the refractory materials have to be selected carefully.

In addition to the lower temperatures, the reduction of fossil power can lead to further problems.

For a reduced amount of fossil fuels, the amount of combustion air required also decreases. The consequence is a lower volume flow throughout the regenerator and the burner neck and therefore a lower velocity of the combustion air at the burner port, which can cause flame instability and possibly insufficient combustion. Furthermore, due to the reduced velocity the flame length will shorten and ▸



HORN hybrid oxy-fuel furnace.



HORN hybrid end fired furnace.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the temperature distribution in the combustion space will change. In order to preserve the flame stability and secure the typical increasing temperature gradient towards the 'hot-spot', the technology of exhaust gas recirculation is applied.

The principle of this technology is to branch off part of the exhaust gases at the regenerator bottom of the exhaust side and mix it with the combustion air on the fire side. With the increased volume, the velocities at the burner port will be brought back to an acceptable level. This stabilises the flame and preserves the temperature gradient.

Energy flexibility

Due to the infinitely variable nature of this technology, an area of energy flexibility can be generated. This means the overall electric share can be varied from 20% up to the maximum value of 40%, while also maintaining the basic principle of the end fired furnace.

Compared to a completely fossil fuelled end fired furnace, CO_2 emissions related to the melting (discounting CO_2 from batch gases) can be reduced by up to 45%.

In the combustion space, the location of multiple oxygen burners along the side walls enables precise regulation of the temperature distribution by adjusting the gas distribution accordingly. For a high share of electric power, for example, the gas distribution can be shifted more towards the refining area, while the energy in the melting area is predominantly provided via the electrodes. This increases the energy flexibility even more, compared to the Hybrid EFF. Starting from a continuous combustion space, the furnace can be operated with up to 50% electric power, with a minimum of around 20%. Compared to a completely fossil oxy-fuel furnace, the CO_2 emissions regarding the melting can be reduced up to 50%.

Optimising power

By introducing the option of a 'shadow wall' – a wall dividing the combustion space and therefore prohibiting the radiation from the hotter (refining area) to the colder parts (melting area), the possibility for even more electric power (up to 80%) arises. The hot flue gases from the combustion out of the refining area will still be led (partly) over the batch to the exhaust. While flowing atop the batch layer, the hot gases emit heat via radiation and convection to the cold batch, thus creating a heat recovery zone. This lowers the temperature of the exhaust gases and slightly reduces the energy needed for melting the batch. The potential for reducing CO_2 emissions is even higher for this concept.

Despite the high maximum electric share and the flexibility, these concepts still maintain the basic principle of the horizontal melting process in an oxy-fuel furnace.

Conclusion

The glass industry is a very traditional sector and a furnace represents a high investment for the manufacturer. Therefore it absolutely makes sense to make an evolutionary, intermediate step between the classic and the super hybrid furnace categories with HORN's hybrid fossil end fired furnaces and hybrid fossil oxy-fuel furnaces. ●

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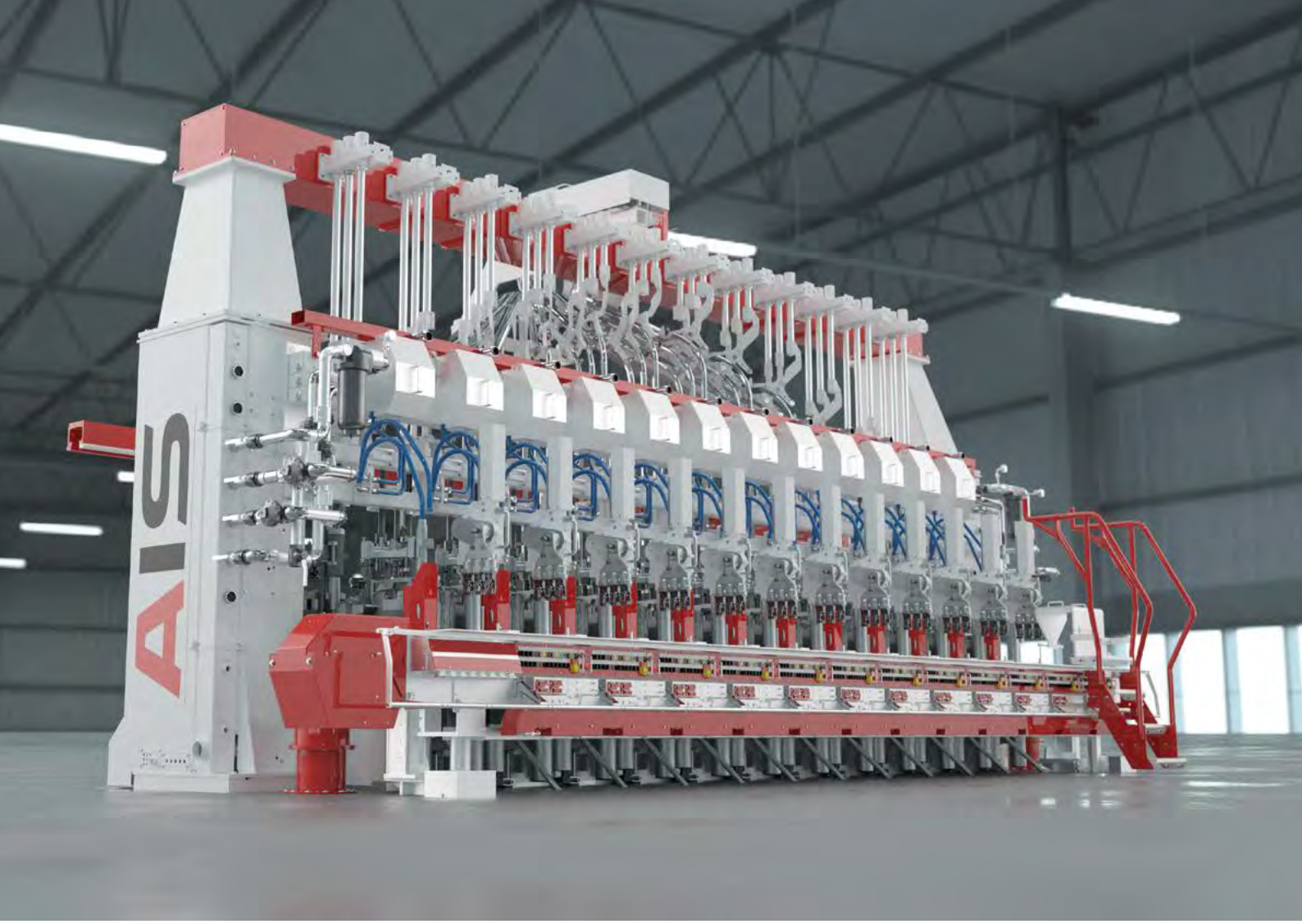

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Personalised energy-conscious production

Francesco Montagnani, Emanuele Donati and Nada Di Guida discuss Glass Service Italy's approach to improving quality and efficiency in pharmaceutical glass production with bespoke oxy furnace design and management.

In May 2021, we reported on the progress being made in ramping up pharmaceutical glass production to meet rapidly rising global demand [see *Glass Worldwide* May/June 2021 p.88]. Growing applications for high quality neutral borosilicate glass from the healthcare sector have been compounded by unexpected and astronomical demand from the pharmaceutical industry as a result of the ongoing global vaccination campaign against Covid-19.

In response, the glass industry is moving at speed to commission, design, build and fire up glass manufacturing facilities around the world, using the latest technological innovations to simultaneously improve plant efficiency, cost, performance and sustainability. This month we want to highlight an exciting case study that has been unfolding in Chongqing, China, featuring cutting edge glass melting technologies and showcasing what's possible for glass manufacturing plants when a bespoke, energy-conscious approach is taken.

Furnace built to produce neutral borosilicate pharmaceutical glass tube alfa 51 to Hydrolytic Class I.

The challenge

For more than 18 months now, Glass Service Italy has worked hand-in-hand with a leading glass manufacturer, one that has produced more than 1000 billion Hydrolytic class II pieces of pharmaceutical glass, including vials and caps, all complying with YBB, ISO, EP, USP standards, as well as accreditation from CNAS. In 2019 the client wanted to go one step further and level up production to Hydrolytic Class I to better meet their customer needs for volume and value. In order to achieve this they came to Glass Service Italy for help.

Glass Service Italy experts were brought in to help hit three specific targets:

1) Production of neutral borosilicate pharmaceutical glass tube alfa 51 to Hydrolytic Class I
2) Reduction of energy consumption by more than 50% compared to their existing furnaces
3) CO_2 emissions reduced by more than 50% (reduction 2220 ton/CO_2 per year)

Targeting new levels of efficiency

These goals represented a substantial change from the existing facility and furnace infrastructure, and specifically required support beyond the initial consultation, design and installation of a new furnace. To achieve new levels of efficiency, factors such as ease of maintenance, furnace productivity and consistency of the output quality become even more crucial and for this, long term support is essential.

In order to hit these targets the team set about addressing several factors that are unique to pharmaceutical glass production, including: very high melting temperatures, the level of glass viscosity, the elevated corrosion rate of refractories, the significant boron content volatilisation and the thermal and chemical homogeneity of glass. To meet the key targets whilst taking into account these unique challenges, Glass ▸

Tubes aligned before checking.

The inside of the furnace.

Service Italy experts stepped in with a bespoke furnace design and installation, followed by comprehensive training on the management, maintenance and testing of the equipment and its output for optimal performance and batch consistency.

Considerations when implementing new melting technology

Every client and every site is different and this is where Glass Service Italy comes into its own. With an expert team that is agile enough to design bespoke solutions for glass manufacturing clients, but large enough to have the experience, credibility and resources to tackle a project at any scale, they are well used to adapting cutting edge design to the specific needs of a client. In this case the team began with key adjustments on the furnace design and features that would mean all performance and quality targets could be met; these included:

- The specific geometry of the site and the corresponding design of the melting tank
- Defining the right heating method for the melting tank, in this case using combined gas fire and electric power
- Including a special batch charger for optimal furnace performance and precision
- Improving temperature control and as a result, glass homogeneity with water cooled bubblers
- Ensuring the quality of refractories for long furnace life
- Managing indirect heating in the working end and forehearths
- Incorporating surface drainage to remove glass defects

The furnace

Using these design features, Glass Service Italy's team designed and installed an oxy-fuel furnace, producing 22tpd of high quality neutral borosilicate pharmaceutical glass tube alfa 51 – designed, engineered, assembled and commissioned in China. The team then remained on site until the production stage to help ensure batch consistency and production efficiency whilst guiding the client on the proper maintenance and performance management.

The time came to fire up the furnace in May and both the client and Glass Service Italy teams came together to mark the occasion with a ceremony to inspire good fortune for the plant and all those who work within it. Everyone gathered with confetti, celebratory banners and speeches as the furnace was fired up.

In May the client and Glass Service Italy held a ceremony to celebrate firing up the furnace.

Production of the glass tubes required by the client.

The results

The data speaks for itself. The tube diameter efficiency for this furnace is >80% on the 22mm diameter and the same for 16mm diameter with wall thickness efficiency of 100%!

Glass is set to play a growing role in future sustainable development, and key installations like this one in Chongqing are important in establishing glass's movement towards a more sustainable, technology-led and efficient manufacturing model. Ongoing developments in end-to-end process management continue to reduce the amount of energy used by glass manufacturing and the renewed focus on plant efficiency, maintenance, monitoring and output quality, signals that there is much more to come from this area of the glass sector. ●

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Reducing energy consumption and CO_2 in fibreglass furnaces

Shrikar Chakravarti, Hisashi Kobayashi and Sireesha Aluri discuss heat recovery technologies for composite and insulation fibreglass furnaces offered by industrial gas and engineering company, Linde.

Process industries – refineries, steel mills, cement kilns and glass furnaces are looking for ways to substantially reduce CO_2 emissions from their operations. As part of the Science Based Targets initiative [the partnership between CDP, the United Nations Global Compact, World Resources Institute and the World Wide Fund for Nature that encourages companies to reduce emissions in line with the Paris Agreement goals], several glass companies have made commitments to sizeable reduction in CO_2 emissions by 2030[1].

Converting air-fuel furnaces to oxy-fuel furnaces with heat recovery provides an expedited and economical means to meeting all or a significant portion of the CO_2 reduction objectives. Oxy-fuel technology is commercially proven with over three hundred glass melting furnaces operating in this mode[2]. Flue gas typically exits the oxy-fuel soda lime silica glass furnaces at 1400–1500°C. With flue gas heat recovery, fuel consumption is estimated to decrease by 20–30% with a corresponding reduction in CO_2 emissions from fuel. Prior work has generally focused on soda lime silica glass – container and tableware.

This article focuses on fibreglass furnaces and discusses two commercially proven heat recovery technologies, offered by Linde, under the OPTIMELT trademark:

1. Thermo-chemical Regenerator Systems (TCR) for composite fibreglass furnaces.
2. Cullet Preheating (through an exclusive arrangement with Johansson Industries) for insulation fibreglass furnaces.

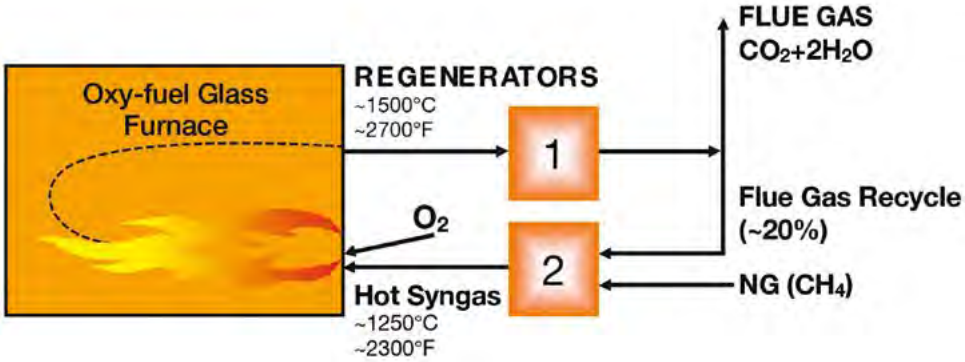

Figure 1: Schematic representation of Linde's OPTIMELT TCR process

Thermo-chemical Regenerator System Technology

Linde's OPTIMELT Thermo-chemical Regenerator (TCR) process is an advanced heat recovery technology for oxy fuel fired glass furnaces[3,4]. The technology is based on a unique waste heat recovery concept called thermo-chemical regeneration, in which heat stored in a regenerator checker during the flue gas exhausting cycle is recovered during the reforming cycle by preheating and reforming a mixture of natural gas and recycled flue gas. Figure 1 shows this cyclic heat recovery process.

The flue gas cycle in regenerator 1 is similar to the conventional regenerator heating cycle in which flue gas waste heat is transferred to and stored in the checker. The unique feature of the TCR process occurs during the reforming cycle where a portion of the cooled flue gas is recycled (Recycled Flue Gas or RFG) to the bottom of an already preheated regenerator (regenerator 2) and mixed with natural gas (NG) fuel. When the gas mixture is heated above a certain temperature, CH_4 is non-catalytically reformed by CO_2 and H_2O in the RFG to form H_2, CO and soot. The reformed gas or 'syngas' is combusted with oxygen in the glass furnace, thus providing thermal energy for glass melting. When the regenerator in reforming mode is getting colder, the regenerators are switched and the regenerator that was previously in reforming mode is heated with flue gas.

Installation at Libbey Leerdam

Following successful commercialisation on a 50tpd container glass furnace in Mexico, the TCR system has been ▸

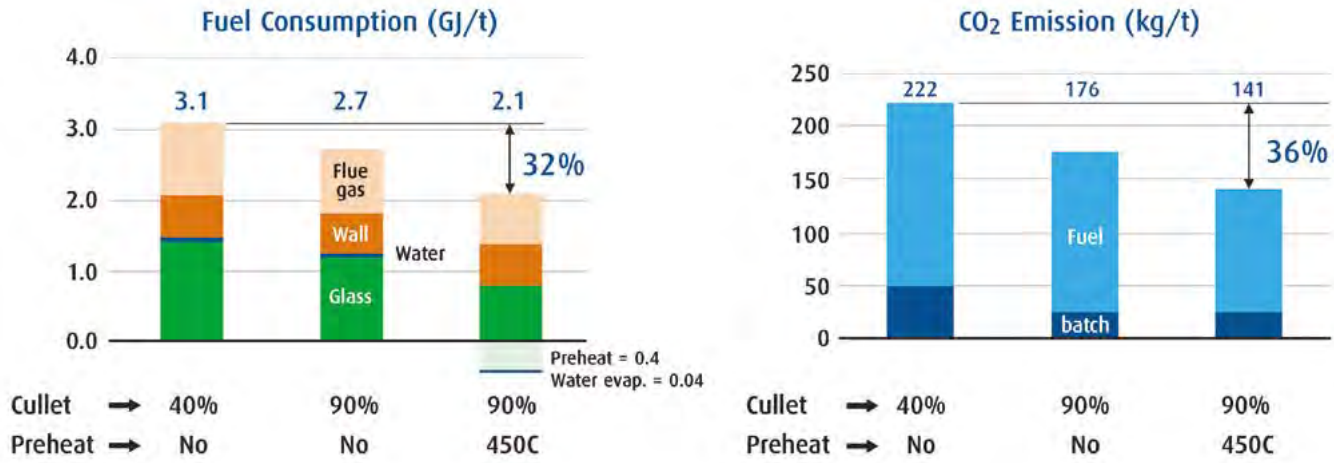

Figure 2: Impact of cullet preheating on 200tpd insulation fibreglass furnace.

Location	Pull Rate (t/d)	Year Installed	Glass	Cullet Ratio	Cullet Rate (t/d)
US	250	1997	Flint	50%	130
Europe	270	2014	Flint	50%	135
Europe	170	2015	Flint	80%	140
Europe	410	2016	Green/ Amber	75%	310
Europe	340	2017	Flint	70%	240

Table 1: List of commercial container glass references for cullet preheating from Linde and Johansson Industries.

in commercial operation on an oxy-fuel fired tableware glass furnace at Libbey Leerdam in the Netherlands since 2017[3,4]. TCR system operation commenced in late 2017. The three-year operating experience with the new furnace has reportedly been very positive; the TCR system has been in continuous operation meeting or exceeding Libbey's glass production and quality needs.

The regenerators are similar in design to conventional air heating regenerators and use similar materials, but the checker volume is only one-third to the size of the air-regen case.

Also, regenerators in air-fuel furnaces are prone to plugging due to formation of salt deposits in the checker channels. Alkali vapours in the flue gas such as NaOH and $NaBO_2$ react with SO_2 and oxygen upon cooling and form Na_2SO_4 (sodium sulphate) and other species, which condense and form liquid and solid deposits on heat exchanger surfaces. Even with periodic cleaning the plugging tendency remains, and heat recovery performance deteriorates significantly. However, with OPTIMELT thermochemical regenerators little deposit accumulation has been observed after multiple years of operation at Pavisa and Libbey. Recent inspection of regenerator refractory at Libbey's L1 furnace showed no degradation of the material due to reducing conditions that are present during the reforming cycle. In fact, these conditions seem to have a positive effect. Sodium sulphate deposited during the heating cycle is being vaporised during the reforming cycle. Evaporation rate of Na_2SO_4 was determined to be faster than its deposition rate under simulated regenerator conditions[5].

This 'self-cleaning' mechanism offers the long-term potential of lower maintenance requirements relative to conventional regenerators. This property should also facilitate the adoption of OPTIMELT TCR systems with fibreglass furnaces that tend to have higher levels of volatile species. Specifically, the TCR system could be an excellent fit for furnaces producing composite fibreglass, with or without boron. The TCR technology recovers energy from the flue gas. Since composite fibreglass furnaces typically operate at temperatures 50–100°C higher than soda lime silica furnaces, there is more energy in the flue gas available for recovery. For large soda lime silica glass furnaces, e.g. >300tpd, a TCR system reduces NG consumption by 18% vs an oxy-fuel system with no heat recovery. However, for composite fibreglass, preliminary calculations suggest that the NG savings on even smaller fibreglass furnaces, 200tpd, could be 18% vs oxy-fuel furnaces.

Cullet preheating

The cullet preheating system from Johansson Industries and Linde is designed to preheat cullet by direct contact with furnace gases, ensuring high heat transfer rates and high material preheat temperatures in the range of 400–450ºC[6]. The preheated cullet is mixed with the batch directly above the charger, so normal furnace charging operations are maintained with little heat loss. Equipment size, cost and performance are significantly better with this approach versus indirect heat transfer. Long term reliability of these cullet preheaters is also well proven (see Table 1 for list of references[7]).

Besides the obvious fuel and oxygen savings to the furnace, another key benefit of this technology is the ability to handle post-consumer recycled cullet. Organic contaminants, e.g. paper, food residue, plastic, are pyrolysed and the fume is fully oxidised in the flue duct. This reduces the net carbon content of the cullet entering the furnace allowing for more stable glass redox control as well as no odour issues from the organic contaminants in the cullet[6].

Recently insulation fibreglass furnaces appear to be increasing cullet input[8]. The source of the cullet is mainly soda lime silica glass. The CPH technology, which has already been proven for soda lime silica, could be deployed in insulation fibreglass furnaces as well.

As shown in Figure 2, it may be possible to achieve greater than 30% reduction in fuel and oxygen consumption and CO_2 emissions by combining high cullet operation and cullet preheating under oxy-fuel firing.

Summary

This article discusses the potential of two commercially proven heat recovery technologies in the context of fibreglass furnaces. Depending on the project specifics, e.g. fuel prices, cullet rate, internal vs post-consumer recycled cullet, CO_2 avoidance costs and capital constraints, Linde can work with fibreglass furnace operators to cost-effectively achieve the near-term goal of 20–30% reduction in CO_2 emissions. Taking this step will also make the glass furnaces future-ready when low/zero carbon fuels like green H_2 become more economically viable. ●

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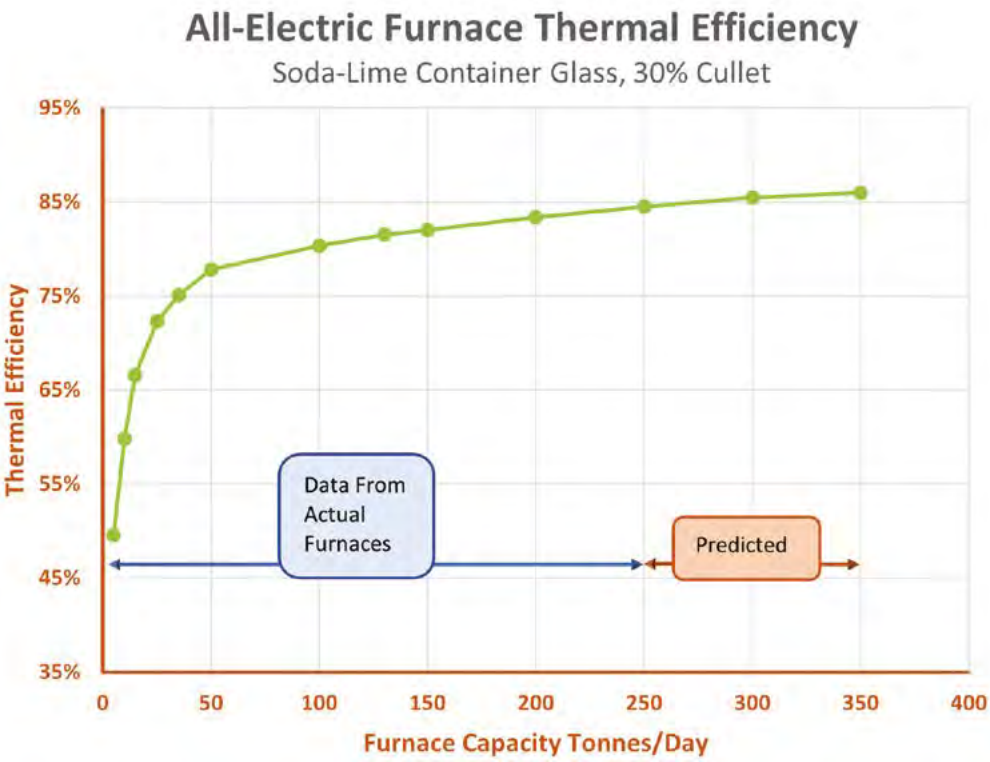
Don't forget the forehearths

When looking at melting technology options, the focus is often on furnaces. Richard Stormont explains his view that, irrespective of the technology adopted for a melting furnace, electric forehearth technology is the logical way forward for the glass industry.

In the drive to reduce environmentally harmful emissions, the glass industry's focus is rightly on the melting process. In most sectors of the industry this is where the large majority of the total energy used in glass production is consumed. As fossil fuels have traditionally been the main source of that energy it is the melting process that has contributed the majority of the industry's harmful emissions, principally carbon and nitrogen oxides.

The glass industry's environmental impact is therefore largely governed by two factors. The first is the primary source of the melting energy used and of course the level of harmful emissions the particular source generates. The second is the efficiency of the melting process, in other words the proportion of the total energy used that actually goes into the glass to melt and refine it, rather than being lost to the environment.



All-electric furnace capacity and thermal efficiency.

Energy sources

Primary energy sources may be grouped into non-renewable and renewable, as shown below. Of these only the non-renewables natural gas and oil can be used directly in the melting process and they still account for the large majority of the industry's melting energy consumption.

At the opposite end of the range of melting energy options to the fossil fuels, in terms of both emissions and energy, efficiency stands electricity. Readily produced using any of the renewable sources of energy in the table below, it is the only form of glass melting energy that can be released directly into the glass itself, by means of immersed electrodes and joule-effect or resistance heating, with no associated carbon or nitrogen oxides gaseous emissions.

Nuclear energy, while technically non-renewable, does not release harmful gases and is also quite readily used to generate electricity. As such many consider it in a similar way to the renewables.

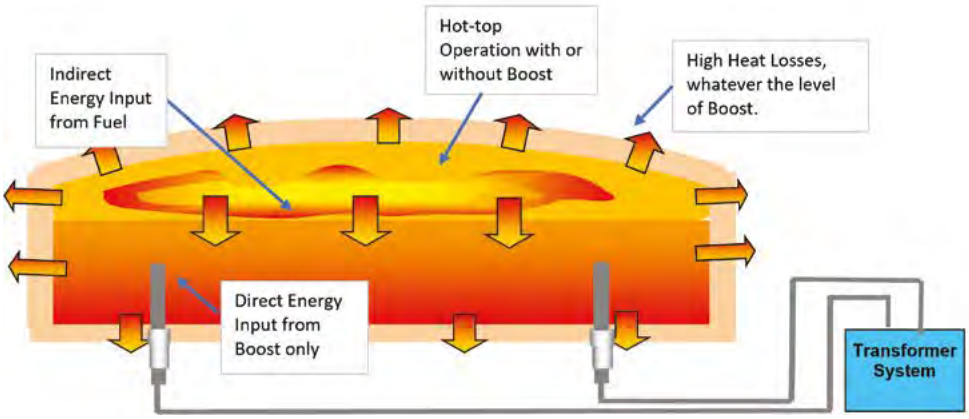
Primary Sources of Energy

- **Non-Renewable**
  - Fossil
    - Natural Gas
    - Oil
    - Coal
  - Nuclear
- **Renewable**
  - Solar
  - Wind
  - Geo-thermal
  - Hydropower

Primary energy sources.

Thermal efficiency

Leaving aside the question of harmful emissions, a typical purely fossil-fuel-fired container glass furnace is unlikely to show an actual thermal efficiency of more than about 45%. This clearly means that more than twice the amount of energy is being used and more than twice the emissions generated than strictly needed to melt the glass. Most fuel-fired furnaces are less efficient than this, many of them ▸



The boosted or hybrid option.

very much less efficient, and all are significantly less efficient when operating at anything less than optimum design output. By contrast a well-designed all-electric furnace of say 250 to 300 tonnes/day capacity can have a thermal efficiency of around 85% and more. (There have been claims of well over 90% based on modelling, but the mentioned 85% is a proven figure from an actual furnace well known to the author). Even at reduced output, say down by a third, an electric furnace of this size can still have a thermal efficiency of around 75%. These high energy efficiency figures are not limited to relatively large electric furnaces. A much smaller electric furnace of say 60 tonnes/day capacity can have a thermal efficiency of about 70% at design output, again a proven figure.

All-electric gold standard

Such a contrast in energy efficiency between fuel-fired and all-electric is easy to understand. The fuel fired heating is indirect and requires a large combustion chamber over the glass. This inevitably loses substantial heat to the environment, in addition to the heat losses in the exhaust gases, despite heat recovery systems. Immersed electrode heating is directly into the glass, allowing 'cold-top' furnace operation in which the entire surface of the glass can be covered in a highly insulating layer of raw materials in a vertical melting process, meaning no hot furnace superstructure and negligible superstructure heat losses. In a well-designed all-electric furnace, superstructure temperatures of well under 100°C are achieved. Heat losses through the melting tank sidewalls and bottom are easily minimised with modern insulating materials and design.

The combination of 'clean' electrical energy from renewable sources, even if backed up by fossil fuel standby or top-up generation capacity, and the elimination of combustion gas harmful emissions, makes cold-top all-electric glass melting the unavoidable gold standard the industry should be striving for.

Oxy-fuel firing

Considerable attention has been given to ways of improving the performance of basically fuel-fired furnaces in terms of both energy efficiency and emissions reduction. Oxy-fuel firing has been developed and used for a number of years and more recently firing with hydrogen has been a focus of technical papers and seminars. Both oxygen and hydrogen are abundant and all around us, but not in usable forms for combustion and energy release. They both require significant investment and processing to isolate, store and transport.

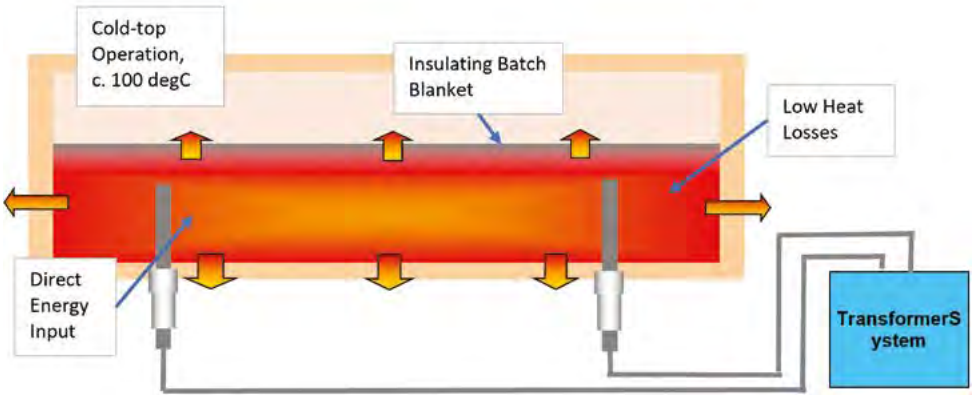
Hybrid furnaces

Another recent focus has been the 'hybrid' furnace approach – essentially using a very high level of electric boosting in what is otherwise a relatively conventional horizontal flow hot-top furnace. Here, care is needed when considering the contribution proportions of electricity and fuel. In a furnace in which say 80% of the glass is deemed produced from electricity and 20% from gas, the ratio of energy usage can be very different with maybe only 65% of the total energy input being electric and 35% still coming from fuel. This is due to the very different thermal efficiencies of the two forms of heating.

To achieve a ratio of 80% electric to 20% fuel in terms of energy input rather than glass produced, the result may be that around 90% of the glass melted is being produced electrically and just 10% by fuel. Given that this still essentially a hot-top furnace with the inevitable heat losses from a hot and fuel-fired superstructure, is it not much better to go to fully electric and cold-top, taking advantage of the insulating properties of the batch blanket, the resulting greatly increased thermal efficiency and the complete elimination of the combustion emissions?

Rethinking furnace size

Energy is the biggest element in the cost of container glass production and the industry has progressively adopted larger and larger fuel-fired furnaces with a key objective of improving



The all-electric option.

thermal efficiency. A well-designed cold-top all-electric container glass furnace does not need to be of comparable size to be efficient. The 250tpd example has a thermal efficiency of around 85%. While there is limited actual experience of larger electric furnaces, even current designs for 300 to 350tpd can be only marginally more efficient than this. Is it therefore time to rethink the focus on furnace size as necessary for production efficiency?

The logical way forward

While the melting process receives most of the attention in efforts to maximise thermal efficiency and minimise emissions, there is established, proven and highly successful technology readily available to greatly reduce the energy consumption and operating cost of distributor channels and forehearths. All-Electric Forehearths and Distributors have been very widely used in various industry sectors for decades, most especially for the volatile glasses such as the borosilicates and fluoride opal compositions. They have also long been successfully used in the container glass sector, but have received limited attention. That is rightly changing. In the large majority of cases, energy cost savings of between 60% and 90% are achieved with a well-designed all-electric forehearth compared with its gas-fired equivalent.

In one current series of projects for a major container-making group, involving eight forehearths either converted from gas or newly installed, the operating energy cost savings compared with gas range from 71% (three high-capacity forehearths) through 75% (two forehearths) to 86% (three very high capacity forehearths). Such savings translate to rapid payback times – and of course the complete elimination of combustion gas emissions. These, combined with thermal homogeneity results equal to or better than equivalent gas forehearths, precision temperature control and ease of operation make electric forehearth technology the logical way forward for the industry, irrespective of the technology adopted for the melting furnace. ●

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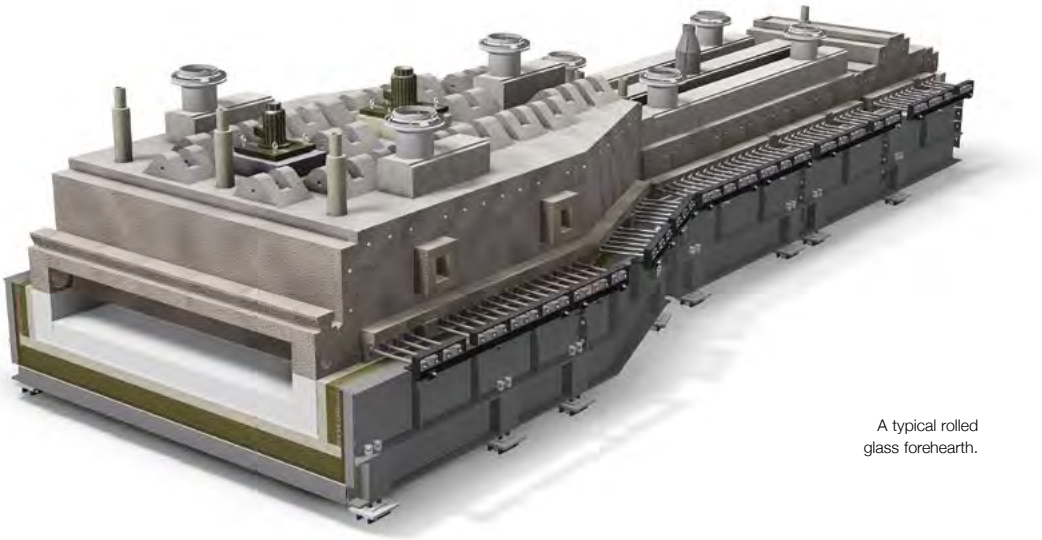
Innovative technology goes solar

The expanding market for producing glass for solar panels has increased demand for rolled glass forehearths. Steve Foulkes outlines how Zedtec's expertise and technologies have been applied to solar glass production.

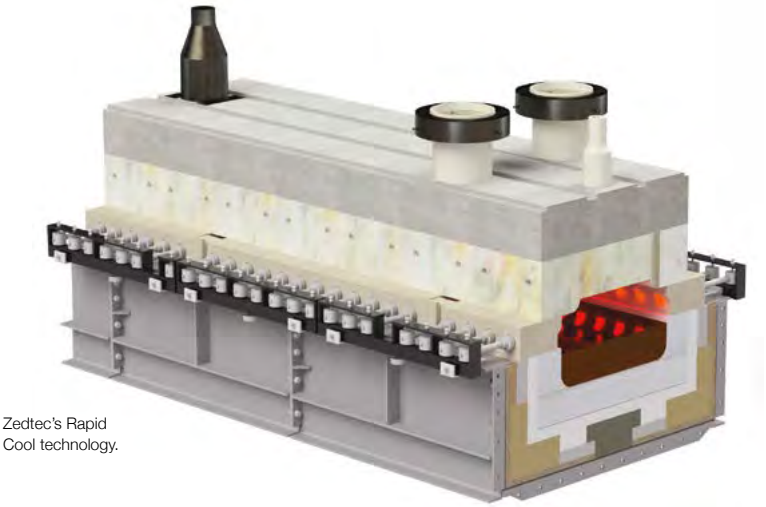
Zedtec is predominantly known within the glass industry for providing top quality forehearths for container, cosmetic and tableware manufacturers. However, in recent years the company has provided a number of forehearths for the production of low iron rolled glass for solar panels.

Typically glass thicknesses of 2–10mm are produced, based on ribbon widths of up to 2.7m. Pulls in excess of 230tpd have been successfully achieved from single Zedtec forehearths.

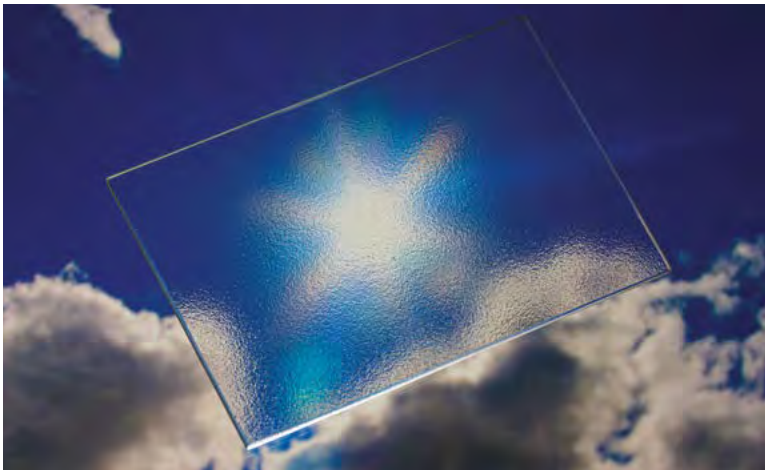
Following an initial flurry in the early part of the 21st century, the solar glass market slowed down, mainly due to production capacity exceeding demand, particularly from Chinese glass manufacturers. However, in recent years, due in part to some countries introducing anti-dumping legislation, the market for producing glass for solar panels has improved with numerous enquiries coming in for rolled glass forehearths.



A typical rolled glass forehearth.



Zedtec's Rapid Cool technology.



The market for producing glass for solar panels has improved in recent years.

Meeting customer requirements

Zedtec has provided solar glass forehearths to customers in Europe, Asia, North and South America; in many cases for major multi-national producers. In addition to solar glass, in many instances customers have also produced figured and U-profile glass from the same forehearths. Sometimes customers also run with different coloured glass on the same lines.

In some cases, Zedtec has provided single forehearths fed from one dedicated furnace; on other occasions, a working end has been provided to allow two forehearths and production lines to be fed from one furnace. Forehearths have also been provided which are supplied directly from offtakes on float furnace working ends, affording glass manufacturers greater production flexibility.

Rolled glass forehearths

Zedtec forehearths are designed to ensure the glass is correctly conditioned between the furnace and the rolling machine, delivering and/or removing heat from the glass as required. Zedtec's own Forehearth Refiner and Mathematical Emulator (F.R.A.M.E) software is used to optimise residence time and hydraulic head loss. Where necessary, CFD modelling is also employed to ensure certain parameters can be achieved.

In most instances, standard Zedtec forehearth technology used in the container and other industries is adapted for rolled glass. Generally speaking, the main part of the forehearth is a typical channel design, albeit often deeper and wider than used on container production. This then opens out to a flare zone at the end of the forehearth, which is as wide as the desired ribbon width.

Zedtec rolled glass forehearths incorporate Rapid Cool technology, usually in either one or two cooling zones. The unique arch block design allows efficient centre line cooling, improving temperature homogeneity across the width of the forehearth which is particularly important in the rolled glass process where a consistent temperature profile across the ribbon width is very important. ▸

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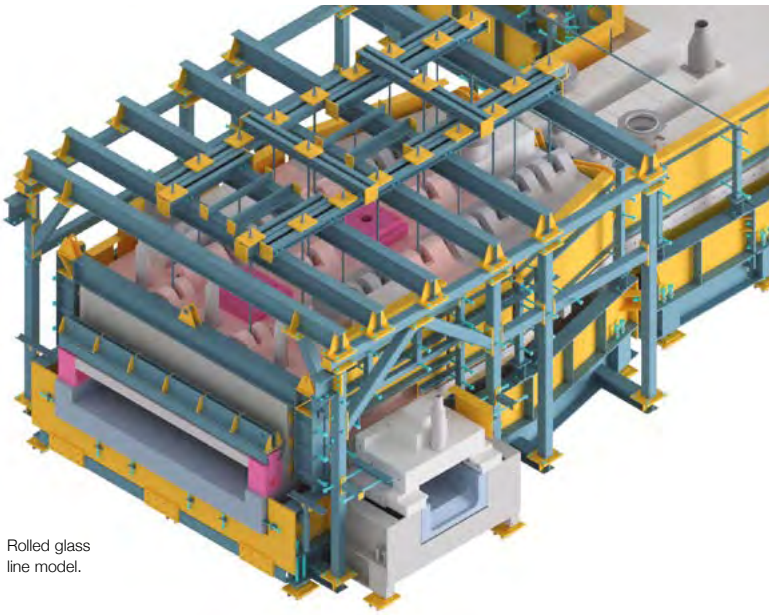
Minimising maintenance

The channel part of the forehearth is also designed with the Zedcel substructure insulation concept which optimises heat losses, by providing better insulation on the outside corners of the channel and reducing the insulating properties of the refractories on the centreline to ensure homogenous glass across the full width of the forehearth.

Pencil burners using natural gas or LPG are employed as the primary energy source, utilising Zedtec's high-pressure duplex governor combustion system. This provides a greater turn down ratio from high to low fire and consequently an improved and more economical control of energy released into the glass. The system prevents the risk of flashbacks, and eliminates carbon build up on the burner nozzles, meaning regular burner cleaning is not necessary.

Rolled glass forehearth installation.



Rolled glass line model.

Forehearth exit to rolling machine.

Zedtec's unique air dampers are used on all zones to maintain pressure within the combustion chamber. A series of internal concentric air jets create a pressurised air curtain at the flue; there are no moving mechanical components on the superstructure of the forehearth, minimising maintenance requirements.

Maintaining optimum temperature

In the forehearth flare zone closest to the rolling machine roof, mounted hot spot burners are incorporated which allow additional centreline cooling if required, but can also be used to provide the excess heat necessary during lip block and rolling machine changes. Zedtec's unique LFV burners are incorporated at the outside of the flare zone to ensure heat release at the extremities of the glass width in order to maintain optimum glass temperature across the full ribbon width and minimise trim loss. A proven suspended roof design is used at the exit zone to suit the relatively large span required.

On several forehearths a side drain has also been provided, often positioned close to the forehearth exit. This drain utilises a modified container glass feeder which can regulate flow and allow the manufacturer to maintain furnace pull and conditions during maintenance periods on the lip block and rolling machine.

Zedtec is proud to be regularly chosen as a principal supplier in a sector of the glass industry where high quality production is so important and pleased that we can play a small, but important part, of this evolving renewable energy sector. ●

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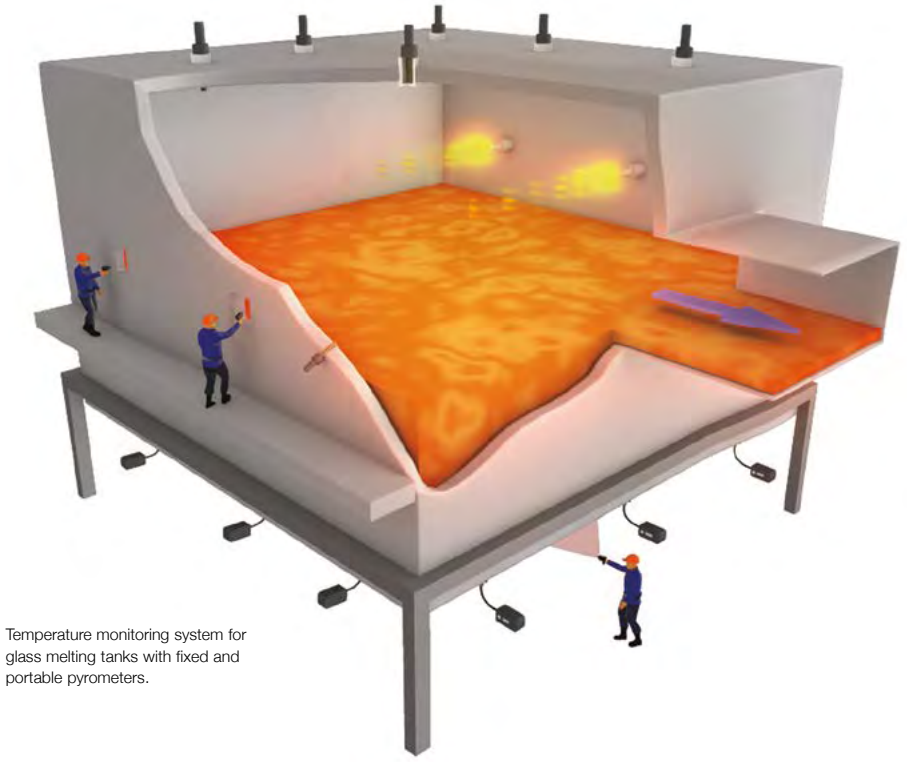
Glass melting process optimisation

Pyrometers, thermal imagers and SCR power controllers provide effective process control for glass melting furnaces and forehearths. Stefan Schiepe and Kathrin von Rein introduce tailored systems from Advanced Energy Industries for energy-efficient production flow and future-proof furnace operation.

Today's industrial processes require precise measuring systems, especially for applications where high ambient temperatures have a substantial influence on the accuracy and duty cycle of the system components involved. Advanced Energy Industries (AEI), which acquired LumaSense Technologies, Inc. in 2018 to expand its portfolio of photonics-based measurement and monitoring solutions, offers a selection of Impac pyrometers and Mikron thermal imagers to optimally control the glass melting process. In addition, AE's SCR power controllers allow for precise power regulation in electrical heating applications.

This powerful combination enables the user to implement a fully automated measurement and control system for each step of glass production, that meets the requirements of Industry 4.0 standards.



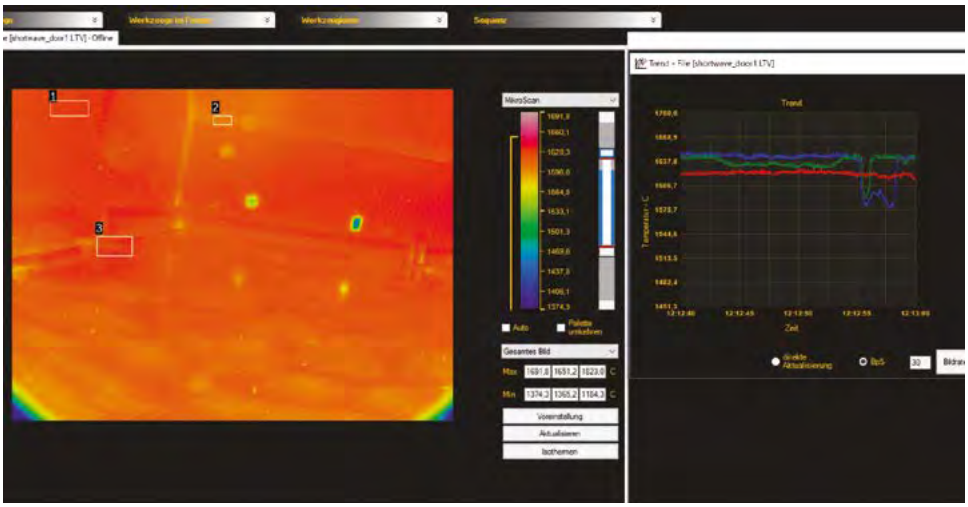
Temperature monitoring system for glass melting tanks with fixed and portable pyrometers.

The glass melting tank

An increasing number of furnaces are heated electrically to achieve the perfect process temperatures for an optimal melting performance, while simultaneously reducing unwanted emissions. In order to provide an optimum level of energy for heating, SCR (Silicon Controlled Rectifier) power controllers by AEI are used in combination with smaller step transformers for boosting in dynamically controlled processes. AEI's Thyro-Family of SCR power controllers are characterised by a wide range of operating and control modes and have the ability to communicate with various modern fieldbus systems and PLC [programmable logic controller] devices.

Because of the high temperatures and corrosive molten glass associated with melting furnaces, protecting the expensive bottom refractory from excessive temperature is essential for longevity. Monitoring the temperatures of the bridge wall and port arch can also provide useful information about the furnace condition.

Temperature measurement is also directly related to glass quality, as well as prolonging the life of critical assets such as refractory walls and the melting tank itself. System solutions involving infrared thermal imagers combined with pyrometers can efficiently help increase production efficiency and reduce waste.



Thermal image of melting tank wall temperatures with ROIs via LumaSpec RT control software.

Fixed pyrometer

Advanced Energy designed the Impac IS 50-LO/GL for measurement of glass melting tanks, forehearth and feeder applications. It is a special two-wire digital pyrometer with a fibre optic head and 4–20mA analogue output. The spectral range in the near infrared is especially suited to a fibre optic pyrometer for measurements of molten glass and enables high measurement accuracy. The digital technology of such a pyrometer achieves a repeatability of 0.1%.

Developed exclusively for glass melting furnaces and feeder areas, the Impac IS 50-LO/GL pyrometer is usually installed in a glass furnace or batch system and uses an optical fibre available in various lengths (standard: 5m, but also 1m, 6m, 10m, 15m, 30m). The optical fibre itself can be fitted with protective tubes made of Inconel or aluminium oxide ceramics, for trouble-free, direct replacement on-site.

By using fibre optics the IS 50-LO/GL pyrometer is able to provide consistently accurate measurement results over many years, without the ageing and drifting phenomena experienced by thermocouples, thus reducing downtime and replacement costs.

An exchange of existing sensors is easy to perform, as the physical dimensions of the pyrometer will match those of the incumbent thermocouple. In addition, the service-life of the sight tubes is considerably prolonged by overpressure inside the measuring tube.

By utilising Advanced Energy's SCR power controllers on electrically preheaters or feeders, very precise temperature control can be achieved, resulting in accurate process control and considerable energy savings.

Portable pyrometer

For measurement comparison and control of the furnace temperature (e.g. burner brick measurement or tank end wall temperatures), portable pyrometers can provide early indications of potential (and expensive) refractory failures. For these applications Advanced Energy provides robust, hand-held pyrometers with through-the-lens sighting for direct readings, high grade optics for detection of contours and ultra-small measuring spots. These portable Impac Series 8 pro pyrometers enable users to store measurement data on-board for easy recall at the touch of a button. The spectral range of the IS 8 pro is chosen to match the stationary pyrometer IS 50-LO. Combined with the IGA 8 pro, which has a slightly longer wavelength, glass mould and refractory temperatures from 250°C can also be measured accurately.

User benefits include flexible inspection capabilities to monitor critical areas and prevent dangerous refractory failures at the melting tank end wall.

Thermal imaging system

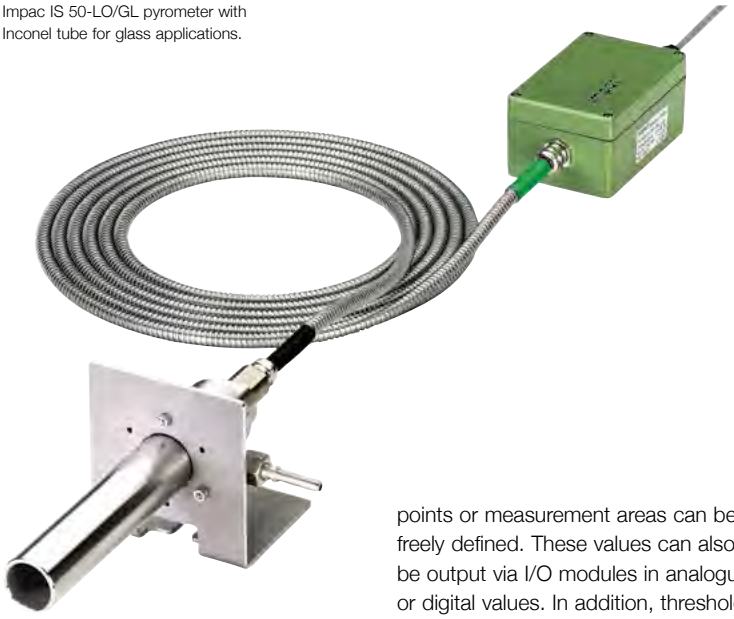
Advanced Energy's FurnaceSpection thermal imaging system has been designed and developed for continuous temperature measurement inside high temperature furnaces.

Available in a portable or stationary version, this is a shortwave infrared camera system with a built-in flame filter, which reduces the influence of furnace chamber flame, as well as the CO_2 atmosphere. This system provides users with a real-time tool for quickly and accurately identifying process abnormalities before they develop into problems that can lead to unplanned outages.

The radiometrically calibrated imager accurately measures the temperature of product, refractory and heat transfer surfaces inside natural gas-fired furnaces. The user is also able to monitor the flame condition, thereby reducing the production of NOx pollution, resulting in less environmental impact, while maximising furnace lifetime.

The latest generation of this high-grade thermal imaging system by Advanced Energy is equipped with a Vortex cooler and special borescope optics, which enable monitoring of the temperature distribution inside melting furnaces through the furnace wall, for example. By utilising high quality optics, a resolution of more than 300,000 pixels can be achieved and the borescope lens system is available in a number of different lengths to suit virtually any application and need.

With the addition of special spectral filters, negative influences caused by burner firing can be avoided. Alternatively, a different set-up of the camera with another spectral filter can be implemented, ▸



Impac IS 50-LO/GL pyrometer with Inconel tube for glass applications.

where the flame image is visible.

Control software for visualisation and closed-loop control enables thermal images to be displayed on a computer screen and viewed with different colour options. Measuring points or measurement areas can be freely defined. These values can also be output via I/O modules in analogue or digital values. In addition, threshold values can be defined by the software.

Process benefits

A significant amount of capital can be lost if a furnace failure goes unnoticed or if the refractory linings are retired too early or too late. With AEI's FurnaceSpection system, multiple measuring points on the furnace ceiling, end wall and side wall can be independently monitored by adding measuring regions of interest. The measured values can be used for monitoring and regulation. Furthermore, the batch melting process can be monitored.

By adding temperature limits, which can be defined via the regions of interests, the entire reflow process can be closed loop-controlled using just the FurnaceSpection system. This ultimately reduces the number of individual measurement points, thereby lowering maintenance and replacement costs.

FurnaceSpection helps operators monitor and control process temperature uniformity through streaming images documented by powerful software for analysis and historical trending, outputs to automation and DCS and a real-time web server to broadcast images on the plant's local network.

Thyro PX Series Advanced SCR Power Controller.

Portable Impac pyrometer Series 8 pro.

FurnaceSpection system, including MCS640 thermal camera heat-protected by a special and very robust housing.

Conclusion

With the combination of SCR power controllers, infrared temperature measurement instrumentation and control software, Advanced Energy provides a broad range of tailored solutions to efficiently control the heating power of the furnace and accurately monitor the different glass production steps to meet stringent Industry 4.0 standards. The company's tailor-made measurement and control system is designed to enable seamless production flow at minimum energy consumption, while reducing maintenance and installation costs and increasing plant availability for the glass industry. ●

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Forecasting a climate of change in glass melting

What will the furnace of the future look like? Hartmut Hegeler from SORG weighs up the benefits and limitations of a number of alternative energy sources and sustainable methods for melting glass.

The multiple benefits and multi-faceted success of glass cannot be denied. Endlessly recyclable, its chemically inert properties have offered innovative versatility, helping to change the course of history over many millennia. But glass has a hard future, when you consider the energy intensive melting required to produce it and the mounting pressure for manufacturers to dramatically reduce their carbon footprint.

The Paris Climate Agreement demands a 55% reduction in carbon emissions by 2030 and carbon neutrality by 2050. Compliance will be essential for glass manufacturers to remain competitive and ensure sustainable economic growth. Today's combustion technology will soon be a thing of the past, as industry moves forward with more renewable sources and environmentally friendly processes.

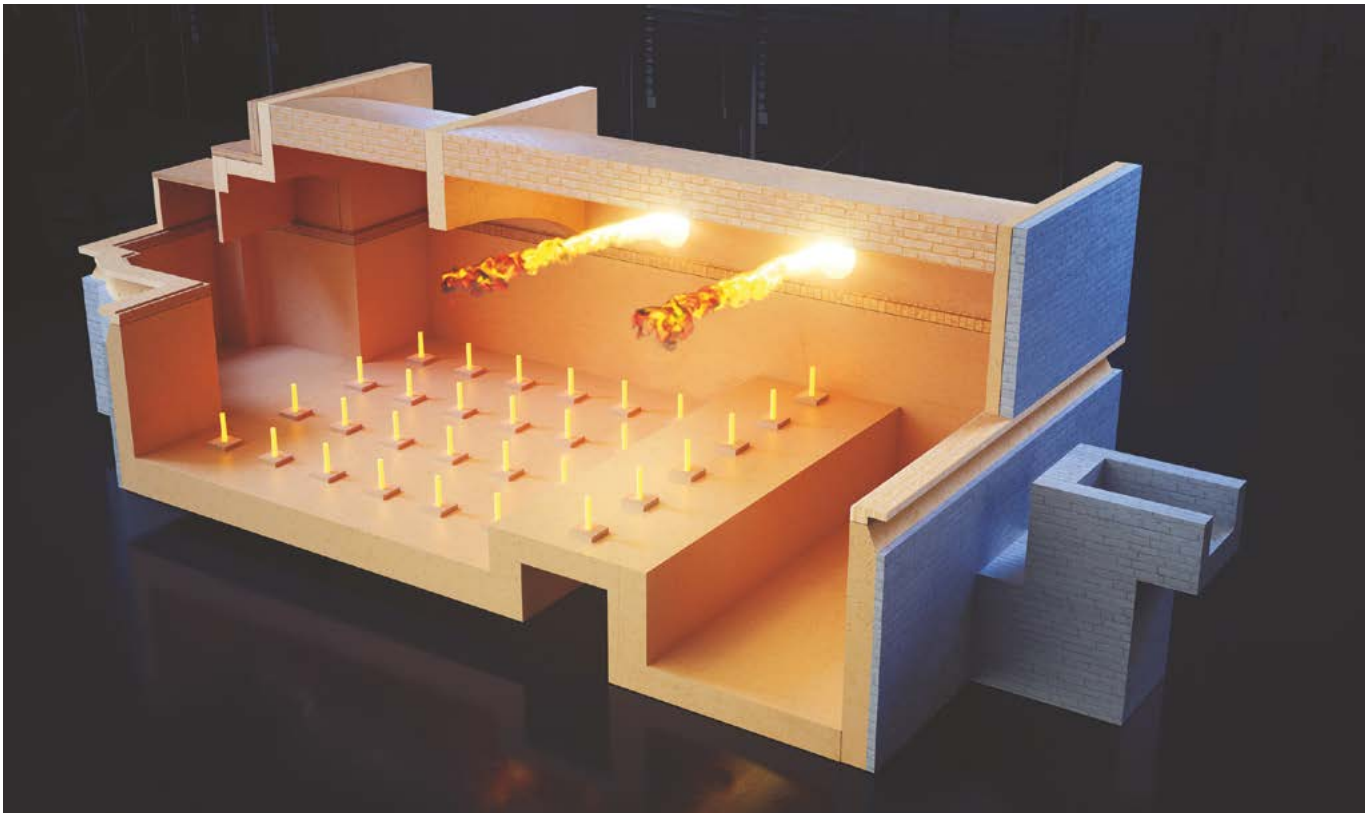
So, what will the furnace of the future look like? Many different innovations have been considered to provide a sustainable energy supply, including electricity and alternative fuels like hydrogen, oxygen and biodiesel. All are currently being trialled and tested, but in general these energies, if even available, often do not provide enough power and stability to operate a furnace and keep temperatures constant, to ensure the sustained high quality of the finished products. Let's weigh up the benefits and limitations of each option, to find out which one offers the most viable solution.

All-electric melting

Electric furnaces, such as the SORG VSM typically operate with a 'cold-top' where the batch melts as it passes down through the furnace. This forms an insulating layer which reduces thermal losses from the glass melt. They are more efficient than air/fuel furnaces because they do not produce large volumes of hot waste gases during the combustion process, and also have a higher efficiency because of the direct energy transfer into the melt by the electrodes. The cold-top traps many pollutants produced by the melting process and the batch charging via the closed rotating crown ensures a nearly dust-free environment around the furnace. Although the furnace has a shorter working life compared to gas-powered furnaces, it is significantly cheaper and quicker to build and rebuild.

There are certain limitations, such as in the possible melter size and pull. Requiring an even layer of batch to be spread across the whole surface of the melt, 100% electric furnaces have a size limit of around 200 metric tonnes' pull per day. Furthermore, the application of 100% electric melting is not suitable for all types of glass and the all-electric melter is more sensitive to raw material and operation variations.

Besides electricity being more expensive than natural gas – up to now – in most parts of the world and therefore uneconomical for standard glasses, significant government investment would be required to make all-electric melting commercially viable. However, as CO_2 taxes are being established and will be increased dramatically over coming years, this changes the picture for the producer and will also push governments to start considering electricity infrastructure. ▸



SORG CLEAN Melter – hybrid furnace.

Hybrid furnaces

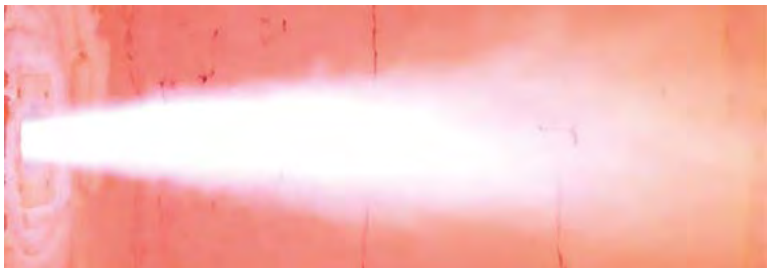
Many conventional glass melting furnaces are using electricity to complement the fossil firing in the form of electric boosting. This enables the furnace to produce higher output and/or better glass quality. The electric share is typically from 10–15% but can be increased to values around 25%. In the case of green electricity, the CO_2 footprint is reduced, with the hybrid furnace able to 'play' with the share of electricity. This would offer greater protection against fluctuations in energy prices or availability of electricity, whilst facilitating the transition from natural gas towards new low-carbon fuels. And if hydrogen is to be used instead of gas, the CO_2 output can be zero.

SORG's new concept, the CLEAN Melter, is a logical continuation of the SORG VSM all-electric furnace. The CLEAN Melter can be operated between a range of 20% electric/80% fossil fuels, up to 80% electric/20% fossil fuels, making it extremely flexible when it comes to energy prices and availability. More importantly, the CLEAN Melter can also support higher tonnages (up to 400tpd), is suitable for all glass types and is not as sensitive to raw material and operation variations as the VSM furnace.

Oxy-fuel firing

An oxy-fuel system fires pure oxygen into the furnace along with, for example, the natural gas, making it noticeably more thermally efficient than furnaces using ambient air. Even though the flame is hotter, no actual nitrogen is fed into the furnace by the combustion air, which results in extremely low NOx levels. This type of furnace is mostly used for specific applications, such as the melting of speciality or high temperature glasses like borosilicate, typically in locations where an economic source of oxygen exists, and to aid an old furnace to meet its campaign requirements (oxygen boosting). Similarly, in some areas, oxygen heated furnaces are demanded for all types of furnaces by authorities.

Technically speaking, oxy-fuel firing does bring unique benefits, however the need for either on-site oxygen manufacture or regular deliveries of liquid oxygen can be fairly costly.



The use of hydrogen could be the key for the future.

Hydrogen

The use of hydrogen instead of gas could be the key for the future. Combined with converting the natural gas network into 100% hydrogen, this would be a great way to decarbonise both industrial and domestic energy applications. The two main routes to produce no or low carbon hydrogen on a large scale are steam methane reformation (SMR), typically known as 'blue' hydrogen, and electrolysis of water using renewable electricity. Low or zero carbon hydrogen production offers a potentially lower fuel cost than electricity, however, further research will be required to compare the future costs to those of biofuels.

With hydrogen it is possible to convert existing fossil fired furnaces to green hydrogen fired furnaces, using the same furnace technology.

Hydrogen could be delivered through existing natural gas pipelines, reducing the cost of delivery to site. Plants will need to make significant investment in infrastructure, such as ATEX approved zones and stainless-steel pipework. Yet it should be possible to convert the current design of natural gas furnaces to a pure hydrogen fuel with relatively minimal disruption.

The right time, the right partner

Pull rate, energy consumption and emissions of conventional furnaces have already been improved considerably. Whichever technology is utilised in the future, there are many determining factors, including geographical location, accessibility to fuels and economies of scale.

SORG is always thinking ahead and investing in cleaner technologies to tackle climate change. Introducing the all-electric VSM furnace 50 years ago and providing electric boosters for over 500 fossil-fired furnaces worldwide, we have also just patented the world's first hybrid furnace to support larger applications. The CLEAN Melter combines our knowledge with proven mathematic modelling carried out by SORG's in house experts. Suitable for all glass types, it emits significantly less CO_2 than conventional furnaces, with up to 80% electric share offering greater flexibility and huge cost savings for furnaces up to 400tpd and even more.

We know that glass manufacturing has to earn the right to continue. We owe it to our industry. We owe it to future generations. And above all, we owe it to the planet. That's why SORG has the vision to find the most sustainable solutions for its customers. Ones that help to optimise productivity, while reducing emissions and safeguarding the future for everyone to benefit from carbon neutral energy. ●

SORG VSM and SORG CLEAN Melter are registered trademarks of SORG GmbH & Co. KG

Top electrodes in the SORG VSM furnace.

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Pollution control with ceramic filtration

For over 10 years Tri-Mer has been championing ceramic filtration systems in the glass industry. Alessandro Monteforte explains why he believes it is the optimum method for furnace emission control.

Ever-increasing public pressure on emissions reduction, sustainability, circular economy, and CO_2 footprint are on the daily agenda of all future-conscious citizens of our planet. These sentiments are shifting from being a regulatory obligation to now being a decisive advantage to customers and end-users of the products they are purchasing and using. Every day, producers and consumers alike are paying more attention to the environmental impact of their activities and the products they use.

Glass furnaces are on the top of the list of polluting emission sources for both micro-pollutants and CO_2, but fortunately air pollution control systems are readily available for reducing these impacts and these systems are constantly improving in performance and operational efficiency.

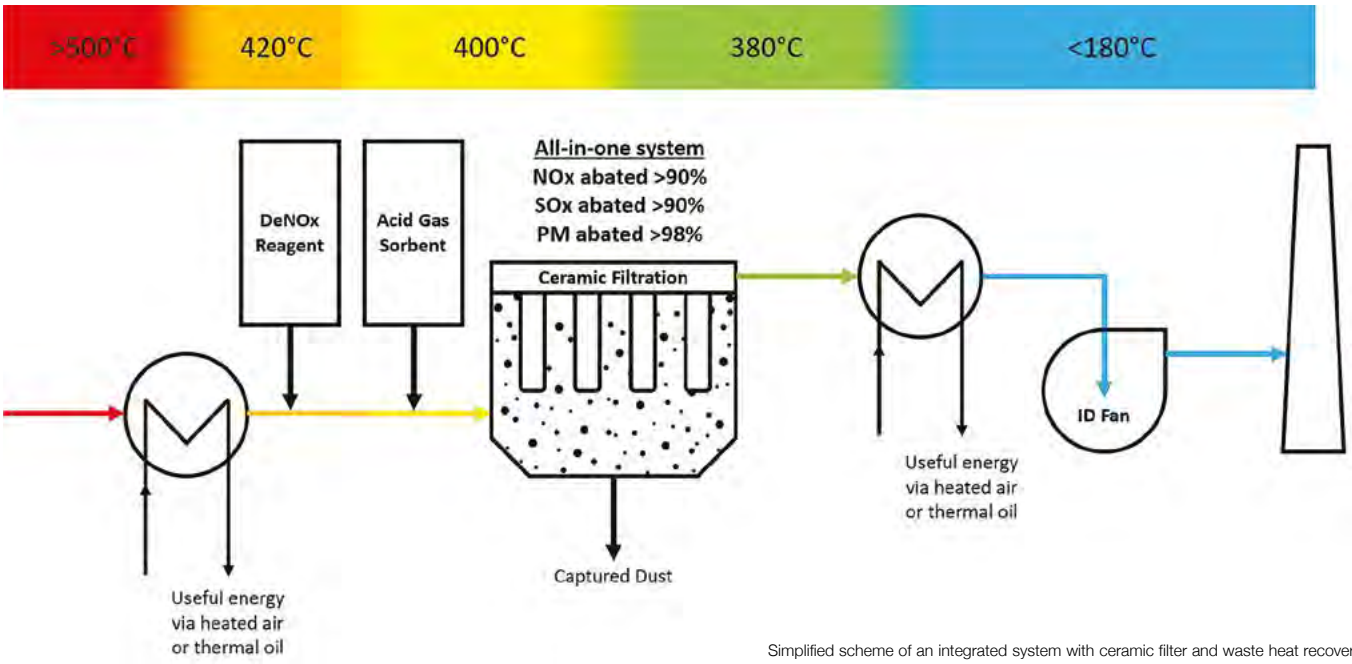
Ceramic filtration (CF) is the cutting-edge technology for furnace emission control; although Tri-Mer began applying this technology in the glass industry more than 10 years ago. Most of the new furnaces in Europe, North America and China are built with this technology, but the ceramic filter system is sometimes seen as a 'dangerous innovation'. Instead, the truth is that this technology can bring big advantages and future-proof plants. Let's try to understand why...

A complete system delivered by Tri-Mer for two container furnaces in Germany.

Typical ceramic filter treatment scheme

A typical ceramic filter system is a compact process, composed of three stages:

- Temperature control stage, where gas temperatures above 400°C/750°F are reduced with heat exchangers, air dilution, water quenching, or a combination of the above.



Simplified scheme of an integrated system with ceramic filter and waste heat recovery.

- Reactant injection stage, usually performed in-duct, with injection of a deacidification sorbent (via lime- or sodium-based) and a denitrification reduction agent (via ammonia or urea dissolved in water).
- Abatement stage, using catalytic ceramic filter housings, where all the pollutant families are abated thanks to a set of ceramic filtration elements, embedded with (selective catalytic reduction (SCR). Abatement includes particulate matter (PM), heavy metals, SOx and acid gases, and NOx.

Other ancillary systems are captured dust collection and recycling to batch and ID fan for suction.

Ready for present and future regulations

The ceramic filter system is more efficient than other air pollution control systems present in the market. For the regulation imposed by some countries, this is somehow too much, but furnace campaigns are going longer and longer, and CF system can ensure compliance to emission limits significantly lower than today's, without any significant modification.

Worldwide, PM emission limits are trending lower with new authorisations in western Europe given for 10mg/Nm^3 @ 8% O_2 dry and likely a differentiation of limits for PM10 and PM2.5 is coming. CF systems usually abate below 5mg/Nm^3 @ 8% O_2 dry, and are highly efficient regardless of particle size. High abatement performance means that submicronic dust, heavy metals and boron compounds that could also become a specific target in updated regulations.

Reduction of emission limits is also expected for SOx to 400 or 300mg/Nm^3 dry @8% O_2, if not lower in some countries like China, where several plants must respect 50mg/Nm^3. CF systems allow for the usage of sorbent in a highly efficient range of temperature, adding to the so-called 'filter effect' that increases performances thanks to the long permanence of fresh sorbent into the filtration cake. Combined with other special technologies (e.g. Tri-Mer's enhanced sorbent injection, dust recirculation, multiple sorbent injection…) this will then allow removal efficiency to reach values above 90%.

Regulations are now targeting NOx <500 mg/Nm^3 @ 8% O_2 dry, even for furnaces able to reach low emissions with primary means. This means, secondary means must be installed, and CF systems can abate NOx with an efficiency easily reaching 90%, thanks to the operation at high temperature, the intimate contact with catalyst embedded in the ceramic filter body and the perfect ammonia distribution inherent in the system design.

The expectation is that there will be also a general reduction of the APC downtime allowed for yearly maintenance, targeting 72 hours as the maximum continuous stoppage permitted. This is already happening in countries such as Germany. Other countries or regions often request even more stringent allowances, with no downtime allowed. Technologies like electrostatic precipitators would require a fully redundant system; however, a CF system can ensure these guarantees with:

- Filter lifetimes often longer than furnace campaigns;
- A modular design, allowing one compartment to be isolated while operating the others;
- Predictive maintenance, thanks to Tri-Mer's proprietary devices, allowing on-line management of the filter status;
- A patented system preventing catastrophic filter failures and maintaining compliant abatement performance in case of minor breakages.

The modularity of the CF system ensures that growing furnace size or unexpected temperature/flow rate increases will not generate problems to the system, allowing the spread of the CAPEX investment along the entire furnace campaign. ▸

Profitable choice for waste heat recovery

Waste heat recovery (WHR) systems are becoming more prevalent in the glass industry, not only for large float furnaces but now also in smaller plants. The best equipment combination is the installation of WHR with CF to achieve a profitable return on investment.

The reason is linked to the following conditions:

- The high temperature available at the exit of the CF.
- The high efficiency on SOx (and namely SO_3) lowers the acid dew point and allows lower temperature of flue gas at heat exchanger exit (+10% recovery).
- The very low dust level after the CF allows the use of finned heat exchangers, without soot-blowing systems, with a reduction of 50% of the heat exchanger cost for the same energy capture.

On a recent project on a container plant with furnaces reaching 900tpd of total pull, a system designed to produce 2MW electric with an Organic Rankine Cyle (ORC) module could reach a payback time of two years. Tri-Mer has now successfully equipped two furnaces with WHR, with two additional systems currently under construction

ORC turbines are the most suitable for power and/or compressed air production from waste heat, but district heating can also be implemented. Low pressure steam and other heat recovery systems have been successfully applied. A combination of waste heat recovery upstream and downstream of the filtration unit is also possible for maximum utilisation results.

Sustainable choice for new applications

The Next Generation EU recovery plan makes it clear that top priority for the EU Commission is the European Green Deal. This plan pushes towards new and ambitious targets of circular economy and sustainability.

CF systems, being highly efficient against all pollutants, perfectly integrate into some of the applications that are connected to glass furnace flue gas:

- Carbon Capture and Storage (CCS) of CO_2: all CCS processes require a very strong reduction of several pollutant families before capturing CO_2. As an example, SOx must be strongly reduced to avoid amine destruction in the amine CO_2 absorption/stripping processes; membrane systems are very sensitive to dust; moreover, all CCS systems concentrate flue gas pollutants, unavoidably increasing the concentration of pollutants that therefore need to be further reduced.
- Flue gas reutilisation: to reduce overall CO_2 emissions and generate a real circular economic case. An interesting example is represented by the direct use of flue gases as a source of concentrated CO_2 gas, as in greenhouses. This requires ultra-efficient treatment achievable by a CF system or a combination of CF with further stages of treatment (typically wet scrubbers) in case of extreme removal requirements.

Conclusions

Summarising the above, we can say that with ceramic filter systems in glass:

- There is no single-stage technology with equal efficiency on the market; this generates advantages that go beyond the simple compliance with statutory emission limits and in addition can generate profit with waste heat recovery systems and flue gas reutilisation.
- The technology is now mature and reliable enough to serve the entire furnace campaign, also in case of future emission limit reduction and new BREFs [Best available technique REFerences] that could arrive during the furnace lifetime. The modularity makes the system flexible and adaptable for real furnace needs.
- The system is easy to operate and maintain with lifetimes above 20 years; nevertheless, its design requires experience and care of a multitude of details that can only come from experienced providers.

The CF system is available worldwide, also on a turnkey basis, and its design can be containerised to reduce on-site activities to a minimum while maintaining maximum quality.

The future of sustainable economy will lead to unexplored and unexpected paths; the ceramic filter system is the air pollution control technology that will allow glass industry to be prepared for them. ●

Heat recovery exchanger. Photo courtesy of Rizzi Engineering.

Enhanced sorbent injection system installed in a glass plant to reduce lime consumptions.

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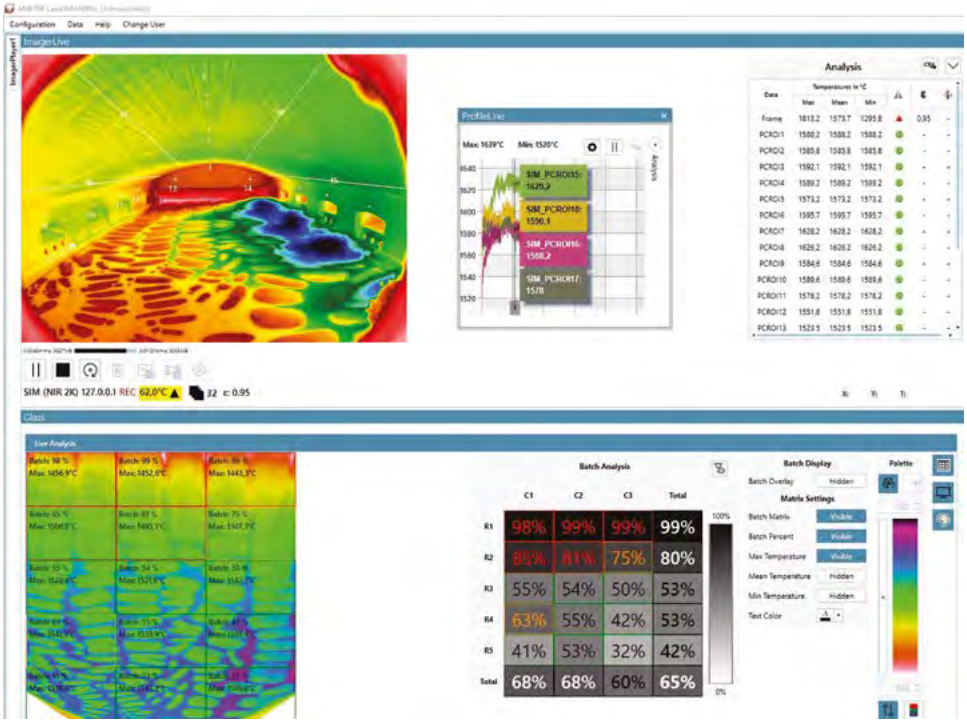
Batch tracking with machine learning and deep neural networks

In glass furnace operations, determining and observing the batch pattern in the melter is essential to achieve stable production. Matt Gillott explains how AMETEK Land is focusing on better monitoring for batch tracking by implementing image processing with neural networks.

To provide a glass product of uniform quality, it is vital to ensure a consistent melt of the batch. This requires monitoring of the furnace to prevent issues such as batch entering the refining zone. However, getting a good picture of the processes inside the furnace can be difficult – flames can obscure the view, cameras can overheat, and making sense of the image can be a problem for untrained operators. To achieve a clearer image of the inner workings of a glass melt furnace, AMETEK Land is implementing cutting-edge machine learning and deep neural network technology, working alongside its high-resolution infrared borescope cameras.

AMETEK Land's IMAGEPro-Glass advanced imaging processing software, combined with high-resolution near infrared borescope thermal imagers for verification and thermal profiling, could easily support operators in adjusting the batch and foaming line identifying the best batch pattern to avoid glass defect and get the proper pull rates. It provides a top 2D view of the melting zone, based on a grid analysis where the critical batch-free location in front of the furnace is monitored. The current model for batch coverage in IMAGEPro-Glass runs well, providing a grid with batch analysis of the melting zone for the users. The next step is to focus on better monitoring for batch tracking, implementing image processing with neuronal networks.



AMETEK Land IMAGEPro-Glass thermal imaging software.

Neural network

Many systems described as artificial intelligence (AI) rely upon a neural network, a highly interconnected and repetitive series of mathematical functions that are trained to perform the required task. The scalability of the neural network has made its use available to a wide range of applications, from recommending which music track you should listen to next and restoring old photographs, to self-driving cars and automatic mass surveillance. The use of neural networks has seen image processing systems become much more capable; for example, the ability to identify an object by pointing your smartphone camera at it demonstrates the capability of an image classification network. The application takes an image as an input and, as the output, generates a probability from a list of known categories. In this case, the system attempts to put the whole image into a single category, but by evolving this approach, it is possible to apply categories to different parts of the image. In the case of furnace monitoring, this allows us to separate out which parts of the image are batch, and which are melted glass. ▸

Example of automatic segmentation of the image.

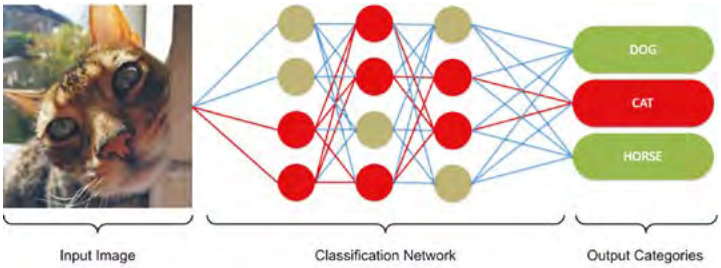
The traditional approach

Traditionally, these image segmentation tasks involved complicated and very carefully crafted algorithms, each of which would be designed for performing a single task. For example, with a glass furnace, one algorithm would need to be written to detect flame, and a separate algorithm to detect batch. In contrast, by using a neural network to perform the segmentation, all the categories can be partitioned in a single pass. Another downside to the traditional approach is that each algorithm also needs meticulous design to handle edge cases and unusual situations – for instance, how to deal with a bright reflection that could cause a false result. As a result, they can be unreliable in some situations or require numerous parameter adjustments to make the algorithm work for a specific task.

Conversely, the performance of a neural network is based upon its architecture and how well it has been trained; adding further training data to the model only improves the performance. During the commissioning of a system, extra data can be collected to ensure optimal performance of the network on the new installation.

Training the neural network

To begin the training process, a set of training data is required. Drawing on its extensive experience in providing solutions for glass applications, AMETEK Land used hundreds of different images from different glass furnaces, cameras, and environments when developing the glass furnace neural network. A glass expert manually segmented each image to differentiate different parts of the image, such as batch, image obscuration, or flame. This formed the primary training data for the network.



Example of image classification neural network.

In addition, several thousand more images were generated from the source images, in a process called data augmentation. This prevents the network from over-learning features that exist in the source images. For example, a common feature when monitoring a furnace through a port is that the corners of the image are obscured, due to the viewing angle and depth of the porthole. When training the network, it mustn't learn that this is a typical feature, as this would lead the network to mark the corners as obscured even when they aren't. Data augmentation prevents this by taking the original images and transforming them with scaling and rotation. This dilutes the number of source images with obscured corners to a smaller proportion.

Once the data has been prepared, the network can be trained by giving it both the input image and the expected segmented result. The training process then attempts to work out how to produce the result from the input. Each image from the thousands of training images is presented to the network multiple times. Every time the network sees an image, some of the parameters adjust, and slowly it starts to understand how to derive features from the input images.

When the training is complete, the network can be tested with images it has not seen before. At AMETEK Land, we used a video recording from the inside of a glass furnace that the network had not seen during training. The result was an impressive automatic segmentation of the image into the categories it was trained to find.

Conclusion

Compared to traditional image segmentation, the neural network offers highly effective performance. The main disadvantage of neural networks lies in the processing requirements. Traditional image segmentation algorithms are highly refined, making efficient use of the available processing power. In contrast, neural networks perform billions of calculations, some of which have no impact on the result and are essentially wasted calculations. This is rarely a problem, however, as most modern PCs are powerful enough to perform these operations at an appropriate speed.

Ultimately, the solution will automatically work on any furnace, up to a point. The commissioning process will then adapt the algorithms to the specific furnace and the network trained with information from that furnace alone, delivering best-in-class classification. For the end-user, this means less commissioning time as well as the ability to adapt the model as a direct result of data collected by the operator and sent back for evaluation.

If a furnace set-up occurs where the current model performs sub-optimally, a furnace specific model could be created from data collected by the user on-site, without the need for an AMETEK Land engineer to visit the site.

There remains much work to be done. AI technology is progressing at a rapid pace, with new and improved network architectures and training methods appearing all the time. AMETEK Land will continue to improve its network architecture and training data to ensure IMAGEPro-Glass software provides the best possible batch tracking solution to its customers. ●

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The hybrid challenge

Gianluca Cera shares BDF's industrial approach to state of the art furnaces and new development in melting technology, in anticipation of the glass industry's preparations for carbon-neutral production.

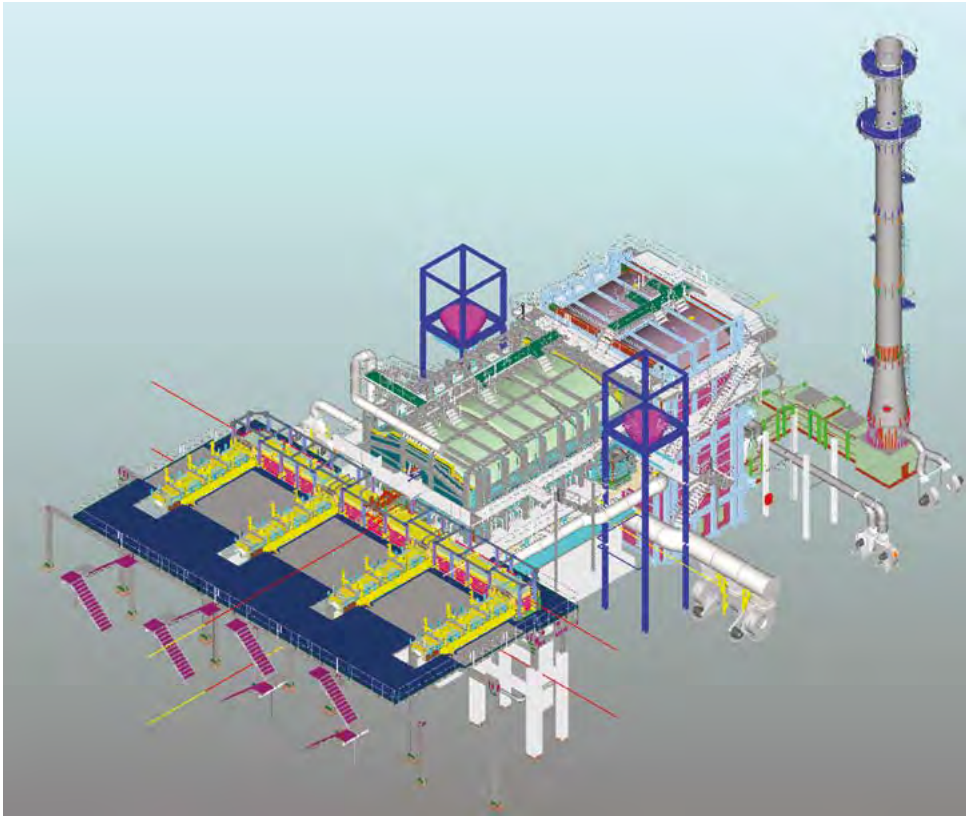
Amid a focus on reducing consumption and increasing the lifetime of furnaces, the glass melting market has only a short time to meet 2050 zero emission targets.

With its glass melting furnace R&D division, supplier of engineering solutions and equipment BDF Industries has designed a new series of end fired furnace models.

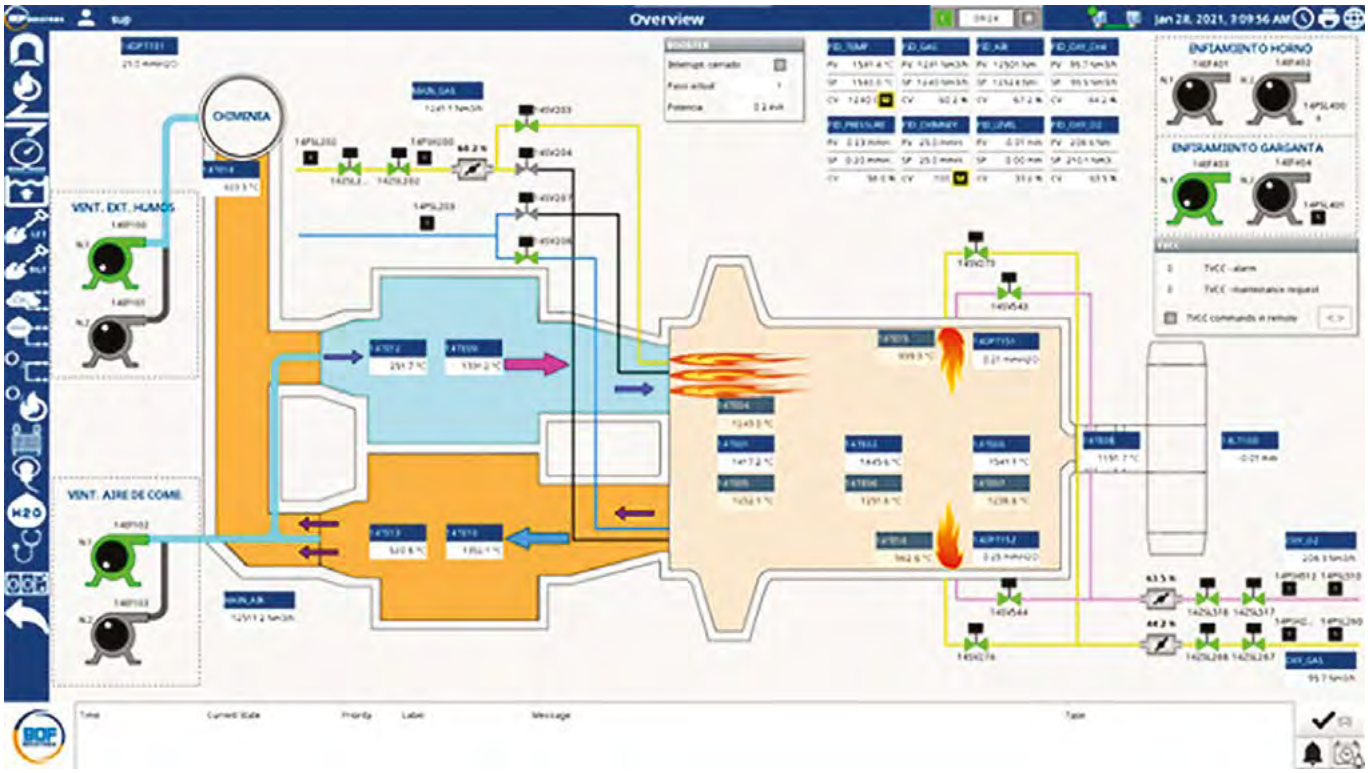
Installing its furnaces all around the world, BDF can vary the solution from customer to customer, and can develop different series of furnaces to enhance the production of high quality glass, or high pull, or low wear of refractory materials and equipment. The idea is that the customer can identify one of these melting ideas and rely on a BDF product that has been studied and proven.

Advanced technology

Benefitting from BDF's mathematical studies, CFD modelling and Finite Element Method and experience, all of the new furnace models are equipped with state of the art technology; they are fully automatised and come with ▸



Typical 3D design of a BDF furnace and forehearths greenfield project.



Typical BDF furnace HMI.

a SCADA acquisition system ready for Industry 4.0 digital upgrade. These efforts are reflected in BDF's new Delta, Sierra and Alpha furnace models.

Over the years BDF has developed and patented contactless continuous glass level control, low NOx burners and batch chargers, with fine tuning batch charger control, continuous emission monitoring system, continuous natural gas analyser that returns both Wobbe index and gas density, and a plant for a conditioning zone that is completely automatic in controlling indirect cooling and the combustion. All of this is controlled by a user-friendly and open SCADA system, aligned with the Internet Of Things using BDF's PANORAMA 4.0 system platform. This product gives the customer the ability to centralise data, create reports, arrange alarms and customise a dashboard from all the BDF system in the hot end. Monitoring operational data has never been so quick and accessible.

Installation of a natural gas continuous analyser.

Hybrid models

BDF's proposal for the zero emission path is its hybrid models. This is seen as the necessary first step to meet the 2030 target [the EU is seeking a 55% reduction in CO_2 emissions by 2030 compared with 2021 levels] and a clear solution that can drive the industry to hydrogen or full electric. In the past BDF has also engineered and commissioned heat recovery plants, but the solution for the future needs to be within the bottle manufacturing process.

BDF's Engineer, Antonino Finarelli, Melting Technical Chief, explains how the company is conducting different projects:

"We are proud of our long experienced engineering team together with process and site manager specialists. These last 'pandemic' years really enhanced the importance of the digital revolution that we implemented in our products. We can assist, tune, help and even start-up by remote! Consider that furnace projects in 2021 have been developed for Mexico, Argentina, Paraguay, Tunisia, Russia, Italy and Germany – often with actual presence but, due to the Covid-19 pandemic in some critical area, the complete commissioning has been carried out by remote assistance and diagnostic. Fantastic. Finally, we are thrilled by the result of our furnace model [...] and really excited about our concept and ideas over the hybrid challenge. The future is already happening in our Technical Office. Technology, automation and reliability are our key drivers." ●

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Supporting a strong furnace roof

AGC Ceramics Co.'s new MB-C αβ-alumina fused cast refractory design improves the durability of glass melting furnace crowns, explains Takuma Kimura.

Oxy-fuel firing has been applied to high temperature industrial processes because of characteristics such as high thermal efficiency and reduction of NOx emission. In addition, oxygen combustion has the potential to support the realisation of 'Carbon Neutral' goals, i.e. no CO_2 emissions with carbon capture system. Thus, oxygen combustion is once again back in focus.

Glass manufacturing is one such high temperature manufacturing industry. Considerable thermal efficiencies and reduction of NOx has been achieved with oxygen combustion. In the oxy-fuel fired glass melting furnace, the alkaline gas vapour pressure is higher than that of air combustion. Due to this atmosphere it is difficult to achieve long furnace life with a conventional silica refractory crown. In such cases, αβ-alumina fused cast refractory and AZS fused cast refractory are used because of their high corrosion resistance, high creep resistance and high temperature stability. AGC Ceramics (AGCC) has materials with reliable quality and engineering services as well as a long history and many experiences of manufacturing fused cast refractories for the crown, as shown in Figure 1.

αβ-alumina fused cast refractory shows good durability in the oxy fired glass melting furnace, however spalling damage, which is caused by surface alteration, sometimes appears after long-term usage. A consideration of the damage mechanism of αβ-alumina fused cast refractory is described in this report. A new type of αβ-alumina fused cast refractory, 'MB-C', which can be expected to have higher durability for the furnace crown than conventional αβ-alumina fused cast refractory is also introduced.

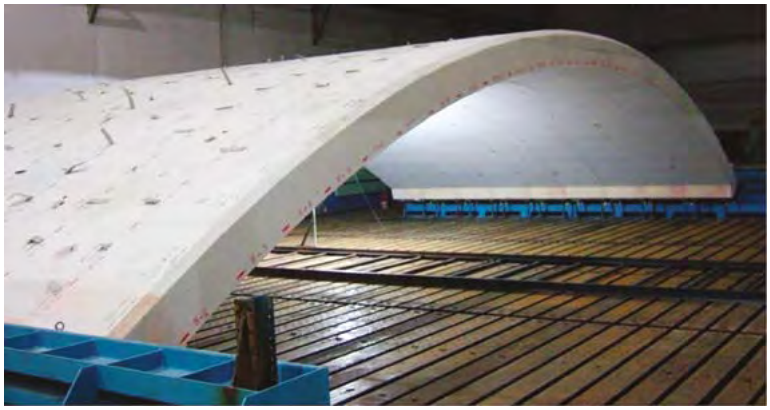

Figure 1: Pre-assembled αβ-alumina fused cast refractory for crown.

Sample Position	Na_2O/wt%	Mineralogical composition		Apparent porosity/%	CCS /MPa
		α-alumina	β-alumina		
A (Original structure)	4.0	+++	+++	1~2	300
B (Altered layer)	0.5	+++++		16	44

(XRD count : Larger +++++> +>-> tr Smaller)

Figure 2: Cross section and analysis results of conventional αβ-alumina fused cast refractory used for crown.

Damage from long-term usage

Conventional αβ-alumina fused cast refractory consists of α-alumina and β-alumina; this ratio is about 50 to 50.

Figure 2 shows the appearance and analysis results of conventional αβ-alumina fused cast refractory sample which was used in the crown of a soda-lime glass melting furnace for about 10 years. Part of the surface layer (thickness 60mm) of the sample had already peeled off, furthermore some cracks were found between the original structure (position A) and the residual altered layer (position B), which had a risk of additional spalling.

Analysis of the altered layer shows higher apparent porosity, lower cold crushing strength and smaller amounts of Na_2O compared to the original structure. As shown in Figure 3, α-alumina is more stable than β-alumina in most glass furnaces. In terms of mineralogical composition, conversion from β-alumina to α-alumina also occurred at the surface of this sample. Since a large volume change occurs with the conversion from β-alumina to α-alumina, it is thought this led to changes to physical properties and cracking.

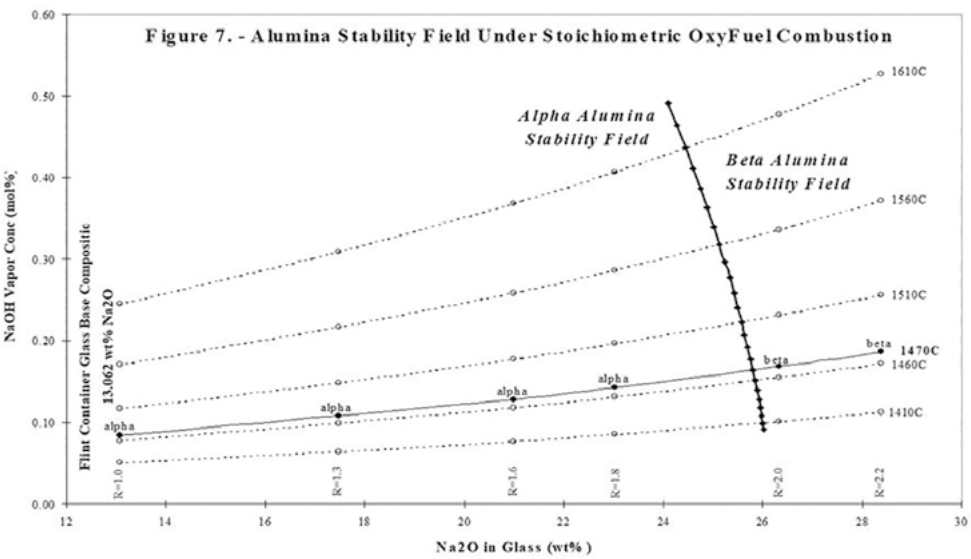

Figure 3: Stability of alumina in glass furnaces.

MB-C refractory solution

Following the damage to conventional αβ-alumina fused cast refractory, a new type of αβ-alumina fused cast refractory 'MB-C' was developed. Table 1 compares typical properties of MB-C and conventional αβ-alumina fused cast refractory. MB-C was optimised in α-β structure to prevent damage of refractory. ▸

		MB-C	Conventional αβ-alumina fused cast
Chemical composition /wt%	SiO_2	0.8	0.8
	Al_2O_3	96.5	95
	CaO	0.3	0.3
	Na_2O	2.0	3.5
Mineralogical composition /wt%	α-alumina	70	44
	β-alumina	29	55
	Glass phase	1	1
Physical properties	True specific gravity	3.70	3.54
	CCS(MPa)	250	200

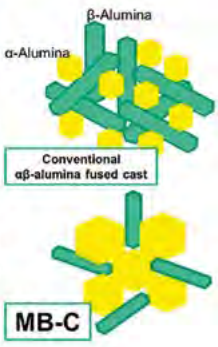

Table 1: Typical properties and αβ structure illustration of MB-C and conventional αβ-alumina fused cast refractory.

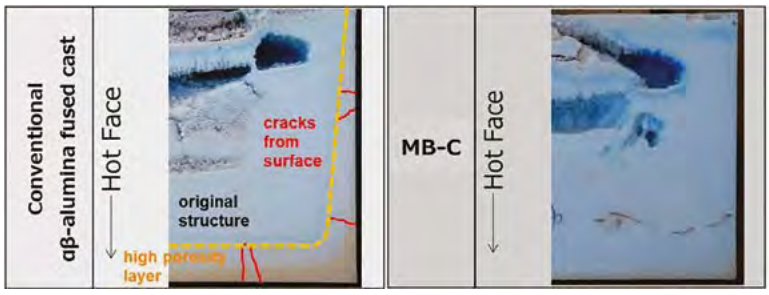

Figure 4: Cross sections of MB-C and conventional αβ-alumina fused cast refractory after two years.

Comparative analysis after two years' operation

MB-C was used for the crown of a soda-lime glass melting furnace for two years. Conventional αβ-alumina fused cast refractory blocks were also used next to the MB-C blocks. Figure 4 shows the cross section of the refractories. The apparent porosity and the amount of residual β-alumina measured in each 10mm of the samples from the inner surface to the outer side of the furnace were shown in Figure 5. SEM images of the cross section also show that the thickness of the alteration layer of MB-C (15mm) was half of the conventional αβ-alumina fused cast refractory (31mm) in Figure 6. The rate of residual β-alumina phase and change of porosity in the MB-C was smaller than that of the conventional αβ-alumina fused cast refractory.

The MB-C shows cross sections without cracks and smaller changes of physical properties compared with conventional αβ-alumina fused cast refractory. According to these results, MB-C can be expected to show higher durability in the crown of a glass melting furnace than conventional αβ-alumina fused cast refractory.

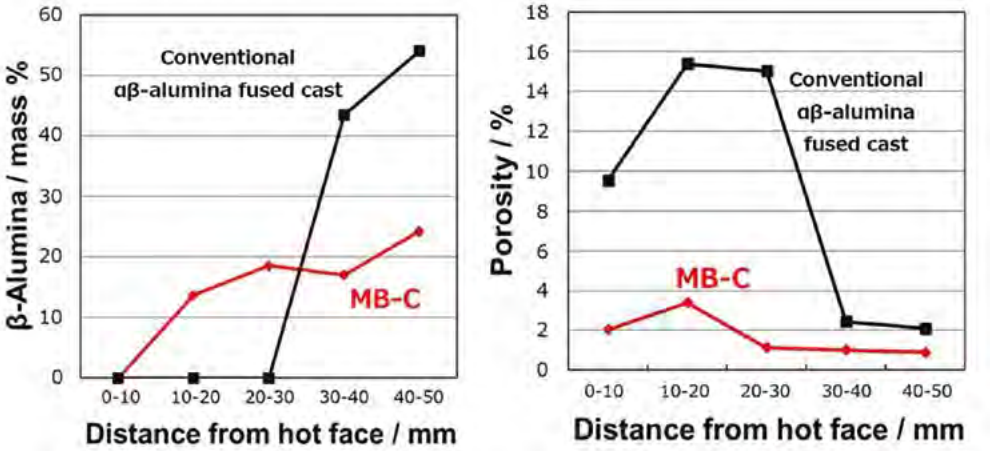

Figure 5: αβ-alumina amounts and porosity vs distance from hot face.

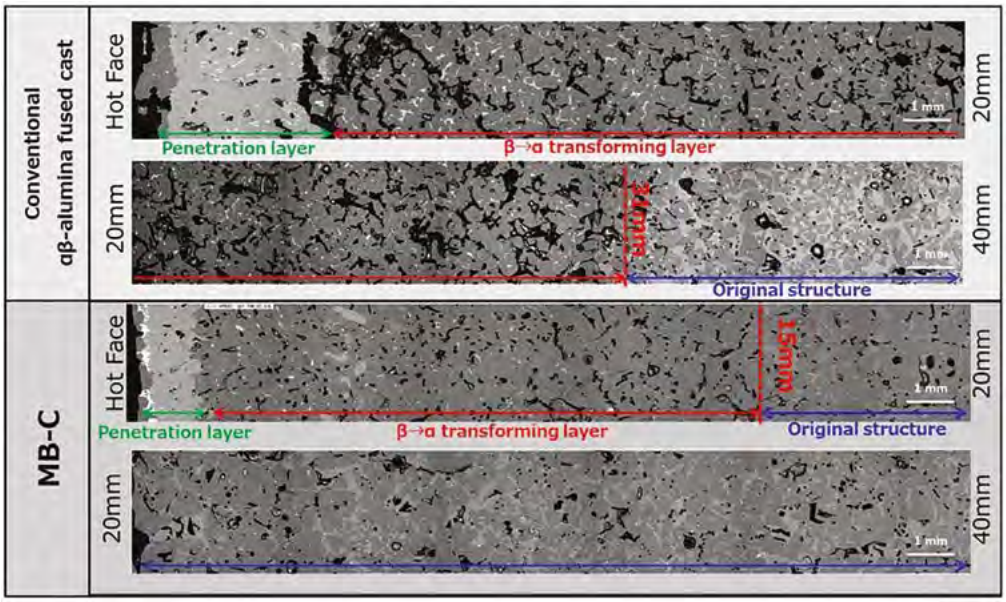

Figure 6: SEM image of cut surface near hot face of conventional αβ-alumina fused cast refractory and MB-C.

Conclusion

AGCC's MB-C αβ-alumina fused cast refractory shows better property in glass melting furnaces according to its αβ-alumina structure.

MB-C can be expected to show higher durability in the crown of a glass melting furnace than conventional αβ-alumina fused cast refractory. ●

Reference:

1. HT Godard, LH Kotacska, JF Wosinski, SM Winder, A Gupta, KR Selkregg and S Gould: Refractory Corrosion Behaviour Under Air-Fuel and Oxy-Fuel Environments, Glass Problems Conference, Columbus Ohio, 1996

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More data is a game changer

PaneraTech's continuous monitoring sensors for steel will soon be available for glass refractories. But IoT sensors and constant monitoring at critical locations will not replace regular check-ups just yet, explains Fred Aker.

After 10 challenging years of development at PaneraTech to solve the problem of using radar on extremely hot materials, SmartMelter was commercialised in 2017. In the summer of 2020, we eclipsed a half-million measurements. At the end of March 21, we were close to 724,000. By the time this article is published, we should break the one million milestone. What does more data mean for our clients?

Up to 2017, PaneraTech was a radar company. We would tell clients [their] remaining refractory thicknesses and it was up to them to figure out what that means. Now, through so much data including monitoring many furnaces over time, we tell our clients what maintenance actions they need to take and when to take them. Even more importantly, we are telling many clients what actions not to take. This enhanced data capability has been complemented by hiring glass furnace technical experts.

Currently, we send equipment, conduct an inspection, and repeat in six months to a year. We are only collecting data at each furnace block location for a few seconds per year. The future is a combination of full surveys and constant monitoring at critical locations using IoT (Internet of Things) sensors.

Continuous monitoring

SmartMelter has been successfully employing permanent sensors on furnace throats for over five years with zero failures. The driver at the time was cramped plant designs that allowed no access to the throats following construction. Since corrosion in glass furnace refractory occurs over time, no thought was given to continuous monitoring. This data is picked up periodically in a manual process.

Enter Polaris. We have developed a new generation of continuous monitoring sensors for steel. The application we are piloting has refractory life which is measured in days and weeks and not in years as in glass. Continuous monitoring is the only option in such applications.

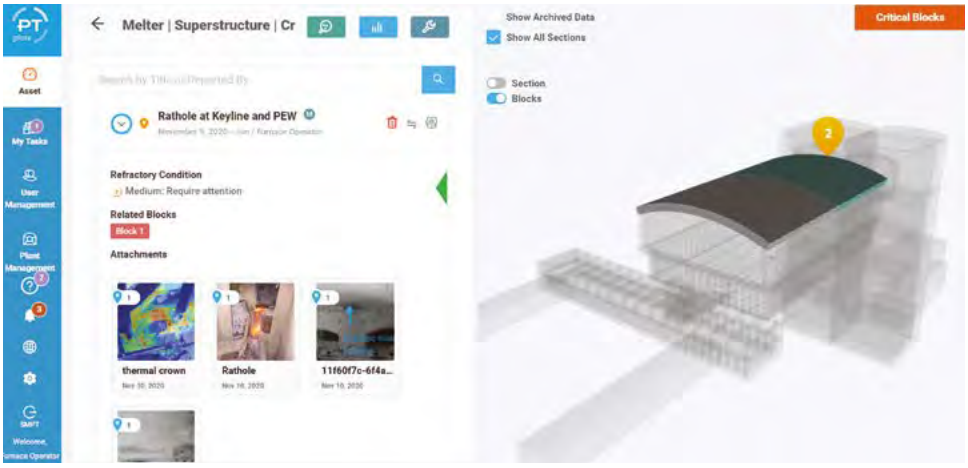
After this pilot is finished, we are going to move these new Polaris sensors into glass.

First generation permanent sensors.

Polaris advantages include:

- Lower cost sensors. Previously we were using our normal sensors for permanent installation tying them up for years at a time.
- Ability to install Polaris sensors in difficult to access areas during construction.
- Ability to continuously monitor high wear areas such as doghouse corners and throats.
- Production flexibility. As furnaces go hybrid or even full electric, there will be more electrodes to work around. For safety reasons, our portable sensors require short windows of turning off boost when collecting data adjacent to electrodes. While we work closely with plants, this can impact production. Polaris sensors can be placed permanently in these areas.
- Timing flexibility. We can install these sensors at construction for suspected high wear areas. These sensors can then be removed to overcoat and be placed back on the new materials. These sensors can also be installed on the fly if a hot spot is discovered or if a regular SmartMelter inspection detects a problem.
- Temperature flexibility. These new sensors will withstand constant temperatures of 1100°C. Measurements will no longer be limited to surface temperatures of 500°C.
- Material flexibility. Through getting more data, we hope to see through more materials including chrome overcoats. We already have good visibility on SEFPRO wool products and are working with major refractory suppliers to develop SmartMelter friendly patch materials.
- Deeper range. Having more data will allow us to see deeper and through additional materials where the data from our two second snapshot is marginal. Both into AZS materials and also through more insulation layers on the bottom. Even though our current sensor range allows us to see two years into the future on bottoms, clients are asking for more.

All of this adds up to situational flexibility. Currently we are looking for ideal conditions as we have two seconds to get our snapshot. In the future, instead of visiting clients annually, we will be touching them daily.



Screenshot from SmartMelter XSight Refractory Platform.

Enhancing regular inspections

What does more data offer? In other fields, constant data from cheap sensors are delivering amazing insights. Recently it has been determined that Fitbit watches sense and can track the effects of Long Covid.[1] This is done by comparing sleep and heart rate data before and after an infection. If Fitbit only had our current two-second window to collect data, it could never detect these effects.

Our mission is to stop abusive operating practices before they result in accelerated refractory wear or even worse, glass leaks.

So, will Polaris IoT sensors and continuous monitoring replace regular SmartMelter check-ups? The answer is no. These sensors will be in locations that make sense but cannot be everywhere on a furnace. Polaris will enhance regular SmartMelter inspections, not replace them.

Polaris sensors will be introduced to glass manufacturers at the end of 2021 as a subscription service with PaneraTech's data analytics engine analysing the data.

SmartMelter product roadmap

Many companies are choosing to use SmartMelter in the last third of a furnace campaign, especially when it comes to risk management and looking at lower sidewall insulation and furnace bottoms. PaneraTech has developed SmartAudit, aimed at mid-life furnaces to reach more furnaces in the second third of their life. This SmartAudit will enhance a current annual visual audit with limited SmartMelter data. During an annual audit, SmartMelter data will be collected at two points on each sidewall. This is not designed to find specific issues; this will give a general indication of how the furnace is performing against predicted wear. If there is a wide variance (positive or negative), then we will want to investigate why this is so. In addition, we will let SmartAudit clients take an additional 10 measurements in insulation areas that they choose. SmartAudits will be available through PaneraTech directly or through our partners.

Development continues on our SmartMelter XSight Refractory Platform. This is already being used to deliver all SmartMelter reports. For customers subscribing to the platform, they can use this to track all observations including visual, thermal, radar and endoscopic. By entering observations in a standard format, this will allow for later machine learning. Currently clients store data in different silos in different formats which do not allow the use of machine learning.

XSight platform's current machine learning capabilities are already being tested with major steel manufacturers in the US and we hope to make this capability widely available to the glass industry soon.

While a subject for another article, next year we will be enhancing superstructure audits. PaneraTech can be your trusted partner to monitor refractory wear from the regenerators through the forehearths. We call this EFM or Entire Furnace Monitoring. ●

SmartMelter and SmartAudit are registered trademark of PaneraTech Inc.

Reference

1. 'Fitbits Detect Lasting Changes After Covid-19', *New York Times* 7 July , 2021

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Prolific multi-tasker engaged in major projects

Indian furnace contractor Furnotherm has successfully undertaken the challenge of accomplishing several running projects, amidst the second wave of Covid-19, writes Jogendra Singh.

On 15 March Frigoglass in Nigeria started the expansion project of its 180tpd container glass furnace to make it a 300tpd Furnace, designed by HORN Glass, Germany. The job involved 645 tonnes steel erection and 3,000 tonnes refractories erection. In addition to that, Furnotherm had executed complete utility piping, total furnace cooling air ducts and nozzles, secondary air ducts and also the installation of the complete electrical and instrumentation job. Initially it was decided to execute this project in 120 days. Furnotherm made it possible to accomplish this project in a record time of 79 days (glass to glass). The first glass came out of Frigoglass' IS machine on 1 June 2021.

Flat glass factory

Furnotherm has also taken the prestigious project of constructing the first float glass plant at Uzbekistan, the green field project of Zarafshon Oyna LLC, designed and supplied by HORN, Germany. The job involves the total steel erection and the furnace refractories and tin bath. More than 80% of the jobs have been completed and the project will be completed soon.

Projects in India

Furnotherm teams are currently engaged in two major projects in India. The company has been contracted for PGP Glass's 250tpd container glass furnace greenfield project in Jambusar, Gujarat, India. The job involves the fabrication and erection of the complete batch house structure and raw materials silos along with the installation of all batch house equipment. Furnotherm is also responsible for the fabrication and erection of furnace steels and the erection of the furnace refractory, along with the installation of all the furnace equipment. The job entails 430 tonnes of steel and 3,500 tonnes of refractories. Furnotherm will supervise heat-up and expansion control. It will also fabricate and erect the cooling ducts and nozzles of the furnace and erect the secondary air ducts.

The second greenfield project is building a 180tpd container glass furnace for Sunrise Glass in Surat, Gujarat. Furnotherm will fabricate and erect furnace steels and erect the refractory for the furnace, plus install all furnace equipment. It will also fabricate and erect the cooling ducts and nozzles of the furnace.

Furnotherm has also taken on the task of rebuilding the 500tpd container glass plant of AGI Glaspac at Hyderabad. The job involves dismantling and reinstalling 4,100 tonnes of refractories.

Furnotherm is successfully managing all of these projects simultaneously in different parts of the world with its most competent teams of efficient manpower. The company is confident that it can undertake any major glass furnace construction project at any time. ●

Furnotherm prides itself on quality workmanship.

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Furnotherm specialises in the construction of various types of glass melting furnaces.

The competent Furnotherm team are well equipped to undertake major glass furnace projects in different parts of the world.

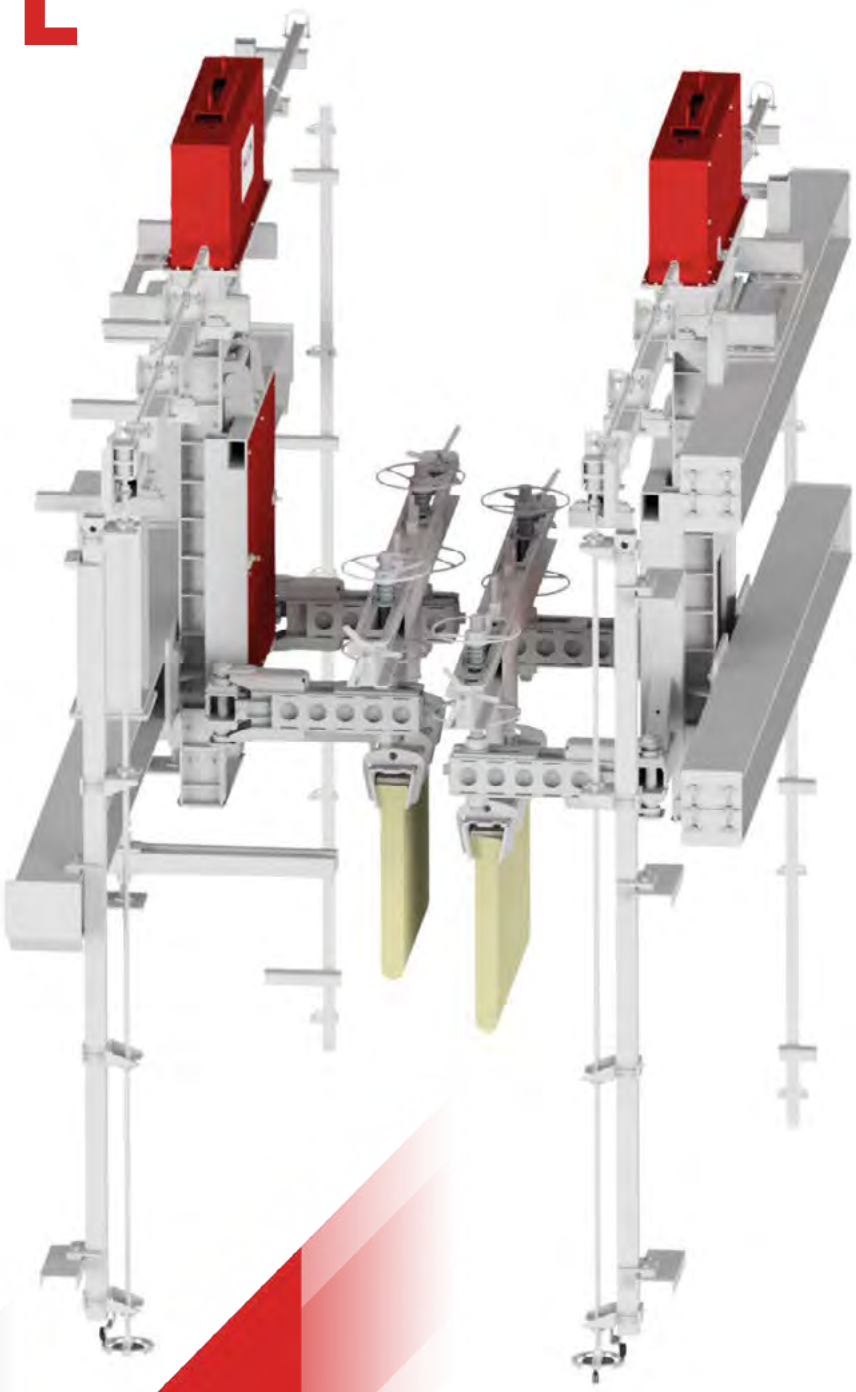
Several projects were successfully completed during the second wave of Covid-19.

TWEEL

SUSPENDED TWEEL

The tweel is one of the most important control instruments within a float glass production plant. It adjusts the flow of the glass melt from the furnace into the tin bath. The tweel can also be used to completely shut-off the glass flow.

The suspended tweel is installed on the tin bath support steel structure. The robust and highly innovative design of the suspended tweel ensures a stable and smooth operation providing all the benefits of a freely accessible spout area. Additional air cooling protects the electrical and mechanical parts from the high temperatures.



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Innovation meets quality

Shamvik Glasstech Pvt Ltd was quick to embrace Industry 4.0 for its IS machines, and the pioneering company has now partnered with Russian tech firm Sibir Telematics to provide advanced turnkey solutions for glass factories.

Shamvik Glasstech Pvt Ltd (SGPL) was founded in 1973 as Maul Eastern Limited, a JV with Maul Brothers USA with the goal of providing the most innovative IS machines built at world-class standards with an affordable price for its customers. Over the years the company has been involved in various technical partnerships with the top European IS machine manufacturers that reflect the latest technology contemporarily available.

Industry 4.0

While the early 2000s and 10s called for a gradual shift towards servo machines for less human interference and error, the last few years have ushered in Industry 4.0 to create an environment of inter-operability and connectivity between machines, which SGPL was quick to incorporate into its manufacturing abilities.

As a result, not only has SGPL integrated Industry 4.0 into its premises to ensure quicker delivery times but the company has also increased its serviceable range for more varied centre distance machines. This has enabled SGPL to offer brand-new IS machines at a price comparable to that of reconditioned machines.

A new era of efficiency

At the same time, SGPL has revived its reconditioned machinery vertical to ensure it is able to match not only the customer's machine configuration requirements but also offer a plethora of machinery that is suitable to customer budget/capital requirements. The company's relations with manufacturers around the world combined with its engineering prowess ensures that customers receive a reconditioned machine that rivals brand-new configurations.

The creation of a separate unit geared towards delivery equipment ensures that customers are able to receive complete sets promptly.

This decade will be characterised by the efficiency glass factories can achieve not only through their IS machine lines but from melt-to-pack as a whole, as the focus shifts to a forgotten aspect of lost revenue that has been further highlighted by the adverse effects of the Covid-19 pandemic.

SGPL has completed over 180 installations and turnkey projects worldwide over almost five decades.

Partnership with Sibir Telematics

Shamvik Glasstech Pvt Ltd has partnered with Sibir Telematics, an innovative company from the scientific and research-oriented region of Novosibirsk, Russa – to provide the most advanced turnkey efficiency solution to glass factories and overcome the challenges of integrating IS machines and the efficiency in achieving glass production in real-time.

This is one of many partnerships yet to be announced by SGPL with the aim of pairing industry-leading technology with cost-efficiency.

The 'Conveyer' solution is a tool, for shareholders and top management, that forms an objective picture of the current efficiency of production processes at the enterprise. Objective data is the basis for staging and monitoring the implementation of key performance indicators (KPIs) aimed at increasing production efficiency. For production workers, it is a tool that will help them achieve new KPIs through the use of the following functions:

- Analytics of downtime (type/reason) that provide module data in real time.
- A system of online notification for target events geared towards improving melt:pack ratio.
- For the management of the plant, the functions in demand are:
  - Formation of the balance of raw materials of the enterprise in real time, in a closed cycle format throughout the entire plant cycle.
  - Calculation of the percentage of waste from a clean charge.
  - Control of losses in all areas.

The solution has already proven its cost-effectiveness at the LLC Siberian Glass and Interglass factory, which is reflected in company's official press release for 2020.

The amount of additional profit generated at pilot plants has ensured an astounding payback period of only six months to one year, given that the plant is able to generate economic benefits immediately after the start of operation of the system. ●

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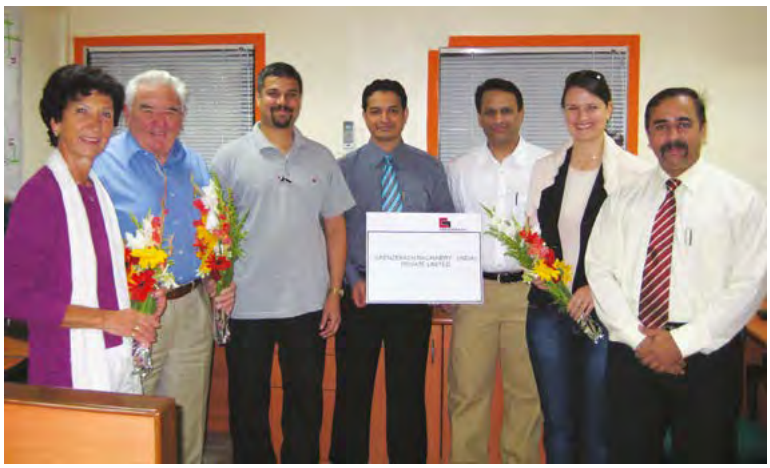
Solar glass for an ecological and economic upswing

India is currently pushing the development of renewable energies and looking to strengthen its economy further with the production of photovoltaic modules. A partner of the glass industry in India for decades, Grenzebach is supporting the solar power boom with innovative production technology for patterned glass.

India's economy has provided strong growth impulses in the last years. In the long term, experts expect a growth corridor of 4–8% for the economy. Almost 1.4 billion people live in India (the second-largest population after China) and the country, which stretches from the Indian Ocean to the Himalayas, is increasingly striving for economic independence from neighbouring states and has also set ambitious climate targets. Images of New Delhi smothered by smog are set to be a thing of the past; solar power instead of coal-fired power is the driver.

With its 'Incredible India' campaign, the subcontinent has been showcasing its diversity for several years now. The economic and ecological upswing is being intensively promoted by the Indian government. While around 75% of solar panels installed in India have so far been supplied by China, the amount of domestically-produced solar panels is expected to rise rapidly. The Indian government has added photovoltaic (PV) modules and battery storage for solar power to the list of the Production-Linked Incentive (PLI) schemes.



Maria and Rudolf Grenzebach (left), the company founder couple, and Sonja Grenzebach-Proeller (second from the right), today the main shareholder of the Grenzebach Group, visit experts at the Indian site in Poona. This archive photo is from 2007. Source: Grenzebach.

High demand for drawing and float glass

Photovoltaic applications (such as solar panels) require ultra-clear glass with high light transmission, a light-focusing structure and low light reflection. Drawing glass, also called patterned glass, meets these requirements.

"At the moment, we are seeing an increased demand for drawing glass lines because the patterned glass is used in PV modules. The production of float glass will also increase further in order to supply the automotive and construction industries with glass products, for example," explains Jan Lukassek, Senior Sales Manager in the Business Unit Glass at Grenzebach. Since 2005, he has been in regular contact with Indian partners and customers, advising on the design of glass manufacturing plants and supporting customers with his expertise through all communication channels until the start of production and beyond. "So far, compared to the country's population and growing economic strength, there are relatively few glass manufacturing plants in India. I reckon that around 70% of the current capacity and the now growing capacity will be used for products for the Indian market. The rest will be exported," he believes.

Supporting manufacturers in India

Grenzebach took its first step into India in 1996 with the installation of a stacking system at the cold end of an existing float glass line. In 2006 Grenzebach opened its own subsidiary in Poona in western India, around 50 miles from Mumbai. From there, Grenzebach employees maintain plants throughout India and also neighbouring countries. "The glass industry in India and in our neighbouring countries has gained great momentum since the Grenzebach team started a quarter of a century ago. Solving day-to-day issues together with our customers and also strategically supporting the companies is a great pleasure," says Prasanna Hedge, Managing Director at Grenzebach Machinery (India) Pvt. Ltd in Poona. As an example of this momentum, in 2009, the drawing glass line premiere in India took place together with Borosil Glass Works Ltd., in 2019 a second line was commissioned and in 2022, another two drawing glass lines for patterned glass will be installed for the newly founded company Borosil Renewables Ltd. Today, a total of six float glass lines from Grenzebach are in operation in India, with a daily capacity of almost 3,800 tons. With the two new plants at Borosil, four ▸

Producing for the energy transition: the second drawing glass line at Borosil was set into operation in 2019. Source: Grenzebach.

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drawing glass lines will then produce up to 1,000 tons of patterned glass per day.

Fine-tuning technology

In order to reduce CO_2 emissions and drive the energy transition forwards – improving the quality of air and thereby the quality of life for the people living in India's 28 federal states, protecting the environment and making a significant contribution to the international efforts for climate protection – the government is relying in particular on the power of the sun.

Grenzebach is prepared for the additional installation of drawing glass lines, which are specifically designed for the production of glass for photovoltaic modules. To meet the increasing demand for solar glass – currently also occurring in China – Grenzebach experts comprehensively revised the company's portfolio for drawing glass and added new technologies; a state-of-the-art product line.

Early adopter

Indian glass manufacturer Borosil anticipated the great demand for solar modules as early as 2009 and put its first drawing glass line into operation with a daily output of 180 tons per day. Another drawing glass line, commissioned in 2019, generates additional 240 tons per day. Borosil continues to expand to meet the increasing demand for drawing glass for PV modules as a result of the international energy transition. In 2022, a further two patterned glass lines will be installed, each with a daily output of 275 tons. They will be located in Bharuch in the federal state Gujarat.

Grenzebach took its first step into India in 1996 with the installation of a stacking system at the cold end of an existing float glass line. Source: Grenzebach.

Borosil Renewables Ltd., part of the international Borosil Group, has doubled its capacity in India for patterned glass to five gigawatts of photovoltaic modules by expanding in Bharuch. The company now meets about 40% of the demand for drawing glass on the domestic market. The remainder is imported from China and Malaysia.

"Investing in green power technology early on has proven to be the absolutely right strategy," states Ramaswami Velayudhanpillai from the Management of Borosil Renewable Ltd. "We knew that drawing glass for solar modules would be of great importance on the Indian market. We will resolutely continue going on this path. The investment in the two additional drawing glass lines is an important step so that we can meet the increasing demand and in addition expand this strategically important business."

The company is also exporting heavily. Borosil Renewables exports about 20% of its patterned glass to the USA and Europe – in particular to Germany, Spain, Portugal, Turkey and Russia.

New Borosil site in Bharuch

Flexibility in production is important to Borosil. Drawing glass for solar modules has a thickness of 1.6mm to 4mm. The formats of the glass sheets depend on the order but range within the parameters of 1–2m^2. "In the area of photovoltaic, bigger glass formats are on the rise. Borosil anticipated that already and the line is designed to allow maximum gross widths. This promotes flexibility," explains Jan Lukassek from Grenzebach. The maximum glass width is defined by the length of the structure roller. The two new lines each have three robots to stack the glass sheets at the line. Flexibility is also an important aspect of this: two single sheets can be picked simultaneously (double pick) or individually (single pick).

The cold end at Borosil's plant is supplied by Grenzebach; the annealing lehr by CNUD EFCO GFT. Following the motto 'from hot to cold', Borosil uses integrated solutions from a single source. With 300 systems installed worldwide, both Grenzebach and CNUD EFCO GFT have immense application knowledge. Together, they cover a large part of the subsections of a glass line and customers benefit from their joint expertise in the hot and cold areas.

Booming potential

Borosil, with its additional expansion, is one of the drivers of India's growing importance in the global energy transition. India has the potential to become an important hub for the enormous international demand for photovoltaic technology.

Although the Indian economy was hit by a slump as a result of the Covid-19 pandemic and the country will have to struggle with the effects of the pandemic for a long time, by 2030 India could become one of the top three economies in the world. The boom in renewable energies and the boom in glass production are significantly contributing to this. ●

(L–R) Pradeep Kheruka, Chairman of the Borosil Group and Jan Lukassek, Senior Sales Manager in the Business Unit Glass at Grenzebach with Sorab Singhal from DGM Glass Service at Borosil meeting at a solar exhibition in 2014. Source: Grenzebach.

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Getting back on track

One of the largest glass manufacturers in Pakistan, Tariq Glass Industries Limited was impacted directly by the Covid-19 pandemic in 2020. However, as Richard McDonough reports exclusively for *Glass Worldwide,* with plans for expansion back on track, the company has good reason to be confident of its outlook for 2021 and beyond.

Established in 1978, Tariq Glass Industries Limited (Tariq Glass Industries) is now one of the largest manufacturers of glass products in Pakistan, producing items such as glass tableware, float glass and glass containers. The company's brands include Toyo Nasic Glassware, Omroc Glassware, Nova Glassware and Tariq Float Glass.

"We have a diverse range of customers both internationally as well as domestically," stated Akbar Baig, Director Exports, Tariq Glass Industries. "For float glass, we supply to the construction industry, the automotive industry as well as the home appliances industry. In container-ware, we supply mostly to the beverage industry like Coca Cola and Pepsi along with other domestic manufacturers. For tableware, we supply to wholesalers, distributors and retail outlets in domestic as well as international markets."

Modern facilities are operated by Tariq Glass Industries Limited from its plant in Sheikhupura (near Lahore), Pakistan. Photo provided courtesy of Tariq Glass Industries Limited.

Expansion

The company started its float glass operations in 2013. According to a statement from the firm, "Tariq Float Glass has quickly established brand recognition not only in Pakistan, but in the international markets as well. This facility is capable of producing clear float glass ranging from 2mm to 13mm as well as 5mm tinted and reflective glass through an online CVD coating machine, along with sandblasted glass and aluminium coated mirrors."

Domestic sales are key for the firm, with international sales throughout the world. Both are anticipated to grow according to the firm.

"Our primary focus has been the domestic market," noted Mr Baig. "For this market, we have increased our float glass production from 550 tonnes per day to 1,050 tonnes per day by adding a second line in 2021. In addition, we will be increasing our tableware production facility in 2021 and 2022 by expanding the production capacity of our existing furnaces."

"We feel that with this increase in production, Tariq Glass Industries will be more than capable to cater to the growing demands of the domestic market," Mr Baig continued. "We also export to more than 40 countries worldwide, which include the Middle East, Europe, Africa, Far East, and Central and South American markets."

Sales and sustainability

From January through December of 2020, Tariq Glass Industries sold 212,141 tonnes of products. The value of these sales, according to the company, was 14,874,580,723 Pakistani Rupees or (US) $91,911,105. (Please note that exchange rates are subject to change. The dollar amounts listed in the news column are based on 161.8366 Pakistani Rupees per US Dollar.) ▸

Tariq Glass Industries utilises equipment from Yaohua Glass Group Co. Ltd, China to process float glass in Pakistan. Photo provided courtesy of Tariq Glass Industries Limited.

H-28 tumblers in the process of being manufactured by Tariq Glass Industries. Photo provided courtesy of Tariq Glass Industries Limited.

Started in 2013, the Tariq Float Glass facility is capable of producing clear float glass ranging from 2mm to 13mm. Photo provided courtesy of Tariq Glass Industries Limited.

Finished goods stock of tableware manufactured by Tariq Glass Industries ready for shipment to customers in Pakistan and abroad. Photo provided courtesy of Tariq Glass Industries Limited.

By comparison, during calendar year 2019, Tariq Glass Industries sold 189,168 tonnes of products. Sales amounted to 15,137,069,000 Pakistani Rupees or (US) $93,533,039. During calendar year 2018, Tariq Glass Industries sold 196,207 tonnes of products. The product sales amounted to 13,689,558,533 Pakistani Rupees or (US) $84,588,768.

Sustainability has been and is anticipated to continue to be a major component of the operations of Tariq Glass Industries. According to Mr Baig, "We recycle glass in our furnaces so that our products contain 30% recycled glass."

Impact of Covid-19

As with other global companies, external forces have affected operations of Tariq Glass Industries during 2020.

"The Covid-19 pandemic caused a significant and unprecedented curtailment in economic and social activities due to the lockdown measures introduced by various governments around the world," explained Mr Baig. "This resulted in a slowdown in the company's production, sales and operations."

Mr Baig noted some specific impacts caused by the Covid-19 pandemic: "A decline in company revenue by almost 40% in the last financial quarter. Heavy expenditure incurred to implement Standard Operating Procedures as advised by the government to prevent, detect, and control the Pandemic. A delay in the commissioning of the company's expansion project of float glass due to travel restrictions."

Beyond the repercussions of the Covid-19 pandemic, energy expenses have also had a bearing on operations of glass manufacturing companies.

"The increase in energy costs, which account for approximately 40% – 45% of total manufacturing costs, has resulted in a significant decline in the profit margins of the domestic industry," detailed Mr Baig.

External forces are anticipated to continue to have some impact on the glass industry as well as overall life in Pakistan.

"Covid-19 continues to play a part in our projections," stated Mr Baig. "With the government-driven vaccination programmes across the country, we are hopeful that businesses will continue their journey towards normalcy in 2021. The effect of currency devaluation remains a factor as it impacts our costs of production and transport. Shortages in shipping containers and increases in ocean freights have slowed down exports. Government-sponsored housing projects are seen to be reviving the construction industry."

Projected growth

"We are optimistic about the outlook in 2021," said Mr Baig. "With a decrease in the rate of [Covid-19] infections globally, markets are opening, which has resulted in an increase in sales both domestically as well as internationally (compared to 2020). Our expansion projects, which had been delayed are now on track and we are hopeful that economic activities will get back to normal and efficiency levels will be achieved." ●

Tableware tumblers being processed by Tariq Glass Industries utilising equipment manufactured in Europe and China in Pakistan. Photo provided courtesy of Tariq Glass Industries Limited.

Sheets of float glass manufactured by Tariq Glass Industries are packed and ready for shipment to customers in Pakistan and abroad. Photo provided courtesy of Tariq Glass Industries Limited.

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The Brazilian post-pandemic recovery

Lucien Belmonte shares an overview of the Brazilian glass industry's experience of the Covid-19 pandemic and evaluates the challenges to stay competitive going forward.

Lucien Belmonte, CEO of Abividro – the Brazilian Association of Glass Industries.

The year 2020 certainly was challenging to the Brazilian glass industry. The unpredictability consequent to the pandemic brought up a scenario of extreme uncertainty, which demanded different experiences and perspectives in the search for solutions

From the beginning of the pandemic the worries were obviously extreme, due to the lack of a contingency plan for this entirely uncommon situation, but also because of concerns on the legal labour field, tax considerations and other important issues for the sector's financial health: how would lockdowns work? What can be considered essential work? What to do with idleness?

Before the increase in household consumption, bars and restaurants accounted for the majority of the returnable packaging market.

Early days

The first few days were filled with discussions so that the glass manufacturing plants were considered as an essential activity, being able to keep operating amidst the quarantine periods. We've shown the government the sector's peculiarities, since an activities' shutdown would cause the equipment to suffer irreversible damage.

The first few months led the industries to slow down their production – with hot hold operations or crushing mode, exceptional and yet essential means to preserve industrial equipment. At the same time, the clients were gone since they had used up all their stocks and didn't buy anything else from factories.

We had a supply and demand imbalance, but from the beginning of June the orders were increasingly renewed. To supply full stocks to the factories and clients and simultaneously meet the volume of lost products demanded some time before going back to normality.

Since the US dollar rules the costs of imported soda ash, of natural gas and the power readjustment rate, these had a 45% financial increase in 2020. Because all these obstacles arose at the same time, we were constantly challenged. The financial increase in the costs were brutal.

Changing habits

Fortunately, 2021 began with a fairly strong demand, so we were able to take up our pre-pandemic economic activity level. A noticeable change we could witness during this period was in the construction sector, which had a major growth due to the refurbishing and construction of new buildings. With the restrictive measurements, people started to work and study remotely, deciding to invest in improving their home environment, which naturally increased the demand for flat glass.

On the other hand, the automotive industry had significant decline, the biggest drop in the last four years, with a production of less than two million automobile units.

The refurbishment and construction of new buildings ensured major growth in the construction sector.

For the glass packaging sector, the change in the consumer profile was also relevant. With restrictions in movement and travel shrinkage, alongside the government payment of an emergency aid, that helped the economy heat up, there was a high demand for beverage packaging, due to the increase of household consumptions – previously bars and restaurants accounted for the majority of the returnable packaging market.

Keeping the industry competitive

Looking at 2021 and going forward, the challenge is in cost control, maintaining the industry's competitiveness in a time when the US dollar had a 15% decrease in value. The future is, in spite of troubled seas, promising. The economic growth expectation for 2021 is up to 5%.

As a result of changes in the consumption profile and the economic changes, the glass industry will continue to have a moderate expansion.

With a well-performing, renewed industrial complex, the industry is prepared for the international competition and the environmental issues that prevailed since the beginning of the pandemic. It's worth noting that the Brazilian energy matrix is essentially green, with the huge potential offered by hydroelectric, solar, aeolian [wind] and biomass sources. We could offer the most suitable products to meet international environmental demands. We're at the forefront of technology – ready for the industry's constant renewal and investments taking place here.

Looking to the future, the Brazilian market balances opportunities and challenges: opportunities in this demanding and increasing market and challenges in managing a daily routine with obstacles and course changes. ●

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Trade in the South American glass industry

Exports and imports are vital for the glass industry in a number of South American nations. Richard McDonough reports on market activity in Brazil, Colombia, Peru, Chile and Argentina.

Trade is critical to the glass industry in South America. While much of the trade in glass and glassware products is domestic, several countries on the continent rely on imports from other nations throughout the world. A few South American countries also export large quantities of glass and glassware products regionally as well as globally.

With two exceptions, import and export statistics for glass and glassware products for 11 of the 13 countries on the South American continent are detailed in this column: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, and Uruguay. The two exceptions are French Guiana and Venezuela. Unless otherwise stated, statistics detailing imports and exports of glass and glassware products to and from South American countries are from reports issued by the International Trade Centre.

Stats were available for 2020 and the preceding four years for the 11 nations except for Ecuador and Suriname; statistics were available for 2019 and the preceding four years for those two countries. Information was not available for Venezuela after 2013. Statistics for French Guiana were included in the overall report for France globally; including all of French imports and exports of these glass products would not present an accurate view of the South American trade situation.

The President of Colombia, Iván Duque Márquez, visited the glass manufacturing plant of Tecnoglass at its headquarters during the Inter-American Development Bank (IDB) Annual Meeting held in Barranquilla, Colombia, earlier in 2021. President Iván Duque stated, "Tecnoglass is an example of excellence which has been shown in the way it has been able to penetrate a very strict and high-quality US architectural glass market. We are proud and encouraged by its growth trajectory and by how it has become a standard for a Company that manufactures high quality, high value-added products and that has become an international leader in the industry. We are also proud about its efforts to help its employees and surrounding communities during a very difficult period." Photo provided courtesy of Tecnoglass, 19 March 2021.

AGC Brasil operates a large facility in the city of Guaratinguetá, São Paulo State, Brazil. The company has two floats at this site, with a production capacity of 1,450 tonnes of flat glass per day. The land area is about 750,000m², and buildings cover 150,000m². Glass produced by AGC Brasil is mainly for the civil construction and automotive industries. Photo provided courtesy of AGC Brasil.

Overview

Comparatively-speaking in the global marketplace, nations in South America have not been generally been major markets for the ten largest exporters of glass and glassware products globally. Brazil was ranked 19th among the export markets for China, the largest exporter of glass and glassware products worldwide in 2020. Among South American countries, only exports to Brazil – at 1.4% of total exports – represented more than 1% of Chinese exports of glass and glassware products in 2020. Chile was ranked 32nd, Peru was 37th and Colombia was 39th among export markets for China.

Hong Kong, part of China, was listed separately for statistical purposes; it was the sixth largest exporter of glass and glassware products in the world in 2020. Argentina was ranked as the 33rd largest export market for glass and glassware products from Hong Kong, Chile was 39th, Peru was 40th, Brazil was 43rd and Colombia was 48th.

While the individual South American national markets were not large given

the size of the overall Chinese export market for glass and glassware products, China ranked high in the value of exports to a number of South American countries. In 2020, China was ranked as the largest source of glass and glassware products imported into Bolivia, Brazil, Chile, Colombia, Guyana, Peru, and Uruguay. China also ranked as the second largest source of glass and glassware products imported into Argentina, and the third largest source of these products imported into Paraguay in 2020. China ranked as the largest source of these products imported into Ecuador and Suriname during 2019. Hong Kong ranked as the ninth largest source of glass and glassware products into Paraguay in 2020.

Six of the countries in South America were among the 50 largest export markets for glass and glassware products from the US in 2020. Brazil was ranked as the 18th largest export market for the US, Colombia was 27th, Chile was 37th, Peru was 39th, Argentina was 41st and Ecuador was 50th. The US is the second largest exporter of glass in the world.

As with China, while the individual countries in South America were not substantial export markets for the US, the US itself ranks high as a source of glass and glassware products imported to nations on this continent. In 2020, the US was the second largest source of these products imported into Chile; the third largest source for Brazil, Colombia, and Peru; the fourth largest source for Argentina; the fifth largest source for Guyana; the sixth largest source for Paraguay; the seventh largest source for Uruguay; and the ninth largest source for Bolivia. In 2019, the US was the third largest source for Ecuador and the fifth largest source for Suriname.

European nations were the third, fifth, eighth, ninth and 10th largest exporters of glass and glassware products – Germany, the Netherlands, Italy, France and Belgium, respectively – on the global stage in 2020.

For German exports, only Brazil was among that country's 50 largest export markets; Brazil was ranked at number 32. Germany was the fourth largest source of glass and glassware products imported into Brazil, the fifth largest source for Chile, the sixth largest source for Argentina and Uruguay, the seventh largest source for Paraguay and Peru, and the ninth largest source for Colombia in 2020.

Only Brazil (at number 25) and Suriname (at number 50) were among the 50 largest export markets for the Netherlands in 2020. This country was the second largest source of glass and glassware products imported into Suriname in 2019, and the 10th largest source for Guyana in 2020.

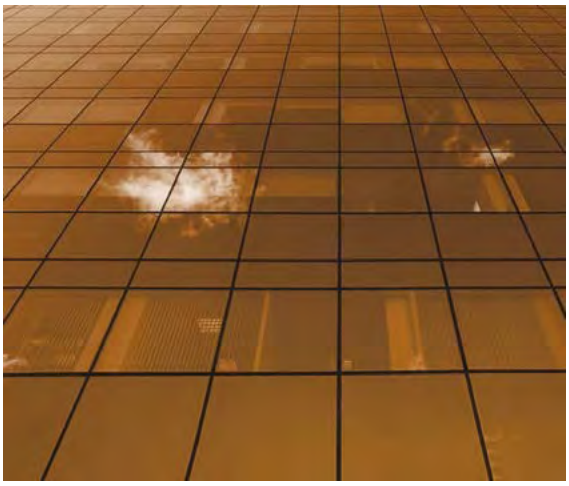
Brazil was the only South American nation ranked among the 50 largest export markets for Italy (ranked as that nation's 28th largest export market) in 2020. In the preceding year, Italy was the fifth largest source of glass and glassware products imported into Ecuador, while in 2020, this nation was the ninth largest source for Brazil and Peru as well as the tenth largest source for Argentina.

Brazil was also the only country on this continent that ranked among the 50 largest export markets for France (ranked at 30th) in 2020. The French nation was the sixth largest source of glass and glassware products imported into Ecuador and the eighth largest source for Suriname in 2019. France was the seventh largest source of these products imported into Brazil, the eighth largest source for Argentina and Colombia, the ninth largest source for Chile and Guyana, and the tenth largest source for Uruguay in 2020.

Three South American countries were among the 50 largest export markets for Belgium in 2020: Brazil, at number 15; Chile, at number 46; and Peru, at number 47. In 2020, Belgium was the 10th largest source of glass and glassware products imported into Brazil, Chile and Peru.

In 2020, two other Asian nations were among the world's largest exporters of glass and glassware products – Japan at number four and South Korea at number seven. For Japanese exports of these products, Brazil was the 42nd largest market; ▸

SCHOTT Brasil Ltda, Itupeva manufactures a variety of vials, ampoules, cartridges, droppers pipettes and other products. This is one of three facilities operated by SCHOTT in Brazil. More than 1,000 employees produce pharma tubing, pharma packaging and flat glass (for home appliances) at these Brazilian facilities. Photo provided and copyrighted by SCHOTT.



SunGuard Amber is produced at the Guardian Glass plant in Porto Real, Rio de Janeiro State, Brazil. According to a statement from Guardian Glass, "… The glass blocks 54% of the heat, allows 44% of sunlight to enter the internal environment, and has external reflection rates of 14% and internal reflection of 12%." (SunGuard Amber is a registered trademark of Guardian Glass.) Photo provided by Guardian Glass, 10 June 2021.

Chile, 44th; Argentina, 48th; and Colombia, 50th. Japan was the 10th largest source of glass and glassware products imported in Bolivia in 2020.

For South Korea, Brazil was number 16 among export markets for these products, Colombia was number 36, and Argentina was number 43. South Korea did not rank as a top ten source of glass and glassware products imported any of the South American nations in 2020.

Several countries outside of South America – not in the top 10 exporters of glass and glassware products globally – ranked as among the largest sources of these products imported into this continent in 2020. These nations include Costa Rica, ranked as the second largest source for Guyana; Malaysia, ranked as the second largest for Peru, the sixth largest for Bolivia, and ninth largest for Ecuador (in 2019); Trinidad and Tobago, ranked as the fourth largest for Guyana and Suriname (in 2019); and Mexico, ranked as the fourth largest for Chile, Ecuador (in 2019), and Guyana; the fifth largest for Argentina; the sixth largest for Peru; and the ninth largest for Uruguay.

Also in 2020, India ranked as the fifth largest source of glass and glassware products for Brazil, the sixth largest source for Colombia, and the ninth largest for Argentina; Spain ranked as the sixth largest source for Chile, the eighth largest for Uruguay, and the tenth largest for Colombia; the United Kingdom ranked as the sixth largest for Guyana; Denmark ranked as the seventh largest for Guyana; the Czech Republic ranked as the eighth largest for Bolivia and Brazil; Guatemala ranked as the eighth largest for Guyana; Panama ranked as the eighth largest for Chile and the ninth largest for Suriname (in 2019); the United Arab Emirates ranked as the eighth largest for Paraguay; Indonesia ranked as the 10th largest for Paraguay; and Turkey ranked as the tenth largest source for Suriname (in 2019).

As for glass and glassware products exported from South America, Brazil is – and has been – the largest exporter of these products among South American nations for the past five years. During 2020, other large exporters of these products – ranked in order of the value of the exports – were Colombia, Peru, Chile, and Argentina. In 2019, Argentina was ranked higher than Chile for these exports.

Detailed information on the five largest South American exporters of glass and glassware products follows.

Brazil

While Brazil is by far the largest exporter of glass and glassware products among the countries of South America, exports of these products from this country have been in decline for the past three years. Each of the top 10 markets for Brazilian exports of these products, with one exception, was located in the Western Hemisphere; the one exception was a European nation.

In 2016, Brazil exported (US) $269,986,000 worth of these products. The amount increased to (US) $275,976,000 in 2017. From that year forward, though, Brazilian exports of glass and glassware products have decreased annually. In 2018, the amount was (US) $258,265,000; in 2019, it was (US) $204,686,000; and in 2020, it was (US) $191,801,000.

Argentina has retained its spot as the top export market for Brazilian glass and glassware products during the past five years, although as with the overall export declines from Brazil, its purchases have declined in each of the past three years. In 2016, Brazil exported (US) $87,945,000 worth of glass and glassware products to Argentina; it was (US) $101,708,000 in 2017, (US) $86,016,000 in 2018, (US) $65,088,000 in 2019, and (US) $56,664,000 in 2020.

Mexico, the US, and Colombia each ranked as a top export market for Brazilian glass and glassware products since 2016. Other than 2019, Mexico and the US were each ranked either as the number two and three export markets for Brazil for these products with Colombia in the number four position; in 2019, Colombia was the number three export market, while Mexico took the fourth place spot in that year. The amounts exported to each of these three nations were ▸

Float glass in the process of being produced at AGC, in Guaratinguetá, São Paulo State, Brazil. Photo provided courtesy of AGC Brasil.

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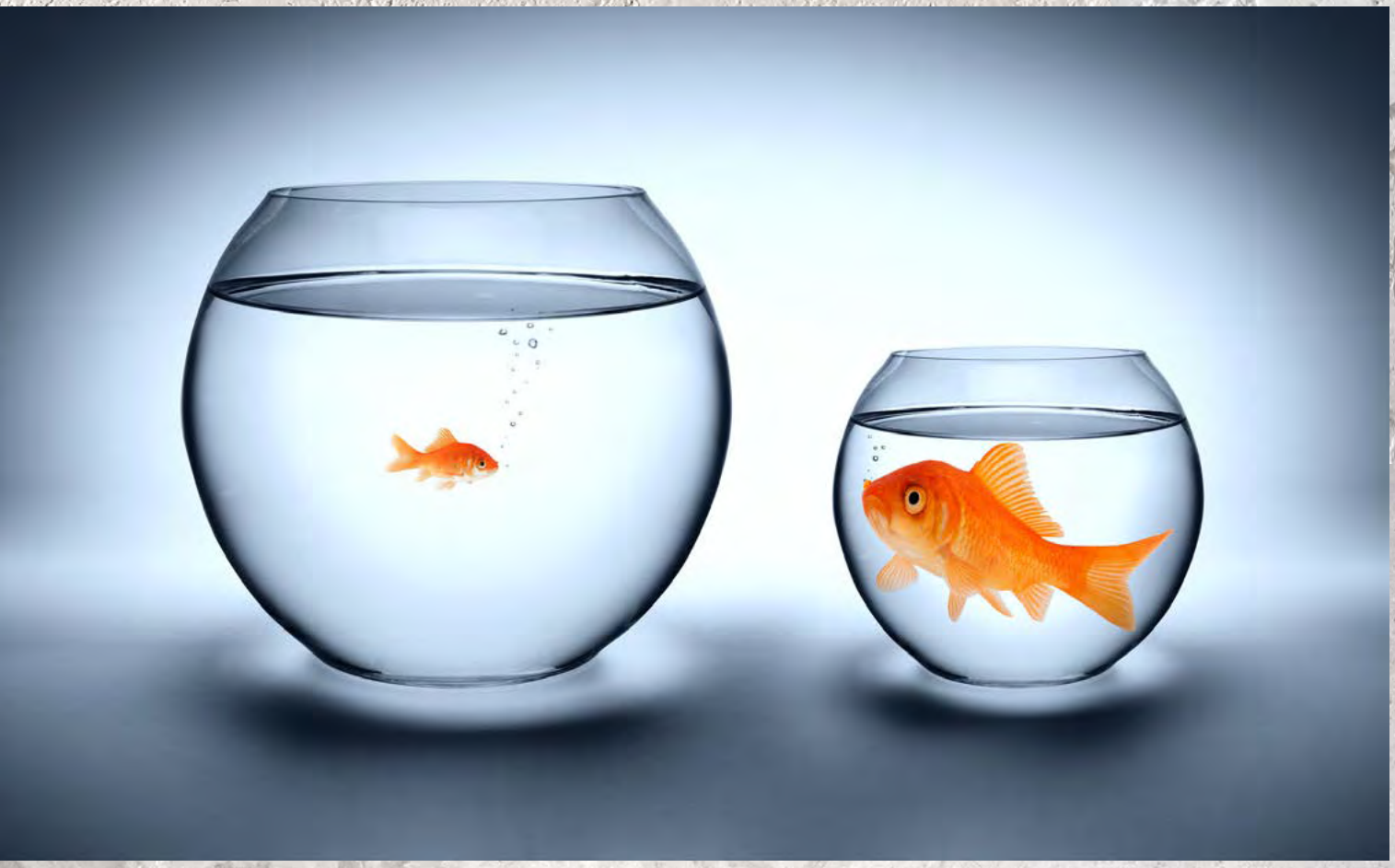

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The sun reflecting in the glass of the Gran Torre Santiago, Costanera Center in Santiago, Chile. This glass encased structure is the tallest building in South America. Photo provided courtesy of Deensel via Flickr, 1 January 2018.

lower in 2018, 2019 and 2020 than in 2016. Brazil exported (US) $25,490,000 of glass and glassware products to Mexico in 2020, (US) $21,691,000 to the US in 2020, and (US) $13,508,000 to Colombia in 2020.

Rounding out the top 10 export markets for these products from Brazil in 2020 were Paraguay, (US) $11,308,000; Chile, (US) $8,386,000; Uruguay, (US) $6,311,000; Belgium, (US) $4,502,000; Bolivia, (US) $3,751,000; and Peru, (US) $3,227,000. Unlike the situation with the eight other export markets for Brazil for these products, exports of glass and glassware products to Paraguay and to Belgium were higher in 2020 than in 2016.

A glass filled with Inca Kola, a favourite drink in Peru and elsewhere in South America. Photo provided courtesy of Letícia Castro via Pixabay, 11 December 2009.

Colombia

Colombia was the second largest exporter of glass and glassware products among the countries of South America in 2020. Substantial amounts of these products were exported by Colombia to two North American countries. Four South American nations, two Central American countries and two island states in the Caribbean Sea were also included in the top 10 export markets for Colombia.

In 2020, Colombia exported (US) $135,515,000 worth of glass and glassware products. This level of exports was the lowest amount during the past five years. The peak years for exports of these products from Colombia were in 2016 – (US) $177,402,000, and 2018 – (US) $177,306,000.

The US has been the prime export market for Colombia for its glass and glassware products. Exports to the North American nation were valued at (US) $71,736,000 in 2020, (US) $64,043,000 in 2019, (US) $66,111,000 in 2018, (US) $84,473,000 in 2017 and (US) $95,950,000 in 2016. These amounts represented more than 37% of all Colombian exports for these products in 2018 compared to more than 54% of all of these products exported from Colombia in 2016.

Mexico has been the second largest market for glass and glassware products from Colombia for the past five years. The amount of these products exported from Colombia to Mexico was valued at (US) $13,417,000 in 2020. The highest value of exports of these products – (US) $20,027,000 – to Mexico took place in 2018, while the lowest level was in 2016 – (US) $12,877,000.

Markets ranked three to 10 for Colombia exports of glass and glassware products, respectively, were each valued at less than (US) $10 million in 2020: Peru, (US) $9,396,000; Ecuador, (US) $9,103,000; Brazil, (US) $5,953,000; the Dominican Republic, (US) $4,530,000; Chile, (US) $3,946,000; Jamaica, (US) $2,989,000; Guatemala, (US) $1,738,000; and El Salvador, (US) $1,454,000. Exports to Brazil, Jamaica and El Salvador were higher in 2020 than in 2019, while exports to Brazil and El Salvador were also higher in 2020 than in 2016. All of the other markets saw decreases in exports of these products from Colombia in both 2016 and 2019 compared to levels attained in 2020.

Peru

In 2020, Peru was number three among the countries of South America in terms of exports of glass and glassware products. This nation has a diverse set of export markets, including substantial sales to the US as well as to neighbouring countries, two island nations in the Caribbean Sea, and the UK.

In 2020, Peru exported (US) $75,578,000 in glass and glassware products; in 2019, (US) $93,705,000; in 2018, (US) $90,073,000; in 2017, (US) $118,890,000; and in 2016, (US) $113,240,000. Exports to the US in the amount of (US) $21,223,000 represented a low of 22% of the overall exports from Peru in 2019, while exports in the amount of (US) $67,124,000 to the US represented a high of 56% of the total exports of glass and glassware products in 2017.

Both the Dominican Republic and Colombia were also key export markets for Peru. These two nations ranked as numbers two and three for these types of export products for the past five years. The volume, though, has varied through the years. Glass and glassware products exported from Peru to the Dominican Republic were (US) $16,841,000 in 2016, (US) $12,816,000 in 2017, (US) $19,383,000 in 2018, (US) $16,048,000 in 2019 and (US) $12,247,000 in 2020. In the case of Colombia, the amounts were (US) $12,417,000 in 2016, (US) $11,245,000 in 2017, (US) $10,889,000 in 2018, (US) $25,421,000 in 2019 and (US) $10,060,000 in 2020.

Exports of glass and glassware products to the UK from Peru have increased more than tenfold during the past five years – (US) $365,000 in 2016 to (US) $4,174,000 in 2020. Increases in exports have also occurred from 2016 to 2020 to other countries, although some have seen ups and downs in individual years. Among those nations were Bolivia, Jamaica, Mexico, Chile and El Salvador. Peruvian exports to Ecuador increased from 2016 to 2018 but then decreased through 2020; amounts went from (US) $2,414,000 in 2016 to (US) $1,689,000 in 2020. ▸

Workers at AGC Automotive in the Adding Value Operation area, which adds fixing accessories to the plain automotive glass with respect to specific customer projects. Photo provided courtesy of AGC Brasil.

Chile

Among South American countries, Chile ranked as the fourth largest exporter of glass and glassware products in 2020. While the amounts of exports from 2016 through 2019 were within a certain range, exports increased substantially from 2019 to 2020. That coincided with a large increase in exports to one specific country – the US.

In 2020, Chile exported (US) $64,765,000 of these products. In the preceding four years, the amounts were (US) $45,535,000 in 2016, (US) $48,650,000 in 2017, (US) $45,283,000 in 2018, and (US) $48,099,000 in 2019. Exports to the US were only (US) $1,515,000 in 2016; in 2020, exports to that North American country were valued at (US) $23,548,000. The amounts for the years in between were (US) $3,517,000 in 2017, (US) $3,255,000 in 2018 and (US) $7,849,000 in 2019. The US represented about 3% of the total export market for glass and glassware products from Chile in 2016; five years later, in 2020, the US represented more than 36% of the export market for Chile.

Other important export markets for Chile for these products were Argentina, Peru and Brazil. Mexico, on the other hand, has steadily declined in importance in exports from Chile. Exports to that North American country have decreased by about half during the past five years. In 2016, (US) $7,330,000 worth of glass and glassware products were exported to Mexico from Chile; in 2017, (US) $6,840,000; in 2018, (US) $5,510,000; in 2019, (US) $3,862,000; and in 2020, (US) $3,635,000.

Additional top 10 markets for exports of glass and glassware products from Chile included Uruguay, Bolivia, Panama, Ecuador and Colombia.

Argentina

Argentina ranked as the fifth largest exporter of glass and glassware products during 2020. Exports of glass and glassware products from this South American country increased from 2016 through 2019, with exports more than doubling from 2018 to 2019. Yet, in 2020, exports dropped by more than half to just less than the amount in 2018. In 2016, these exports were valued at (US) $31,300,000; in 2017, (US) $33,961,000; in 2018, (US) $36,824,000; in 2019, (US) $78,003,000; and in 2020, (US) $35,128,000.

Please note that the statistics detailing exports of glass and glassware products from Argentina have a few unusual aspects compared to other South American countries. No specific nations were listed for about 35% of these exports in 2020, 17% in 2019, and 38% in 2018.

During 2018, 2019, and 2020, 'Area NES' (Not Elsewhere Specified) was ranked either as the largest or the second largest location where these products were exported from Argentina. According to the International Trade Centre, 'Area NES' is territory not specified by the national authorities. For Argentina, it is an important partner due to the new statistical law that serves for confidentiality of trade flows. In 2016, (US) $1,000 of these products were exported to Area NES; in 2017, (US) $0; in 2018, (US) $14,108,000; in 2019, (US) $13,447,000; and in 2020, (US) $12,318,000. In terms of rankings, Area NES was the second largest recipient of exports of these products from Argentina in 2018 and the third largest export market for Argentina in both 2019 and 2020.

In addition, please note that while there was only (US) $1,000 in exports and zero exports from Argentina to Area NES in 2016 and 2017 respectively, there was (US) $203,000 in exports of glass and glassware products to 'Free Zones' in 2016, and (US) $149,000 in 2017. The International Trade Centre defines 'Free Zones' as locations that '…belong to the geographical and economic territory of a country but not to its customs territory. For the purpose of trade statistics, the transactions between the customs territory and the free zones are recorded. Free zones can be commercial free zones (duty free shops) or industrial free zones.'

Given that statistical background for Argentina, the information that follows is as detailed as possible.

Brazil has steadily grown as an export market for Argentinian glass and glassware products. In 2016, Brazil accounted for more than 13% of the exports of these products from Argentina. In 2017, Brazil accounted for more than 23% of the exports from its neighbour; in 2018, it was more than 31%; and in 2019, it was more than 70%. Even with the decline from 2019 to 2020, Brazil accounted for more than 56% of the exports of glass and glassware products from Argentina.

While exports from Argentina to Brazil have grown, exports to other neighbouring countries have decreased substantially during the past five years. In 2016, the value of the exports of glass and glassware products from Argentina to three countries – Paraguay, (US) $8,158,000; Uruguay, (US) $6,187,000; and Chile, (US) $4,553,000 – were each larger than the value of exports to Brazil – (US) $4,263,000. In 2020, exports from Argentina to Brazil were (US) $19,698,000; to Uruguay, (US) $2,486,000; to Paraguay, (US) $536,000; and to Chile, (US) $12,000. ●

Expansion continued during 2021 at Vidriería Argentina SA (Vasa), a subsidiary of NSG/Pilkington, in Exaltación de La Cruz, Buenos Aires State, Argentina. The scheduled start date of operations for this facility is projected to be April 2022. Photo provided courtesy of Abravidro – the Brazilian Association of Flat Glass Distributors and Processors, 28 April 2021.

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Richard McDonough is a civic journalist based in the USA. He writes on a variety of topics in the glass industry.

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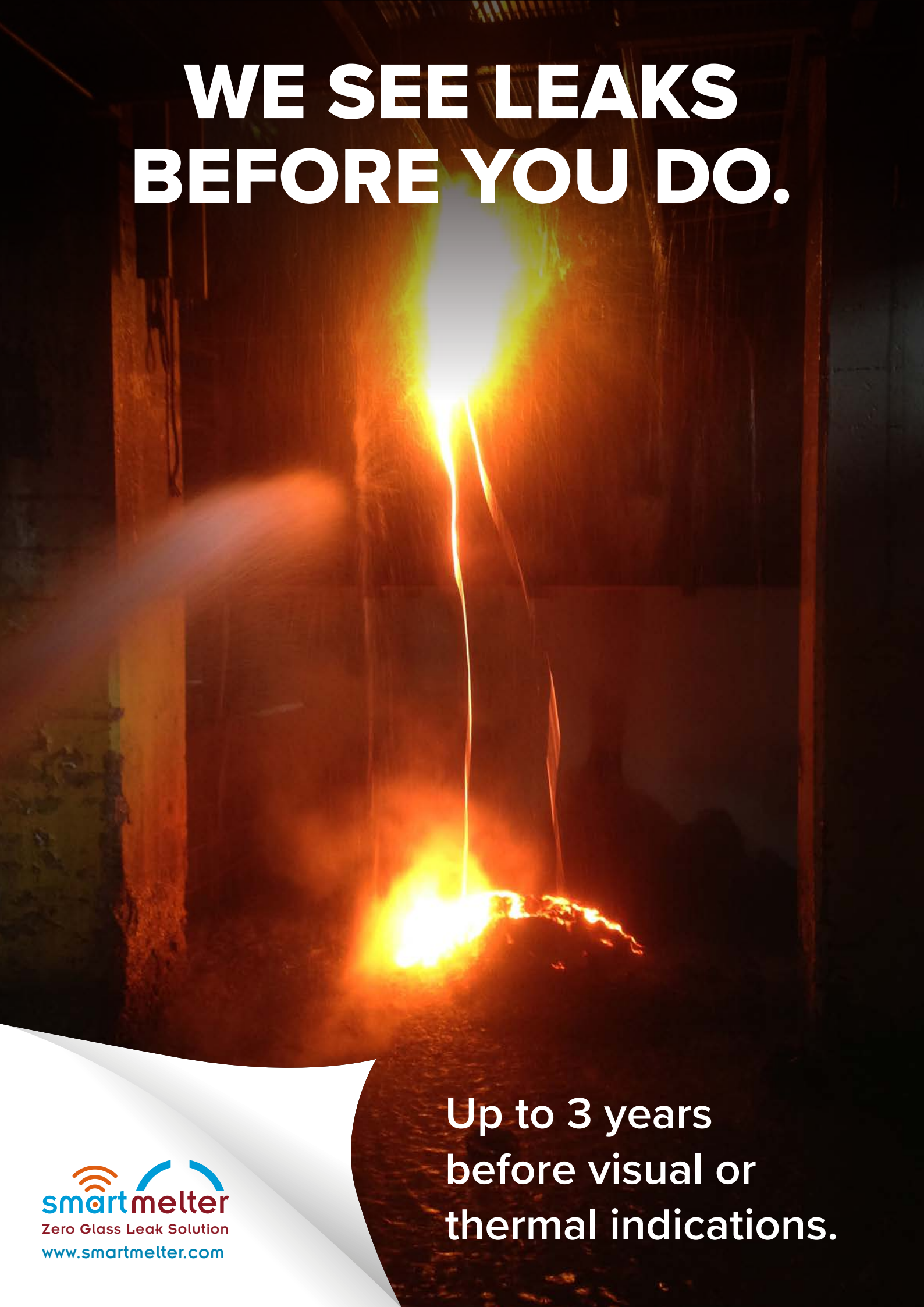
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Italian glass industry bouncing back with optimistic forecasts

Data presented at the general assembly of GIMAV, the Italian association of manufacturers and suppliers of machinery, equipment and special products for glass processing, reflected the impact of the Covid-19 pandemic but getting 2021 off to a good start raised hopes for at least a partial recovery.

Michele Gusti, GIMAV President

VITRUM 2021 is scheduled to take place 5-8 October 2021 In Milan.

Industry performance in 2020 showed that production is down 16.6% due to a drop in exports (-14.9%) and in domestic sales (-20.7%). This is how the pandemic negatively affected the performance of Italy's industry of manufacturers of glass processing machinery and technologies that closed 2020 with overall sales of €2,027 million.

Imports also fell (-11.1%), causing the domestic market to shrink (-17.2%). There was an overall drop in trade (-14.2%) as well as in the trade balance (-16.1%) which, however, remained very positive at nearly €1,080 million.

Fighting back

If 2020 was the year of global economic crisis, Italy's glass industry companies fought back with extraordinary buoyancy and resilience, as seen in competitiveness indicators that position the industry among Italy's domestic achievers. In fact, the ability to penetrate international markets increased, with a 71.5% export share of sales, while sales on the domestic market held at 60.9%, a minimal drop justified by the strong restrictive measures adopted to limit the effects of the pandemic.

"Our industry was really put to the test by 2020," stated GIMAV President Michele Gusti. "Despite the pandemic that swept in waves across our sector and the ensuing lockdowns and border closures, the manufacturers of glass processing machinery and technologies acted swiftly to limit their losses, more successfully than their international competitors."

Flat glass processing technologies were the worst hit by the pandemic with lower revenues, exports and domestic sales for all of 2020, compared to 2019 (except for November sales). Nonetheless, there was better international market penetration and a firmer foothold in the domestic market was established.

Overall better results for hollow glass processing technologies which, in 2020, limited sales losses to -8.9%, thanks to the positive performance of domestic sales (+17.7%). This owes much to the fact that the hollow glass industry could keep working – notwithstanding the restrictions to limit the effects of the pandemic – being part of the supply chain considered strategic to national interests. This helped balance out the 15% drop in exports. The sector improved its own domestic market presence, but experienced a drop in international competitiveness.

The accessories and other glass processing technologies sector limited its losses in revenues, exports and domestic sales to 10%. The sector's international competitiveness remained fairly stable, which improved its foothold in the domestic market.

The '2020 effect'

The GIMAV Study Centre's analysis of the early effects of the global pandemic became available in March, when the glass processing machines and technologies industry suffered a 2.9% drop in revenue, compared to the previous month,

GIMAV represents Italian manufacturers of glass processing machinery, systems, special products and accessories.

rather than the expected seasonal growth (+29.5% in 2019).

The catastrophic effects of the crisis were even more apparent in April 2020 when the emergency measures adopted by the authorities on the heels of the so-called 'first wave' [of Covid-19 coronavirus], brought normal business activities to a standstill, with the resulting crash (compared to April 2019) in exports (-57.3%), domestic sales (-45.6%) and thus, overall revenues (-53.6%).

Thanks in part to the first re-openings, the next two months were marked by a 'technology rebound' which began to narrow the gap, until November. That's when, aside from the 'lost ground' of previous months, for the first time in absolute value, revenue outpaced that of 2019. Nonetheless, the arrival of the so-called 'second wave' in December 2020 curbed the recovery, perhaps concealing the truly positive factor: the ability of the industry's business fabric to react to and withstand extremely unfavourable circumstances for the domestic economy and, even more, for international trade.

The macro-family of flat glass processing technologies was, without doubt, the hardest hit by the effects of the pandemic – exports suffered the effects of obstacles to shipping merchandise and in international travel, and domestic sales were handicapped by measures adopted to limit the effects of the pandemic. Revenues fell below 2019 levels throughout 2020, highlighting how the sector was more severely damaged by the second wave.

The performance of the accessories and other glass processing technologies sector was much the same as in the first part of the year. In August, however, very similar figures to those of the previous year were recorded and November and December rose higher than in 2019, proof that, in this case, the sector was not affected by the so-called second wave.

From March to August, the hollow glass sector was also severely affected by the slump in international demand. Starting in September, exports regained their usual momentum and revenues remained firm at values higher than those of the previous year. Thanks, in part, to the ongoing contribution provided by domestic sales in meeting demand from the food and pharmaceutical industries, the industry also succeeded in riding-out the second wave of the pandemic.

2021 forecast

By January 2021, the negative December 2020 performance had already subsided, paving the way for recovery in February, thanks to good domestic sales and a partial resurgence in exports that stabilised in March as exports fully resumed.

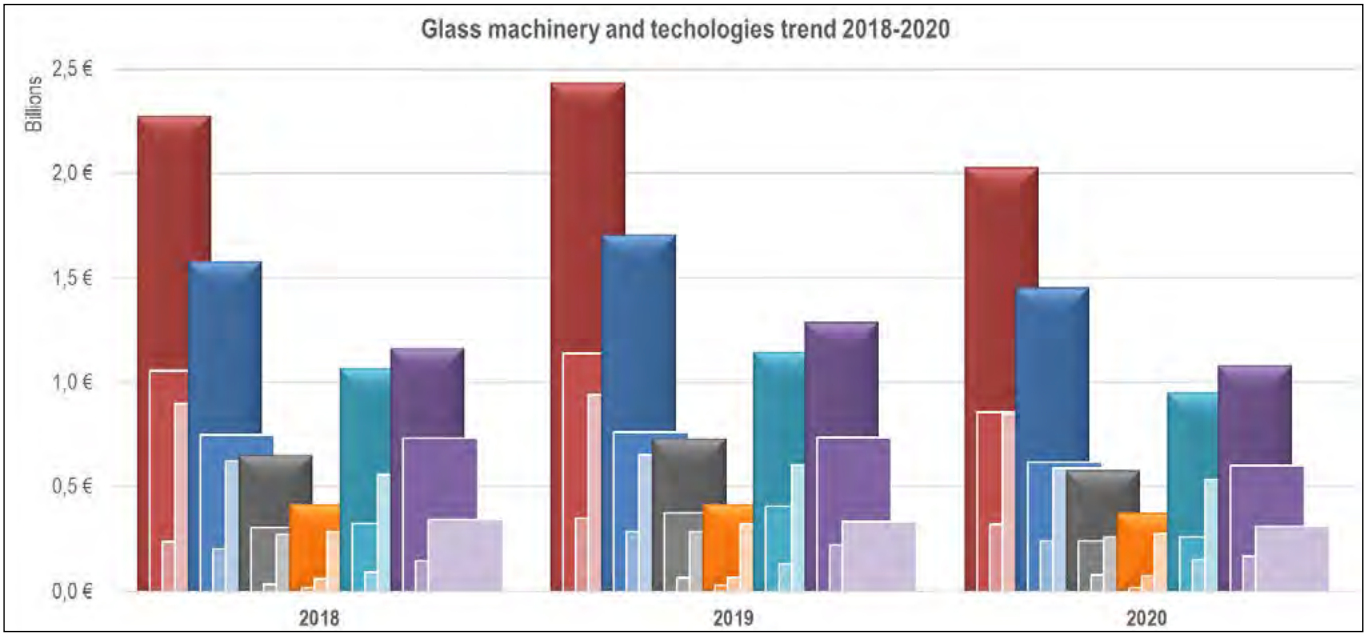
Projecting first quarter results to December 2021 – without taking into consideration any changes that could occur by year-end to positively or negatively affect industry businesses – revenues are expected to grow by 4.5%. This is still a modest result, fuelled by good performance from the accessories and other glass processing technologies industry, by substantial stability in the flat glass sector, compared to 2020, and by negative results for hollow glass, due to exports that remain stagnant.

Bearing in mind, however, that the forecast does not take into account second quarter results – still unavailable, and during which time the international scenario has partially normalised, thanks to the strengthening of the Covid-19 vaccination campaign – and, in fact only includes the results of a period still conditioned by the second wave. It can be reasonably assumed, therefore, that the 2021 results could be better than forecast and, given the reduction in infections and the vaccination drive continuing at full speed, they could possibly come close to 2019 levels, as clarified by GIMAV Director Fabrizio Cattaneo: "The data says it all: 2020 was a tough year for everyone, including the manufacturers of glass processing machinery and technologies. However, given the encouraging first-quarter figures, our industry can look to 2021 with optimism. Basing our forecast on the little data available, we have predicted moderate ▸

growth expectations but we are well aware that a major underestimation is inherent to the method. Nevertheless, taking into account the unprecedented times we are living in and that we have not entirely put behind us, it seemed more judicious to propose an approximate 'rounded down' estimate that could possibly be reviewed as things improve in the future, rather than making a more optimistic forecast and then having to adjust it downward."

VITRUM 2021

The trend toward a definite recovery is also confirmed by the optimism surrounding VITRUM 2021, the international exhibition of glass ▸



	2018	2019	2020	19/18	20/19
Turnover	2.275.595.940,33	2.431.912.592,14	2.027.075.874,85	+6,9%	-16,6%
flat	1.086.629.540,49	1.140.281.622,86	857.927.767,47	+4,9%	-24,8%
hollow	250.230.898,93	350.416.461,32	319.185.266,91	+40,0%	-8,9%
accessories and other tech.	938.735.500,90	941.214.507,96	849.962.840,46	+0,3%	-9,7%
Export	1.626.214.045,10	1.704.331.033,65	1.450.308.720,10	+4,8%	-14,9%
flat	757.849.536,30	764.094.206,45	617.897.026,85	+0,8%	-19,1%
hollow	217.742.619,15	284.829.632,70	242.011.855,90	+30,8%	-15,0%
accessories and other tech.	650.621.889,65	655.407.194,50	590.399.837,35	+0,7%	-9,9%
Domestic sales	649.381.895,23	727.581.558,49	576.767.154,75	+12,0%	-20,7%
flat	328.780.004,19	376.187.416,41	240.030.740,62	+14,4%	-36,2%
hollow	32.488.279,78	65.586.828,62	77.173.411,01	+101,9%	+17,7%
accessories and other tech.	288.113.611,25	285.807.313,46	259.563.003,11	-0,8%	-9,2%
Import	415.975.753,20	416.746.073,10	370.363.022,40	+0,2%	-11,1%
flat	24.887.940,00	28.852.530,70	17.645.725,30	+15,9%	-38,8%
hollow	66.377.145,80	66.336.291,00	74.111.308,60	-0,1%	+11,7%
accessories and other tech.	324.710.667,40	321.557.251,40	278.605.988,50	-1,0%	-13,4%
Domestic market	1.065.357.648,43	1.144.327.631,59	947.130.177,15	+7,4%	-17,2%
flat	353.667.944,19	405.039.947,11	257.676.465,92	+14,5%	-36,4%
hollow	98.865.425,58	131.923.119,62	151.284.719,61	+33,4%	+14,7%
accessories and other tech.	612.824.278,65	607.364.564,86	538.168.991,61	-0,9%	-11,4%
Trade balance	1.162.872.834,28	1.287.584.960,55	1.079.945.697,70	+10,7%	-16,1%
flat	732.961.596,30	735.241.675,75	600.251.301,55	+0,3%	-18,4%
hollow	151.365.473,35	218.493.341,70	167.900.547,30	+44,3%	-23,2%
accessories and other tech.	325.911.222,25	333.849.943,10	311.793.848,85	+2,4%	-6,6%
Commercial exchange	2.042.189.798,30	2.121.077.106,75	1.820.671.742,50	+3,9%	-14,2%
flat	782.737.476,30	792.946.737,15	635.542.752,15	+3,3%	-19,9%
hollow	284.119.764,95	351.165.923,70	316.123.164,50	+33,7%	-10,0%
accessories and other tech.	975.332.557,05	976.964.445,90	869.005.825,85	+7,5%	-11,1%

Industry performance in 2020 showed that Italian glass production is down 16.6% due to a drop in exports (-14.9%) and in domestic sales (-20.7%).

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technologies – the numbers for the next edition are positive. "We said it during the pandemic and we reiterate: VITRUM 2021 will be the industry's recovery trade show, not only for manufacturers but also for those who use glass processing machinery, with a special focus on end users through the concurrent GLASS WEEK events," remarked Dino Zandonella Necca, President of VITRUM and of the glass processing accessories and other technologies section. "From October 5th to 8th, Milan will be the stage upon which every aspect of glass will be projected and we are working hard to make it a great event for everyone!"

Board of arbitrators and sole auditor appointed

During the GIMAV General Assembly, following approval of the statutory changes needed to provide the Association with suitable tools appropriate to a modern system of business representation, the Arbitrators who will make up the Board for the four-year 2021–2025 term were appointed. The appointees are: Adelio Lattuada (Adelio Lattuada Srl), Roberta Triulzi (Triulzi Cesare Special Equipment Srl), Sergio Valsecchi (Bavelloni SpA), Andrea Zafferani (Zafferani Glas Srl) and attorneys Giuseppe F. Bonacci and Edoardo Tosetto (Legali Riuniti Lex).

At the same time, Clara Alberta Tenconi (Studio Tenconi) was elected GIMAV Sole Auditor for the 2021–2025 four-year term. ●

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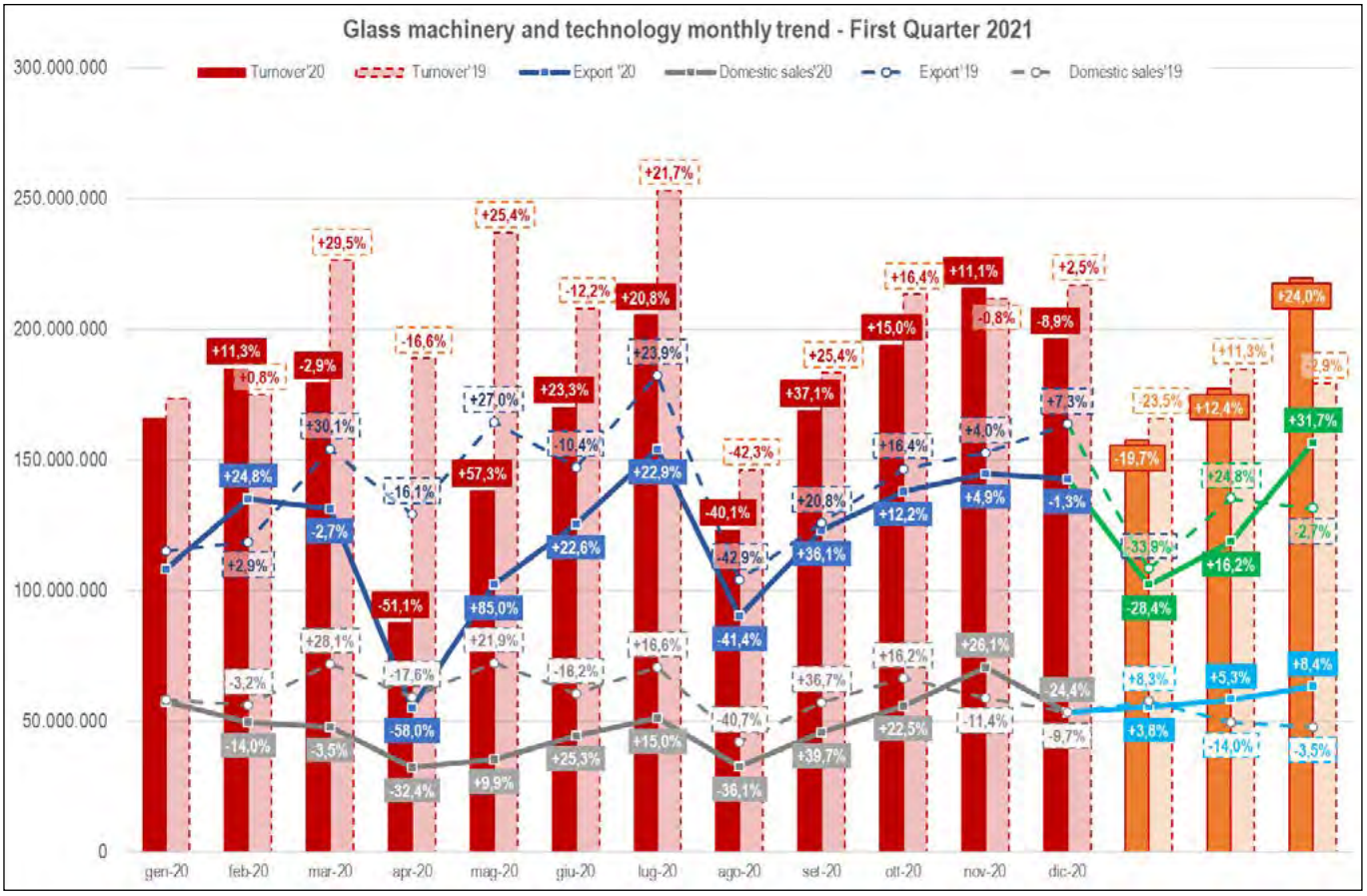
	2018	2019	2020
E/T	**71,5%**	**70,1%**	**71,5%**
flat	69,7%	67,0%	**72,0%**
hollow	87,0%	81,3%	**75,8%**
accessories and other tech.	69,3%	69,6%	**69,5%**
Ds/Dm	**61,0%**	**63,6%**	**60,9%**
flat	93,0%	92,9%	**93,2%**
hollow	32,9%	49,7%	**51,0%**
accessories and other tech.	47,0%	47,1%	**48,2%**
Tb/Ce	**56,9%**	**60,7%**	**59,3%**
flat	93,6%	92,7%	**94,4%**
hollow	53,3%	62,2%	**53,1%**
accessories and other tech.	33,4%	34,2%	**35,9%**

Flat glass processing technologies were the worst hit by the pandemic with lower revenues, exports and domestic sales.



	Turnover'20	Export '20	Domestic sales'20	Import'20	Domestic market'20	Trade balance'20	Commercial exchange '20
2020	**2.027.075.874,85**	**1.450.308.720,10**	**576.767.154,75**	**370.363.022,40**	**947.130.177,15**	**1.079.945.697,70**	**1.820.671.742,50**
FORECASTS 2021	2.117.981.117,14	1.459.465.573,87	658.515.543,27	412.811.577,66	1.071.327.120,93	1.046.653.996,20	1.872.277.151,53
2020	**-16,6%**	**-14,9%**	**-20,7%**	**-11,1%**	**-17,2%**	**-16,1%**	**-14,2%**
FORECASTS 2021	+4,5%	+0,6%	+14,2%	+11,5%	+13,1%	-3,1%	+2,8%

Projecting first quarter results to December 2021 – without taking into consideration any changes that could occur by year-end to positively or negatively affect industry businesses – revenues are expected to grow by 4.5%.

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The Italian operation of Eurotherm by Schneider Electric supplies specialised power and control technologies to glass manufacturers from a range of business sectors. Giorgio Morando, Sales Specialist, Power Solutions discusses Eurotherm Italy's approach to offering personalised solutions and partnerships in an increasingly global and digital arena.

Giorgio Morando is Sales Specialist, Power Solutions at Eurotherm by Schneider Electric.

Established in 1974 with its first projects in the glass industry dating back to the 80s, Eurotherm Italy is part of Eurotherm by Schneider Electric (see Glass Worldwide March/April 2021 for a recap on the acquisition that took place in 2014). The Italian operation comprises 60 members of staff and mainly serves the glass business in Italy, where five of the most important European OEMs are located.

Giorgio Morando joined Eurotherm Italy 13 years ago as a service engineer. "Since then I have had several roles that brought me closer to the world of the glass industry, in fact I have been deeply involved in our glass market initiatives here in Italy but also abroad," he explains. "Since 2018, I have been responsible for power applications in the Oil & Gas and Mining, Metals and Minerals (MMM) segments for Italy and I worked in close relationship with the global Eurotherm glass team and also with our Schneider Electric colleagues."

The Eurotherm-Schneider union broadened both companies' offerings, according to Mr Morando, and was "particularly beneficial for our approach to the glass industry. We call it 'From Grid to Glass', meaning that we can now offer everything from medium and low voltage distribution equipment, to process automation and electrical power control systems."

Working with key OEM glass players in the region, Eurotherm Italy supports float and container glass manufacturers, as well as producers of glass fibre and display glass. "Hollow glass is very important especially for the pharma market and flat glass is equally key," says Mr Morando. "In Italy, there are five flat glass plants with significant prospects for growth.

"Recently we have been working with pharmaceutical glass customers," he recounts. "We have designed control solutions for refurbishing existing pharma glass plants, but also for greenfield plants for pharmaceutical glass pipe and glass flask production."

Power and control

An experienced supplier of power and control technologies, Eurotherm provides scalable, modular solutions, from the simplest SCR power controller to full-scale information integration and plantwide distributed control systems.

"Our control systems are based on state-of-the-art technology," says Mr Morando. "We engineer specialised solutions based on robust and high reliability, precision control products. These are the factors differentiating our offering from general purpose PLCs."

Eurotherm has developed a high-efficiency solution for bushing power control using the EPower power controller in automatic load tap changer control mode. This provides control with a clean waveform, "while drastically reducing harmonic generation and helping to keep the power factor at a much higher level than a standard silicon controlled rectifier (SCR) controlled system," explains Mr Morando. The controller also features Predictive Load Management for resolving 'flicker' issues that can be present in multiple burst-fired electrical control systems. "This feature is highly appreciated in roof-heating applications, especially during start-up phases," reports Mr Morando. "It characterises our latest flat glass production plant refurbishment made in Italy."

Recently, Eurotherm Italy replaced hundreds of obsolete power units in a glass fibre production plant with EPower advanced power controllers in automatic load tap changer control mode. According to Mr Morando the solution allowed the customer to achieve higher power quality (cos-phi) with a two-year return on investment.

Working with OEMs that sell their furnaces worldwide, Eurotherm Italy's reach extends to the Far East where the market is very active. "We collaborate with OEM furnace builders who are marketing their furnaces across emerging economies," confirms Mr Morando, "but at the same time, we are partners to global industrial businesses where we supply turnkey solutions."

Giancarlo Quintana, Sales Manager for Southern Europe states confidently that "Our aim is to be recognised as the go-to partner by the glass market." However he cautions that "general purpose products and commercial visibility are not enough. We need to go further, by offering more specific, precision hardware, complemented by fit-for-purpose software packages, and enhanced by 'peopleware', able to add unique value thanks to decades of expertise and highly regarded support."

Global customer support

The Italian glass team has very successful relationships with its customers and works closely with other regional glass business development managers and the global team, according to Mikael Le Guern, Global Glass Business Development Manager. This interaction is "essential" with a global glass business, he stresses. "It enables us to deliver consistent solutions in multiple regions to help facilitate supply chains." ▸

Predictive load management strategies and hybrid firing modes in EPower Advanced SCR Controller help to optimise energy use.

"We believe it's vital to share expertise and knowledge, and provide optimised, cost-effective, high-performing solutions," says Giorgio Morando. Drawing on a global, comprehensive support network and its highly trained engineers, Eurotherm Italy can approach clients with the confidence of having a wide, global and experienced team to rely on for any challenge which may arise, he explains. "The expertise of our service and application engineers and the availability of products such as the EPower controller, able to manage multiple Fieldbus communications, make it easy for us and our customers to interact with other suppliers.

"One of Eurotherm's mantras is 'Customer First'," he continues, "but it is not only that: I strongly believe that a win-win outcome can only be achieved through a solid relationship with customers, by being a trusted partner to them, committed to creating synergies of knowledge and experience for long-term relationships. This is particularly true in the glass industry where furnace campaigns are usually onerous and long-term investments.

"In Eurotherm, and this is especially valid for Italy, we have a lot of customers with whom we've been collaborating for many years, sometimes decades," Mr Morando reveals. "This longevity is inevitably due to the trust we've built over the years thanks to our experience and specific application knowledge, as well as the reliability of our products and solutions. We passionately support our customers, acting as trusted advisors."

Eurotherm's project engineering teams and approved solution providers offer cost-effective and high performance process and power control solutions to meet the needs of global glass manufacturers and OEMs.

Digital transformation

Eurotherm Italy is committed to helping clients working in the glass industry to be in line with the goals set by the Paris agreement, "which means bringing total carbon emissions down to zero and implies moving from fossil fuels towards more electrical power in a transition to hybrid or all-electric solutions," clarifies Mr Morando.

"The decarbonisation trend is leading to large opportunities where we already have expertise relating to the electrification and digitalisation of glass melting and heating processes," notes Mikael Le Guern.

In fact, the Eurotherm Italy office recently became the first Italian building of the group to achieve Schneider's zero CO_2 status. Whether a factory, office, R&D centre, service centre, etc., a Schneider building is classed as zero CO_2 when it uses only renewable energy sources, purchased from suppliers or produced on site; moreover, emissions must be reduced without purchasing carbon credits.

The company's business has also become increasingly digitalised over the years. "We are building on this basis," says Giorgio Morando; "enhancing our solutions' capability to boost industrial process optimisation, leverage servitisation and help our customers to effectively adopt and benefit from IoT technologies."

"Eurotherm is strongly committed to providing a factual contribution to support the glass industry's move to electrification as an integral part of its digital transformation," agrees Giancarlo Quintana. "Our Southern Europe glass team, just like the Eurotherm global glass team, is joining forces with major players in the glass market to build a new and different hot-end approach aimed at satisfying the 2050 carbon footprint expectations and improving glass production throughput and quality." ●

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Eurotherm's T2750 PAC system hardware provides high availability dual redundant process control for high efficiency glass manufacturing applications.

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Middle East manufacturers face challenging times

Despite demand for high performance architectural glass and increasing focus on eco-friendly sustainability solutions, there may continue to be contractions in parts of the glass industry in the United Arab Emirates, reports Richard McDonough.

Glass products manufactured in this Middle Eastern nation are focused on a variety of industries. The United Arab Emirates (UAE) is one of the 30 largest exporters of glass and glassware products in the world, according to the International Trade Centre. (Unless otherwise stated, statistics detailing imports and exports of glass and glassware products to and from the UAE are from reports issued by the International Trade Centre.) The UAE's exports represented 0.9% of world exports for glass and glassware, ranking it at number 25 for world exports [for glass] as of 2019. Imports of glass and glassware products to the UAE represented 1% of global imports for these products in 2019, making the UAE the 28th largest importer for these products worldwide for that year.

Exports

The value of glass and glassware product exports from the UAE was (US)$660,527,000 in 2019. Saudi Arabia imported 22.7% of that total; exports to that nation amounted to US$150,118,000 in 2019. Exports to Oman were (US)$54,426,000; Australia – (US)$39,756,000; Kuwait – (US)$39,203,000; and Iran – (US)$34,309,000 worth of glass and glassware products. About 48% of exports from the UAE were sent to these five nations collectively.

Other top export markets for glass and glassware products from the UAE included Egypt, USA, France, India and Bahrain. The UAE exported US$103,303,000 collectively to these five nations. Overall, these top ten export markets for the UAE represented more than 63.6% of the country's global exports of glass and glassware products.

Whilst exports decreased to Australia (down by 6%) and Iran (down 21%), the value of glass and glassware products exported from the UAE increased to all of its top 10 export markets from 2015 to 2019.

From 2018 to 2019, exports of glass and glassware products to five of the UAE's top 10 export markets decreased: Oman (exports down 4%), Australia (down 12%), Kuwait (down 7%), Iran (down 46%) and Egypt (down 19%).

EmiCool Classic T sputter-coated high-performance glass produced by Emirates Glass at the Al Bidda Platinum Tower in Doha, Qatar. Photo courtesy of Emirates Glass.

Imports

Imports of glass and glassware products into the UAE are substantial. In 2019, the value of these products imported into the UAE was (US)$744,942,000. About 47.2% of these imports came from two countries: China – (US)$270,925,000 and India – (US)$80,683,000. Slightly more than 60% of all glass and glassware product imports (62.5%) into the UAE came from those two nations plus Saudi Arabia – (US)$47,648,000; the USA – (US)$35,432,000; and France – (US)$30,444,000.

Other top sources of glass and glassware products imported into the UAE included Belgium, Germany, the Czech Republic, Austria and Italy. These five countries collectively provided (US)$110,054,000 in glass and glassware products imported into the nation. Overall, UAE imports from these top 10 markets represented 76.3% of the country's global imports of these products.

During 2015–2019 imports of glass and glassware products fell from only one country in the UAE's top ten import sources: the USA (down 1%). From 2018 to 2019, imports of glass and glassware products from five of the UAE's top 10 import sources decreased: Saudi Arabia (down 19%), the USA (down 12%), Belgium (down 2%), Germany (down 21%), and Italy (down 11%).

Emirates Glass

Emirates Glass LLC, a subsidiary of Dubai Investments, is a major glass company in the UAE. "Our product range includes more than 400 different and in-house developed performance coatings, from hard and solar control coatings to low-emissivity single and double silver coatings across the entire colour spectrum to meet even

the most challenging requirements we receive from consultants and architects in terms of performance and aesthetics," stated Rizwanulla Khan, Executive President of Emirates Glass LLC.

"Emirates Glass also provides a wide array of double or triple glazed insulating glass units, safety, bullet-resistant and laminated glass, non-rectangular and bent elements – or a combination of any of the above," Mr Khan continued. "Some more special products include glazing units with captured or suspended elements for aesthetic or performance enhancing applications such as honeycomb diffusers, metal and synthetic meshes or mashrabiya inserts to reflect our local heritage and ability to integrate traditional elements in modern and contemporary architecture."

According to Mr Khan, some of the specialised glass products include "ARMAX, our own anti-reflective coated glass" and "SmartLite – the state-of-the-art switchable glass, which changes its state in just about 400 milliseconds at the flick of a switch and turns from a clear to an opaque glass panel to create on-demand privacy whilst also allowing for plenty of natural light whenever needed."

He noted that "bullet-resistant glass is also on display by Emirates Glass which is a multi-layered laminated glass with a combination of glass lites and polycarbonate sheet to give the glass the required ballistic resistance. As such, bullet-resistant glass combinations are much thicker than the conventional architectural glass panels which are designed primarily as IG units for achieving the required thermal performance."

Customers of Emirates Glass include architects and consultants as well as other contractors.

"Emirates Glass was established in 1997 by Khalid Bin Kalban to become the leading provider of energy efficient architectural glass in the Middle East," said Mr Khan. "Since its inception the company has been an integral part of Dubai's growth and evolution, having supplied glazing and architectural expertise to some of the most iconic buildings across the city. Having consolidated its position as a local market leader, Emirates Glass has also expanded its international presence and we are proud to have supplied our glazing solutions to Gulf Cooperation Council countries such as Saudi Arabia, Oman and Kuwait, but also to Azerbaijan, Turkey, India, Sri Lanka, Pakistan, Bangladesh, Eastern and South Africa and even Canada."

Contending with Covid

According to Mr Khan, "Emirates Glass has recorded revenue growth of 67% and [its] bottom line has surpassed a negative figure to [grow] more than 100% from 2011 till date." Reflecting on the level of business in 2020, compared to the level of business in previous years, he explained that "Our figures did not meet the set targets; however, we did not report negative figures either. I can proudly state that we have been amongst those companies in the glass industry that all employees got their salaries on time and when we deemed necessary, we did the least salary deductions in the Covid-19 lockdown time and also restored them as soon as the lockdown was over.

"The Covid-19 outbreak has caused widespread concern and economic hardship for consumers, businesses and communities across the globe," Mr Khan continued. "It is also presenting a range of challenges to the construction industry. Some construction projects have been delayed, and some cancelled as a result of the impacts of Covid-19 on the companies and governments that commissioned them. Further, possible supply chain bottlenecks of equipment and raw materials cause project delays in currently funded projects, or reduced spending on future ones. The industry is especially vulnerable given that the bulk of its workforce is employed in on-site jobs that cannot be done remotely. Additionally, many manufacturers are facing cash-flow liquidity challenges and difficulties in managing debt obligations. The most ▸

Rizwanulla Khan is the Executive President of Emirates Glass LLC, LumiGlass Industries, and Saudi American Glass. Photo courtesy of Emirates Glass.

immediate impacts are being felt at the subcontractor middle market of the industry. Subcontractors may be especially vulnerable to bankruptcy, which could occur after a site shutdown of only weeks. The industry may see some manufacturers struggle to recover."

Emirates Glass provided glass products at Terminal 3 of the Dubai International Airport. Photo courtesy of Emirates Glass.

Future developments

"The glass industry in the UAE has evolved leaps and bounds in the last few decades – from usage of uncoated monolithic glass products in windows to the use of high-performance double and triple glazed insulated glass products," stated Mr Khan. "Technological developments in the glass industry have considerably helped to reduce cooling loads in buildings increasing efficiency. Furthermore, international standards for glass processing have also been reviewed and modified to address glass quality and safety factors that were not addressed in the old days. Local governing bodies and regulatory authorities too have implemented guidelines and regulations (Green Building Codes, for example) that are focused on sustainability and increased efficiency."

Various elements of the company could be set to change during 2021.

"The year ahead will vary for Emirates Glass depending on the areas of operation where we have felt the greatest impact from the pandemic," said Mr Khan. "It may focus on rebuilding lost revenue streams; require recalibrating supply networks to serve different market demands. But all in all, it includes a commitment to increasing agility in operations. By continuing to invest in digital initiatives across our production process and supply network, Emirates Glass can respond to the disruptions caused by the pandemic and build resilience that can enable the company to thrive." ▸

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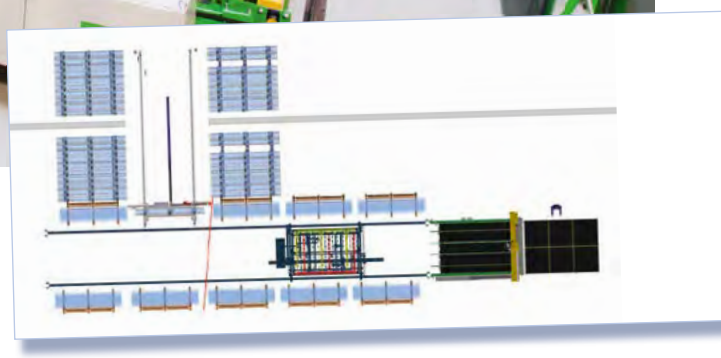

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Glass production at Emirates Glass. Photo courtesy of Emirates Glass.

"Looking forward, Emirates Glass will further expand its footprint across the GCC [Gulf Co-operation Council] and Middle Eastern region," stated Mr Khan. "We aim to be the preferred glazing supplier in at least three more countries, with a wide range of products fulfilling the current and upcoming green building regulations. Of course, we will continue to put our blood and sweat into the development of energy efficient glass solutions and special products that will further transform the landscape from regular buildings to pieces of art and architectural ingenuity. We are committed and dedicated to drive innovation throughout the Middle East and beyond and strive to be even closer to the creative minds within architecture firms.

Burj Khalifa in Dubai in the UAE. This is the tallest structure in the world. Glass from Guardian Glass was utilised in its construction. Photo courtesy of Balasubramanian G V.

Mr Khan indicated that "Increasing the market share will be accomplished by improving the efficiency of our manufacturing process with new machines, etc. Increased demand of the oversized IG panels can be catered by the use of Jumbo Size Glass Processing Units. Upgrad[ing] of [the] Terra- G coater will also enable… [an improvement in] the performance and durability of the temperable-coated products. Likewise, we will be investing in people because, when all is said and done, they are our most valued asset. These efforts in addition to others will allow Emirates Glass to pass our savings along to our customers.

"Given the company's emphasis on keeping up-to-date with customer needs and the technological advancements that take place within the glass industry, we plan to update the plant with new high-efficient machines that will increase production at a reduced cost in the future," continued Mr Khan. "The company's personnel are also expected to be equipped with highly professional technical knowledge, thus playing their part in decision making. All this, we believe, will help us in acquiring a greater market share which will ultimately result in the growth of the company's profits and revenue. The surging demand for Emirates Glass LLC's eco-friendly glass further reinforces the growing commitment towards sustainable development and green building principles. With such quality products, Emirates Glass is aggressively aiming at increased market share in existing and new geographies."

Sustainability

One of the goals that the firm is focusing on as it continues to grow is sustainability.

"Emirates Glass has a waste and recycle management committee in place to reduce the materials consumption, to increase recycling and to find new methods of saving the cost," explained Mr Khan. "In this regard, we are sending all the broken, rejected clear glass by QA/QC department to our sister company in Abu Dhabi – Emirates Float Glass as they are the float glass manufacturers and they use it in the recycling. For the broken, rejected coloured glass by QA/QC department – we have a few specific vendors that collect it and dump it into wastage."

In addition to the glass recycling, Mr. Khan stated that Emirates Glass had programmes in place that involve "… converting the physical systems to use electronic documents in overall work activity to reduce paper wastage, [returning] empty printer cartridge...to suppliers for reuse, [and] giving generated electronic waste to Dubai Municipality."

The firm is also using "trade wastewater analysis [carried out] every three months through Waterbird and getting the disposal permit through Dubai Municipality, using our non-hazardous wastewater for irrigation purpose after recycling the water with filter systems, sending used aluminium oxide powder… for recycling, [and] solar panels are being installed at the office/factory premises to reduce energy costs."

Guardian Glass

Global manufacturer Guardian Glass produced glass that was used in the construction of the tallest structure in the world – the Burj Khalifa tower in Dubai in the UAE. According to a statement from Guardian Glass when the Burj Khalifa was opened in 2010, "the building [featured] more than 1.8 million square feet (174,000 square metres) of Guardian SunGuard Solar Silver 20 and Guardian ClimaGuard…Together these Guardian products offer superior solar and thermal performance. The glass provides an anti-glare shield for the strong desert sun, and a high light reflectance to keep the interior from overheating. It also has to withstand extreme desert temperature swings and strong winds."

Mirodec Gulf

Operating globally, Mirodec Gulf produces a variety of glass products manufactured in the UAE. The firm also provides a number of services to the glass industry. Products and services include fused glass, curved glass, UV-printed glass and etched and engraved glass.

"Our customers include interior designers, fit-out contractors," and businesses active in industries such as "hospitality, high-end residential, retail, fashion and beauty, and government," stated Michael Khoury, General Manager of Mirodec Gulf.

"Despite having less sales value than 2019, the company still managed to be profitable in 2020," noted Mr Khoury. "2020 was a tough year on all sectors including manufacturing and construction. We had an 8% decrease in turnover."

Difficulties cited by Mr Khoury included "PCR requirements between the different emirates, inability to travel and attend our sites outside the UAE, and higher cost of shipping between our two facilities (Beirut and Dubai)."

This year is anticipated to be a better one for Mirodec Gulf: "2021 is a very promising year and we expect a growth to be in the double digits," said Mr Khoury. "Expo 2020 occurring in 2021 is expected to be a positive external force."

One aspect of the industry that Mirodec Gulf has focused on is recycling. "Like most other industries today,

going green is definitely the driving force in the manufacturing sector," stated Mr Khoury. "This can be demonstrated in the rising LEED [green building rating system] and ESTIDAMA [a sustainability initiative developed and promoted by the Abu Dhabi Urban Planning Council] material requirements of most new prestigious projects being built in the UAE today."

Mr Khoury indicated that there has been an increase in "the use of wood backing, LED lights, aluminium frames, stainless steel frames, metal frames and many other complementary accessories. Moreover, one more example that would highlight the use of glass in our business in UAE is the PDLC [Polymer-Dispersed Liquid Crystals] glass also known as 'Magic Glass' which can turn from opaque to transparent in a click of a button. Whilst this isn't a new product, the technology behind it has developed, making it very affordable in comparison to its pricing a few years ago."

Euromonitor International

Market research provider Euromonitor International has issued a forecast that the overall market for glass and glassware products in the United Arab Emirates is anticipated to decrease in size 2% from an estimated (US)$722,900,000 in 2020, to an estimated (US)$708,200,000 in 2021. The overall market for glass and glass products "is an aggregation of flat glass, shaping and processing of flat glass, glass fibres and other glass products," according to Euromonitor International.

Tradeshows

Gulf Glass is scheduled to take place at the Dubai World Trade Centre from 12–15, September, 2021 (at time of writing). According to the organisers of this exhibition, "The Middle East's largest glass event, Gulf Glass, is a highly-specialised event designed to showcase glass products, tools and techniques for every applicable industry. The event gathers specialist knowledge and equipment together from around the globe and presents it to an audience of architects, consultants, operation managers, procurement heads and other key decision makers from diverse industries." ●

Emirates Glass has become the leading provider of energy efficient architectural glass in the Middle East. Photo courtesy of Emirates Glass.

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Breaking the mould

Marabu and Koenig & Bauer have partnered to develop an innovative inkjet solution that allows the direct printing of highly customised glass products. The companies' collaboration offers an alternative to conventional embossing, explain Katharina Rogner and Tim Schnelle.

Digital printing enables sophisticated designs and a high degree of personalisation at low cost. However, this process was, until recently, not suitable for three-dimensional decorations on standard glass products – instead, a costly made-to-measure mould had to be created for each item. Now, Marabu and Koenig & Bauer have joined forces to create a pioneering solution to this problem. It offers glass product manufacturers an attractive alternative to traditional embossing techniques.

Textured varnish finishes can be combined with coloured elements to produce striking visual effects.

The precise printing method permits the creation of highly customised decoration without the need for dedicated moulds.

Innovative inkjet solution for relief printing on glass

The manufacture of glass products with textured decorations conventionally requires a variety of preparatory steps prior to embossing. This process is associated with high energy consumption, and short production runs are prohibitively expensive. Each glass object to be given a textured decorative finish must be made with its own dedicated mould to produce a suitable raised surface for the embossed decoration. Production is time-consuming and requires corresponding planning. However, embossing is not ideal for highly customised glass items, for which there is currently strong demand, for example, in the perfume and beverage industries, i.e. for wines, spirits and beer. Marabu and Koenig & Bauer have now developed an innovative inkjet solution that allows the direct printing of highly customised glass products of all kinds, from one-off items to large industrial-scale volumes – in conjunction with excellent results. Contours, for instance, are far sharper than with conventional embossing. The precise single pass application of multiple varnish layers is possible, producing extremely textured finishes. This is performed with printing systems from Koenig & Bauer's KAMMANN K15 and K20 family. The method also permits large areas to be printed, including colour gradations, often required for brand logos. In addition, textured varnish finishes can be combined with coloured elements to produce striking visual effects. All ▸

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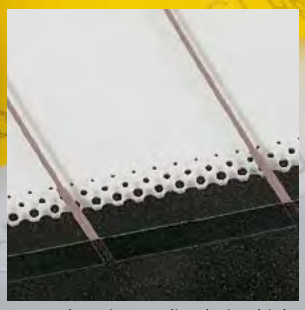

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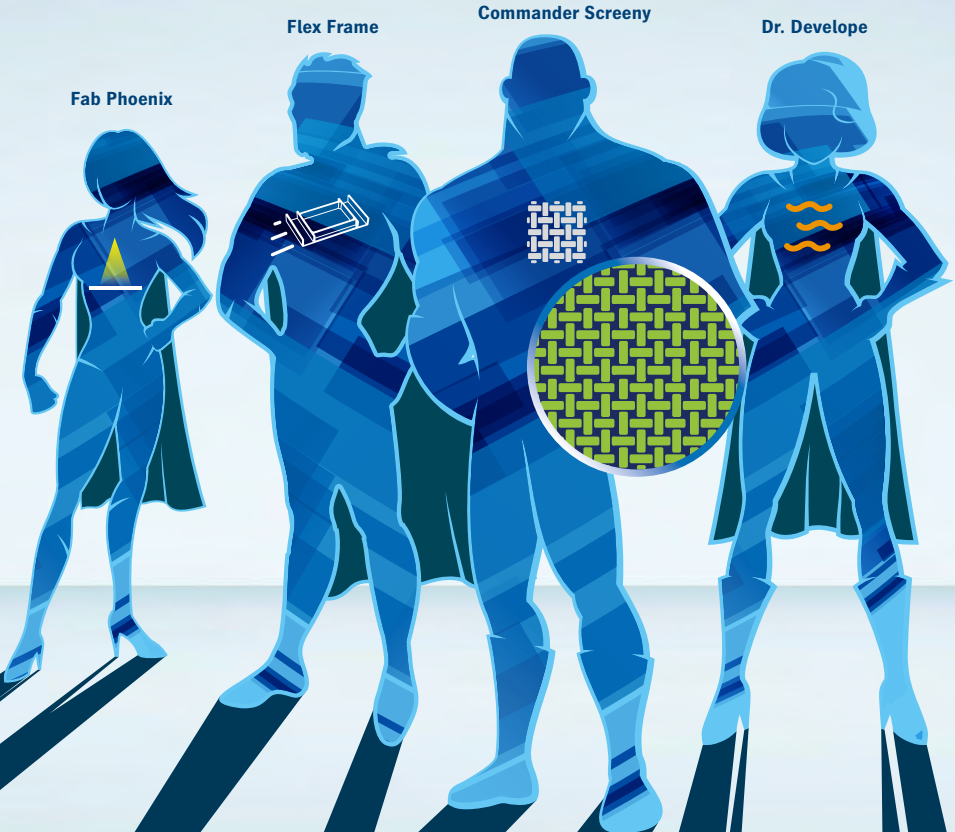

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printing process steps are seamlessly integrated into the K15 and K20 systems. Servo motors are employed to accurately position and move the object to be printed and the print unit. This allows the raised decoration of glass products of any shape. The corresponding varnish was developed in close cooperation between Koenig & Bauer and Marabu to ensure it was perfectly tailored to the printing process. During the development stage, the corresponding decorations achieved excellent results for dishwasher resistance and resistance to chemicals and abrasion, in line with applicable standards. This simple yet effective process is therefore a highly attractive alternative to conventional embossing.

Benefits of Marabu high-precision varnish

Marabu's new varnish was conceived for digital printing of textured decorations, particularly on glass substrates. The precise printing method enables sophisticated and elegant designs to be applied to glass objects such as perfume bottles, drinking glasses and beverage bottles. The number of layers can be varied in accordance with customer-specific needs. The use of this purpose-developed digital-printing varnish permits the creation of highly customised, personalised decorations without the need for dedicated moulds. The benefits include excellent contour sharpness, extremely fine textures and exact points, coloured and transparent designs, printing of convex and concave shapes, and rapid, simple adjustments during the printing process. Unit costs are not dependent on volume. It is possible to apply any number of designs to the chosen glass product during a single print pass. There is no need for a minimum production quantity or unique moulds. The results comply with the requirements defined for dishwasher resistance: 500 cycles in an industrial dishwasher and 50 cycles in a domestic dishwasher. The varnish is also highly recycling-friendly: the print oxidises entirely without residue when the glass substrate is melted down for reuse.

The mass customisation megatrend

Demand for customised products is on the rise, and can be observed in a variety of fields: packaging, games, fashion, household goods, and many other everyday items. Consumers are also prepared to pay a premium for such products. According to a survey by the Deloitte Consumer Review, 30–50% of respondents are willing to pay up to 20% more for a personalised product. Manufacturers and retailers are responding accordingly, and are keen to find corresponding solutions. Against this background, Marabu and Koenig & Bauer have pooled their skills and resources to make it possible to produce highly attractive designs quickly and inexpensively, without compromising on quality.

"State-of-the-art technology has great potential with regard to decorating glass," emphasises Tobias Lang, Product Manager for Digital Inks at Marabu. Tim Schnelle, Sales Manager at Koenig & Bauer Kammann, adds, "Koenig & Bauer and Marabu have given the packaging industry a further tool with which to address emerging challenges." The new varnish and the matching printing method represent a unique glass decoration process that complements existing techniques. ●

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The glass plant of the future

Adopting the latest Industry 4.0 technologies is now crucial for the international glass container industry. Supplier of production technology and performance equipment for the container glass industry Heye International can offer customers a partnership on their path towards a smart plant, resulting in the creation of a highly automated and cost-effective glassworks, says Hans Renders.

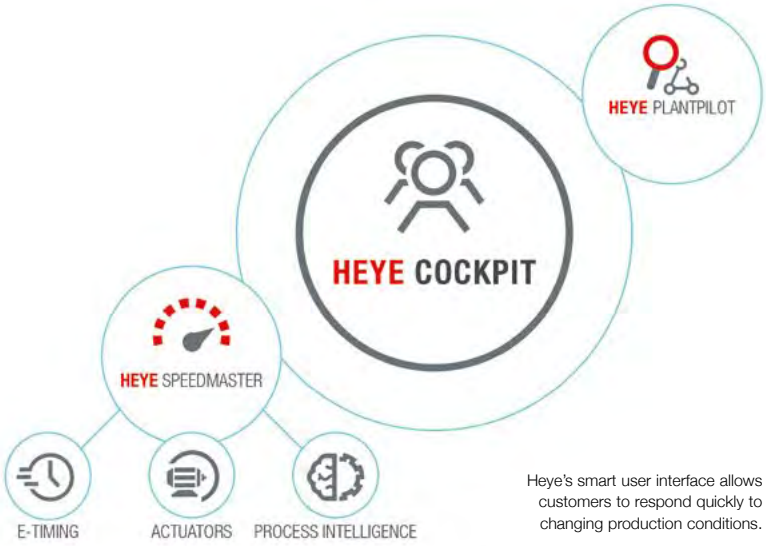
Selection is key to defining the perfect path but it's a challenging job to keep track of the Industry 4.0 jungle. The availability of smart user interfaces for operators has become especially important.

The Heye Cockpit is the central user access to the Heye SpeedMaster hot end control and process intelligence portfolio. The Heye SpeedMaster consists of three modules: E-timing, motion control (servo and pneumatic actuators) and the process intelligence solution set, combining all process control closed loops.

The approach employed is user-centric. The central collection point for all data from Heye SpeedLine is the new Communication Tower. Here, the data from all control systems of the machine are merged and managed in one central cabinet. Data integration between hot end and cold end especially helps to gain time. "With the technology behind Heye's smart user interface our customers can respond quickly [to] changing production conditions and finally keep the overview, which is essential for efficient glass production," underlines Hans Renders, Head of Product Management at Heye International.

The Communication Tower has a pre-integrated a multi-functional remote maintenance router, which enables access via a VPN tunnel, if required. Combined with precise mechanisms, the latest servo technology helps to achieve maximum production speed at high quality levels.

High production flexibility is another result of the technology. Glass plants with short production runs and many different jobs have two advantages. First, job changes can be performed in a very short time, as important parameters will be retrieved and the major parts of the machinery will be adjusted automatically in the future. Second, the operators can produce different bottles on one IS machine, by using multi-weight assortment technology. This makes the production of samples or short job runs extremely efficient.



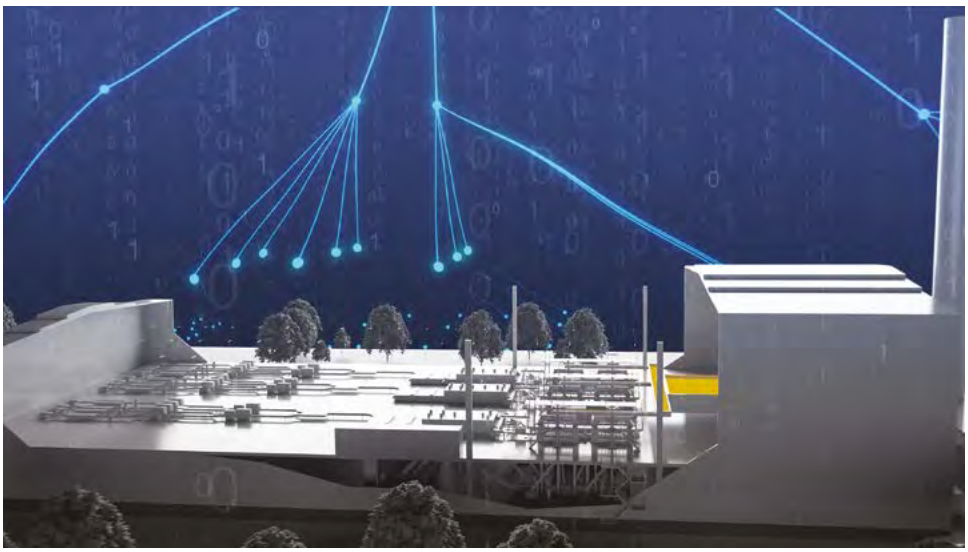
Heye's smart user interface allows customers to respond quickly to changing production conditions.

Process control and closed loop solution set

As well as being the inventor of the NNPB process, Heye has set the standard in closed loop production technology. A large set of closed loop solutions gives the customer a competitive edge. Heye offers operator assistance for gob loading, closed loops for gob shape and weight for NNPB and press-blow operation with the Heye Process Control. For heavy and premium articles produced by blow-blow operation, the Heye GobMaster satisfies demand for a closed loop solution according to gob shape and weight by visual gob measurement.

Following the glass flow, on the blank mould side, closed loops for cooling and press duration/ glass distribution are available. The Swabbing Robot eliminates one of the most important manual working steps, at the same time being the basis for precise, temperature measurement on the blank side.

Closed loops on the blow side allow accurate, high speed ware handling. Dead plate cooling is controlled, creating the basis for proper bottle movement by the high speed pushers, while the closed loop for ware spacing is a second speed-relevant factor. Furthermore, both loops eliminate defects generated by an incorrect ware handling set-up. Many of these solutions are already available, while others are in the prototype phase. In some areas, operator assistance is a good first step and in other situations, full closed loop systems are already in place.



From sensors and communication networks to robots and automation, the Heye smart plant concept combines different innovative solutions to create a highly automated and cost-effective glassworks.

The Heye PlantPilot uses internet-based technology to connect different machines or modules to manage the plant.

Connecting hot end and cold end

The Heye PlantPilot is a cornerstone in the field of data integration in the glass plant. By using internet-based technology, different machines or modules can be connected to manage the plant. In addition, important analysis possibilities are offered to optimise the production process. In particular, data integration between hot end and cold end helps to gain time.

Via the Heye Cockpit, the hot end operator has a perfect overview of the defect situation on the different cavities. By a future extension of the database to an expert system, recommendations for the correction of production defects can be given. As production companies encounter increased challenges to find skilled people, these expert systems for glass forming will become an important success factor.

Heye remote services

Besides supporting machine-to-machine (M2M) communication, many of the connected devices also provide an interface that allows Heye to monitor them across the internet from any geographic location. Depending on customer settings, this remote control capability can be used to perform such tasks as virtual maintenance checks without stopping system operation. It is also used for latest software updates, failure detecting and giving a helping hand in any imaginable scenario. Connecting machines in this way is the first step towards creating smart factories.

Summary

The Heye smart plant concept combines different innovative solutions in major areas. All of these have become possible through a set of enabling technologies, from sensors and communication networks to robots and automation. The Heye Glass People can be your partners to develop a common roadmap for the journey to a smart plant, a factory that will be able to produce high productivity containers at low cost, resource-efficiently and with consistently high quality. ●

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Cost savings and higher product quality with water-based coatings

Using water-based mould coatings from ACMOS offers numerous advantages including environmental and safety benefits, extending the life of the mould and producing a higher quality product, says Marina Littau.

Mould coating is a part of a standard process for many container glass manufacturers, but there are still some markets where moulds are not coated at all, or only partially, even though this additional step has many advantages in for process and quality.

Besides the automatic lubrication systems, which are already accepted and used in practice, the implementation of mould coatings represents a further opportunity to reduce the use of lubricants, making the process safer while at the same time achieving significant cost savings through a reduced rejection rate.

ACMOS Chemie KG is a manufacturer of heat-resistant coatings, lubricants and release agents, cleaners, and other process auxiliaries for the container glass industry. As a specialist in water-based process chemicals, ACMOS develops and produces coatings with active substances that are dispersed in water as a carrier medium. Water-based coatings significantly reduce risks to the people and the environment by substituting organic solvents for water. For environmental and personal safety reasons, water-based products are increasingly being used in the container glass industry.

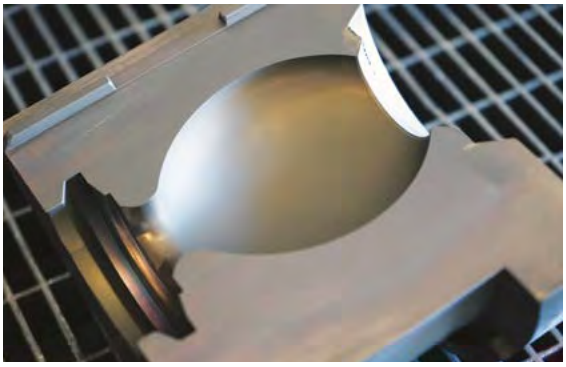
The advantages of water-based coating are obvious when looking at the labelling: a solvent-based mould coating is labelled with numerous pictograms along with hazard or safety information, such as H226 'Flammable liquid and vapour' and requires cautionary measures during its application. In contrast, ACMOS' water-based coatings are not classified as hazardous.

Longer life and lower costs

In addition to the environmental and safety aspects, [water-based] mould coatings offer many process advantages and lead to an improvement in the quality of the final product, which are illustrated in the Figure 1.

Studies have shown that mould coating can double, and in some cases even quadruple lubrication intervals. If the moulds have been pre-coated, there is no need for lubrication, which can be seen as a disruptive factor in the production process, for about the first 20 minutes after a job change. So, the operators gain time to start the process, to overcome initial difficulties and to achieve higher output from the machine. Also, during the entire production, lubrication intervals can be significantly extended, and mould lubrication can be kept to a minimum due to a lubrication buffer that the coating provides even several hours after a job change.

As the measurement data in Figure 2 shows, the mould coating wears off continuously in the first 20 minutes after a mould installation, but after 20 minutes the wear slows down, so even after 60 minutes at least 50% of the initial layer thickness is still present and thus mould coating continues to function.



A coated perfume bottle mould.

It has been observed that a well-adjusted drop cut and a central drop fall have a significant impact on mould coating durability (see Figure 3). If the drop hits the mould wall first, there will be a strong mechanical load at this point due to friction between the glass gob and the mould coating, which results in an early wear of the mould coating and an increased need for lubrication. Once the drop is adjusted correctly, the service life of the mould coating and therefore the lubrication intervals can be significantly extended. Longer lubrication intervals save not only lubricant consumption, but also ensure a longer mould service life, as the less lubricant applied, the lower is its build-up and contamination in the mould.

Extended lubrication intervals also reduce the rejection rate, having a direct positive impact on total costs. This is particularly evident for articles with a high mould change frequency.

Increased safety and product quality

In addition, there are reduced risks in personal safety because of a reduced intervention of operators onto a moving machine. At the same time using a mould coating ▸

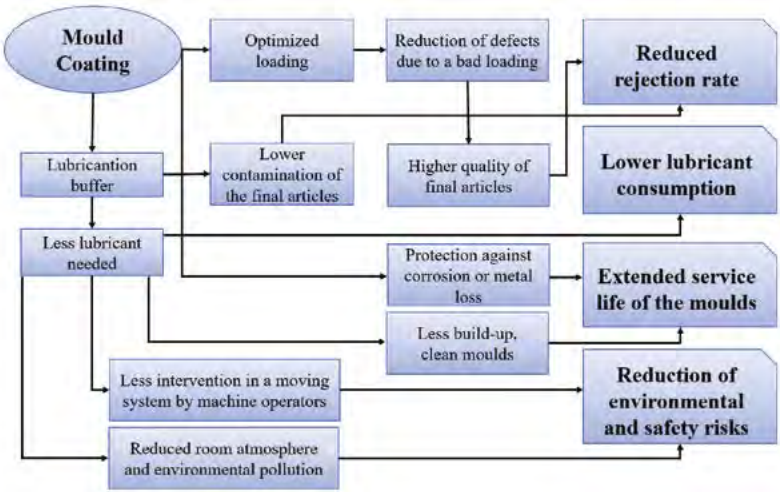


Figure 1: Advantages of using a mould coating.

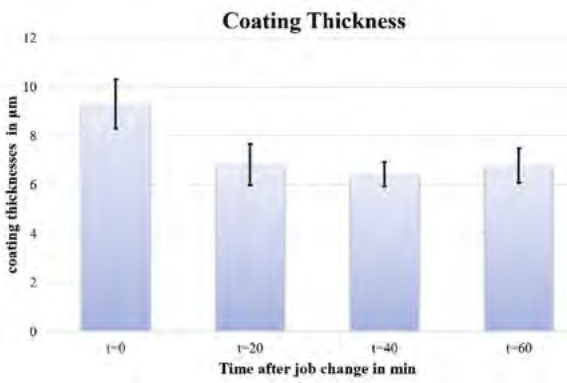


Figure 2: Coating thickness depends on time of the mould in production.

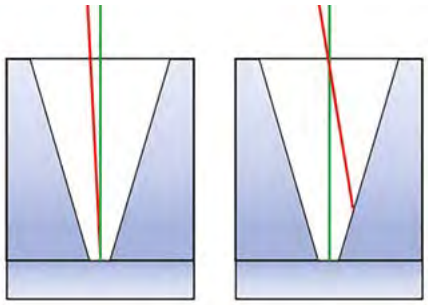


Figure 3: Schematic representation of an optimal and a bad drop load.

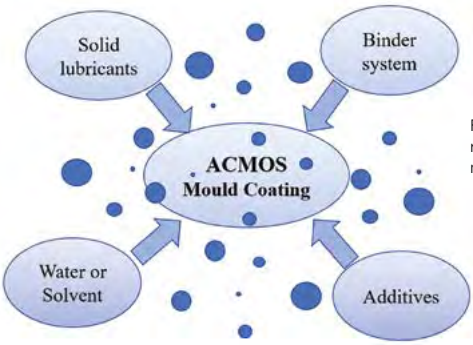


Figure 4: Schematic representation of a mould coating structure.

Figure 5: Process steps required for an optimal coating application.

can also reduce room atmosphere pollution caused by vapour generated during lubrication.

But a mould coating can do even more: the quality of finished articles can be significantly improved. Studies show that by combining the coatings with the usual lubricant, the rejection rate can be reduced significantly. The sliding of glass (gob) and metal (mould surface) as a tribological system causes friction and wear, which has a negative impact on the load and therefore on the article surface. This negative effect is shown by defects such as loading marks, washboards, or cracks. With a mould coating, problems in loading and article defects mentioned above can be avoided, which also has a positive effect on other quality parameters, such as bursting pressure.

Further, a mould coating protects the mould surface against corrosion or metal loss – both have a positive effect on the quality and service life of the moulds and reduce maintenance and purchase costs.

Coating composition

ACMOS offers a wide range of mould coatings available as bulk material and in spray cans. The user can choose between universally applicable coatings or products developed for a specific mould area, such as neck rings.

The chemical structure of ACMOS mould coatings is very similar to conventional lacquers, whereby the consumption of the sliding layer as a wear layer is intended, and the conventional lacquer is designed for longevity (see Figure 4).

ACMOS mould coatings are also called solid lubricant systems because they are based on solid lubricants, such as graphite, boron nitride, aluminium, or molybdenum sulphide, which are integrated in an organic or an inorganic binder system. Due to a high temperature load, only high-temperature resistant systems such as silicones and inorganic binders can be used as binders. Solid lubricants, binders and additives are dispersed in water or solvent.

The fineness of ACMOS coatings is ensured by using a grindometer, following the ISO 1524:2013 method for determining the fineness of grind of paints, inks and related products.

One of the biggest challenges in the production of such mould coatings is to ensure a certain grain distribution and the formation

of an even layer on the mould surface at the customer side. To meet this challenge, ACMOS uses state-of-the-art dispersion technology and continuously optimises its manufacturing methods. The company has successfully demonstrated its blank mould coating process for perfume bottle production at Heinz Glas, manufacturer of glass flaçons for the perfume and cosmetics industry.

Application of ACMOS coatings

To take full advantage of a mould coating, ACMOS advises paying special attention to product choice. The optimal mixture of active ingredients and the kind of coating depends on the article type and mould area to be coated. In the case of blank moulds, bottoms and neck rings should also be coated because the benefits of a coating are particularly effective in these areas. The final moulds can be coated completely or in areas of engravings only to minimise checking and cracking issues in these problem zones.

The type of article, production speed as well as other process parameters have a significant impact on the service life of a coating which can be considerably extended using ACMOS lubricants as they are matched to each other and fully develop their advantages in the production process when used together.

The performance of a coating does not only depend on the product selection, but the correct application is of great importance (see Figure 5). ACMOS recommends paying special attention to the following process steps:

First, moulds must be properly cleaned. A metallically clean and grease-free surface is a basis for an optimal application and a long service life of the coating. Blasting with abrasive material (sand, metal balls, glass beads) is the usual method and is also recommended by us. If the mould surface seems to be too rough after blasting, it can be repolished. Before coating, a chemical cleaning or degreasing is recommended to eliminate possible dust and grease residues.

For initial trials, the use of spray cans as a possible delivery form of the ACMOS coatings is suggested to be able to test the coating without having to invest in application technology. After that trial stage, however, the use of bulk products should be considered for environmental and cost reasons – but return on investment can be achieved in only a few months. ACMOS is happy to advise on selecting the best application technique for your process.

An important aspect that is often overlooked is the stirring of the container content before applying the coating. For spray cans and smaller containers, this can be done by shaking it manually; for containers of net 5kg or more, a stirring device should be installed.

After the mould surface is free of dust and grease, you can spray the coating on the shaping mould surface as well as on the space between the mould halves double and crosswise, but in very thin layers. The motto 'less is more' applies here. Our experience shows that coating thicknesses of 6–7 microns are sufficient. Extra thick layers are rather counterproductive because they can spill off the moulds after the curing process.

After a double and crosswise application, the coating must be polymerised at a temperature between 300°C to 400°C for approximately one hour. Preheating ovens are frequently used and are well suited for this purpose. The volatile components of the coatings flash off and do not lead to any room atmosphere pollution in the production. Later, the mould can be preheated and installed as usual. ●

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Re-engineering cold end inspection lines

As container inspection technology progresses towards fully automated glass plants, the replacement of mechanical solutions is imperative. Mark Ziegler examines options from optical inspections specialist Dr. Günther for designing new cold end lines or re-engineering existing lines.

Modern container glass productions are subject to increasing demands on product quality and safety. Brand owners cannot afford to risk the health of the consumers and spoil their reputation on the end user market.

In the past, mechanical inspection solutions have been the standard for surveying the production process, resulting in high costs for set-up (longer downtimes) and for tooling (large stock and wear). This has completely changed with the advent of new innovative software technology, including machine learning and the constant improvement of camera technology. For example, the inspection of dip/saddle (tightness) or bore diameter (gauge) is now possible with intelligent image processing.

A limiting factor in terms of speed for engineering of cold end lines is still the star wheel machines, as the flow of produced articles has to be interrupted and the bottles have to be placed into the pockets of the star wheel. With today's technology, wall thickness measurement remains the only inspection method that requires the bottles to be rotated in the stations of the star wheel machine. In-line camera inspection machines with a new camera set-up and light sources combined with machine-learning based software modules will be a way to tackle this issue in the future.

Solution for bore diameter and ovality

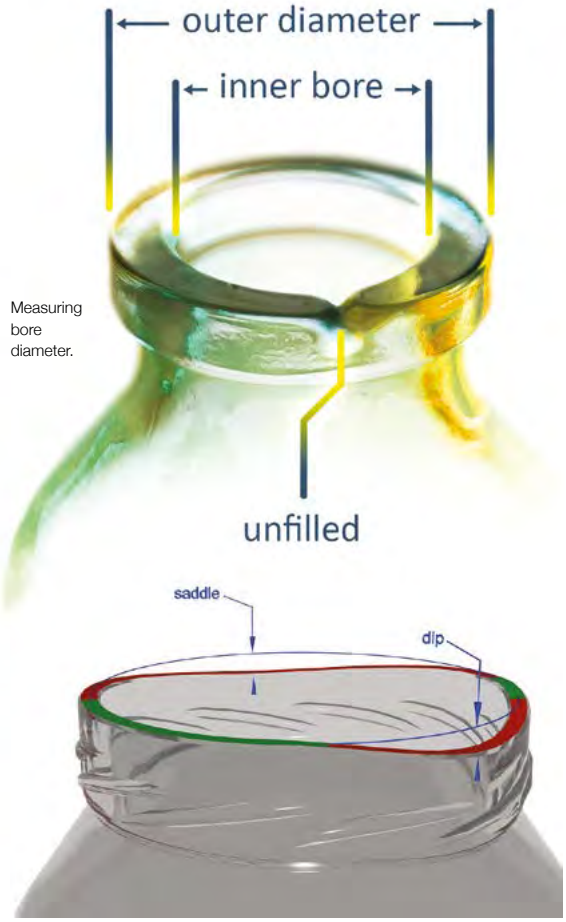
Detection of the inner bore diameter has been done with mechanical solutions in the past, causing high costs for tooling and maintenance. Dr. Günther Inspections (DGI) has developed a solution that can be used as stand-alone retrofit machine, or integrated into a standard bottom/mouth camera inspection machine (BMF type). 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 also ovality problems are detected as well. Optional for the stand-alone unit is a second camera, allowing inspection of the outer diameter and checks in the mouth rim.

Measuring wall thickness

Dr. Günther inspections offers an innovative camera-based solution suitable for many containers types produced in BB productions. The design of the sidewall machine with all cameras perpendicular to a dedicated light-source allows more precise images, as the optical conditions for every camera are the same. As a result, it is possible to detect problems with the glass distribution, based on a teaching mode. This enables a quick set-up of the inspection machine.

DGI has already provided specific solutions for inline measurement of wall thickness for shaped articles and is currently working on a solution for round articles as well. ▸

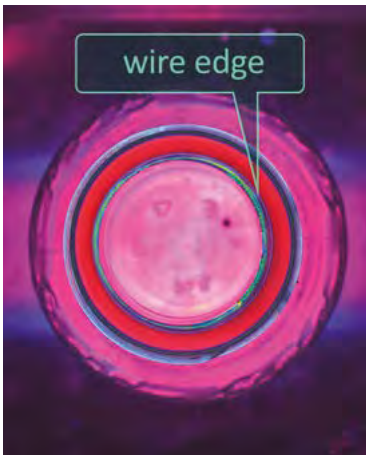
Measuring wall thickness.



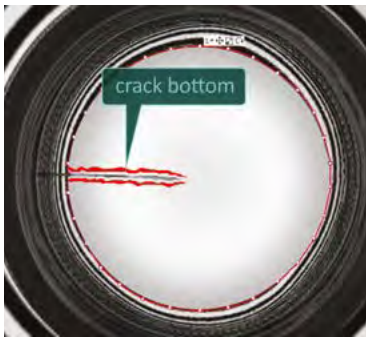
Measuring bore diameter.

Dip and saddle detection.

Defect detection: overpressed.



Defect detection: wire edge.



Crack in the bottom.

Crack in the finish.

When this solution is available, it will no longer be necessary to slow down the production process to set up the inspection points.

Of course, the wall thickness of ultra-lightweight NNPB bottles is more critical, as it needs to be extremely precise. "For these applications, we have reliable partners whose competences are in stop-rotate machines with dedicated wall thickness sensors" states Dr. Friedrich Günther.

Check detection by camera

Camera-based check detection using modern image processing software has been available for around 10 years. One requirement for these solutions is a rotating station, turning the bottle several times. For many container types, the check detection can be transferred to the camera sidewall inspection machine (CSWI) and the bottom/mouth inspection machine (BMF), which the Günther team has designed. The combination of both machines and the unique camera/light source design allows several images from different positions, but all with the same optical conditions. This paves the way for the detection of defects in the mouth, body and bottom of the container.

Inspecting planity and tightness

When inspecting for planity (flatness) and tightness, the wider the mouth, the greater the challenge, which is of course the case in jar productions. Dr. Günther offers a solution integrated into the standard camera sidewall inspection machine (CSWI) or as stand-alone solution. Two cameras survey the mouth rim. Even smallest deviations (±20 microns) can be found and as a result, dip or saddle deviations or breakouts are detected. Any containers with a critical tightness defect are eliminated by these two camera solutions.

As the stand-alone PLA machine can easily reach inspection speeds of up to 600bpm, a flexible integration into the Cold End layout is essential, points out Tilo Günther, responsible for R&D at Dr. Günther. The machine's footprint is just 550mm x 650mm and it can be installed on existing conveyor belts with ease. The stand-alone machine is often used in plants that have jars in their portfolios. The machine can be moved from one line to another; it is also available with wheels for easier re-positioning.

Detecting wire edge and overpress

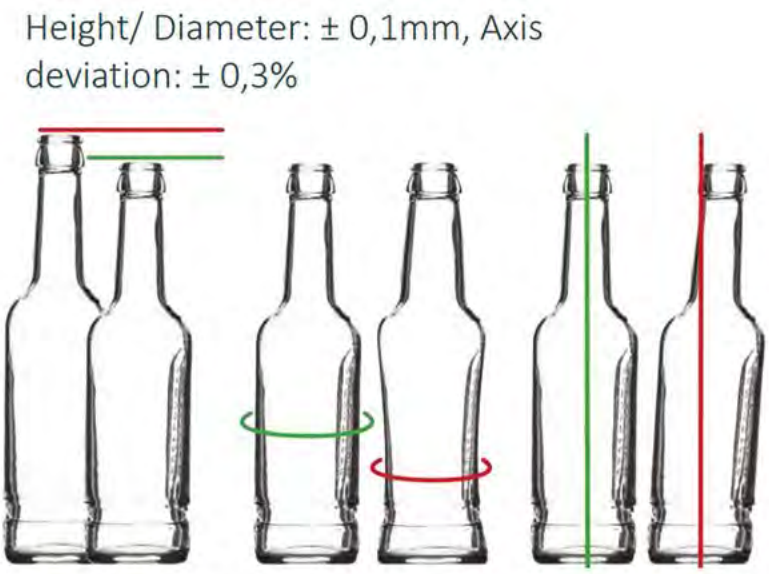
Among the most critical defects in glass container production are overpress and wire edge, particularly for narrow neck press and blow (NNPB) producers. An overpress is located on the inner rim of the sealing surface, like a fin of glass extending above the sealing surface. Wire edge is also a fin of 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 Dr. Günther camera machines, 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.

Dimension defects

Another inspection procedure that can be covered by the sidewall and bottom/mouth camera inspection machines is container dimension, including height, diameter, leaner and out-of round defects. These defects are found by the sidewall camera machine, which is usually the first inspection machine, located behind the annealing lehr.

After decades of incremental progress, the container inspection technology has started to take larger steps towards a fully automated glass plant. The replacement of mechanical solutions is a prerequisite for this. A new design of cameras and light sources, combined with new approaches to image processing will level the path. ●



Examples of dimension irregularity and out of round.

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Fast, smart and robust digital glass printing

Designed help flat glass processors increase capacity and shift larger production batches to the digital platform, Dip-Tech's powerful DX-3 printer offers an enticing solution for the flat glass architecture market, says Keren Peleg.

Last October Dip-Tech, the digital ceramic glass printing business unit of Ferro (global supplier of technology-based functional coatings and colour solutions, which acquired the company in 2017), launched its DX-3 digital printer for flat glass applications. The machine was designed and developed for flat glass printing of ceramic inks and is the product of extensive feedback and analysis of customer needs, along with Dip-Tech's own critical analysis of its previous generation of machines.

Based on feedback from customers, system robustness and serviceability were critical design goals for the DX-3, centred around four guiding principles. First, reduce daily maintenance to a minimum with zero ink removal, zero wash and zero purge. Secondly, design the system for quality reliability and longevity. The third was to incorporate automatic, autonomous diagnostics; and fourth, to have a very short and easy-to-repair nozzle cycle.

SmartDrop technology

The result was SmartDrop Technology – Dip-Tech's combination of printheads, empowered electronics, innovative software and an all-new ink system for impressive speed and image quality with resolution up to >2880dpi. The autonomous quality consistency system saves time and enhances printing consistency and reliability; the system combines automatic machine calibration, nozzle performance inspection, nozzle compensation and printing quality inspection. Dip-Tech's DX-3 can automatically scan and correct image position on the glass to ensure perfectly seamless multi-panel designs, while constant monitoring of printheads and glass temperature adds to continuous control of printing quality.

Printed façade of a school in the Netherlands.

Glass façade that envelopes the Ryerson University Student Learning Centre in Toronto, Canada.

Ease of inking

Intended to be a game changer in the world of digital printing on glass, the DX-3 is designed help flat glass processors increase their capacity and shift larger production batches to the digital platform, including mass production jobs such as dots and lines, or even fully coated spandrels. The new model incorporates innovative features to improve serviceability and user-friendliness. For example, the ink system has 12 ink cartridges which are on the outside of the machine making

Dip-Tech's CMiX colour system.

it versatile and easy to service. If a customer wishes to print either a façade or dots and lines, the performance of the printer can be optimised by filling the colour tanks accordingly, thereby achieving great speed and performance according to the application required.

The new ink system features an easy-to-use drawer design that can simply be pulled out from the machine for fast servicing and/or fixing of any problems. Additionally, ceramic ink needs to circulate and must be agitated at all times to prevent sedimentation and blockages. The Dip-Tech DX-3 incorporates an uninterrupted power supply (UPS) so even if there is a power cut, vital components such as valves and pumps will continue to operate; this feature has the potential to save a lot of downtime and associated cost.

Specifications

The versatile DX-3 can print glass 2.8–3.3m in width and from 2.6–18m long, with a thickness of 2–19mm. Photorealistic images can be printed at speeds up to 262m²/hr, black frames up to 800m²/hr and single-color dots and lines up to 1050m²/hr.

The DX-3 features exceptional jetting capacity, a 12-colour ceramic ink system for maximum versatility and a split conveyor system for optimal productivity. It offers quality consistency and reliability, thanks to autonomous tracking and correction of print quality and performance, and automatic glass scanning systems engineered into the machines. The machine's robust ink system is designed for maximum reliability with minimum service level and maximum user friendliness.

Dip-Tech's DX-3 is a harbinger of the company's new-generation machines, designed to deliver new and innovative technology that is tailored to customer needs and set a new standard in the market. The DX-3 provides a solution for the architecture flat glass market, while Dip-Tech's VX-3 for printing on automotive glass is designed for the specialty transportation sector. ●

Glass curtain wall with ceramic print at Parkland Memorial Hospital in Texas, USA.

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Adding value with laser upgrades

Applying a laser finishing treatment to glass can enhance its value and functionality with a high degree of precision and flexibility. Carsten Koch explores options available with HEGLA's Laserbird system.

Thanks to laser technology, the glass industry can do something that would be almost inconceivable in any other sector. Laser finishing treatment enables manufacturers to enhance the value of largely standardised products and increase their functionality. With prices for traditional IG [insulated glass] units and facade cladding coming under increasing pressure, using laser upgrades to create bird protection glass, RF [radio frequency]-transparent glass and anti-bacterial glass gives manufacturers the chance to tap into new target markets and increase their profit margins.

HEGLA boraident of Halle/Saale, Germany, is a company that specialises in these types of laser applications. The HEGLA Laserbird is a system that can manipulate the top layer of a pane of glass or use laser printing to alter its properties, thus providing the glass with an additional benefit for the customer. "The high degree of flexibility and precision that laser technology offers is what sets it apart from other processes. You can switch between different finishing treatments without wasting time retooling, and the system can be used to work on both individual panes and finished IG units," explains Dr. Thomas Rainer, Head of Development at HEGLA.

The HEGLA Laserbird is a system that can manipulate the top layer of a pane of glass or use laser printing to alter its properties.

Bird protection and RF-transparent glass

RF-transparent glass is created by removing a layer of the coating in a dodecagonal pattern with extremely thin lines. Once this is done, the interior behind the pane of glass in question will enjoy full data and phone reception – perfect for conference rooms, office buildings and public transport. The pattern is almost invisible, and imperceptible when used as part of a finished IG unit.

Birds can be protected from colliding with glass by lasering a different shape into its coating. For optimum results, Dr. Rainer recommends applying the laser to the pyrolytic coating on the outside of the IG unit. However, the glass can also be functionalised without this layer. In such cases, a laser printing process is used to apply a pattern that birds will recognise as an insurmountable obstacle onto the outside of the facade glass. "In Europe alone, 250,000 birds die every day from collisions with glass windows and doors," Dr. Rainer reports. "New legal requirements at the international level have opened up a new market for these applications, and the demand for these types of glass in public and commercial buildings is growing in many local markets as well." The print is weatherproof, scratchproof and lightfast.

Silver ions for an antibacterial effect

An antibacterial effect can be generated using a new, patented finishing treatment that involves embedding silver ions in the surface of a pane of glass. When bacteria and germs come into contact with such a surface, the silver ions reliably kill them off. There are plenty of potential applications for this technology, especially in sectors with strict hygiene requirements, such as hospitals, commercial kitchens and public buildings.

Technical application

The physical conductivity of the top glass layers also makes them suitable for technical applications. For example, the low-E layer can be textured in such a way that it creates conductor circuits. This technique can be used to slightly heat up the glass panes in cooling units to prevent them fogging up. This technology is especially popular in conservatories

Adding value to standard products: the Laserbird adds extra functionality to standard products, thus offering potential for new target markets and higher profit margins.

in cold countries, which need to be protected from excessive snow loads. Conductive glass can also be used for burglary protection systems, triggering an alarm if the glass is damaged or broken.

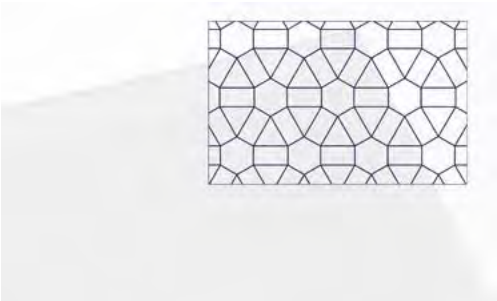
Gentle de-coating

Whether you want to perform edge de-coating or partial coating removal to create lighting effects, laser technology makes the process gentle and precise. "The lasered area is crystal-clear and free of scratches, which means this form of de-coating produces perfect results even for the high standards of structural glazing and visible areas in general," Dr. Rainer explains. The surface of the glass remains completely intact, as do its dazzling looks.

App control and automation

The Laserbird's various finishing treatment programs can be selected via an app-based control system. The lasering jobs can be created in advance using the work preparation software in your office, then you can save them in your ERP system or directly in the Laserbird system itself. Once the job has been selected, the glass is automatically transported into the system and the lasering begins. The Laserbird system can also be integrated into your ERP system for full data access, or you can use glass markings and an automated scanner to create a localised control system – thus making the experience even more user-friendly. As soon as the pane of glass or IG unit is available, the system scans the marking and the finishing treatment is activated. If your Laserbird is fitted with this scanner-based control system, the glass can be loaded onto it from a rack or harp rack in any order. Alternatively, it can also be connected directly via an AGV, for example. "The best place to position the Laserbird is at the end of your production line, as a stand-alone process station," Dr Rainer recommends. "This keeps the finishing treatment separate from the glass flow, so it can be optimised to suit the process and delivery deadlines at hand." ●

Gentle edge de-coating with the Laserbird creates crystal-clear, aesthetically pleasing results.



RF-transparent glass is created by removing a layer of the coating in a dodecagonal pattern with extremely thin lines. The texture is imperceptible to the human eye.

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With silver ions embedded in the glass using laser technology, germs and bacteria have no chance of survival. The antibacterial effect is suitable for any environment where hygiene is paramount.

Boosting closed loop glass recycling in Europe

FEVE
The European Container Glass Federation

While FEVE supports the Close the Glass Loop partnership to increase the European collection for recycling rate and improve the quality of recycled glass, Deposit Return Schemes are not the way forward, believes Vanessa Chesnot.

Vanessa Chesnot – "including glass in a DRS could have a range of negative consequences and put existing collection and recycling systems at risk."

More than 125,000 people work in the glass packaging value chain across Europe. FEVE represents the European container glass industry, which is strategic to the European economy because it services the essential European food, beverage and pharmaceutical sectors as well as cosmetics and perfumery. The industry serves these sectors in domestic markets and is an enabler for the export of products across the world, which in turn delivers wealth to our economies through trade.

We are proud to produce healthy, reusable and infinitely recyclable closed loop packaging. Glass is a permanent material, meaning it can be endlessly recycled without loss of its intrinsic properties. It is inert and always remains healthy and safe for food grade packaging no matter how many times it is recycled. Unlike many other waste streams, there is a high demand for recycled glass and the average collection rate across Europe is currently 76%, with most of the bottles recycled being reprocessed back into bottles. There is potential and ambition to do more and – as part of the multi-stakeholder partnership Close the Glass Loop – we aim to boost the European collection for recycling rate to 90% by 2030 and improve the quality of recycled glass, so that more recycled content can be used in a new production loop.

glass WORLDWIDE
Preferred journal of FEVE

Including glass in a DRS

When applied to plastic containers, a Deposit Return Scheme (DRS) scheme can help reduce littering, boost collection rates and optimise plastic recycling processes for food contact applications. [However,] we support the response submitted by British Glass on the public consultation on "Introducing a Deposit Return Scheme in England, Wales and Northern Ireland". Evidence across Europe shows that DRS does not maximise quantity or quality of recycled glass and we consider that including glass in a DRS could have a range of negative consequences and put existing collection and recycling systems at risk.

EPR schemes

Extended Producer Responsibility schemes already ensure that all types of glass containers are effectively collected and recycled at the end of their life. The top three European countries (Belgium, Slovenia and Sweden) in terms of glass recycling, operate an EPR only scheme. Of the 10 countries with a glass recycling rate above 80% only three operate a combined DRS/EPR system (Denmark, Germany and Finland). Contrary to DRS systems, which are typically only used for beverage containers (beer, water, soft drinks), EPR schemes already ensure that all glass packaging types – and not simply a small portion – are collected and recycled effectively via kerbside and bottle bank collection. DRS cannot be considered a mainstream solution for tackling waste glass as the six DRS (Croatia, Denmark, Estonia, Finland, Germany, and Lithuania) in operation across Europe only accounts for 436,000 tonnes of the 14 million tonnes of waste glass generated, i.e. it only accounts for 3.1% of the waste glass generated across Europe. Only in Croatia and Finland is the DRS the major collection mechanism, while in the other four countries less than 20% of glass is collected via the DRS.

Recycling rate

Diverting glass packaging away from EPR schemes through a recycling DRS puts at risk the viability of continued kerbside and bottle bank collections of glass and undoes decades of investment in infrastructure & education. The implementation of a recycling DRS could impact on the efficient collection by the local authorities of

out-of-scope packaging. The DRS removes high value, high quality glass from the EPR system which can have a major impact on the viability of the EPR system. For example, DRS are in operation in Croatia, Estonia and Lithuania and although the recycling rates for the in-scope glass are high the overall national recycling rates are below the EU-27 average and placing all three countries within the eight lowest recycling nations in Europe. In the case of Lithuania, the recycling rate for glass since the implementation of the recycling DRS in 2016 has been below the 2015 rate of 74.3%.

Costs

The cost of operating a DRS scheme is substantially higher than that of EPR schemes – especially for glass. Evidence from existing DRS shows that the handling and management of glass is far harder than PET or cans and this is reflected in the material level producer fees. The inclusion of glass in a recycling DRS results at best in marginal gains but at a very high cost. The cost of operating the DRS varies considerably from €124 per tonne in Estonia to €333 per tonne in Finland, with an average cost across the four countries of €213 per tonne. The operating costs associated with the Extended Producer Responsibility (EPR) scheme can be seen to be far more consistent across the four countries. These vary from €77 per tonne in Germany to €112 per tonne in Finland, with an average cost of €94 per tonne.

Consumer confusion

Running two glass collection systems in parallel can lead to confusion among consumers – meaning less effective recycling. The majority of the countries that operate a recycling DRS had or still have a well-established refillable DRS and consumers have been accustomed to the two-system approach, and hence, the transition to the recycling DRS was easy. However, in many of the Member States the refillable markets have disappeared and consumers are used to just the one system of recycling. Therefore, running two glass collection systems in parallel is more confusing for citizens, and risks less glass being recycled as a result of a dual system. Additionally, it is burdensome for consumers to identify DRS waste packaging, for which they can claim a deposit, from non-DRS waste packaging.

Packaging market shift

The inclusion of glass in the recycling DRS risks shifting the packaging market away from glass and into PET (or metal cans). The unintended market distorting effects of DRS for glass are clearly visible within market data. The impact of DRS on the market share of glass for in scope products is very stark, with those countries operating a dual EPR/DRS system having a glass market share 65–78% lower than those without an existing DRS.

Best recycling system for glass

Our aim is to have people recycling more and better and we do not believe a DRS is the right recycling system for glass. We consider that the highest recycling rates for glass can be achieved when there is a separate single glass collection system, consistent kerbside and bottle bank collections, and effective public communication initiatives, under a system of Extended Producer Responsibility. We therefore support improved Extended Producer Responsibility schemes and municipal waste management systems that make collection simple for the consumer and optimal for the recycling value chain. ●

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A turning point for the flat glass sector

GLASS FOR EUROPE

High-tech glazing is set to play a crucial role In the journey toward climate-neutrality. With some 'fine-tuning', the European Commission's Fit for 55 proposals will provide important support for the glass industry as it focuses on reducing manufacturing emissions.

Philippe Bastien, President of Glass for Europe and Regional President of AGC Glass Europe.

glass WORLDWIDE *Preferred journal of Glass for Europe*

On 14 July 2021, the European Commission revealed its strategy to reduce its emissions by 55% in the next decade and make Europe the first climate neutral continent by 2050. "With the release of the so-called 'Fit for 55' package, the European Commission does not fall short of its ambition" says Bertrand Cazes, Secretary General of Glass for Europe. "This is a turning point and a remarkable moment for a sector like the flat glass industry."

The Fit for 55 package contains more than a dozen inter-twined legislative proposals. The European Commission aims to update several pieces of its Energy and Climate legislative framework to align the requirements to the increased climate ambition of the Union. New initiatives have been put on the table to secure contributions to the CO_2 emissions reduction goal from sectors such as buildings and transport. Glass for Europe is particularly supportive of measures which have the potential to support the market uptake of CO_2 avoiding products, such as initiatives to boost energy efficiency and renewables in both buildings and transport.

Renovating with glass

Philippe Bastien, President of Glass for Europe and Regional President of AGC Glass Europe, explains: "In the journey toward climate-neutrality, high-tech glazing will play a crucial role to renovate ageing buildings, to support the clean mobility transition and to increase the share of solar energy. In Europe's flat glass sector, we stand ready to make this essential material available while developing novel ways to lower our own industrial emissions".

The release of the Fit for 55 package is the first step of a long legislative process which could take up to two years. In the coming months, both the European Council and the Parliament will have their say and intense negotiations will take place before the final agreement. "While a clear political direction is provided with this package," continues Bertrand Cazes, "some fine-tuning will be needed to make sure this framework supports our industry's efforts to reduce its manufacturing emissions." Glass for Europe will be active to make sure that the Fit for 55 legislative package does trigger a virtuous decarbonisation cycle for the European flat glass industry.

"Glass for Europe will work in the coming months to make sure today's legislative package does trigger a virtuous decarbonisation cycle," concluded Glass for Europe's President, Mr Philippe Bastien.

Review of the Emissions Trading System

The EU's Emissions Trading System (ETS) is the world biggest carbon market and covers both the power sector and manufacturing industry. Under the EU ETS, flat glass companies are required to buy carbon emissions permits for their installations. In order to further increase the price of carbon, the European Commission has proposed to lower the emission cap and increase its annual rate of reduction.

Glass for Europe believes that new proposals may need improvement to ensure that frontrunners like the flat glass industry are not penalised and that sectors at the risk of carbon leakage are thoroughly protected.

Residential and transport decarbonisation

This is probably going to be one of the most controversial proposal included in the Fit for 55 package. The Commission intends to create a new, separate ETS to decarbonise the residential and transport sector. In practice, fuel suppliers of domestic heating and combustion cars will have to pay a price for the carbon emissions of their products.

Glass for Europe calls on extreme vigilance with regards to the extension of the EU ETS to buildings. While it may generate funds for building renovation, citizens' buy-in for the measure should remain a pre-requisite.

Energy efficiency in buildings

In addition to the new ETS for building, other pieces of the legislative puzzle under review are targeting the building sector, which is by far the market of reference for the flat glass products. In its proposal, the European Commission set a more ambitious energy efficiency target that could drive the energy renovation of the European building stock and demanded national governments to lead the way. Member States are in fact asked to renovate annually 3% of the floor area of all public buildings, including healthcare, education and public housing and to consider energy efficiency solutions in policy and investment decisions in energy systems and non-energy sectors (i.e. buildings).

Glass for Europe welcome the proposal to increase the energy efficiency target and to make it binding at EU level. It also supports the creation of a fund potentially available for building renovation through instruments, such as the EU Emission Trading Scheme and the New Social Climate Fund. ●

Bertrand Cazes, Secretary General of Glass for Europe.

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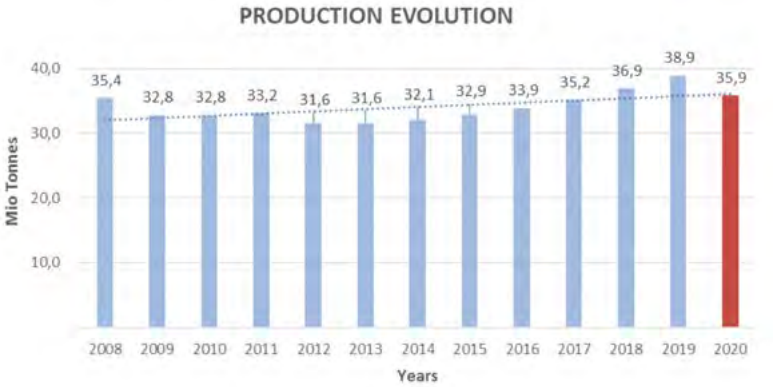
EU glass industry maintains global stability

Analysing figures for 2019–2020 and the effects of the Covid-19 pandemic, Glass Alliance Europe reports on the state of the EU glass industry.

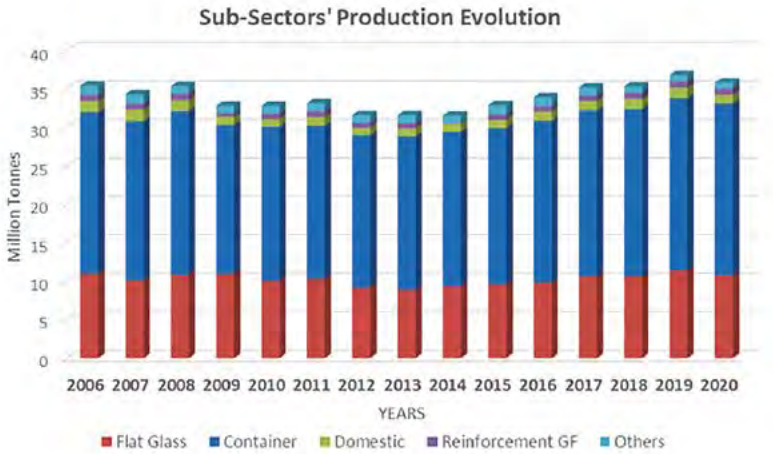
Covid-19 has disrupted the normal operations of the glass sector, with some companies being more exposed to the effects of shut-downs than others, resulting in them coming under severe financial pressure.

The state of the European glass industry has however maintained a satisfactory global level. Figures for 2020 confirm the global stability of our industry, with production of 35.85 million tonnes, which represents a decrease of 2.6% compared with 2019.

This reduction indicates that the market suffered from the pandemic, at different levels according to each glass subsector. Indeed, the domestic glassware (-14%) and flat glass sectors (-5.5%)[1] were particularly hit by the very low demand; difficult working conditions; decreased activities in catering, the construction sector, the car industry and the energy sector; while the container and special glass sectors – considered essential to the economy (food services) and to fight against the pandemic (laboratory glassware) – were able to maintain their production levels.



EU glass production (million tonnes). Source: Glass Alliance Europe



Production evolution within sectors (million tonnes). Source: Glass Alliance Europe

Compared with 2019, 2020 extra EU-27 exports decreased by 3.82 million tonnes, while imports decreased by nearly 4.58 million tonnes. Source: Eurostat

Glass remains an important player in EU economy

The glass industry can be proud of the achievements realised so far. It remains an important player in the European sustainable economy. Co-operation with authorities and high commitment within the industry are key factors for maintaining glass production in Europe and for success in the future.

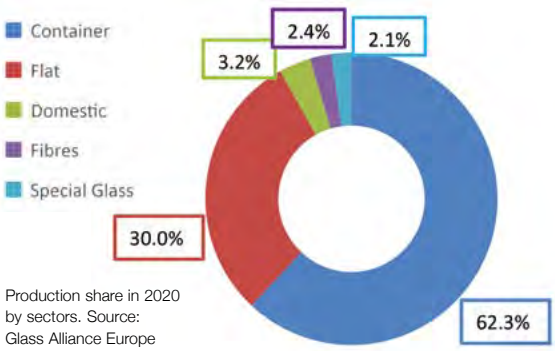
Production level means that the EU retains its position as one of the largest glass producers in the world, along with China and North America. Germany remains the EU's biggest producer, responsible for about one fifth of the volume, closely followed by Italy, France and Spain.

Consumer demand is rising again at almost pre-crisis level. It is anticipated that the production will resume to pre-crisis level by the end of 2022.

External trade

Regarding foreign trade, imports from Asian countries, and in particular China, remain big competitors. Compared with 2019, 2020 extra EU-27 [the European Union of 27 member states] exports decreased by 2.6% in volume at 3.82 million tonnes and by 8.8% in value with 7.28 bn Euros. The EU-27's four major clients in volume are the rest of Europe (60.97), including UK (19.4%), Switzerland (13%), Turkey (7.5%), Serbia (3.8%) and Russia (3.5%), followed by the USA (9.5%), North Africa (5%) and Far East Asia (6.7%) including China (3%).

As for extra-EU27, imports in 2020 also decreased compared with 2019, by 6.9% in volume (nearly 4.58 million tonnes) and by 8.4% in value (7.28 bn euros). Far East Asia accounted for 30% (including 24.2% from China alone), the rest of Europe for 58.4% (including UK (14.5%), Turkey (12%), Russia (7.5%), Switzerland (8%) & Ukraine (8%), North Africa for 4.8%, United Arabic Emirates (2%) and the USA for 1.9%. ▸



Production share in 2020 by sectors. Source: Glass Alliance Europe

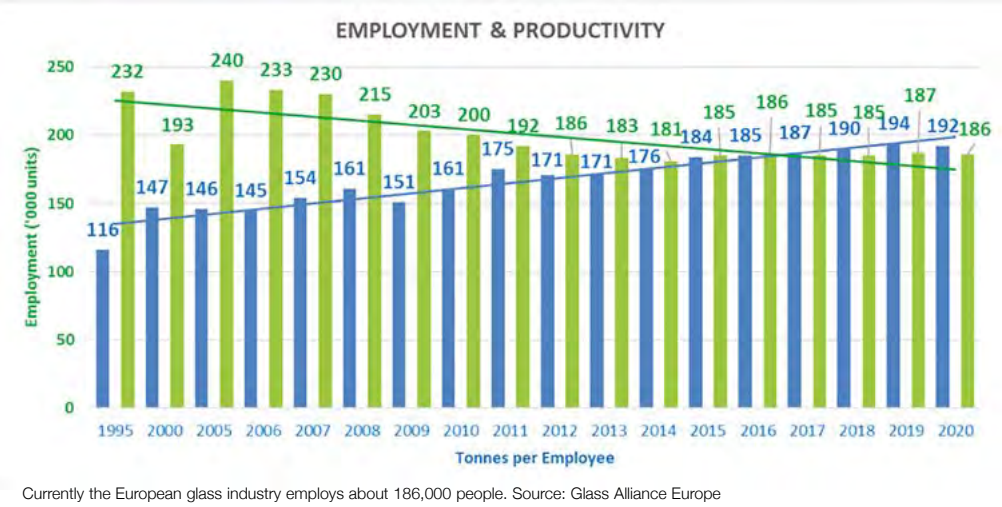
Employment

The number of glass industry employees has stabilised since 2013. Currently, the EU-27 glass industry employs about 186,000 people (including processors), showing a stable socio-economic situation.

Outlook

Behind these 2020 figures aggregated at the level of the whole glass industry, it is important to realise that the situations are contrasted in the different sectors. Evolution in production and employment, as well as in the origin of imports into the EU, can be very different between glass sectors. However, the global trend indicates steadily increasing imports in all glass sectors with rather limited exports. Investment outside European borders has materialised and imports are gradually and insidiously increasing, taking greater EU market shares in all glass sectors.

With tough market conditions, a difficult global sanitary situation and consumer confidence still to be restored, competition remains intense with non-European glass manufacturers.



Currently the European glass industry employs about 186,000 people. Source: Glass Alliance Europe

For 2021, next to the high influence of worldwide context, the recovery of the economy will remain very dependent on the pandemic evolution, implementation of national recovery plans and on EU support to the industry, while EU stringent climate policies (Green Deal, Fit for 55 package, ETS revision, Decarbonisation, REACH, Food Contact, etc.) will further impact all EU glass sectors. One can predict an ever-challenging manufacturing climate and a slow recovery. ●

Reference

1. 5.5% represents the fall in melted glass production. However, decrease in saleable glass figures reaches double digit figures. This difference is due to the several furnaces that remain in 'hot holds' during the pandemic: melted glass is produced but it cannot be sold.

Further information:
Glass Alliance Europe, Brussels, Belgium
tel: +32 2 538 44 46
email: info@glassallianceeurope.eu
web: www.glassallianceeurope.eu

Glass that makes disinfection superfluous

How often do you touch something made of glass? Gesine Bergmann from the Mechanical Engineering Industry Association (VDMA) explores glass surface pre-treatments that can kill off viruses and bacteria.

The last industry working group of the Glass Technology Forum dealt exclusively with glass surfaces and their specific properties. These are permanently under the influence of their environment and not only through weather and air pollution. Wherever people come into contact with glass surfaces, they leave traces and thus also viruses and bacteria; however, a special coating can prevent them from surviving on the surface.

Glasses such as these from the NSG Group are used in the medical sector or are part of interior design. Furniture surfaces lend themselves to this, especially in places with a lot of public traffic.

Photocatalytic effect

SaniTise glass from Pilkington contains a coating based on titanium dioxide, TiO_2 that is applied in a CVD [chemical vapour deposition] process at 600°C during float glass production. The photocatalytic effect is triggered by UV light. Sunlight destroys 90% of the viruses on the surface after about 15 minutes. An 'accumulator effect' means that about 80% of the viruses are still destroyed after 60 minutes. Additional UV light sources are necessary indoors. The layer is active for the glass's life and does not restrict further processing steps in the manufacturing process. Since it is very thin, the glass can be recycled.

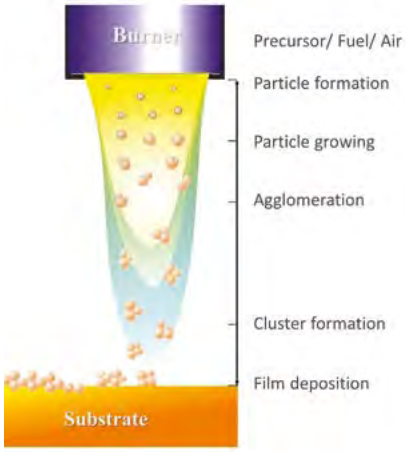
With laminated glass, the film used must be UV-permeable. If the active surface is printed on afterwards, the photocatalytic effect is reduced because the printed area can no longer reduce the virus load. Special cleaning agents are not necessary.

Silver ions

Another option for creating an antibacterial function is a process offered by technology and engineering company HEGLA boraident (see page 148). A laser heats the glass surface and initiates the transfer of silver ions from a transfer medium on the glass surface into the glass surface. Silver ions are known to kill bacteria that get onto the glass surface through skin contact. The process can be used to treat glass handles or other surfaces that are frequently touched.

Glass surface reactions

In general, glasses react to external influences. Ninety-five percent of glasses that are used are silicate glasses.



Flaming can clean the surface of older glass and, depending on the process, remove the cold end coating at the same time. Image source: SURA Instruments GmbH

Due to the hybridisation state, the SiO_2 [silicon dioxide] ensures that a three-dimensionally linked silicate network with four bonding arms is created. This is hard to dissolve. Nevertheless, the surface reacts impressively – if new surfaces form, loose and thus reactive bonds are present. This is also reflected in the strength: the smallest defective spots in the surface cause brittle fractures when tensile stress occurs. Consequently, it is helpful to introduce compressive stresses into the surface. This is done, for example, via chemical or thermal pre-stressing.

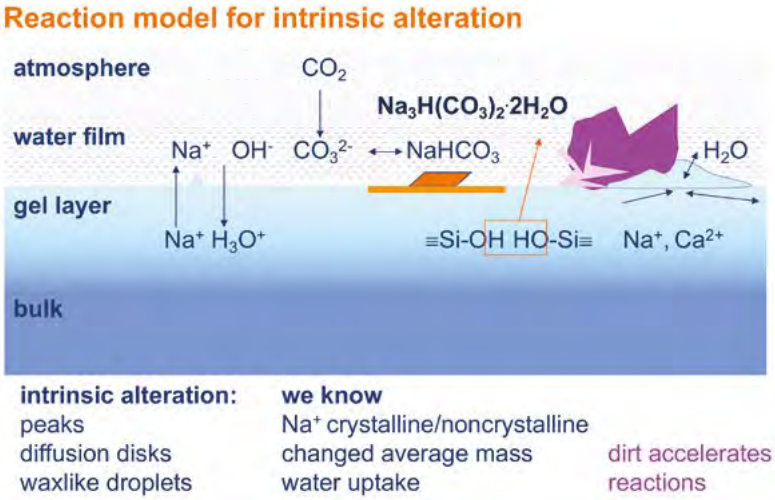
The glass surfaces change over time. In particular, the reaction with moisture damages the surface ('deficient water attack'). A gel layer forms in which, on the one hand, crystallisation takes place, but which, on the other, can act as a protective layer depending on time. Why these gel layer bumps form has not yet been explained. The TU Ilmenau [The Technische Universität Ilmenau – a German public research university] is also researching this. Sodium hydrogen carbonates are often found there. The weathered and dried gel layer can flake off over a large area and reveal a new glass surface. In our daily environment we encounter glass surface reactions, for example in the dishwasher, but external environmental conditions such as dust or sand also show great effects.

Coatings and adhesion

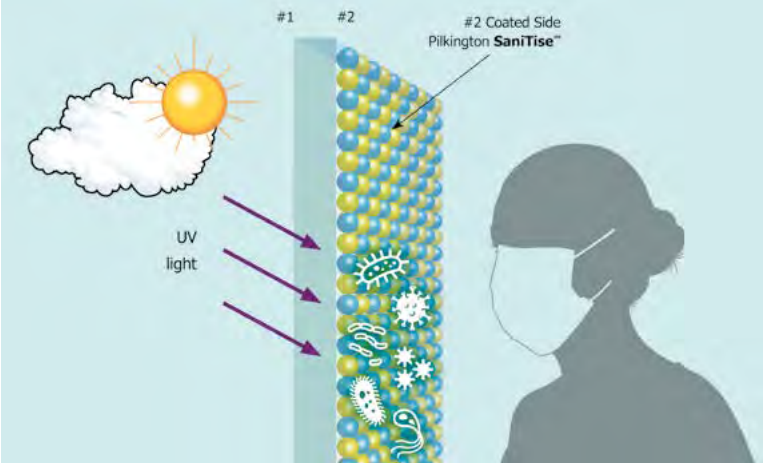
The gel layer that develops during the ageing and corrosion process requires glass to be pre-treated before printing or coating. This is a core competency of SURA Instruments GmbH, manufacturer of machines and materials for pre-treatment and activating surfaces. One possibility is to silicatise the surface using pyrosil technology. This involves burning a gas mixture with a precursor containing silicon. A silicate network with a high number of OH groups is formed. The result is a hydrophilic layer on which the water contact angle is reduced to values between 0 and 5 degrees. This is important for the application of lacquers or adhesives, but it also affects the reflectance of the surface.

Digital printing, especially with organic, fast-curing inks, is becoming increasingly important. This process enables the smallest batch sizes and the highest degree of individualisation. Unfortunately, organic inks are very sensitive and do not contain an adhesion promoter. A mechanical bond [formed] by clinging to the surface is usually not present in glasses. Physical bonds are always present (dipole forces, hydrogen bonding) but are not sufficient to ensure long-term adhesion. Chemical bonds, however, (covalent bonds) can arise when impurities and absorption layers are removed.

The best basis for coatings is a juvenile glass surface.



When a glass surface reacts with moisture a gel layer forms in which crystallisation takes place. Image source: TU Ilmenau



Sunlight destroys 90% of viruses present on the surface of Pilkington's SaniTise glass after about 15 minutes. Image source: NSG Group

Older glass must be pre-treated. Flaming is one possibility; it can clean the surface and, depending on the process, remove the cold end coating at the same time. The adhesion strength increases significantly with adhesion promoters, and the fracture pattern no longer shows adhesion failure.

Mechanical stress on displays

Touch, swipe and zoom actions on a touchscreen not only generate abrasion but also leave skin grease, cosmetics and bacteria on displays. The Institute for Surface and Product Analysis (ISPA) investigates and tests the effects. Humans cannot see changes on the surface that are smaller than 40 microns. The fingertip, however, can feel changes up to one micron in size. The speed of the movement is decisive for the magnitude of the damage. Mechanical stress tests often do not reflect reality because they are performed too slowly.

An established standard test is the ABREX Abrasion Test. It simulates the contact of a viscoelastic, rough and inhomogeneous finger surface and can take into account various solids and liquids as well as temperature ranges. The contact angle of 45 degrees is particularly important. Depending on the requirements in the end application, different load levels and speeds are used. These and other test methods have been tested and further developed by the German Flat Panel Display Forum. An evaluation of the test result is carried out by measuring the contact angle. ●

ABREX is a registered trademark.

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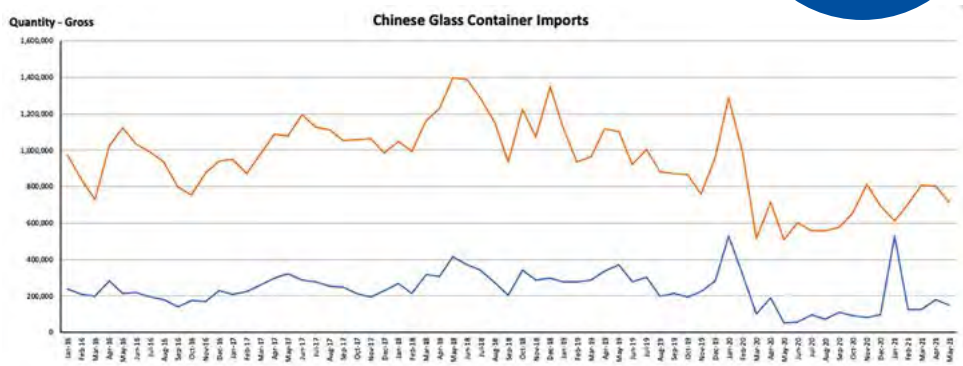
Tracking glass container imports

Scott DeFife presents the GPI's position on tariff implementation on glass containers imported from China, following the news that American companies and stakeholders may be able to request tariff exemptions that were previously denied under the Trump Administration.

Scott DeFife, President of the GPI.



Chinese glass contact imports (source: GPI with data from the US International Trade Commission as the source).

The Senate in the US Congress has included a provision in a chamber-passed, but not yet approved, broad-based China Security bill that would re-open the tariff exclusion process, permitting companies and stakeholders to again request specific product exemptions for Chinese, and other in-place tariffs. The vast majority of initial tariff exemption requests were previously denied by the USTR under the Trump Administration. GPI will continue to follow the tariff process and any to-be-determined timelines, as Congress and the Administration address the issue into 2022.

Throughout the year, the Glass Packaging Institute (GPI) and its member companies follow a number of industry, customer and supplier packaging trends. In addition to the association's primary reporting on the number of US glass bottles and jars produced and shipped each quarter, GPI closely monitors aggregate data for imports of empty glass containers (to be filled with product) by customer bases within the US.

For glass containers, similar to other commercially imported goods arriving to US ports of entry, customs procedures require a vessel's manifest data to include details on all cargo for inspection, tariff assessment and other legal requirements. Glass containers for food and beverage packaging are collectively captured under a broad-based harmonised tariff schedule (HTS).

The broad glass container HTS code (7010.9050) can be broken down by size into sub-categories, and that information is then reported publicly through the US International Trade Commission (USITC) database. As the imports are reported out in size-only measurements, ultimate food and beverage end markets are not always apparent. For example, a 12oz [0.4l] bottle import could be filled with beer, flavoured alcoholic beverages, carbonated or non-carbonated beverages, and in a similar fashion, a 750ml bottle could be filled with either wine, spirits or even water.

Glass container import increases and tariff implementation

While reviewing the USITC import database, GPI and its member companies took notice of a significant increase in the import of glass containers from China beginning in 2016. Imports of all Chinese food and beverage empty glass containers increased by 11% in 2017, and by an additional 12% in 2018. During that time, several US-based shipment categories that GPI reports saw declines, despite relatively steady customer demand.

In the early part of 2018 the

US government, through the Office of the US Trade Representative (USTR) took notice of the import surge from China as well and began to solicit stakeholder input. After careful deliberation, in August of 2018 GPI testified before the USTR in support of tariffs on Chinese glass container imports, in support of our North American member companies and workforce.

After numerous stakeholder and testimonial hearings, the USTR implemented a 10% tariff on a broad range of imported products from China, including glass containers. This went into effect in September of that year. After further discussion and input, that set of tariffs (commonly referred to as List 3 or Tranche 3), increased in duties from 10 to 25% in May of 2019.

Since Chinese tariff implementation began, GPI has closely followed the flow of Chinese glass container imports. In 2019, overall food and beverage glass container imports decreased by just over 19%, and last year were down 26%. Through May of 2021, those imports are down an additional 8%. Given the Covid-19 pandemic, resulting restrictions and overall impact on the import and export environment, it is difficult to discern how much of that decrease post-March 2020 is a result of the implemented tariffs.

Tariff impact and glass container import shift

While US shipments of glass bottles and jars cannot be directly correlated to Chinese imports, the association has seen positive trends through the first quarter of 2021 in several major categories. Beginning in 2019, several quarters saw shipment increases for many of the major food and beverage categories; wine, flavoured alcoholic beverages, non-alcoholic beverages and food among them. A future *Glass Worldwide* column will go into more detail on US shipments through the first half of 2021.

Post-tariff implementation, GPI has also looked for an import shift in empty glass containers from countries outside of North America. Of the largest volume countries, Taiwan's glass food and beverage container imports increased 27% from 2020 to 2019, and through May, are up an additional 17%. While smaller in overall volume, similar import increases have been seen in the Philippines, Thailand and other countries near the Southeast Asian region. These, and other countries' smaller import gains, have more than made up for the decrease in Chinese imports, with overall food and beverage glass container imports up 12% YTD.

What's next for glass container imports and tariffs?

Since taking office in January, the Biden Administration has left the Chinese tariffs in place as they review the most current data, trends and imports fluctuations from around the world, with the hindsight and perspective of imports in some product categories having gradually decreased from China.

The Senate in the US Congress has included a provision in a chamber-passed, but not yet approved, broad-based China Security bill that would re-open the tariff exclusion process, permitting companies and stakeholders to again request specific product exemptions for Chinese, and other in-place tariffs. The vast majority of initial tariff exemption requests were previously denied by the USTR under the Trump Administration. GPI will continue to follow the tariff process and any to-be-determined timelines, as Congress and the Administration address the issue into 2022. ●

glass packaging institute

Further information:
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Arlington, Virginia, USA
tel: +1 703 684 6359
email: info@gpi.org
web: www.gpi.org

82nd Conference on Glass Problems

Robert Weisenburger Lipetz previews this year's Conference on Glass Problems for *Glass Worldwide,* exclusive official journal. The event will combine an extensive technical programme with short courses, a symposium and an exhibition.

The 82nd Conference on Glass Problems (GPC) takes place on 1–4 November in Columbus, Ohio, USA. For more than eighty years, the Conference on Glass Problems has been the leading forum for the exchange of ideas to address shared challenges for glass manufacturing professionals. It is at the GPC that the world's leading technical experts address current problems in manufacturing, with solutions citing real-world examples. It also provides an exhibiting platform for solutions providers to share their innovations that delivers high participation by manufacturers.

Bruno A. Purnode, Owens Corning Global Leader Melting Controls & Modelling Technology, Sr. Research Associate, provides this assessment: "I find the Glass Problems Conference to be the best conference for the glass industry in North America. I learn from high quality lectures from leading industry scientists and technologists. Workshops result in beneficial discussions among industry representatives. At the same time, the conference allows me to meet with my suppliers and their latest innovations. This conference has it all in one place. This is perfect for the limited time I have as a technical manager."

Conference on Glass Problems is the leading forum for the exchange of ideas to address shared challenges for glass manufacturing professionals.

The Conference on Glass Problems is organised by the Glass Manufacturing Industry Council (GMIC), the trade association bridging all segments of glass manufacture and Alfred University, the USA's leading glass research institution. The American Ceramic Society endorses it, with *Glass Worldwide* as the official journal.

The GPC programme content is directed by an industry advisory board and is composed of invited papers and submitted abstracts, with the proceedings published by John Wiley & Sons. Speakers providing real world data from manufacturing plants are given preference. In addition to the extensive two-day technical programme on 2–3 November, the conference also provides hard to obtain technical education. On 1 November, two excellent technical short courses are offered on, 'Fundamentals of Batch and Furnace Operations' taught by C. Philip Ross and 'Electrical ▸

STOP PRESS

83rd Conference on Glass Problems will take place from 31 October to 3 November 2022 at the Greater Columbus Convention Centre and the Hilton Columbus Downtown in Columbus, Ohio, USA

Bob Lipetz is GPC's Conference Director and Executive Director of the GMIC.

Including Fosbel, hospitality will be provided by various supplier organisations at the conclusion of the conference sessions.

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GPC booth exhibitors/hospitality suites

Regular intervals to the Conference on Glass Problems will allow delegates to visit a sold-out booth exhibition of leading suppliers of glassmaking plant, equipment and services. In addition, hospitality will be provided by various supplier organisations at the conclusion of the conference sessions. At the time of going to press, exhibitors and hospitality suite hosts include:

Advanced Control Solutions, Inc.
Integrator of advanced control system solutions.
www.acsitoledo.com

Airpro Fan & Blower Co.
Manufacturer of centrifugal fans for process air requirements.
www.airprofan.com

Air Products
Innovative melting technologies for better glass.
www.airproducts.com/glass

Allstates Refractory Contractors LLC
A full service industrial process general contractor.
www.allstatesrefractory.com

American Ceramic Society
The professional society for ceramic/glass scientists, engineers and manufacturers, with over 10,000 members worldwide.
www.ceramics.org

AMETEK Land
Infrared non-contact temperature measurement.
www.ametek-land.com

ANTONINI S.R.L.
Designer, manufacturer, supplier and installer of annealing and decorating lehrs.
www.antoninisrl.com

BASF Corp
Supplier of temperature sensing products.
www.catalysts.basf.com/tempsensing

Batch House LLC
Batch plant and cullet handling systems provider.
www.batchhouse.com

CANTY
High temperature cameras for glass applications.
www.jmcanty.com

C B Mechanical LLC and Part for Lehrs LLC
Companies dedicated to installing, starting up and servicing lehrs.
www.partforlehrs.com

CelSian Glass & Solar BV
Glass technology and knowledge provider.
www.celsian.nl

Cemtek Instruments, Inc.
A leading supplier of analysers for continuous emissions monitoring.
www.cemtekinstruments.com

Chiz Bros., Refractory and Insulation Specialists
Refractory and high temperature insulation supplier.
www.chizbros.com

Clean Air Technology Ltd.
Offering the filtration performance of DeSOx, DeNOx and Dioxin resolve.
www.cat-filter.com/?lang=en

DSF Refractories & Minerals Ltd.
UK's largest shaped refractory manufacturer and specialist in glass industry applications.
www.dsf.co.uk

Dura Temp Corporation
Hot ware handling & SEFPRO expendables distributor.
www.duratemp.com

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www.ortonceramic.com

ERTL Combustion
Pipe trains, burners, valves and components.
www.ertlcombustion.com

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A world leader in innovative electrical heating technologies for melting and conditioning of all glass types.
www.fic-uk.com

Fives In Glass
A leading supplier in high quality glass melting and conditioning.
www.glass.fivesgroup.com

FlammaTec
Supplier of advanced burner technology for glass furnaces.
www.flammatec.com

Fosbel Inc
Wide range of repair and inspection services.
www.fosbel.com

Frazier-Simplex Inc
Engineering, design, construction and consulting.
www.frazier-simplex.com

Fuse Tech/Hot Tech Group
Glass furnace refractory maintenance, repairs and rebuilds.
www.fusetech.com

Glass Manufacturing Industry Council (GMIC)
Glass industry trade association representing all four glass sectors.
www.gmic.org

Glass Service
Consultant for glass melting/conditioning, furnace control, operation and furnace modelling.
www.gsl.cz

Haldor Topsoe
Offering NOx, SOx, PM and VOC removal through catalytic filtration.
www.topsoe.com

HarbisonWalker International
Engineers, manufactures and supplies quality refractories for glassmaking.
www.thinkHWI.com

Heraeus
Precious metals – fabricated products and services for glass manufacturing.
www.heraeus.com

HFT
Quality engineering and construction solutions from full turnkey greenfield sites to upgrades and repairs.
www.hft.com

Holland Manufacturing Corp
High quality refractory shapes for glass applications.
www.hollandmanufacturing.com

Hotwork-USA
The only continuous operating Hotwork heat-up company since 1965.
www.hotwork.com

JADCO Manufacturing Inc
Leading provider for wear materials and solutions.
www.jadcomfg.com

Jenike & Johanson
Solids handling experts.
www.jenike.com

Johnson Matthey
Precious metal solutions and technical expertise.
https://matthey.com/markets/glass

Lahti Glass Technology Oy
Batch plants and cullet return systems.
www.lahti-glass.fi

LGP International LLC
Specialising in precise measurements of glass and melt properties for more than 50 years.
www.glass-properties-lab.com ▸

Lhoist North America
Calcium for batch and air pollution control.
www.lhoist.com

Lilja Corp.
A leader in industrial and glass furnace construction.
www.liljacorp.com

Linde
A leader in oxy-fuel and combustion technologies.
www.lindeus.com/glass

Magneco/Metrel Inc
Colloidal silica bonded monolithic refractory.
www.magneco-metrel.com

McGill AirClean LLC
Providing air pollution control systems worldwide for over 50 years.
www.mcgillairclean.com

Mixer Systems Inc
American manufacturer of four types of mechanical glass batch mixers.
www.mixersystems.com

New Hudson Corporation
Annealing lehr rollers and services.
www.newhudson.com

New York Blower Company
Heavy duty industrial fans and blowers.
www.nyb.com

Nippon Sanso Holdings Corporation (NSHD)
Offering advanced oxygen combustion technologies.
www.nipponsanso-hd.co.jp/en/

Optris Infrared Sensing LLC
A world leader in IR temperature measurement.
www.optris.com

PaneraTech-SmartMelter Inc
SmartMelter solution for furnace life optimisation.
www.smartmelter.com

Plansee USA
Leading global manufacturer of GME's, nozzles, stirrers.
www.plansee-usa.com

Ramsey Products Corporation
Manufacturer of silent glass conveyor chains.
www.RamseyChain.com

RHI Magnesita
A global leader in refractories.
www.rhimagnesita.com

Rockwell Automation
Industrial automation and information.
www.rockwellautomation.com

RoviSys
Glass industry process & information solutions.
www.rovisys.com

Safety Controls Technology (SCT)
Glass industry safety partner.
www.sct.us.com

SEFPRO
Refractory products and services.
www.sefpro.com

SGT (Society of Glass Technology)
Serves people interested in the production, properties or uses of glass.
www.sgt.org

Shanghai Precision Dosing and Weighing System Co Ltd
Complete solutions for batch plant.
www.shpws.com

S.I.G.MA. srl
Glass furnace refractories.
www.sigmaref.it

SORG USA
Turnkey installations and equipment from raw materials delivery through the glass gob worldwide.
www.sorg.de

Special Shapes Refractory Co Inc
Manufacturer of special, engineered, high quality refractory products.
www.specialshapesrc.com

Specialty Rondot
Serving the glass container industry for 32 years.
www.specialtyrondot.com

SSOE Engineering
Full service engineering company and resource for glass plant engineering.
www.ssoe.com

TANAKA Precious Metals
A Japan-based precious metal manufacturer.
www.tanaka-preciousmetals.com/us/

Toledo Engineering Co Inc
Glass plant engineer, designer, constructor and technical service provider.
www.teco.com

Tri-Mer
Offering full range of air pollution control solutions across the glass industry.
www.tri-mer.com

Watteredge, LLC
Engineered specialty products and assemblies.
www.watteredge.com

Wear Concepts, Inc.
Wear resistant and material flow solutions.
www.wearcon.com

Glass Melting – an Introduction' taught by René Meuleman, Business Development Director and Corinne Claireaux, PhD, Glass Scientist, Academy Manager, both from CelSian. Of particular note, is the full day symposium on 4 November entitled **'Automation in Glass Manufacturing'**. This symposium, co-organised by the Glass Manufacturing Industry Council and GlassTrend, is presented by leading experts in this field who provide a detailed examination of sensors, industrial artificial intelligence, data analytics, controls, remote management, and other automation tools invaluable to efficient sustainable glass manufacturing.

Combining high value technical seminars with robust exhibiting and excellent networking, the Conference on Glass Problems provides an abundance of value for time invested and is what sets the Conference on Glass Problems apart from other trade shows and conferences.

GPC sessions

To be presented at the Greater Columbus Convention Centre and the Hilton Columbus Downtown the conference programme at the time of going to press includes:

2 NOVEMBER

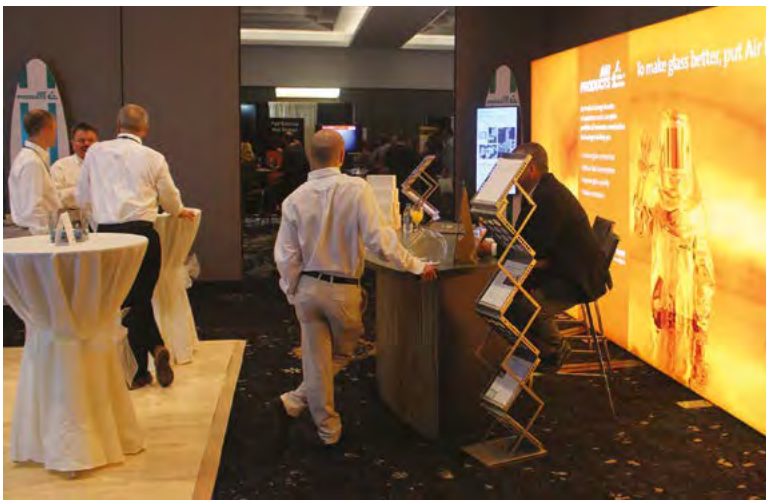
Plenary session:

- *United Nations International Year of Glass,* Manoj Choudhary, Adjunct Professor of Materials Science & Engineering, The Ohio State University/United Nations
- *With COVID an Ongoing Dilemma, especially from a Manufacturing Standpoint,* Elizabeth Nagel, Plant Engineering Manager, Corning Inc.
- *Re-Balancing the Issue-Driven Sustainability Dialogue that is Hurting Glass. How We Got Here and What We Do About It,* Randy Burns, O-I Chief Sustainability and Corporate Affairs Officer, O-I

Refractory session:

- *Mullitisation – The Key to Regenerating Regenerators,* ▸

Erik Muijsenberg from Glass Service Inc will present papers in the GPC programme and the GMIC symposium.



A long-term supporter of GPC, Air Products will be present this year with a hospitality suite.

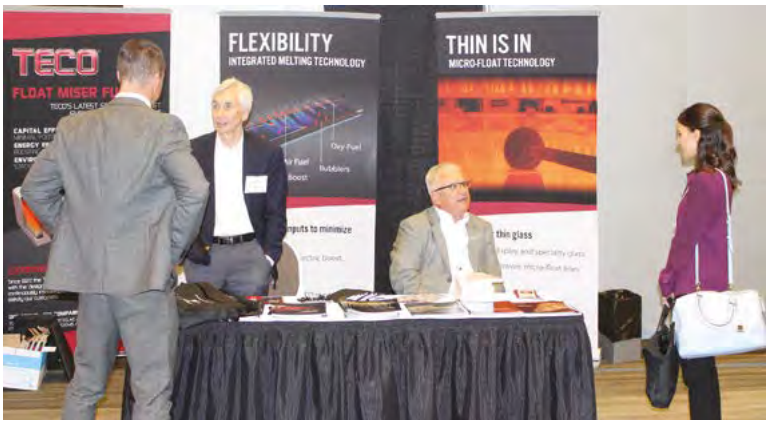
GPC provides an exhibiting platform for solutions providers to share their innovations.

Christopher Windle, Technical Director, DSF Refractories & Minerals, Ltd.

- *Know What's in Your Furnace: All Bonded AZS Refractory Brick Are Not the Same,* J Terry Fisk, Senior Scientist/Owner, JTF Microscopy Services, LLC
- *How Efficient Non-Destructive Control of FC AZS will Support High Quality Glass Melting,* Pierrick Vespa, R&D Project Leader, SEFPRO

Data, chemistry and energy session:

- *Your New Problem Began Two Years Ago: Tracking Refractory Performance and Glass Infiltration Over Time with Data,* Alexander Ruege, PhD, Chief Engineer, VP, Data Analysis and Reporting Division, PaneraTech, Inc.
- *Updated Soda-Lime Glass Compositions Help to Reduce Energy Consumption and Emissions,* Oleg Prokhorenko, PhD, Director, LGP International, LLC
- *Ultrafast Glass Engineering,* S. K. Sundaram, PhD, Program Director, Alfred University
- *Electrical Glass Melting and Boosting Solutions of the Future Designed for Efficiency, Flexibility and Micro-Grid Capability,* Mikael Le Guern, Global Business Development Manager for Glass, Eurotherm by Schneider Electric
- *Heat Exchanger on Glass,* Martin Schroeter, Product Manager, Tri-Mer Corporation



TECO is a longstanding supporter of GPC.

3 NOVEMBER

Plenary session:

- *Solving Quality Problems Associated with Pharmaceutical Glass Containers,* Robert Schaut, Scientific Director, Corning, Inc.
- *Collaboration within Competitive Spaces, The Future of the Glass Industry,* Aston Fuller, General Manager, Glass Futures Ltd.
- *The Green Story of Cardinal FG,* Milo Renberg, Technical Manager, Cardinal FG

Energy/combustion session:

- *Hydrogen as Fuel for the Glass Industry, What are the Challenges?* Oscar Verheijen, Team Lead R&D Training, CelSian
- *Thermoelectric Waste Heat Recovery in an Oxyfuel Melter,* Adam Polcyn, Vitro Architectural Glass
- *Carbon Reduction Strategies,* Corrine Claireaux, PhD, Glass Scientist, Academy Manager CelSian and Andries Habraken, Team Lead Process Automation, CelSian

Sensors/energy session:

- *Carbon Reduction Comparison Electric or Hydrogen Power,* Erik Muijsenberg, Vice President, Glass Service, Inc.
- *All-Electric Melting Back to the Future,* C. Phillip Ross, President, Glass Industry Consulting
- *Technical and Economic Investigation of Next Generation Fuels for Glass Melters,* Shrikar Chakravarti, Business Development Linde, Inc.
- *In-furnace Thermal Imaging Survey of a Float Furnace for Combustion Optimisation,* Philippe Kerbois, Global Industry Manager-Glass, Ametek Land

GMIC symposium

'Automation in Glass Manufacturing' is the title of a symposium co-organised by the Glass Manufacturing Industry Council and GlassTrend on 4 November.

To sustain their competitive advantage, today's glass manufacturers must take advantage of the latest advancements in automation, digitisation and smart manufacturing. Challenged by the need to reduce emissions, extend furnace campaigns, and make production more efficient, it's critical that manufacturers have full knowledge of current innovations in automation tools. This symposium is presented by leading experts in this field who provide a detailed examination of sensors, industrial artificial intelligence, data analytics, controls, remote management, and other automation tools invaluable to efficient sustainable glass manufacturing.

The audience will be glass manufacturers, refractory ▸

On behalf of Glass Futures, Aston Fuller will present 'Collaboration within Competitive Spaces, The Future of the Glass Industry'.

Philippe Kerbois of Ametek Land will present a paper entitled 'In-furnace Thermal Imaging Survey of a Float Furnace for Combustion Optimization'.

The accompanying exhibition will include leading suppliers such as Hotwork USA.

'Electrical Glass Melting and Boosting Solutions of the Future Designed for Efficiency, Flexibility and Micro-Grid Capability' will be the subject of a presentation by Mikael Le Guern from Eurotherm.

XPAR Vision's Paul Schreuders will present 'Digitalisation Robotisation as a Means to Further Strengthen and Automate the Forming Process' at the GMIC symposium.

and equipment suppliers, sensors and automation suppliers, raw material and energy suppliers, design engineers, process engineers, academics, and glass researchers, technology, process design, analysis and improvement.

Participants should come away from the symposium with knowledge of the current technologies and future trends in automation in glass manufacturing.

The symposium Director is Bob Lipetz, Executive Director of the Glass Manufacturing Industry Council (assisted by Donna Banks) and the Programme Co-Chairs are Keith Bagarus, Director, Global Automation – RoviSys [GMIC Board of Trustees] and Bruno A Purnode, Leader Melting & Fiberizing Technology; Senior Technical Staff – Owens Corning [GlassTrend managing Board].

The programme committee includes: Ryan A. Bockbrader, Director, Engineering Process, Libbey Glass; Paul Castañuela, Global Leader – Automation & Controls, Engineered Products, Johns Manville; Mathieu Hubert, Development Associate, Corning [Representing GlassTrend]; Sanjay Mansukhani, Principal Engineer, Advanced Process Control, Digital Transformation, Owens Corning Advanced Manufacturing; Ivan Solis Martinez, Engineering Project Manager, Vitro Architectural Technology; Glenn Neff, Vice President, Glass Service USA; Udaya K. Vempati, Analytics and Automation Discipline Leader, O-I; and Oscar Verheijen, Senior Consultant, CelSian [Representing GlassTrend].

The following programme of papers has been organised:

Oscar Verheijen from CelSian and GlassTrend will present during the energy/combustion session of GPC and the sensors session of the GMIC symposium, co-organised with GlassTrend.

Sensors session

- *NIR Camera and Inspection Results* – Erik Muijsenberg, Vice President, Glass Service
- *State-of-the-art of Advanced Sensors for Process Automation* – Oscar Verheijen, Senior Consultant, CelSian
- *Digitalization Robotization as a Mean to Further Strengthen and Automate the Forming Process* – XPAR Vision, Paul Schreuders

Industrial artificial intelligence and data analytics session

- *Big Data, Machine Learning, and Artificial Intelligence* – Bryan DeBois, Director, Industrial AI, RoviSys
- *20% Reduction of Down Time with AI-Powered PdM* – Shannon Friedman, Sales Engineer, Senseye, Inc.

Control session

- *Digital Twins – Simulation Models to Streamline Design, Analysis, and Operations* – Michael Sarvo, Support Manager, Rockwell Automation and Sameer Kher, Senior Director, Product Development ANSYS
- *Digitalization Brings Plant Wide Automation to the Next Level* – John Ryan, Glass Industry Manager, Siemens and Heinz-Josef Lennartz, Glass Industry Manager, Siemens AG

Remote management session

- *Security* – Scott Reynolds, PE, Manager, Industrial Security, ITD – Johns Manville
- *How Mixed Reality, 3D Visualizations and Laser Scanning Allow Onsite and Offsite (remote) Experts to Work Together* – Steven Ostrowski, 3D Laser Scanning and Mixed Reality – Trimble, Inc
- *Accelerate Innovation from Edge to Cloud to Improver Operations* –Timothy McCain, Digital Partner Program Manager – Rockwell and Mark Beckmann, Director Industry Solutions – Microsoft ●

Further information:
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7 September: GlassTrend webinar on glass production transition to renewable fuels
12–15 September: Gulf Glass 2021 (Dubai, United Arab Emirates)
13–15 September: GlassBuild America 2021 (Georgia, USA)
27 September – 1 October: CelSian training course - general glass technology training (Eindhoven, the Netherlands)

OCTOBER 2021

5–8 October: Vitrum 2021 (Milan, Italy)
6–8 October: Intersolar 2021 (Munich, Germany)
6–8 October: PRINTING United Expo (Orlando, USA)
12 October: CelSian training course – heat transfer in glass melting furnaces (Eindhoven, the Netherlands)
12–15 October: FESPA Global Print Expo (Amsterdam, the Netherlands)
13–14 October: CelSian training course - burners, combustion and NOx emissions (Sheffield, UK)
20–22 October: GPD Finland 2021 (Tampere, Finland)
26 October: GlassTrend webinar
26–27 October: CelSian training course - refractory selection, maintenance and related defects (Eindhoven, the Netherlands)
28–29 October: CelSian training course - flat glass melting and forming (Eindhoven, the Netherlands)

NOVEMBER 2021

1–4 November: 82nd Conference on Glass Problems (Columbus, Ohio, USA)
16 November: GlassTrend webinar
18 November: Glass Focus Awards 2021 (UK location TBC)
23–25 November: Celsian training: glass melting and process improvement for Indian glass industry (Mumbai, India)

DECEMBER 2021

5–8 December: ICG Annual Meeting (Incheon, Republic of Korea)
12–17 December: 14th Pacific Rim Conference on Ceramic and Glass Technology / PACRIM 14 including Glass & Optical Materials Division 2021 Annual Meeting / GOMD 2021 (Vancouver, Canada)
14 December: GlassTrend webinar

FEBRUARY 2022

10–11 February: IYOG Conference (Geneva, Switzerland)
17–18 February: Glassman Asia (Seoul, Korea)

MARCH 2022

3–5 March: glasspex INDIA 2022 (Mumbai, India)

APRIL 2022

2–3 April: Deco '22 (Columbus, USA)
5–6 April: GlassPrint 2022 (Düsseldorf, Germany)
13–16 April: China Glass 2022 (Shanghai, China)

MAY 2022

11–12 May: Glassman Latin America (Monterrey, Mexico)

JUNE 2022

6–9 June: Mir Stekla 2022 (Moscow, Russia)
29 June – 2 July: Glass South America (Sao Paulo, Brazil)

JULY 2022

3–8 July: ICG 2022 – 26th International Congress on Glass / DGG Conference (Berlin, Germany)
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