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BI-MONTHLY INTERNATIONAL MAGAZINE FOR GLASS MANUFACTURING

YEAR 36 • ISSUE NO. 3/2023

SPECIAL
Furnace developments

Ingeniously simple and simply ingenious: HEYE's dual motor shears

New victories for SIGMA's high purity alumina A 95 V

Technological innovations at FAMOR ENGINEERING herald fresh business opportunities

An interview on ARDAGH GLASS Africa

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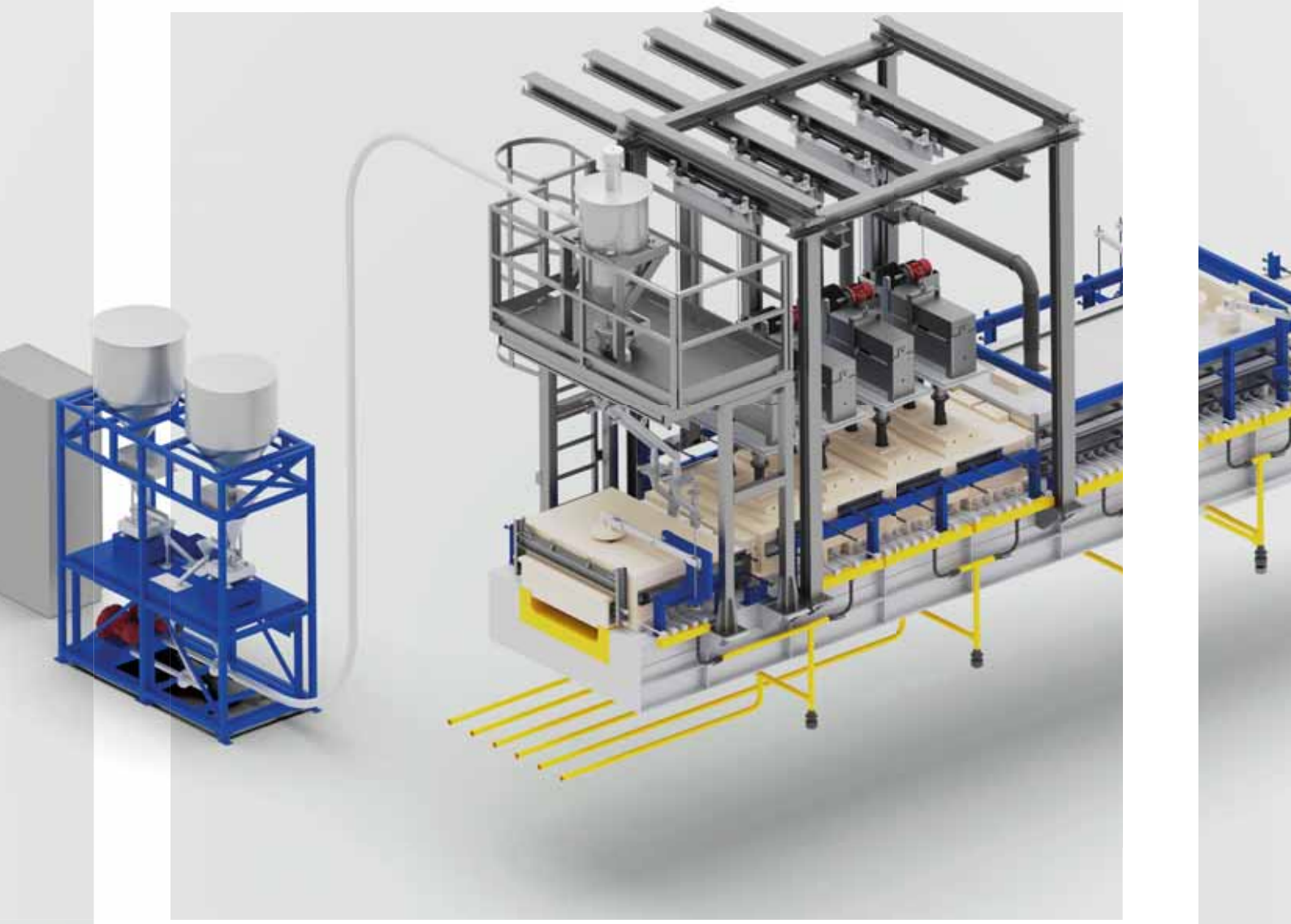

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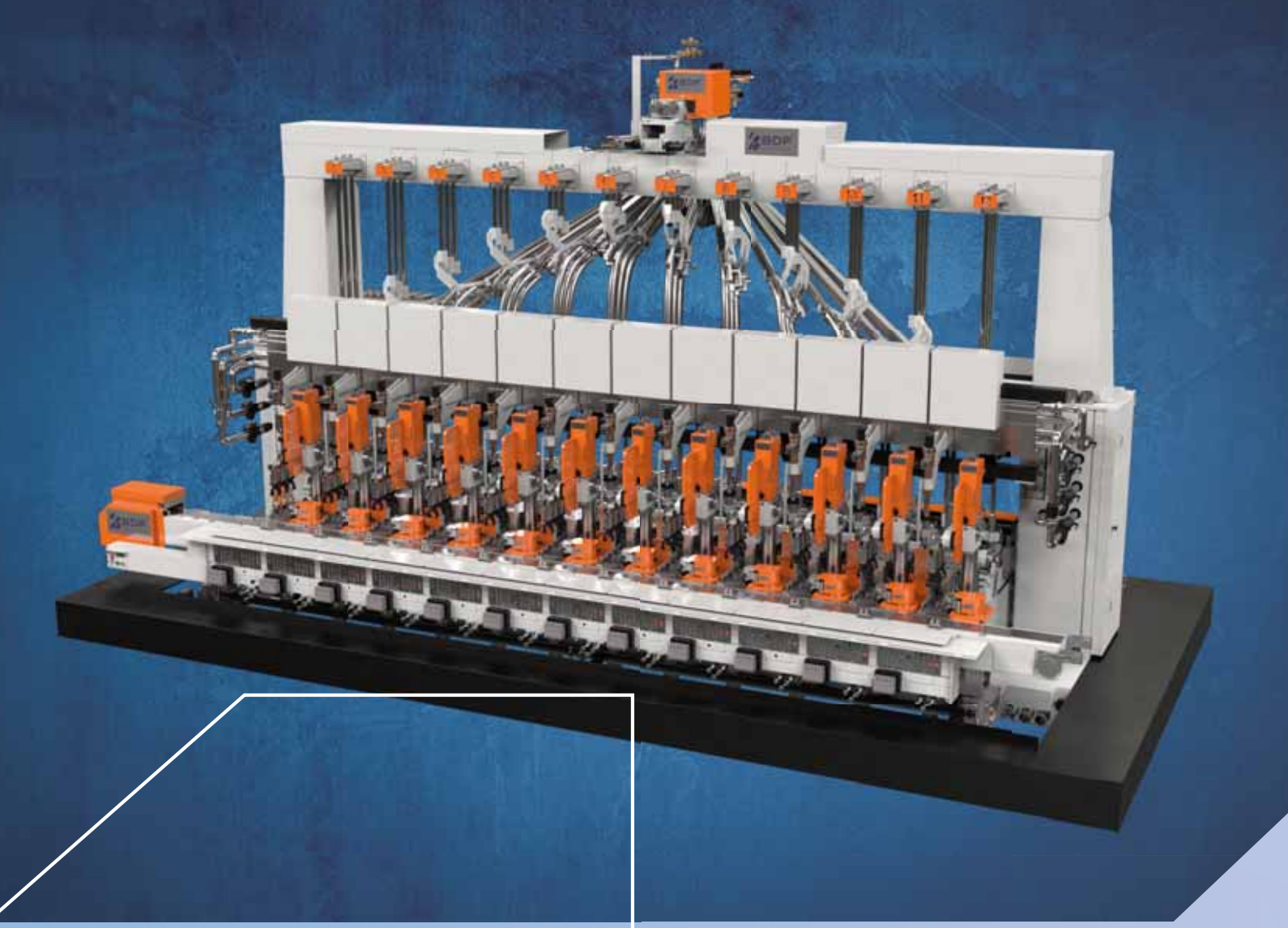

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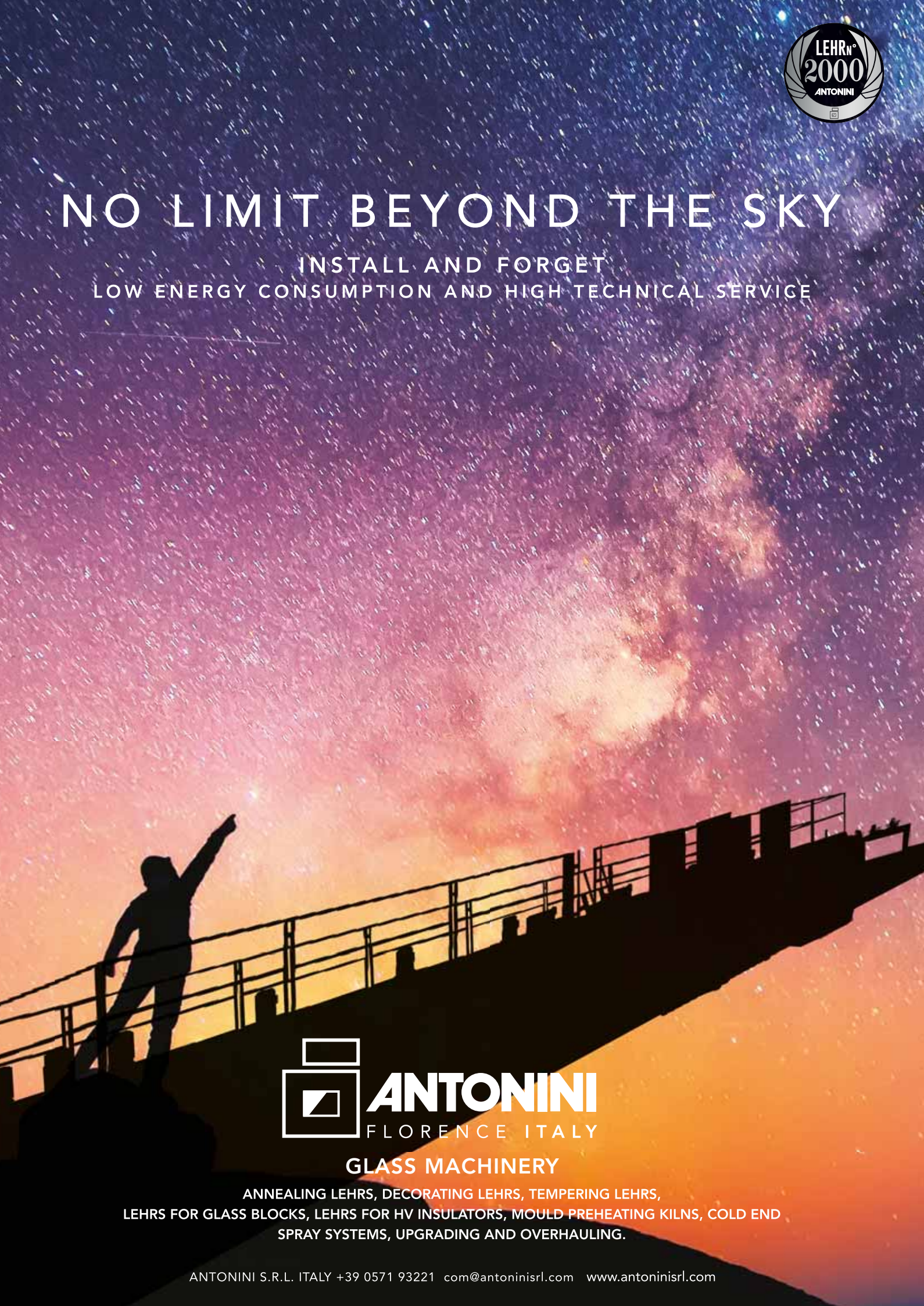
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2023 TRADE FAIRS CALENDAR

The magazine will be distributed at the following Events

issue	exhibition/conference	date	venue	deadlines
2023 1	**GLASSMAN EUROPE**	8-9 February	**ISTANBUL** Turkey	Editorial files: 13-01-2023
	COSMOPACK	16-18 March	**BOLOGNA** Italy	Deadline Adv files: 17-01-2023
2023 2	**GLASSPRINT**	25-26 April	**DÜSSELDORF** Germany	
	INTERPACK	4-10 May	**DÜSSELDORF** Germany	Editorial files: 20-03-2022
	CHINA GLASS	6-9 May	**SHANGHAI** China	Deadline Adv files: 30-03-2023
2023 3	**GLASSMAN USA**	6-7 June	**CLEVELAND** (OH) USA	
	FURNACE SOLUTIONS CONFERENCE	7-8 June	**ST HELENS** UK	Editorial files: 26-04-2023
	16TH SEMINAR ON FURNACE DESIGN	21-22 June	**VELKE KARLOVICE** Czech Republic	Deadline Adv files: 05-05-2023
	FEATURED CONTENT: FURNACE DEVELOPMENTS			
2023	**Glass Industry Directory** 			Editorial files: 05-06-2023 Deadline Adv files: 19-06-2023
2023 4	**VITRUM**	5-8 September	**MILAN** Italy	
	GLASSPEX INDIA	14-16 September	**MUMBAI** India	Editorial files: 21-07-2023
	GLASSMAN ASIA	20-21 September	**SEOUL** South Korea	Deadline Adv files: 28-07-2023
2023 5	**AFGM**	Date to be announced	South East Asia	
	LUXPACK	3-5 October	**MONACO**	Editorial files: 04-09-2023
	CONFERENCE ON GLASS PROBLEMS	30 October 2 November	**COLUMBUS** (OH) USA	Deadline Adv files: 11-09-2023
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2023 6	**ICG ANNUAL MEETING**	12-15 November	**HANGZHOU** China	Editorial files: 09-10-2023
	GULF GLASS	4-7 December	**DUBAI** UAE	Deadline Adv files: 16-10-2023

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ZIPPE & VETROPACK

Turnkey batch house: Successful cold test at Boffalora

Zippe batch house in the Vetropack plant being built in Boffalora, Italy

After nearly one year of construction, **ZIPPE** has successfully completed the erection of the batch house for the **VETROPACK** plant at Boffalora, Italy. With the batch plant and cullet recycling systems all ready now for operation, all test runs have been accomplished with success.

The order was processed by Zippe on a turn-key basis. The project comprises all parts, including steel construction, erection, pipework, cabling, commissioning as well as training of Vetropack personnel. The batch house is designed to supply two melting furnaces.

The installation of two cullet recycling systems has also been part of this project. In May 2023 the complete plant will go into operation.

Error correction:

We hereby inform readers that on page 30 of issue 2/23 of Glass Machinery Plants & Accessories it was incorrectly reported that the entire batch plant was made by Sorg. We apologise for the unintentional error.

WWW.ZIPPE.DE - WWW.VETROPACK.COM

TIAMA

New camera-based check inspection solution

TIAMA has released a unique, camera-based check inspection solution called Saturn to replace traditional manual detection on carousel machines. Check detection has always been a complex and time-consuming as inspection to run on glass containers. Traditionally, LED modulated lights sources and digital sensors have been used in this detection. At job changes it requires accurate light setting and sensor angles trained upon the area to be inspected. An oscilloscope display would confirm the right angle set up of each light and sensor combination. Even with highly experienced personnel, that guess work impacts production downtime significantly without providing the most accurate results. With 60 years of experience in non-contact vision technology, Tiama has developed Saturn to revamp manual check detection. With 6 to 11 wide-angle cameras (30 by 15-millimetre inspection areas) plugged on swivel arms, Saturn allows detection checks on all container parts including finish, shoulder and base - as well as the body. Once the cameras are oriented towards the article, detection thresholds and minimal check surfaces are the only 2 parameters that must be set up. As a result, job changes can be reduced significantly in comparison with standard manual technology. In addition, Tiama has implemented Saturn into its latest user-friendly interface - making it even easier to set up.

At a pace of 350 BPM, Saturn can analyze up to 792 high-resolution images to catch the tiniest checks on bottles and jars. Production quality is kept at the highest level while any false reject level is significantly reduced. Resorting -often caused by checks defects- can also be reduced by up to 90 percent compared to standard technology.

Tiama Saturn adapts to any container colour without dimensional restrictions. It can be installed on all Tiama carousel machines - making it a versatile solution that's adaptable to most production set-ups. The base offer starts with six cameras for finish & neck inspection and can be complemented with three body cameras and two base cameras for a full article inspection. With the Saturn, Tiama now offers an easy set-up and high-performance alternative to standard checks detection options. It will become the standard choice for manual checks detection on Tiama carousel machines while the renowned Tiama Atlas offers a fully-automatic solution.

WWW.TIAMA.COM

O-I GLASS

Completion of EUR 50M investment at Vayres plant

O-I GLASS Inc. has completed an EUR 50M investment to advance the sustainability of its plant in Vayres, France, by installing the latest gas-oxygen combustion technology and heat recovery systems.

These investments in the sustainable performance of the plant are set to reduce energy consumption and lower CO2 emissions by up to 20 percent. In addition to the decarbonizing impacts, these new technologies also reduce NOX emission by up to 60 percent. When combined with the plant's high usage of recycled glass, the positive impact on greenhouse gas reduction and energy use is bringing to life O-I's vision to be a significantly innovative and sustainable glass packaging provider.

With more than 400 million bottles produced each year, the Vayres plant is a key site dedicated to modern high-tech glassmaking. It is the only glass factory in Gironde, located in the immediate vicinity of the famous Bordeaux and Cognac vineyards.

"The Vayres investment is emblematic of O-I's holistic approach towards addressing sustainability by increasing energy efficiency, upgrading furnaces, creating more resilient supply chains and forging strategic partnerships," said Randy Burns, Chief Sustainability Officer for O-I. "Our sustainable commitment will help move us toward a truly circular economy for packaging that leverages the infinite recyclability of glass."

Said Thibaut Guichard, Vayres plant manager: "This is a strategic project that has been successfully completed. It is a strong expression of O-I's determination to advance our sustainability roadmap - and it has received the support of the French Agency for Ecological Transition (ADEME). The Vayres plant brings together modern real-life technology, know-how and capabilities. Eighty percent of our customers are located within a 100-kilometre radius and our plant supports the local economy, local wine producers as well as a local recycling system - a great example of working towards building a sustainable local circular economy."

WWW.O-I.COM

GLASSICA CJSC

USD 26M investment in Sumgait Chemical Industrial Park

Azerbaijan's **GLASSICA CJSC**, a resident of Sumgayit Chemical Industrial Park under the management of the Economic Zones Development Agency (EZDA), is to build a second factory for the production of glass products with an investment of AZN 44.4M (USD 26M) on two hectares in the Industrial Park.

According to Corporate Director Emil Asgarov, the annual production capacity of the enterprise is of 60-90 million various coloured glass bottles. The production capacity of the new plant will be three times higher than the capacity of the current one.

At present, Glassica CJSC provides permanent jobs for 140 people. Since the beginning of the enterprise, more than three million bottles have been produced.

The company became a resident of the Sumgayit Chemical Industrial Park in 2020.

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BORMIOLI PHARMA

Commitment to sustainability reaffirmed

BORMIOLI PHARMA recently presented the second edition of its Sustainability Report, which aims to reaffirm and consolidate the company's commitment to environmental and social responsibility, protecting the well-being of people and the environment, in line with its mission to 'Make health a positive practice, accessible to everyone, kind to the planet.'

The report includes several new items, involving both the objectives to be achieved and the governance system through which Bormioli Pharma intends to achieve an increasingly sustainable development path.

Of the main targets, the 30 percent CO2 reduction by 2030 (compared to the 2021 baseline) has been confirmed, and new ones have been introduced, such as the commitment to carry out an initial LCA analysis on a glass product by the end of this year and to complete the assessment of 'Scope 3' emissions -i.e. related to but not directly attributable to the Group's business, such as those arising from employee mobility, supply chain operations and the use of manufactured goods- by 2025.

The '50 in 5' target of increasing the share of sustainable raw materials in production processes has also been confirmed: this is a goal that the company has already come a long way towards reaching 39 percent in 2022 versus a target of 50 percent by 2025.

The goal of reducing water consumption, to be achieved by 2030, has been made more challenging and raised from -30 percent to -41 percent compared to the consumption recorded in 2021, demonstrating how the company has already embarked on a virtuous path and wants to commit itself further in this direction. This revision is in fact supported by already achieving a 35 percent reduction in 2022.

A further new factor concerns the strengthening of interventions to promote Diversity & Inclusion, with the publication of a company policy dedicated to these issues in 2022 and the definition of a structured training course that will involve almost the entire company workforce by 2025. The goal of closing the gender pay gap by 2028 has also been confirmed.

"From the war in Ukraine to rising energy prices, 2022 was a year marked by a series of huge geopolitical and macroeconomic events. Despite this, Bormioli Pharma has always guaranteed production continuity, confirming its solid position as a partner of excellence for the international pharmaceutical industry and strengthening relations with the entire supply chain," commented Andrea Lodetti, CEO of Bormioli Pharma. "This second edition of the ESG Report also confirms our commitment to a path that has already been traveled for several years and which sees the company active on issues of primary importance, such as the creation of a range of products with a low environmental impact that are clearly identified by the EcoPositive label, the optimisation of industrial processes with a view to greater sustainability and the constant enhancement of diversity and talent at all levels of our organization."

In addition to the areas of focus related to product offerings and industrial processes, the second edition of the Sustainability Report reinforces our desire to monitor not only internal processes but also the entire supply chain that supports them. The commitment to complete the assessment of 90 percent of suppliers on the international EcoVadis platform by 2026 has also therefore been confirmed. Using this tool, the intention is to ensure a supply chain that shares the same high standards as the Group with respect to various ESG issues.

The document also contains organizational innovations such as the direct involvement of stakeholders in the materiality analysis and the creation of a dedicated team headed by an ESG Manager, who will be responsible for overseeing the involvement of all corporate functions in the definition of actions aimed at ensuring the achievement of set objectives.

The economic results achieved in 2022 -with a turnover of over EUR 315M, an increase of over +20 percent compared to 2021- confirm the validity of the strategic choices made, and reaffirm how it is possible to plan long-term economic development while continuing to generate value for people, the environment and society.

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FEVE

EU packaging regulation threatens Belgian business innovation

As attention in Brussels turns to the proposed revision of EU Packaging and Packaging Waste (PPWR) rules, a Belgian glass factory illustrates how any move to limit innovative packaging offerings designed and produced in Europe risks having unintended consequences on local businesses.

Frédérique Ries, MEP for Belgium's French-speaking community and leading lawmaker on the PPWR proposals, visited Saverglass' container glass factory in Ghlin, Wallonia, to discover the latest innovations in glassmaking, and the contribution of glass producers in bringing unique, fully circular designs to customers in Belgium and beyond. This comes as EU policymakers get set to debate the European Commission's proposed PPWR revision, where proposals to limit creative design possibilities will force standardization on the market, posing risks to the business of both European container glass factories and their customers.

As rapporteur of the Committee on Environment, Public Health and Food Safety (ENVI) – the committee leading the PPWR through the European Parliament - the visit offered MEP Ries a first-hand view of the container glass industry's role in driving a circular local economy through their offer of designs that deliver on sustainability, quality and branding needs as well as closed loop recycling.

Ries' tour came in combination with a further visit to glass packaging waste recycling facility, Minérale S.A., which provided her with insight into how glass reduces waste in the real circular economy. Today, a record 80 percent of all glass put on the market in the EU is collected for recycling and used in new production loops. Belgium is particularly successful in this regard. Thanks to its highly efficient and consumer-centric recycling scheme - overseen by the Producer Responsibility Organisation, Fost Plus – the country achieved a glass collection recycling rate of 114 percent in 2021, according to Fost Plus' latest data.

A Belgian success story that delivers innovative designs for the market

Saverglass's Ghlin facility is today hailed as a premium container glass success story. One of Belgium's oldest glass makers, initially producing regular glass bottles in 1962, the factory now specializes in premium bottles and precision decoration designed for high-end wine and spirits products, resulting in more value creation for the factory and local economy. The plant exports to other European countries, and employs 342 people in the Hainaut province – the region of the country with the lowest employment rate (61.4 percent), according to the Belgian statistics office's 2022 data.

The European container glass industry supports the PPWR's ambition to reduce waste and create a truly circular economy, but has previously raised concerns that certain elements within the proposal -such as packaging minimisation criteria that does not allow for product design in the weight of a container, or allow brands to market their products through distinct packaging designs if they add weight- are likely to threaten the successful business model of factories like Saverglass' Ghlin facility.

Commenting on the impact the proposed regulation risks having on Saverglass' operations, Saverglass President, Jean Marc Arrambourg said: "The focus on weight reduction rather than waste reduction is problematic. As a company, we deliver value for both our customers and local communities by producing creative, high-precision glass containers that are fully recyclable. Packaging does more than just contain and protect products. It also helps shape a brand's identity and often evokes cultural heritage and identity. By threatening a wave of packaging design standardization, the proposed Packaging and Packaging Waste Regulation puts our current business model and, by extension, places the value we deliver to the real economy at risk."

Adeline Farrelly, Secretary General of FEVE, commented on the revised PPWR's potential impact on European industry more widely, ➜

"Some of the proposed measures in the revised Packaging and Packaging Waste Regulation would have strong negative repercussions by limiting the availability of packaging and by extension the consumer goods they are packed in. This risks damaging the reputation, competitiveness and profitability of European industry and would significantly harm the glass industry. Despite increasing challenges in recent crisis times, our factories have remained resilient in face of exceptionally high market demand, providing a health-conscious and circular packaging that ensures continued supply of essential products to consumers."

Investing in circularity while meeting customer needs

The container glass industry pairs its promise of responsible production with a commitment to offer customers distinctive packaging designs that are fully circular and climate neutral by 2050. Innovations in design and production are setting a new standard for glass packaging that delivers on sustainability, quality and brand identity, while lowering the industry's production footprint and increasing recycling and collection rates in further support of circularity goals. Today, 'lightweighting' or "right-weighting" -reducing how much glass is needed to make glass bottles, jars and flacons while maintaining performance criteria on strength, quality and design- is already a market reality. Glass packaging today is 30 percent lighter than 20 years ago.

In January of this year, based on the latest available figures, the container glass industry recorded its highest ever production levels, producing 42.3 billion glass containers for critical European sectors in the first half of 2022. The industry met this record-high customer demand despite challenges such as the continued impact of the COVID-19 pandemic and extreme energy prices.

As it stands, Europe's container glass manufacturers support a total of 125,000 direct and indirect jobs. The annual exports of products packed in glass containers account for EUR 250 billion, giving a strong boost to Europe's balance of trade. However, despite this wide-reaching impact, the container glass industry is still highly localized, with factories and other sites embedded in local communities that use local raw materials, together with as much recycled content as is available, in the creation of reusable and endlessly recyclable glass packaging.

WWW.FEVE.ORG

STOELZLE GLASS GROUP

Installation of batch preheater at Austrian plant

STOELZLE GLASS GROUP has successfully completed the installation of a cutting-edge batch preheater at its Austrian production site in Köflach after seven months of construction work.

This innovative technology uses hot exhaust gas from the furnace to dry and preheat the batch. By reducing the electricity needed for melting, users are able to significantly lower the energy consumption of the glass melting process.

Overall, this results in energy savings of about 4,000 MWh/year, which is equivalent to energy savings of eight percent for the amber furnace and approximately 1.3 percent for the entire Austrian production site. This project was made possible through the BMK's environmental promotion programme.

Stoelzle reports that its remains committed to constantly improving its manufacturing processes and finding innovative solutions to minimize its environmental impact.

WWW.STOELZLE.COM

GRODNO GLASSWORKS

Construction of new plant at final stage

The construction of a new production site of the FEZ Grodnoinvest resident **GRODNO GLASSWORKS** in the industrial park in the Auls district of Grodno, Belarus, is at its final stage.

In January of this year a glass melting furnace with a capacity of 220 tons of glass melt per day was fired up - beginning the process of debugging equipment and industrial testing of production lines.

The construction of the new glass factory had started in the spring of 2021. The organization of the new production was based on solutions for maximum mechanization and automation of technological processes. Thanks to modern approaches and innovative equipment, the new plant will be able to produce a wide range of small-sized glass containers with high productivity.

In the production process, a new technology for the Republic of Belarus of a three-drop operation mode will be used. The technology for manufacturing lightweight containers using the NNPB method will be integrated. Innovative approaches will then make it possible to produce lighter glassware without losing consumer properties.

The new production is to be launched in the second half of this year - meeting the ever-increasing domestic demand for high-quality and environmentally-friendly packaging while developing the industrial potential of the region and the country as a whole and increasing export supplies.

WWW.GRODNOGLASS.BY

EME & KRS

A winning formula for glass

For many years **KRS** has been an important centre of plant engineering and separation technology for the glass recycling industry, known for its optical sorters to detect and separate off-colours, CSP, metals, plastics and heat-resistant as well as leaded glasses. By combining the proven expertise of KRS and **EME**, the reliable supplier of batch and cullet technology that endures the harshest of environments can offer glass recycling plants of the highest quality.

The meeting took place at the KRS test facility at Neuschönau, Germany, to discuss the latest projects, technologies and trends in container and flat glass recycling.

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O-I GLASS

First purpose-built plant for MAGMA technology

O-I GLASS broke ground recently for a state-of-the-art greenfield glass plant in Bowling Green, KY, USA. The facility is the first O-I facility purpose-built to leverage the company's MAGMA technology.

Attended by O-I CEO, Andres Lopez, KY Lieutenant Governor Jacqueline Coleman, and a host of company and regional dignitaries, the event marks the beginning of a multi-phase investment of up to USD 240M to enable the continued development of the company's revolutionary MAGMA technology, while providing an unprecedented level of service to our customers and local market.

"O-I's proprietary MAGMA glass-making technology, and the new plant here in Bowling Green built around this technology, will continue our journey to transform the future of glass container production," said Andres Lopez, CEO of O-I Glass. "This facility will showcase our next-generation capabilities, from a new modular batch system, the MAGMA melter, and new forming machines to sustainability advancements and the look and feel of the factory itself. Here, in Bowling Green, in proximity to the Bourbon Trail, this state-of-the-art facility will demonstrate the value of near-location and will be a key hub for future customer collaboration. It will also serve as a place where our investors, customers, and other stakeholders can explore and collaborate."

MAGMA technology is designed for flexible, modular glass production and can reduce the environmental footprint of glass production. Facilities built for MAGMA will feature a smaller melter and will be constructed using more sustainable methods and materials. MAGMA technology will enable advanced technologies, including ULTRA light-weighting potential, on-off capability, and can include feed-forward and feed-back control loops to promote premium quality glass.

The proximity to key customers, for O-I, will reduce logistics and further enhance the company's customer service, flexibility, and sustainability. The first phase of construction for this facility is expected to be complete in mid-2024 and could grow to include two additional production lines and up to 140 new jobs in the state and region. Lieutenant Governor Coleman conveyed congratulations from Governor Andy Beshear.

"I want to congratulate leaders at O-I Glass as the company moves forward with this incredible project creating 140 full-time jobs in Warren County," Gov. Andy Beshear said. "I am proud the commonwealth will be home to this innovative facility that introduces new technology to increase speed and efficiency within the company's manufacturing process. I look forward to a long and successful partnership between Kentucky and O-I Glass."

WWW.O-I.COM/

RATH

Expert lecture on hot gas filtration in the glass industry

International refractory manufacturer **RATH** was represented at the Hotbels Seminar on April 18 and 19 in Lexington (USA) with an expert lecture on hot gas filtration in the glass industry.

Manfred Salinger, Director Advanced Ceramic Filtration Solutions RATH Group, presented a holistic approach to emission control and heat recovery at his lecture. In addition the proven expert on hot gas filtration reviewed the experience gained and the key to reliable operation and long service life of filter elements.

High-temperature filters are key components in emission control and heat recovery solutions. In many thermal process facilities, the clean-up stage cools the exhaust gases to low temperatures that are insufficient for re-use. Cleaning of exhaust gases at elevated temperatures of up to 1400 degrees Fahrenheit allows the gas to be re-used in thermal processes or for power generation.

In order to reduce the footprint of the emission control equipment, hot gas filters can now be equipped with ceramic filter elements up to 20 feet long. The new generation of longer filter elements lowers capital investment costs while maintaining the important functions of particulate removal and selective catalytic reduction of nitrogen oxides.

In his presentation, hot gas filtration expert Manfred Salinger compared the improved emission control system with the conventional solution, introduced the range of available filter element lengths and reviewed lessons learned as well as the keys to reliable operation and long service life of the filter elements.

For many years, RATH has been developing innovative ceramic hot gas filter elements, which make it possible to filter particle-laden industrial flue gases at temperatures up to 1000 degrees Celsius and to reduce emissions of nitrogen oxides.

Since 2016, all resources, capabilities and know-how in hot gas filtration have been pooled in the Meißen facility, Germany. This RATH research and production site is home to cutting-edge facilities for the manufacture of RATH's FILTRATH® hot gas filter cartridges and FILTRATH®CAT catalytic filter elements. The latter were developed for pollutant emission control: These rigid yet highly porous and catalytically coated ceramic filter elements are used for multiple pollutant control of (fine) dust, acid gases, dioxins and nitrogen oxides in hot gas flows (at temperatures of 250 to 420 degrees Celsius) and can easily replace conventional textile filters.

Doubling of the production capacity for hot gas filter elements in Meißen Recently, RATH has doubled its production capacity for both catalytic and non-catalytic hot gas filter elements at its Meißen production facility. As the only remaining European manufacturer of filter elements, RATH can produce up to 40.000 filter elements per year depending on requested dimensions and quality. The new production line is already in operation and running at the highest efficiency level.

WWW.RATH-GROUP.COM

AGR

Glass analysis capabilities expanded at Delft research facility

Offered by the Agr Delft, Netherlands analytical laboratory, a new top-of-class Scanning Electron Microscope now compliments and expands the capabilities of the analytical services for the European glass industry. **AGR**, a leader in consulting, training and analytical services for the glass packaging industry since 1927, operates laboratories located in Butler, PA and Maumee, OH in the USA and Delft, The Netherlands. American Glass Research is a division of AGR International Inc.

The American Glass Research (AGR) laboratory in The Netherlands is now home to this leading-edge work in the field of microscopy is nothing new to the Netherlands. Indeed, the Netherlands is also the birthplace of the modern microscope and Delft itself is the city where microscopist Antonie van Leeuwenhoek invented some of the first practical microscopes in the 1700s. The AGR's Delft laboratory is proud to continue the fine tradition of Dutch microscopy by installing a JEOL IT-510LA scanning electron microscope. This new device goes far beyond the capability of the early microscopes and will allow the Delft lab to provide its European customers with the highest level of analysis and digital data acquisition.

The JEOL IT-510LA represents the first SEM of this model to be installed anywhere in the Netherlands and boasts a magnification capability of up to 300,000X. Equipped with a JEOL Energy Diffractive X-ray Spectrometer (EDX), the SEM will enable the scientists in the Delft lab to perform chemical compositional analysis of glass surfaces/substrates along with point analysis of materials or residues embedded on or within the glass. Enhanced software incorporated in this system harnesses the EDX for constant scanning of the glass surface over the entire field of view. The capability makes it possible to immediately highlight the presence of any foreign materials, facilitating quick and accurate identification.

In addition, the system incorporates a large-sized SEM chamber that allows samples up to 200 millimetres long and 80 millimetres wide to be analyzed as well as low vacuum mode which circumvents the need to apply carbon or metal coating. These features permit analysis of samples with minimal alteration, which is an advantage for consumer complaints or product liability cases.

The many advanced features and functions of the new SEM will greatly compliment and expand the capabilities of the Delft lab beyond the routine uses of SEM-EDX for stone identification, fracture diagnosis, and compositional analysis.

Visitors are welcome to the Delft lab to tour the laboratory and observe a demonstration of this new, advanced microscope.

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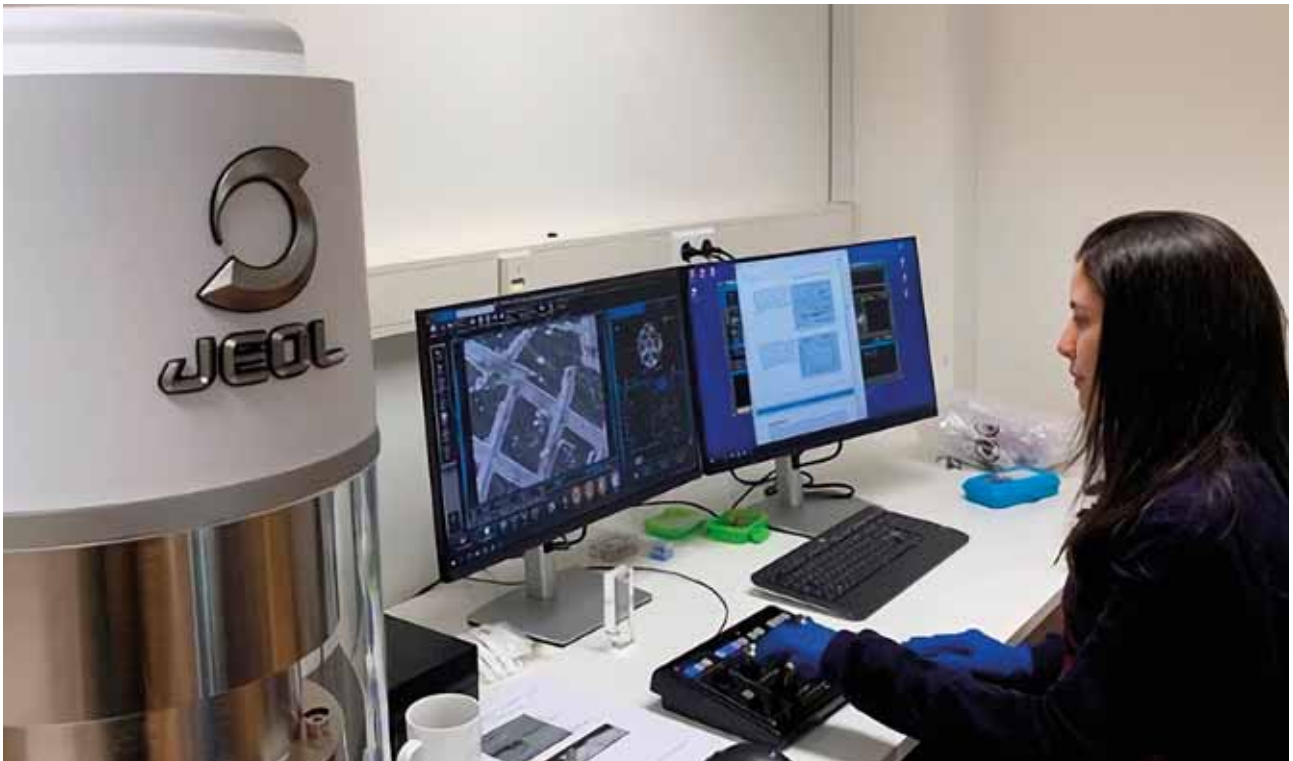


FORGLASS & ARDAGH

Turnkey batch and cullet plant received from Forglass

Ardagh Glass Packaging, Europe (AGP Europe) has recently completed its newest greenfield project in Poland with its latest suite of sustainable technology for reducing emissions and improving energy and resource efficiency. Greenfield projects on this scale are massive investments and rarely undertaken in Europe - so choosing the right contractors was of paramount importance.

FORGLASS delivered to **ARDAGH** the batch and cullet plant as a turnkey system - from design and engineering through fabrication of all components in Forglass' own facility to installation and start-up. The plant includes storage for raw material and five types of external cullet, all of the dosing, mixing and transport equipment, as well as a complete cullet return system for both cold and hot end.

The advanced system for weighing and dosing raw materials includes an innovation from Forglass, Vibe® – a high performance vibratory dosing feeder, which is more precise than specified and allows the new batch plant to operate just nine hours per day while allowing the furnace to produce with maximum pull in the same time

The autonomous cullet dosing system provides precise dosing in a wide range of ratios between 20 and 80 percent cullet content. Noteworthy are two other innovations from Forglass included in the cullet return system: SmartScraper® and Selectable Grain Crusher™.

The SCADA control system is custom-designed for Ardagh, allowing functionalities like user permissions management, PLC live status, weighing parameters, three modes of sand moisture measurement, daily batch quality and precision auto-reports, and automatic adjustment of cullet and batch feeding up to recipe quantity. To ensure reliability, the system is equipped with double redundancy and four types of batch plant operation management.

Forglass and Ardagh teams are both very proud to inaugurate one of the largest single furnace container glass production facility in Europe and certainly one of the most environmentally friendly.

WWW.FORGLASS.EU - WWW,ARDAGHGROUP.COM

VERALLIA

Credit rating upgrade

VERALLIA recently announced that Standard & Poor's has upgraded the Group's long-term credit rating to BBB- with a positive outlook.

The issue rating on the group's two Sustainability-Linked bonds of EUR 500M each, issued on both May and November 2021 respectively, is also raised to BBB-.

This upgrade is a sign of full recognition of the Group's financial strength and the robustness of its profitable growth business model.

Verallia is now rated Baa3 by Moody's with a stable outlook and BBB- by Standard & Poor's with a positive outlook.

"The upgrade of Verallia's credit rating by Standard & Poor's, shortly after the upgrade of the credit rating by Moody's, confirms the Investment Grade status of the Group. It reflects Standard & Poor's confidence in our financial policy and in the robustness of our operational performance and profitable growth strategy, reinforced by a clear decarbonation roadmap," said Nathalie Delbreuve, Chief Financial Officer of Verallia.

WWW.VERALLIA.COM

Ingeniously simple and simply ingenious: HEYE's dual motor shears

While it's well known that seven is a lucky number, the serial number 777 of HEYE's dual motor shears is currently being assembled and is all set for delivery later this year. In this case, however, 'three times seven' is hardly based upon luck alone. Instead it derives its excellence from good, solid engineering work.

With one of Heye's first dual motor shears from 1996 still at work today, those bearing the end-number 23 remain operational after two overhauls in 2013 and 2019 respectively - all to the full satisfaction of the customer at the Lagnieu plant of Verallia, France, from which the following statement is reported: "Due to our positive past experiences, Heye's dual motor shears have fully convinced us. The safe and low-maintenance operation in particular has turned out to be a complete success."

DMS N° 23 IN USE FOR 27 YEARS

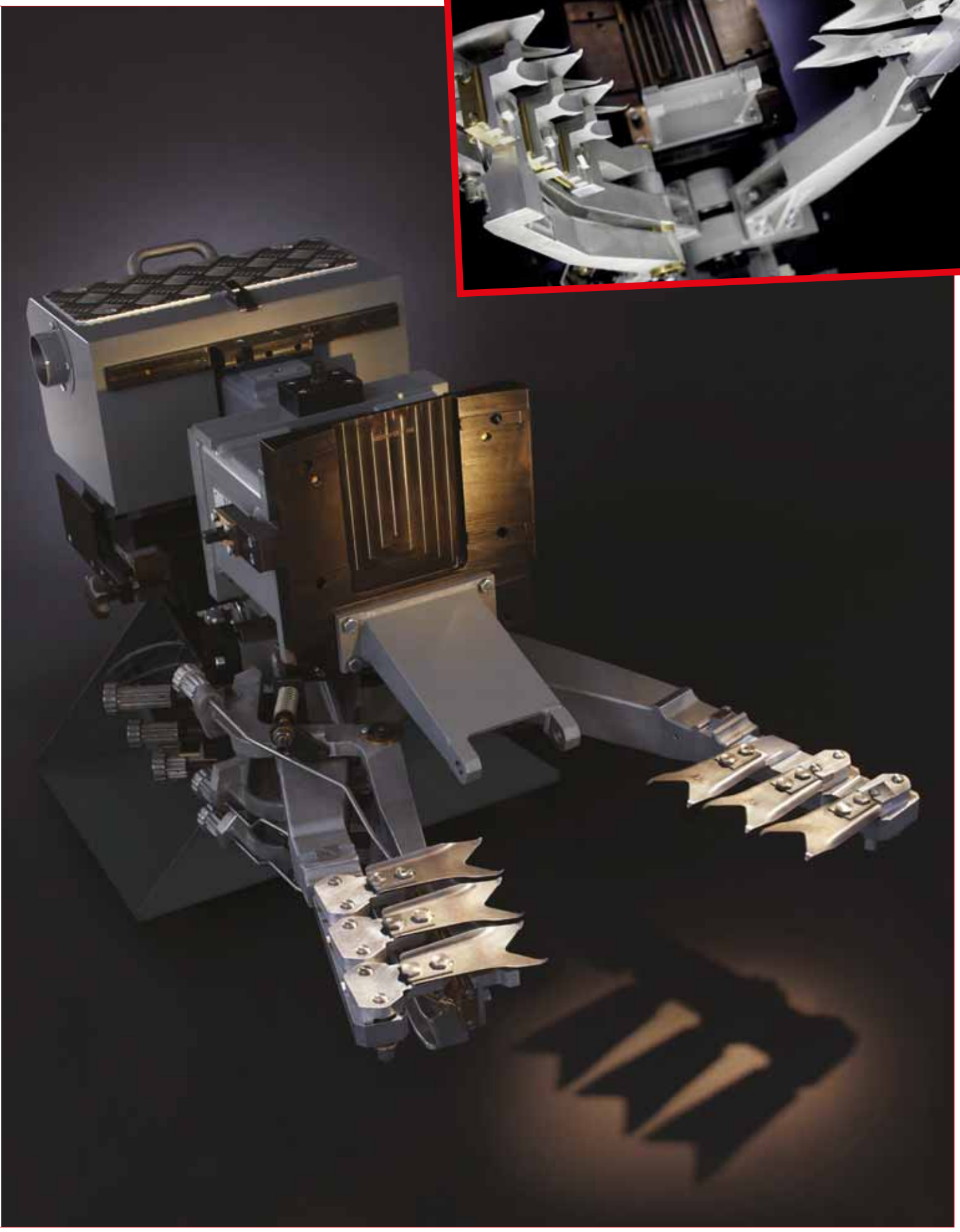
So what made the Heye dual motor shears 2323 such a role model in the container glass industry? To understand the success of this development we'd need to observe the requirements placed upon such a mechanism, namely:

- High, repeatable cutting speed with optimal cooling
- Stable control system
- Appropriate operation principle
- Reliability and durability

Here, by using materials of elevated quality as well as standard parts from well-known manufacturers, Heye International can guarantee high, repetitive cutting. It's especially important that the shear blades are arranged in a way that ensures the glass gobs are cut both precisely and at a parallel - regardless of whether it's Double Gob, Triple Gob or Quad Gob that is driven. In this way, an unwanted influence upon drop shape and drop fall gets avoided. Not only. Besides the high cutting speed -so essential for any clean cut- there's also sufficient downtime of the shear blades for optimal cooling.

MOTOR SHEARS

For control of the dual motor shears, Heye relies upon superior-quality technology from Siemens®, namely the Simotion® Servodrive. The shear blades move in a circular arc, thus releasing a near wear- and backlash-free suspension of the shear arms. Preselectable movement profiles and a production speed of up to 250 cuts/minute then complete the requirement profile. When designing the double motor shears, engineers at Heye paid particular attention to



function, which necessitated complete fulfilment as well as a cutting process that had to be carried out in a stable and repeatable manner. To do this, the most suitable geometry was chosen - designed to achieve low-wear operation of the mechanism and, as such, a long service life. Finally, all was fitted into the existing space to ensure good accessibility.

FACTORING IN THE OPERATOR

Of course, the concept also had to take people into close consideration. What also makes the dual motor shear system so superb is the fact that the user can easily understand the functional principle. Indeed the operating elements are easy to reach and their function can be quickly understood. As a central point in the production process, the shear mechanisms are of great importance in terms of both reliability and durability. Any breakdown would affect the entire production line just as frequently necessary and lengthy maintenance would. On one hand, production interruptions quickly cause very high costs owing to the resultant loss of production. On the other, for glass manufacturing personnel they're also associated with a heavy workload - first in terms of repair, then owing to restarting of the production line.

PRODUCT RESILIENCE

For more than 25 years, Heye dual motor shears have been setting the benchmark. Depending upon use conditions, an overhaul/revision only becomes necessary after six to nine years. Many shears have already had a service life of between 12 to 16 years without having undergone a general overhaul. Indeed the success of this product clearly shows that the aforementioned conditions were taken into account to a very high degree when constructing the dual motor shears. Not surprising, therefore, the consistent feedback from customers rates as positive, which explains why the precision, reliability and ease-of-use of the product leads to both satisfaction and a high acceptance level among users.

CONSISTENT R&D

Heye International finds confirmation of its well-founded development work, which has remained ongoing over decades - testimony to why products such as the dual motor shears are still successful on the market, all thanks to continuous improvements which even have their functional principles adopted by other shear manufacturers. These same achievements encourage the company to continue to invest a great deal in the development of well-founded technology in order to develop products for its customers that will hold their own in the market due to their quality - all the while making everyday work easier for the user. Last but not least, it is the proven sustainability in every respect (environment, yield, handling) that has confirmed the exceptional quality of this high-class product for many years. ■

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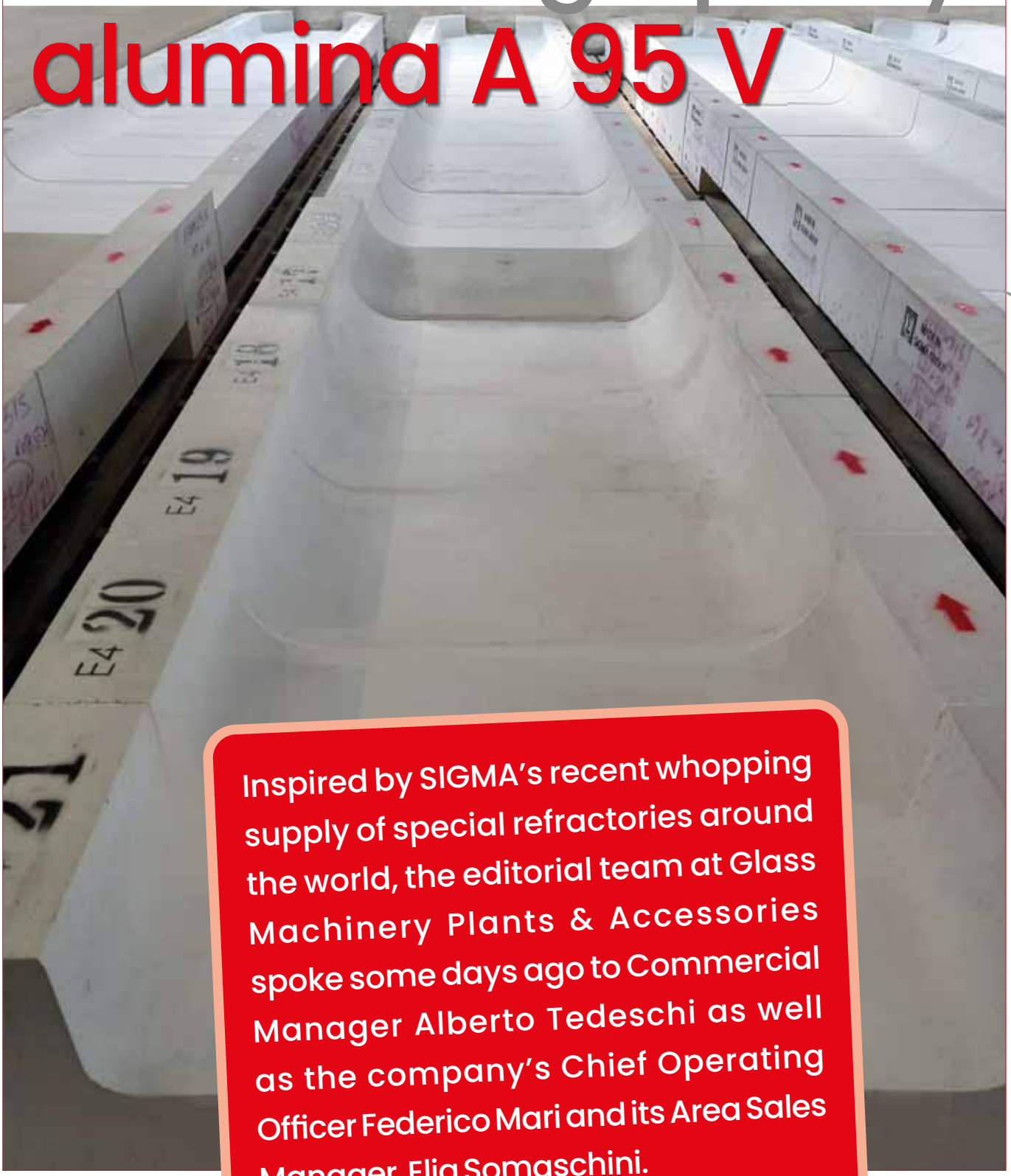
ABOUT HEYE INTERNATIONAL

Based at Obernkirchen, Germany, Heye International GmbH is one of the international glass container industry's foremost suppliers of production technology, high performance equipment and production know-how. Its mechanical engineering has set industry standards for more than five decades. Extensive industry expertise combined with the positive attitude and enthusiasm of Heye International employees is mirrored by the company motto 'We are Glass People'. Its three sub-brands HiPERFORM, HiSHIELD and HiTRUST form the Heye International equipment portfolio, addressing the glass industry's hot end, cold end and service requirements respectively.

New victories for SIGMA's high purity alumina A 95 V



Inspired by SIGMA's recent whopping supply of special refractories around the world, the editorial team at Glass Machinery Plants & Accessories spoke some days ago to Commercial Manager Alberto Tedeschi as well as the company's Chief Operating Officer Federico Mari and its Area Sales Manager, Elia Somaschini.

Plovdiv facility

GMP&A: ALBERTO, PLEASE GIVE US A BRIEF OVERVIEW OF CORPORATE DEVELOPMENTS AT SIGMA IN RECENT YEARS – ESPECIALLY IN THIS POST-COVID PERIOD.

AT: Sigma made its global footprint much more visible considerably in the last years, while increasing its turnover as well. Notably, the company increased the quantity of refractories manufactured and distributed on the global market, thus placing itself in a leadership position with regard to the production of special pieces.

I started working here in June 1998. At that time Sigma had just 26 people. The main market was domestic - Italy, thus we exported relatively few products. Today we are exactly in the opposite situation, exporting over 80 percent of the total range. By the way I would like to add that, while our production being initially based in our HQ in Locate Varesino, we count now on two production facilities: one here in Italy and the second one in Plovdiv, Bulgaria. Sigma Group has currently 100 employees. Initially Sigma started here with just one small building, then gradually developed, finally reaching the coverage of the whole industrial area surrounding, next to the main street. The construction of the first unit in Bulgaria began in August 2013 and the production then in March 2014. We have just completed the construction of a fourth industrial building in Plovdiv. In Bulgaria we can nowadays boast of seven sintering kilns. Along with nine ones in our HQ in Italy, we count in total on 16 sintering kilns. What just said makes Sigma an international leader of special shapes, particularly those of considerable tonnage, with an average monthly production of around 600 tons of shaped refractories and 650/700 tons of pressed refractories.

GMP&A: How are you perceived by the glassworks? Would you rank Sigma as the ideal partner for special refractories?

Locate Varesino facility

Channel blocks layout

AT: Yes, surely. Glass manufacturers always need a reliable partner, which can technically guarantee all materials - both special pieces and standard bricks for glass furnaces, forehearths and regenerators. This makes Sigma really eclectic in case of any glassworks' requirement. As a matter of fact, it may happen that one supplier only is able to present the most convenient and reliable path for a glasswork, thus placing it in a safe condition. On the other hand, concerning large Groups, the parceling out of purchases is quite normal. That may happen thanks to their clear structure, including technical staffs responsible both for standard and special products. In this way, a Group can get also different prices. Considering that several refractories' producers play on the marked, we do not all make the same product. The same may happen with the refractory grades required in case of glass furnaces rebuilds. The only way in some cases is to trade certain products, thus to match the customer needs as well as widen the suppliable range. However, in some cases it may be easier and more convenient for glassworks to have an interlocutor only, who is able to constantly look after their needs. Sometimes Sigma takes the role of main contractor. A recent example is our latest deal with Vetreria Etrusca, which commissioned us the whole range of refractories for their furnace rebuild, excluding fused cast materials.

GMP&A: Of course, in many cases you do not act alone. Do you have any partnership with engineering companies?

AT: Engineering companies acquire the whole furnace construction package and we may sometimes become their suppliers. They must guarantee to the final customer both the validity of their projects and the quality of all refractories selected and then installed on site. We practically work with all engineering companies worldwide. By the way, we recently received a very important approval from the company Sorg regarding our high alumina premium quality A 95 V. Sorg performed corrosion tests on a wide range of high alumina products available on the market and finally identified Sigma's quality like the best in comparison with the other ones, in terms of glass corrosion resistance, by soda-lime glass.

Forehearth superstructures

Ultrasonic test

GMP&A: Speaking of quality, what tests are performed on your product, and are they carried out by the glassworks or by Sigma itself?

AT: in case of important orders and always, if required, we can certify the quality of our products through issuing the relevant quality certificates. In this way the customer knows that the refractories installed show exactly the properties certified by our internal tests. Sigma is any time able to carry out specific tests on its products. There is actually an European standard, which identifies the chemical analysis of different products and, on this base, Sigma can always accompany its products with the above-mentioned quality certification. In this way our customers can any time check that what has been provided really corresponds to what has been declared. Sometimes it may happen that the customer asks for samples of the materials purchased and we are always ready to fulfil its needs. Our internal laboratory checks daily that the production complies with the parameters fixed according to the European standard. As a matter of fact, the values guaranteed are not absolute, they must be inside a range established

Spare parts for feeder

Forehearth superstructures

by those standards. The reason can be searched in the fact that the refractories are non-homogeneous materials, essentially coming from diverse natural raw materials.

SUCCESS STORY GMP&A: Can you speak on new market areas developed and new customers?

AT: Sure, we are present on all five continents. We are grateful for the trust received by all our customers, one of our most important target is now and will always be in the future to deliver worldwide added value, both in terms of best quality and excellent service. Of course, the sales penetration in the different areas can change accordingly. Some shall be further developed, while business activity needing to be intensified. That is why we hired new sales people, such as Elia Somaschini, who will mainly deal with the Middle East.

GMP&A: You mentioned several very important Groups. Let's take your latest big project for example: what was exactly Sigma's contribution to the new green field plant in Milan area?

FM: Firstly, let's say that we are really glad to be a part of the worldwide glass family. We are also very proud to have taken on supply of the new green field plant in Milan area. This is not just because the plant is close to us, but also since the supply was really meaningful. We are talking about materials for two furnaces, purchased and supplied like a single order. It does not deal just with the forehearths glass contact material - channels: it is all Sigma material in the forehearths - from the beginning to the gob area. Another important supply was to Vetreria Piegarese for furnaces at both the new San Giorgio di Nogaro and the Piegaro plants. Once more, all materials ordered are completely Sigma - from the beginning to the forming machines. Furthermore, among the recent and most important supplies, the Eskisehir plant in Turkey should be certainly mentioned.

GMP&A: Besides your A 95 V high alumina premium quality, what are your other leading products?

FM: Definitely, our zircon-mullite grade, which is used for feeders - the last part of the forehearth, leading to the gob forming. Another important quality is our premium mullite grade MUL 70 M, mainly used to manufacture bricks for regenerator chambers.

GMP&A: Will experimentation recently being carried out on the new furnaces generation somehow affect refractory materials?

FM: I think so. There will be surely some important changes in the future. Probably, the special refractories will keep on being required worldwide. Sigma is meanwhile preparing to face this new challenge. It is not yet exactly known, if the glass furnaces will turn into electric, or based on a hydrogen-oxygen mix combustion. It is on the other hand clear, that glass furnaces will always need forehearths materials, thus to make the gob forming possible. ■

Technological innovations at FAMOR ENGINEERING herald fresh business opportunities

Having already gained much experience in the construction of machines and technologies for forming hollow glass, the team at FAMOR ENGINEERING has been hard at work over the last three years – delighted as ever to share the company's expertise, going forward, with both existing and potential customers.

For over two thousand years, before the advent of automation technology, iron gathering was the only way glassmakers could remove molten glass from their furnaces for further processing. As for Famor's contribution to the industry, the company's four technology solutions are Suction Robot Technology (SRT), Gatherer Robot Technology (GRT), Platinum Feeder Technology (PFT) and Gob Feeder Technology (GFT).

FAMOR AND BALL GATHERER ROBOT TECHNOLOGY

Founded in 1977, Famor Engineering was already involved in small machinery production, better known as semi-automatics, from early in its journey. One of its first machine developments was that of Ball Gatherer Robot Technology. The company then expanded its production range thanks to its investments in technology.

	Traditional manufacturing	Suction feeder
Advantages	Lowest investment costs extremely high flexibility suitable for shortest production runs suitable for pot furnaces and day tanks	High quality glass products reduction of reject level reduction of personnel costs reduction of energy costs glass maker exposed to fess heat

	Suction feeder	Platinum feeder + Billet Casting machine
Advantages	Lower investment costs lower personnel costs per article no waste glass between gathers utilisation of existing working ends	Highest product quality

SUCTION ROBOT TECHNOLOGY

Besides article quality, investment costs are a necessary consideration in Suction Robot Technology. These usually increase disproportionately when article quality improves. It may not be immediately clear why achievable quality with the Suction Robot Technology is better. In high quality glasses a depleted layer develops on the glass surface, with a slightly different chemical composition. This layer appears on the surface of articles produced with the suction feeder, is very thin and is usually removed by subsequent acid polishing. By contrast, when the glass is gathered manually, this layer becomes part of the parison and subsequently appears as a cord. When the parison gathers there is always the risk that bubbles get produced, or that bubbles floating on the glass surface are picked up. The suction feeder collects glass mostly from below the surface in the working end - where the glass quality is better. So far, the suction robot has only been installed on continuous melting furnaces, where the glass level may vary to a limited extent (up to approximately 50 mm). Should the glass level vary by more than 5 mm then the suction robot can be supplied with auxiliary equipment - allowing the suction head to follow the glass level automatically.

The new generation of Brushless Servomotor is used to lower the suction head in the right position. The software and set up will send the right information to Servo Drive to stop the lowering movement as soon as the mould touches the glass bath. However, the glass level must not be allowed to drop below a certain level as the suction feeder arm would otherwise rest on the tank sidewall block. This is one of the reasons the suction robot cannot be used with day tanks or pot furnaces. In addition, a special suction feeder for these applications would be technically complicated. It is also to be expected that the glass quality would be reduced as a result of the lock of currents in the glass bath. Finally, the suction robot is designed to remove large quantities of glass and this capacity is not required with day tanks or pot furnaces. A special design of this type would therefore be both technically and economically nonsensical. Good quality glass can only be attained with the suction robot when there is a current in the working end. This current is produced by stirrers'

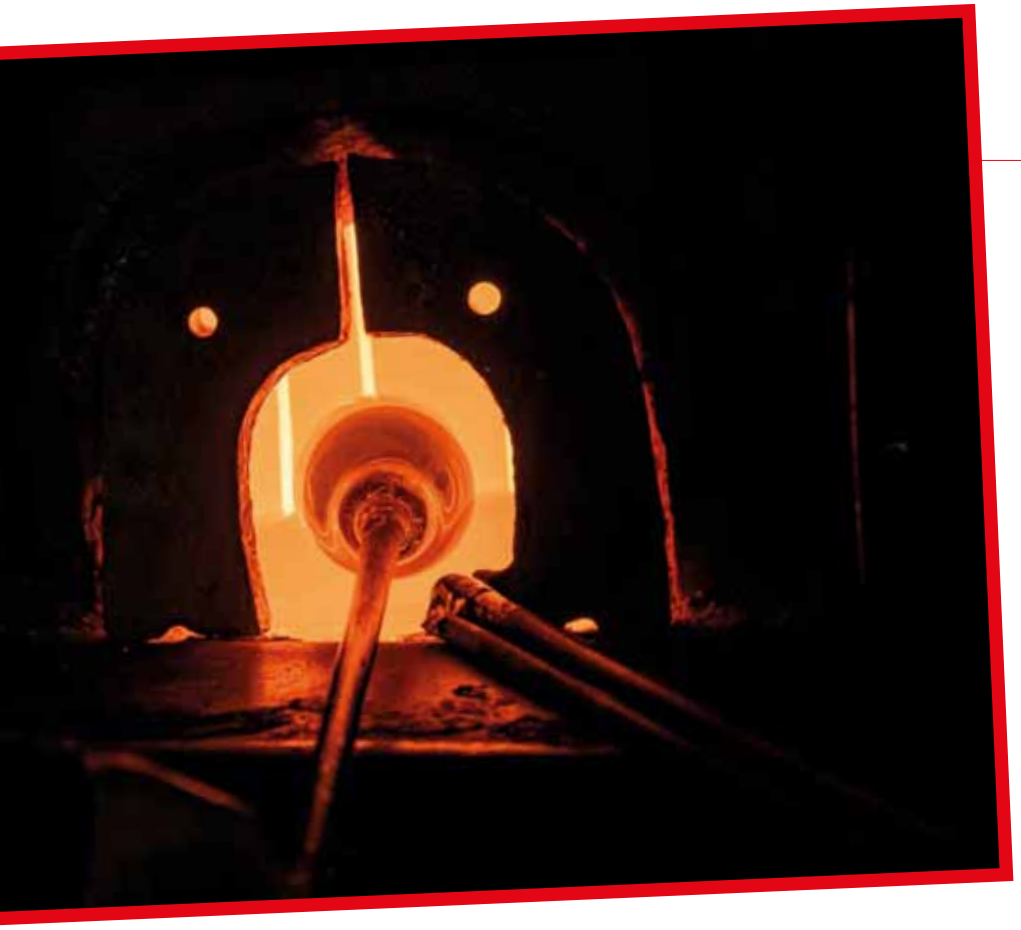
mechanism, but in tanks without stirrers' mechanism, the appropriate movement of the suction robot itself through the tank must produce this current. The shears of the suction feeder are relatively cold and form mould - a layer that then breaks when the shears cut (crack formation). These areas would produce seed in the glass when it is sucked in. A stirrer in the working end causes these faults to move in a spiral towards the outside. Cords, seeds, and blisters move to the outside and collect on the glass surface in the working end. Bubbles burst here and the cords dissolve without trace (one can see the spiral current by throwing a piece of cullet into the working end). The spiral current can be changed by altering the speed and height of the stirrer.

FACTORING IN THE STIRRER

If it is not possible to install a stirrer in the furnace, or if the quality improvements produced by a stirrer are not required, then the currents in the glass must be produced by a suitable operating procedure. Where a stirrer is being used the glass is cut off immediately after the vertical emergence of the suction robot head. If there is no stirrer the glass is cut-off during the travel to the outside. Here it is important that the cut-off end of the glass does not fall onto the glass bath. Bubbles and seeds would occur if this happened. It is much better if the cut-off end lands on the outwardly sloping surface of the tank sidewall block - or preferably in a so-called glass pocket, from where it can drain off. An additional, low, constant flow of glass through this pocket also helps reduce glass faults. The best solution is a combination of both systems. i.e. stirrer and glass pocket with a constant overflow.

THE INJECTION CHANNEL

When the glass is fed into the reservoir, either manually or from a ball gatherer, it tends to run some way into the injection channel and cool down. This effect can often be seen in the finished article. Where the injection channel is small this effect is reduced, but on the other hand the risk of folds forming during injection increases and as the injection channel freezes quickly there is also the risk of vacuum bubbles and/or sunken areas. The cold skin on the surface of the suc-



tion robot, gather means that much larger injection channels can be used, virtually eliminating the problems described above. The larger channel section means that much lower pressing forces are required. The reduced pressure in the glass causes less wear on the moulds, especially on the edges, prevents over-pressing of the articles and makes it possible to suck in more glass - possibly aided by compressed air. Furthermore, in the case of solid articles the virtually cord and bubble free glass quality from the suction robot is a definite advantage.

THE BALL GATHERER

One of the greatest advantages of the ball gatherer, as compared with the gob feeder. The ball gatherer lies between manual gathering and gob feeder. As is so often the case, no one system is ideal for all applications. Here the most suitable process must be selected for each individual application, which is why companies considering such an installation should first consult Famor Engineering in advance.

FURNACE DESIGN

Furnace design is an important aspect to consider. Is a suitable working end available? Does the gloss level leave enough height to deliver the gob into the forming machine to be used? What are the maximum and minimum cutting rates possible for the forming machine? Besides these important questions, other factors can be no less relevant, including production programme, factory layout, quality requirements, mould number per set, furnace melting capacity, direct gob drop or direct feed, etc.

MAIN APPLICATIONS AND APPLICATION LIMITS OF THE BALL GATHERER

The main area of application for the ball gatherer is for three-shift production, mostly for flat articles - with production rates of up to six items per minute and average glass quality requirements in soda-lime or lead crystal glasses. The equipment is also used at higher production rates and for borosilicate glass, but these applications are not common.

The main application limitations result from:

- the lack of flexibility about higher operating speeds
- glass extraction from the surface
- the impossibility of producing gobs to fit the moulds

To look at these three points in more detail, the gathering ball of the ball gatherer itself must travel relatively long distances of up to four metres during its operating cycle. The loading limits of the machine and gathering ball allow only limited values of acceleration and deceleration. Furthermore, the sum of the processing times, for example, for

the winding on, thermal homogenising and feeding of the gather, is relatively long. As a result, in practice only a few systems can operate at speeds higher than six articles per minute. In the case of blown articles, where higher quality is required, this operating speed cannot be reached.

VOLATILISATION

Various tests have shown that all types of glass suffer from volatilisation when in a molten state. This tendency to volatilise depends on several parameters, such as the glass composition, temperature, etc. As a result of this volatilisation the surface layer of the glass differs to a greater or lesser degree from the base glass composition. This surface layer with its different chemical properties (e.g. composition) and physical properties (refractive index, structure) is repeatedly picked up by the ball gatherer and is then present in the different areas of the glass on the gathering ball. This automatically results in inhomogeneities in the finished glass article. The ball gatherer is totally unsuitable for tall articles such as vases, as the glass flows off as a relatively thin stream at the end of the feeding. Folds occur in this stream when it has been cut off.

FOCUS UPON LIMITATIONS

The limitations described above for conventional ball gatherer technology are generally known. Great effort has always been made to overcome these limitations. However, as they apply to the principals involved, such efforts using conventional technology were only partially successful. In order to be able to make a definite step forward, it was logical that other technologies be investigated in the search for new development possibilities. From the many systems known and used, the gob feeder principle was regarded as the most practical. This principle does have certain disadvantages when compared with the ball gatherer - even if a modified gob feeding system probably remains the best system for most applications. An analysis of conventional feeders and their limitations indicates the various criteria which must be fulfilled by a new system. The conventional gob feeder becomes more difficult to control as operating speed decreases. Low glass viscosity is necessary or high-quality articles are mode using modern technology. However low glass viscosity cannot be retained between gobs in standard feeders at low production rates. Therefore, in order to achieve satisfactory results, the operator had to use various tricks, such as making a cleaning cut between two gobs.

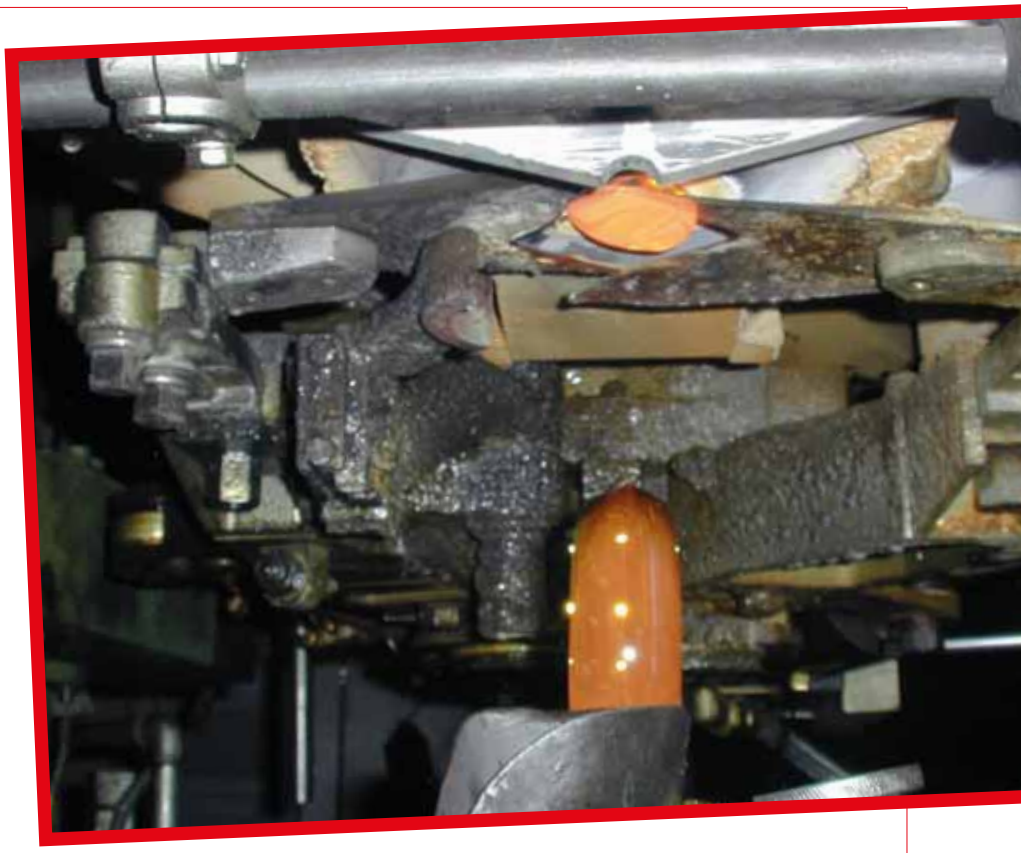
CONTROL SYSTEMS

Gob feeders are generally mechanically controlled by cams or electronically controlled by electronic cams. This is a very robust system, but adjustments are usually very time consuming. A modern electronic control system offers definite opportunities for reducing adjustment times. In conventional feeder's heat is continually transported to the surrounding refractory material by the gloss currents. The glass is therefore thermally inhomogeneous. i.e. thermally layered. An important requirement has thus been to achieve similar temperatures in the glass and the surrounding refractory material.

CONSTRUCTION AND OPERATING METHOD

The nucleus of the special feeder is a monolithic block made from highly resistant refractory material. The block is provided with horizontal and vertical holes. The glass enters the feeder from the forehearth channel (which should ideally feature a covered glass surface) through the horizontal hole. A ceramic screw plunger is installed in the vertical hole. The screw plunger controls the flow of glass from the orifice by means of a combined vertical and rotational movement. The feeder block is electrically heated and is maintained at the same temperature as the glass. The actual thermal insulation is installed outside the feeder block. This design assures the thermal homogeneity of the glass. The screw plunger has a double thread with a specific pitch and can be rotated both clockwise and anti-clockwise. Clockwise rotation of the plunger works against the natural glass flow, whereas when the plunger is rotated anticlockwise the natural gloss flow is assist-

ed. Relatively large quantities of glass can thus be fed to the forming machine in a relatively short time. The process is further supported by a programmable, plunger-like movement of the complete mechanism, like that used with conventional feeders.



GOB AND PLUNGER CONSIDERATIONS

A gob suitable for the forming machine in use can be produced. Smaller gobs at a relatively high cutting rate are produced as on a conventional feeder. However, the system provides greater influence on the gob shape through adjustment of the speed and direction of rotation - and the stroke of the plunger. The speed with which the glass flows out of the orifice ring can be greatly reduced by changing the direction of rotation and rotating the plunger clockwise as mentioned above. This capability is used for the provision of large gobs at low cutting rates, such as when the feeder is used as a downdraw system. In order to keep the amount of waste glass to a minimum two cuts are made within one operating cycle. The first cut is mode as a cleaning cut, immediately before the actual feeding process. The anti-clockwise rotation of the screw greatly increases the glass flow speed. When the required gob weight has been reached the glass - stream is cut again.

The small amount of waste gobs which run out of the orifice ring is removed from the forming machine via a chute and then fritted. The support frame for the electro-mechanical drive units is mounted above the vertical hole for the screw plunger in the feeder block. The drive units are low-inertia, electronically-controlled, high-power ser-

vomotors which enable precise and quickly-reversible movement sequences. The top end of the ceramic screw plunger, which is attached to the drive shaft for rotary motion, is cone-shaped - which guarantees exact centering of the plunger. During operation, a vacuum is applied to the plunger to prevent air from entering the glass from the plunger. In order to exchange the screw plunger, the whole drive unit for the rotary motion is moved to its uppermost position. The plunger is then outside the feeder and is freely accessible.

EASY ADAPTATION TO SUIT FORMING MACHINES AND AUXILIARY EQUIPMENT

The electronic control system can control any glass forming machines and the auxiliary equipment of such machines. By making use of suitable hardware adaptations and extensions it is possible to use different types of drive units, such as brushless servomotors. Famor Engineering supplies the software and hardware adaptations for controlling the forming machines. Therefore, the user has many options available which can minimise the total investment and simplify system operation. Many different versions of this feeder have already been supplied. For the standard version ER 1711 refractory material or similar is used. For applications where the glass colour is not an important factor ER 2162 is used, as this is more wear resistant. A platinum coated plunger and platinum lined feeder are also available for production of the highest quality.

EQUIPMENT DESIGN ACCORDING TO CUSTOMER NEEDS

Focusing upon some interesting technical details of the feeder, it operates with glass of a relatively low viscosity. The company always has complete feeder heads available in stock so it can offer some-day supply of a replacement. Any defective feeder head is returned, immediately refurbished and put into stock. Returning now to the main applications of Famor's special feeder, it's mainly used to produce high-quality articles with cutting rates of between two and 10/12 items per minute. A cleaning cut must be mode at low cutting rates, which results in glass losses. The application limits are determined by the glass throughput per 24 hours, the melting capacity of the furnace and the space available.

THE CONVENTIONAL GOB FEEDER

As the development of electronically-controlled feeders was only carried out for high-capacity feeders for the container industry, today's manufacturers of conventional gob feeders tend to concentrate progressively more on obtaining the highest possible cutting rates and throughputs for their feeders. Famor Engineering can now supply a feeder to fill this gap - a new feeder constructed much like traditional feeders, except that the vertical movement of the plunger and the shear movement are provided by high-capacity servo motors. These motors are typically controlled by the electronic control system of the forming machine, though a separate electronic control system can also be supplied. The stemware line, for example, can be fed by two identical feeders. The changeover times from one article to another will be drastically reduced once feeder setting parameters have been included in the data sets of the press. It is also possible to use this concept to convert existing feeders.

APPLICATION LIMITS OF STANDARD FEEDER WITH ELECTRONIC DRIVE

The lower limits are where the glass is too cold, or where it is not possible to form a clean gob. The upper limits are in the region where high-capacity feeders for the container industry come into use. ■

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Furnace Developments

Increased electrical power sees HORN boosting sustainable glass production

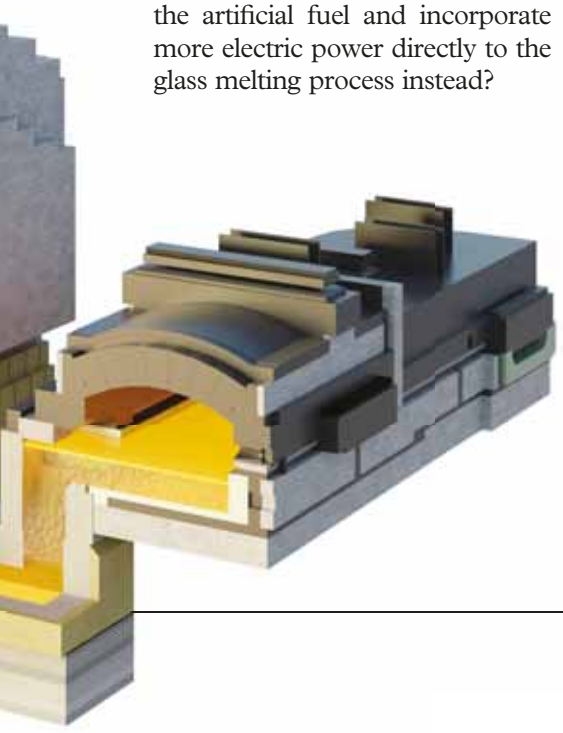
Coupled with the need to cut CO2 emissions, rising fossil fuel costs in many parts of the world is pressuring industries to explore and leverage alternative energy sources. Here glass is no exception, which is why HORN continues as a supplier to create fitting solutions that ensure glass producers can better tackle such challenges.

Oxy-superhybrid furnace powered 80% by electricity.

All electric furnace with top electrodes for 200tpd.

In the race towards net zero, a leading notion -perhaps the best solution out there- is that of wholly substituting fossil energy sources with green alternatives. Here biogas or green methane can be used as a more direct replacement to natural gas. Hydrogen, at the centre of much talk, is another option.

However, low efficiency as regards electric energy input represents a problem for most of these substitute solutions. But wouldn't it make more sense to simply bypass the artificial fuel and incorporate more electric power directly to the glass melting process instead?



On that score, HORN's conceptual approach can be subdivided into three groups:

- Hybrid technology: Increase the electric power input in a classic setup (end or side-fired) up to 40 percent or even 80 percent;
- The All-Electric furnace: Use the long-existing technology of all-electric melting and update it to match the requirements of glass producers outside high quality and specialty glass;
- Electric forehearths: Apply electric heating - not only to the melting process but to glass conditioning and distributing too.

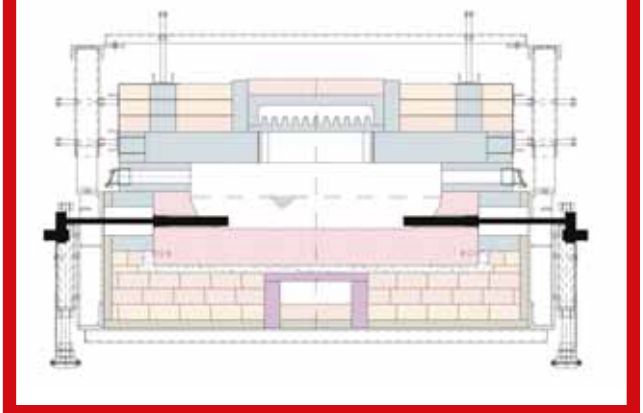
HYBRID FURNACES

HORN divides furnaces into three basic categories depending upon their electric share:

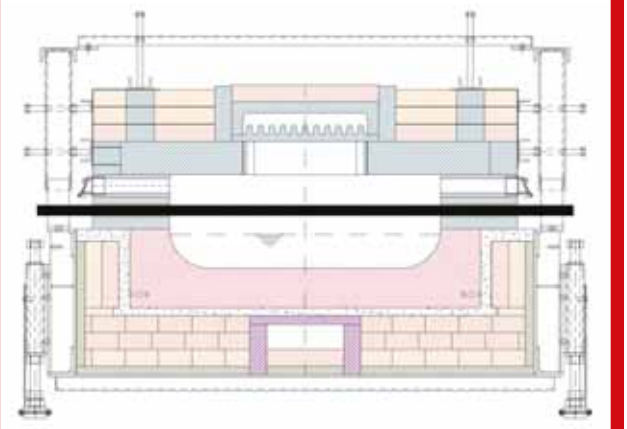
- Boosted (Classic): with up to 20 percent, representing the upper limit of what is done;
- Hybrid: ranging from 20 to 40 percent for end-fired regenerative furnaces and up to 50 percent for oxy fuel furnaces;
- Superhybrid: from over 50 percent to 80 percent of electric share for oxy fuel furnaces.

The two hybrid categories bring some challenges to furnace design and conceptualisation. Temperatures for different parts of the furnace will differ greatly from what is experienced in the more classic setup. Lower temperatures in the superstructure are the result of reduced fossil combustion - requiring an adapted refractory concept (lime free silica <-> standard silica). The high electric input on the other side will increase glass temperature in the distributor. Combined with a steep increase of convection due to the influence of a high number of electrodes, corrosion especially of the tank bottom is expected to be much higher.

A main goal of the hybrid furnaces is to maintain the well-known horizontal melting process principle of classic fossil furnaces. For an oxy fuel furnace the distribution of a multitude of burners along the glass flow allows for excellent tuning of the temperature profile to match that of a classic furnace. An added shadow wall dividing the superstructure into two parts is only deemed necessary when flexibility is very high. Depending on size, quality and flexibility, other additional features could be



Forehearth with electrode heating and indirect cooling.



Forehearth with SiC element heating and indirect cooling.

a refining shelf, a deeper refining part and the possibility of flue gas recirculation to increase the burner port velocity and secure a proper flame formation for hybrid end fired furnaces.

THE ALL-ELECTRIC FURNACE

Electric melting is hardly 'new'. Nowadays usage of the term usually refers to high quality or specialty glass, given that certain challenges hamper the production of, say, container glass. The culprits are a limited pull rate maximum (< 200 to/d), restrictions concerning pull change flexibility, cullet fraction and a shorter lifetime. Here HORN is hard at work tackling the disadvantages with a view to overcoming them or at least softening their impact.

To best meet the needs of glass producers, upscaling of an all electric furnace is crucial. This is because a pull rate of 200 to/d is currently around the lower end of the scale for the production of container glass (not to speak of flat glass). To achieve it, HORN is shifting from the round shape (octagonal or dodecagonal) to a rectangular shape for bigger, all-electric furnaces. For a round furnace the distance between top electrodes would be much higher in an upscaled version (80 percent increase by going from 60 to/d to 200 to/d). The direct result would be a high instability in the melting process. In the rectangular setup, the distance would only be 10 percent higher and the process still controllable. The rectangular furnace is a proven furnace shape. This furnace type has been successfully installed and operated for decades by HORN's daughter company JSJ Jodeit.

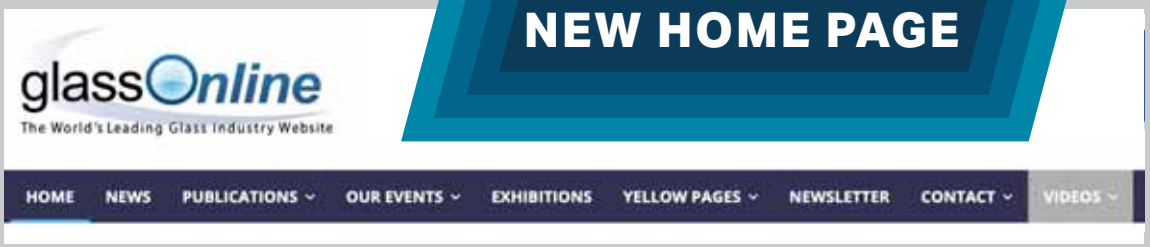
In today's most recent all-electric furnaces, flexibility regarding cullet fraction changes and pull rate is very reduced. This can mostly be attributed to the stability of the insulating batch layer on top. Changes to this layer by using more or less batch can lead to insufficient thermal exchange between glass and melt or the creation of holes in the layer as well as, subsequently, an elevated thermal loss. By using a higher furnace depth the glass residence time is increased. If changes to the cullet fraction/pull rate now require a reduction in electric power then longer residence time helps to secure glass quality with lower electric input as well (and therefore lower temperature level). Being able to operate the furnace with a lower temperature level will also help to increase the lifetime.

ELECTRIC FOREHEARTHS

With most energy consumed by the melting process, glass conditioning and distribution is also an area where a switch to electric heating can save fossil fuel (and potentially costs). Here electric heating options include both a direct and an indirect possibility. For direct heating, Molybdenum electrodes are installed in the glass bath. This may be used for coloured glasses but it can lead to defects with flint glass (sulphate fining). Another disadvantage is the use of indirect cooling only - which can limit flexibility.

For indirect heating, SiC electrodes are placed above the glass melt. Glass colour is no factor here, but the restriction of indirect cooling applies as well.

High investment costs for these electrical heating systems (and their restrictions) must be weighed against the long-term potential of energy savings (e.g. from 70 percent up to 85 percent for 120 tpd). ■



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Still one step ahead, ANTONINI elevates its avant-garde technologies

Thanks to long-term experience and high level know-how, Antonini can now realise any kind of development and installation of its solutions - leveraging excellent references while continuously investing in bettering its offer to clients as it commits to guaranteeing maximum performance.

The company's work and effort have always been defined by four key factors:

- Flexibility
- Customer focus
- State of the art design
- High-level equipment

As such, it's has been able to reach the following targets:

- Tailor made design
- Optimal energy efficiency
- Proper manufacture
- Reliability

With the last three decades seeing ANTONINI consistently integrate tradition and innovation, the Tuscany-based company has become a world leader in annealing, decorating and tempering lehrs ever since its establishment in the 1940s - making it synonymous today with quality, reliability and sustainability.

TUNNEL MODULES

Going into more depth about the technological aspects, one might say Antonini has consistently set itself apart from competitors regarding the quality of its manufactured goods - especially tunnel modules. These are categorised by the following trio of labels: Heating, Mix (Heating and Cooling) and Cooling. Each one's made of three main components, namely an interior tunnel module made mostly of stainless steel, an insulating material made of rock wool and an external metallic structure.

HEATING MODULES

Every heating module includes an air recirculation system (top ventilators) to ensure homogeneous, stable temperatures within the tunnel. Antonini's heating modules, such as its gas burners or electrical heaters, all excel thanks to their superb performance at every level of power. Here heating power is split appropriately along all heated zones of the tunnel - thereby allowing for a balanced distribution of temperatures during the processes of annealing, decoration or tempering.

MIX MODULES

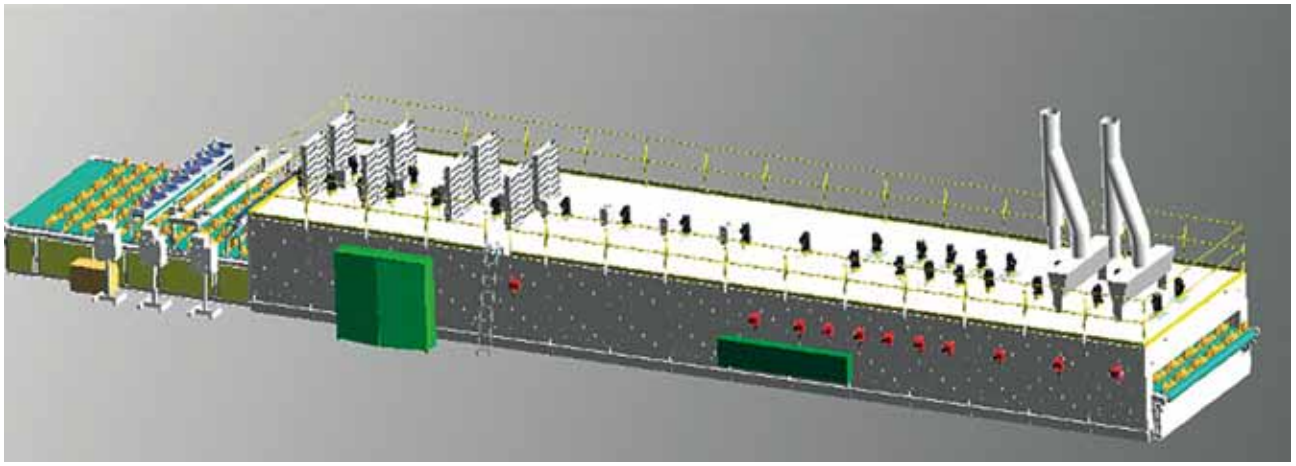
The mix-modules are well-equipped with the means of both heating and cooling. Proportional control valves allow for an external air inlet to the recirculation system. This, in turn, permits air in the tunnel to mix with the external fresh air without interfering with the temperature of the glassware.

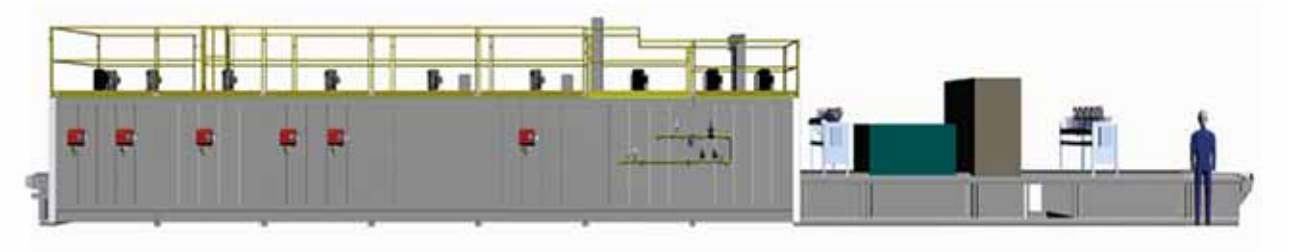
COOLING MODULES

In the last modules of the tunnel (the cooling area), a specialised chimney discharges any overpressure from hot air. Each module of the tunnel has its own air rebalancing 'air-drift control' system which assures independent, extended control of temperatures in all areas of the tunnel. This then guarantees constant set point temperature values throughout the manufacturing process.

Antonini's flexibility has allowed the company to develop specialised solutions that are aimed at reducing energy consumption by:

- Employing the most efficient electrical motors on the market;
- Introducing a smart management system applied to the motor of the top ventilator as well as all other motors installed on a lehr with a specific software interface to ensure intelligent energy usage;
- Substantial reduction of the power needed for air circulation systems to reduce shadow areas and increase production capacity;
- A reengineered top ventilator unit, which eliminates all unnecessary energy consumption caused by superfluous compo-





nents - a must now for all lehr supply;

- Reduction of energy waste due to localised overheating by employing multistage burners. This is achieved thanks to an array of burner heads - each of which functions with maximum energy efficiency;
- Electric power saving by using burners without a dedicated air-blower - all thanks to the use of gas pressure that will suck the necessary combustion air;
- A reduced component count that guarantees safety of the instalment and so minimises energy waste;
- Energy dispersion reduction given that specially-designed structures are employed that avoid energy loss of the glass containers while entering the lehr (less heat dispersion = less gas or electricity consumption).

As for the study of new product development, the latest 3D-modelling technology has been deployed for the design of highly-customised solutions. The company has also focused on planning and building 'dual fuel' or HYBRID lehrs over the past few years. This ensures greater flexibility, energy consumption optimization and use of the most local available fuel - allowing for individual fuel choices for value specific areas of the lehrs. Over these past three years, Antonini has manufactured and installed 330 Lehrs worldwide. Today the company is present in 94 countries - having already supplied over 2200 lehrs. ■

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Success story

Renovation of VETRERIA DI BORGONOVO's sensational melting furnace

Having its roots in a distant past, the glass industry has seen many of its innovations develop over millennia, just as uses of the material and human needs have changed with time. The industrial furnace at VETRERIA DI BORGONOVO is one such example - testifying both to the company's ingenuity and to its ability to always create new and effective solutions.

Production activity at Vetreria di Borgonovo is based upon the operation of two end port furnaces equipped with regeneration chambers and rear burners. These have separate dimensions, namely 23 sqm and 41 sqm respectively. Different sizes correspond to different production capacities, namely 60 tons/day and 120 tons/day. Together the two furnaces can feed nine production lines.

SMELTING FURNACE CAMPAIGNS

To guarantee the rate of industrial production, a melting furnace must remain at a constant temperature. This is precisely why shutdown is so infrequent - being necessary only at the end of a campaign. Indeed it's the mechanical and thermal wear and tear to which furnaces are subjected over time that necessitate renovation work. As such, any campaign will correspond to one of many melting furnace 'life cycles' - each of which lasts circa seven years. After each of these periods, a kiln must be switched off for refurbishment so as to start operating at full capacity again - all to ensure optimum quality of the final product. Here's why each melting furnace has several campaigns and as many restructurings behind it. At Vetreria di Borgonovo, the furnace that's just been renovated at the glassworks -the larger of the two- reached its fifth campaign this year.

1992: THE FIRST CAMPAIGN

The newly-renovated fur-

nace enjoys a long and rather remarkable history. It was first activated in 1992, launching an initial campaign that lasted a full eight years, though subsequent campaigns -such as the latest which just ended- have always had a duration of seven years.

POST SHUTDOWN FURNACE RENOVATIONS

Operations to renew the furnace, from switching it off to restarting it, lasted about a month and a half. Over that period, each step was carried out with great care - all with a view to guaranteeing the final objective, which was to ensure the kind of perfect functioning that's essential for the production of excellent articles of elevated quality. Here the basic steps for refurbishing a furnace can be summarized as follows:

1. shutdown
2. emptying at controlled temperature
3. demolition
4. replacement of worn parts and insertion of the new prefabricated building, i.e. new refractory material blocks
5. preheating
6. definitive restart

The preheating phase itself lasts about ten days and is required to gradually bring the furnace up to the temperature that will allow it to operate at full capacity, which is 1350/1400°C. To progressively reach this temperature only scrap glass is introduced - that is, a part of the vitrifiable composition which, once melted, will be transformed into liquid glass, given that it has a lower melting temperature.

UNTIL THE NEXT CAMPAIGN

This newly-renovated furnace returned to operation just recently, thereby inaugurating its fifth campaign - a long life indeed in which, thanks to the added synergy and expertise of the technical teams at Vetreria di Borgonovo, has consistently ensured quality glass. ■

Reducing emissions with GLASS SERVICE's advanced new furnace

During the upcoming Glass Service conference in June 2023, which is held every two years, glass producers and suppliers present the latest developments and discuss the results and reliability of furnace models. It is quite logical that no glass producer will build a new furnace concept melting 300+ tons per day without thorough analysis, calculations and extensive CFD modelling - something Glass Service has already been doing since its founding in 1990. The company has developed GS-GFM, a leading Glass Furnace Modelling Software. GS GFM is currently licensed to 35 glass producers and leading suppliers, with about 1000 solvers now licensed. Glass Service has performed about 1000 furnace design and optimization studies in-house. Lately most of these are asking how to reduce carbon emissions by increasing the amount of either electric melting or hydrogen. Such intensive use of CFD modelling was already seen when Oxy-fuel applications emerged, and now with the next generation of large Hybrid (with more than 50 percent electric boosting) or all Electric melter, another increase can be seen.

This year the main topic at GLASS SERVICE's sixteenth International Seminar on furnace design, operation and process simulation will be that of working out how the company can reduce its carbon emissions by way of new furnace concepts and ideas - all safely developed and tested by using Computational Fluid Dynamics (CFD) modelling.

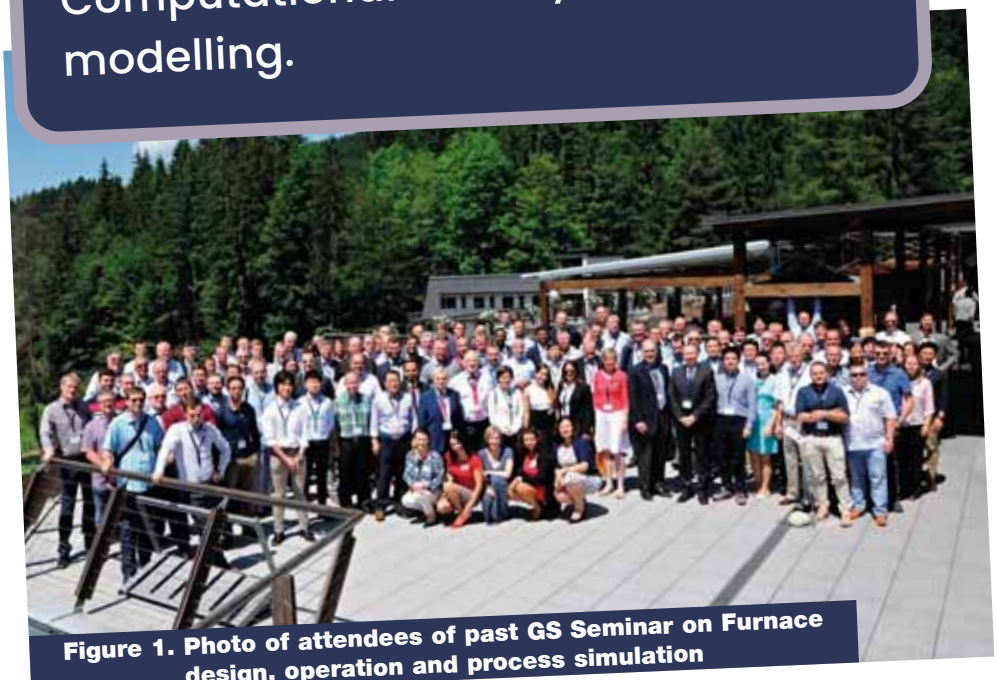

Figure 1. Photo of attendees of past GS Seminar on Furnace design, operation and process simulation

Besides the main seminar there will be separate meetings of ICG Technical committee 15&21 on Furnace design and operations, as well as a GS GFM Users meeting and a high level glass defect workshop.

Glass plays an important role in our society. Its usage in housing, transportation, communication, food storage, etc. is crucial to enjoying a high quality of life. Glass production requires both raw materials and energy. Reducing dependency on the need for materials is possible through further recycling. Indeed a significant advantage of glass is that it can be endlessly recycled without loss in quality or purity - even if glass waste needs to be purified, cleaned, and colour separated before use.

Using more cullet for melting means not only considerable savings in raw materials costs and energy usage, but CO2 emissions are also lower. Clean cullet needs to be reheated and homogenised; but melting reaction energy is not required and every ten percent cullet addition reduces the energy consumption of glass melting by two to three percent. To melt soda lime glass from raw materials requires energy of about 2.6 MJ/kg. As pure cullet, this is reduced to 1.9 MJ/kg. More importantly, re-melting cullet avoids CO2 emissions from soda ash (Na2CO3) and lime (CaCO3) in the batch. Every metric ton of waste glass recycling saves about 315 kg of CO2 that would be released manufacturing a new glass product. The most common, efficient, end-fired, container glass furnaces, melting with an average of 50 percent cullet, consume about 3.5 MJ/kg.

Melting glass requires considerable energy to reach the necessary high temperatures (>1500°C). Glass production used to take place in 'glass houses' where people had local resources - sand and wood ash as raw materials and wood from the forest for energy. Old glass houses can still be found in forested areas. As much as 150-200 kg of wood was needed then to melt a kg of glass [4]. Assuming wood burning generates about 19 MJ/kg, this equates to >2850 MJ for a kg of glass. Today's result of 3.5 MJ/kg is astonishingly 800 times more efficient.

Over the last century, the main energy source has shifted to fossil fuels such as oil and natural gas. Modern glass melting uses about 1 percent of all industrial energy much less than for example steel production. Nevertheless, it is energy intensive and massive improvements have been made over the years.

Furnace efficiency has increased because new refractories allowed higher combustion and crown temperatures, and increased melting temperatures. Furnaces became larger, producing more glass per m2 of heat loss surface. Some flat glass furnaces now produce a remarkable 1200-1500 tons/day while container glass furnaces can melt a high 800 tons/day. But furnace size is limited by the maximum crown span (width), the size of equipment, flame length, and other factors. Larger regenerators have increased heat regeneration from 50 percent to 70 percent, close to the theoretical maximum of 75 percent. This maximum arises from the difference in heat flow in the waste gas (greater mass and specific heat) than the air being preheated.

Figure 2 shows the design of the most common U flame (end-

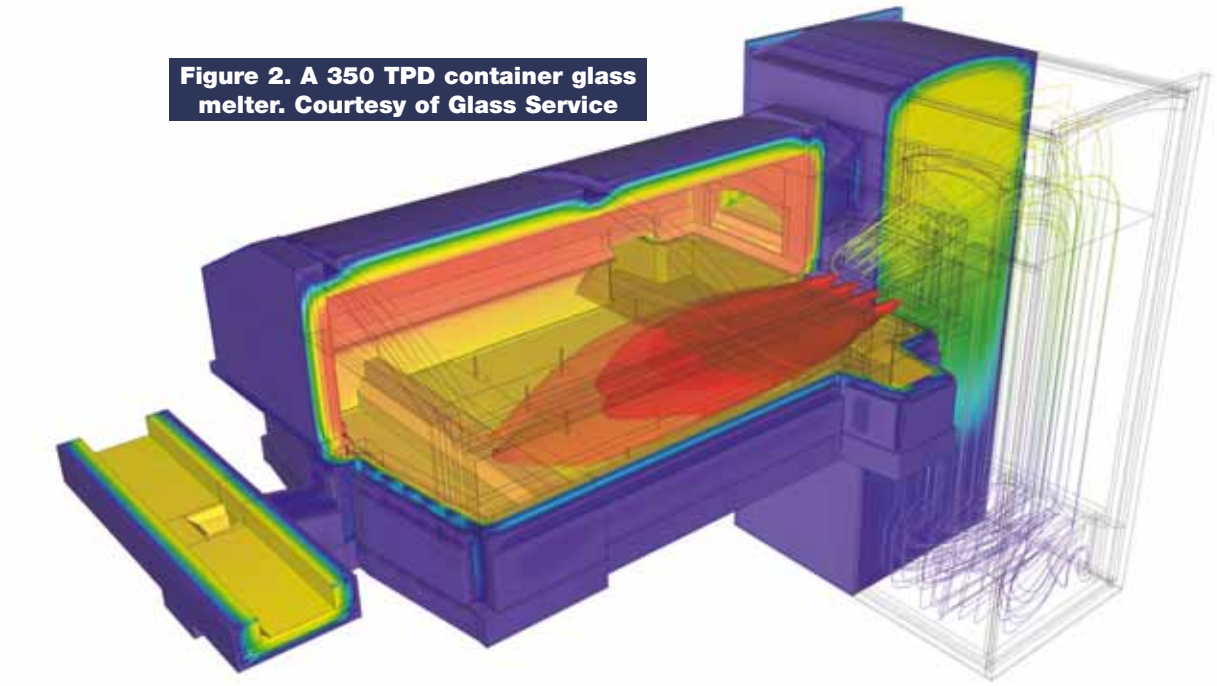

Figure 2. A 350 TPD container glass melter. Courtesy of Glass Service

fired) container glass melting furnace, producing about 350-380 TPD (tonnes/day). Cold air enters the base of the regenerator at the right and is preheated to 1200-1300°C, before leaving at the top and entering the combustion chamber. Gas (or oil) is injected into the hot air at the base of the port. This example has four injectors. The iso-temperature surfaces indicate the flame shape that develops. The hot gases radiate heat to the glass melt surface, the furnace walls and the crown, the latter two re-radiating energy to the glass. The waste gases then circulate round the furnace and exit via the left exhaust port, entering the opposite regenerator, and preheating it until the process is reversed after 20-30 minutes. Raw materials enter into the melting basin from two sides. First the batch under the flames is melted. Some designs have a barrier wall (0.8 m high) on the bottom of the furnace to bring the glass from a typical depth of about 1.3 m to the melt surface to aid the removal of small bubbles, the so-called fining process. The glass then dives down into the sunken throat to be delivered into the distributor which connects to the forehearth which takes the glass to the forming machines. The small rods protruding from the bottom of the glass basin are molybdenum electrodes that assist in melting the glass by electrical Joule heating, often called electric boosting. Such a melter is typically about 15 m long by 6 m wide.

The second most common glass melter is the cross-fired regenerative float glass furnace. Flat glass is formed after leaving the melter by floating the melt on a molten tin bath. This glass is mainly used for window glass or automotive windshields also solar panels or sometimes LCD products can be produced. The furnaces can be 35-40 m long and 10-12 m wide. The most typical pull rate is 600-800 TPD, but some furnaces produce 1200 or even 1500 TPD. These cross-fired regenerative furnaces alternate firing from opposite sides. They have five to nine burner ports on each side and the preheated air comes from brick regenerators on each side. Injectors introduce gas into preheated air to create flames crossing the glass melt surface, the hot waste gases exiting to the opposite regenerators. This process is reversed about every 30 minutes. Figure 3 shows a 600 TPD float furnace with 5 ports with 2 gas injectors on each side. Raw materials are introduced by batch chargers. After melting, the glass is cooled in the working end and then leaves via the canal onto the molten tin, where it spreads out to form a flat sheet.

OTHER FURNACE DESIGNS

Other technologies include the recuperative and the oxy-gas furnace. Oxy-gas furnaces use pure oxygen, extracted from air and may seem more energy efficient than the best regenerative furnaces. However any correct analysis would require the energy and cost of separating the oxygen to be considered and would usually favour a regenerative furnace. That said, oxy-gas furnaces can bring other benefits, including NOx reductions and a smaller footprint. Recently, two industrial gas suppliers have reduced energy consumption by preheating the fuel and oxygen.

Linde (Praxair) developed the OptiMeltTM technology to save another 20 percent of energy by preheating the natural gas with waste gas from the oxymelter to create a syngas (CO + H2) formed by cracking CH4 with CO2 in the waste gas. An interesting side benefit is that CO tends to reduce foam on the glass surface, increasing heat transfer and lowering seed counts.

Air Liquide designed HeatOx technology with heat exchanging recuperators using furnace waste heat to preheat the natural gas and oxygen indirectly to 400-500°C, giving 9-10 percent additional energy savings. Should

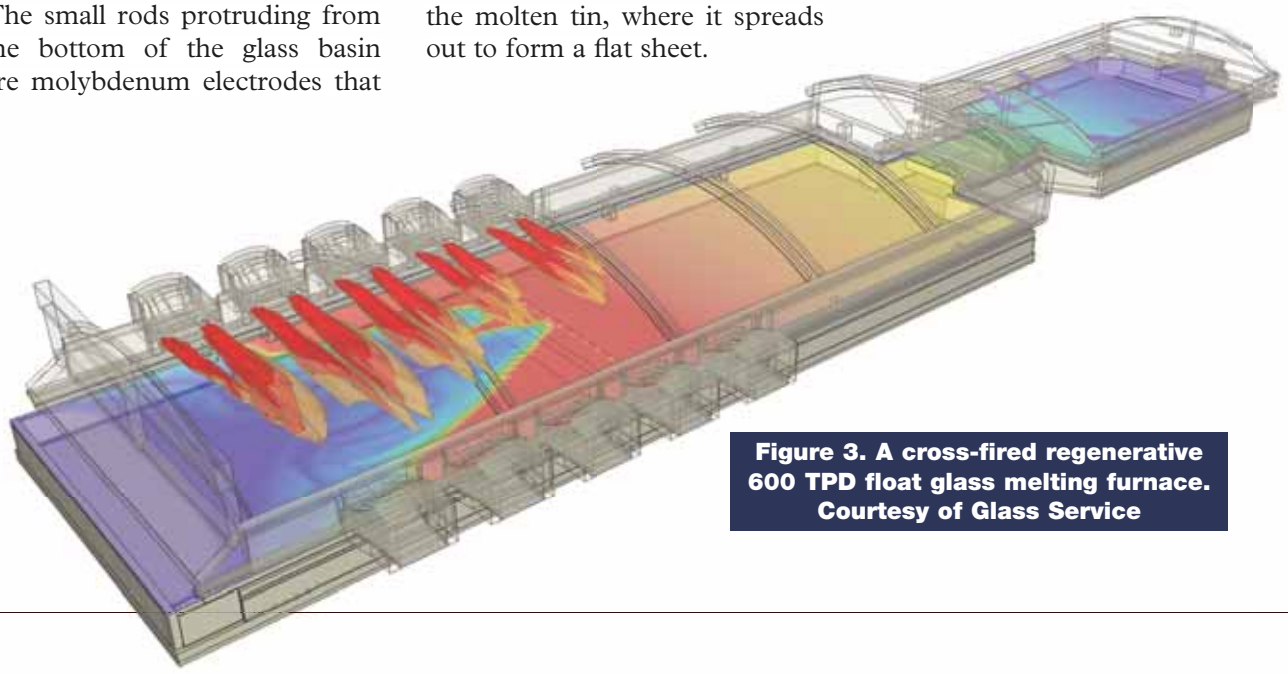

Figure 3. A cross-fired regenerative 600 TPD float glass melting furnace. Courtesy of Glass Service

this technology be installed in a conventional regenerative float furnace converted to oxy-gas firing, a total of 20-25 percent energy savings may be achieved. A side effect would be a major NOx reduction.

Finally an oxy-gas furnace is apparently converted to burn hydrogen more easily than an air-fired furnace. Burning hydrogen with air gives higher flame temperatures typically equated with higher NOx emissions. Oxy-gas furnaces may therefore be more attractive when hydrogen is affordable.

ELECTRIC MELTING

The first continuous regenerative glass melting furnace was invented by Charles William Siemens of Westminster England between 1872 and 1880 and modern regenerative furnaces have changed little since.

Many do not realise though that continuous all-electric melting (AEM) is almost as old as gas-fired regenerative melting. The first electric furnace was built in 1905 following French Sauvageons design and was for window production. The specific energy consumption was even then only 0.73 kWh/kg. Many designs have been implemented since then, though electric melting recently became unpopular due to its high cost compared to widely available fossil fuels.

Global warming and pressure on carbon footprints, has rekindled interest in full or partial (hybrid) electric melting. Alternative energy sources for electricity have helped to lower costs and production is essentially CO2 free; for example in Germany, 40 percent of electricity is generated using renewable resources such as wind, solar, hydro, and bio. The question for the future is not if more electricity will be used for glass melting but what will be the balance between fully electric and hybrid furnaces (substituting bio fuel for fossil fuel).

Glass is important in generating green renewable energy, or 'green electricity'. Most wind turbine blades are composed of reinforced glass fibre. And most solar panels use large quantities of flat glass. In the future photovoltaics will probably be widely integrated into windows. These applications mean that glass is not only a consumer of renewable energy. It also has an important role in generating it.

For larger furnaces with higher pull rates, the higher volumes and lower wall losses make recuperators or regenerators sensible. Gas-fired furnaces can be cheaper than the efficient electric melter. This was historically so in most countries because electricity was generated from fossil fuels, and typically 2.5 to 3x more costly per kWh than the fuel alone.

Even small electric furnaces are 70-85 percent thermally efficient. While a fuel fired furnace without a recuperator at a low pull is only ten percent efficient, adding a regenerator improves efficiency to 45 percent and an oxy-gas fired furnace can achieve 50 percent efficiency.

Most common all-electric melters produced 10-30 TPD, sometimes up to 80 TPD. They were round or hexagonal to avoid heat losses via the furnace walls and to allow more easily distributed batch charging and electric connections. Figure 4 shows a larger rectangular melter at 80 TPD. These cold top electric melters used the batch cover as a heat insulating blanket, conserving heat inside the melt. They were called vertical melters, as the glass melts on the surface near the batch, refines at lower levels and flows out via a bottom throat into a working end/distributor. To maintain batch coverage and hence an insulating blanket, the cullet content was usually below 50 percent. Electric melters were mostly used for high quality clear glasses and crystal (lead) glasses, as the redox (colour) control is best managed with this process.

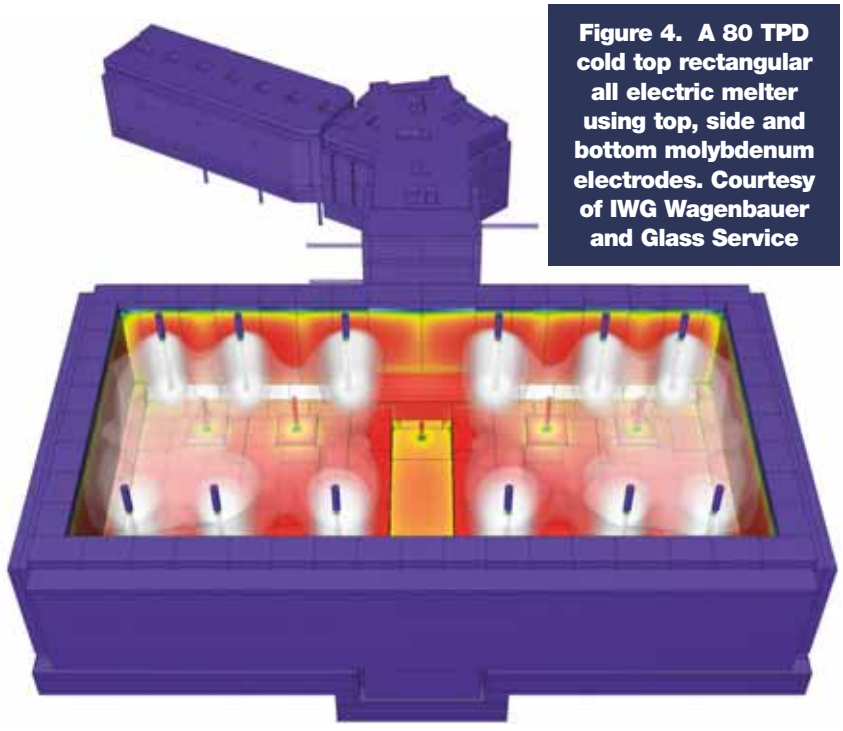

Figure 4. A 80 TPD cold top rectangular all electric melter using top, side and bottom molybdenum electrodes. Courtesy of IWG Wagenbauer and Glass Service

During the 1970 global oil crisis, some glass producers, especially in the United States converted all their regenerative furnaces into electric melters. They retained the infrastructure and horizontal configuration because other shapes were difficult to incorporate into their existing space; sidewall losses are less important at higher pull rates.

THE FUTURE OF CARBON FREE MELTING – ELECTRIC, HYDROGEN OR HYBRID?

Currently, 95 percent of all glass melting uses fossil fuels, mostly natural gas or heavy oil; but industries are now strongly encouraged to follow the Paris Climate Agreement guidelines and are seeking to minimise CO2 emissions. Many but not all countries are enforcing rules, with penalties for carbon emissions and benefits for reductions. Either way, the glass industry knows its consumers expect low-carbon or carbon-free production, so are working to achieve this while remaining competitive amongst themselves and with other packaging materials.

Four key technologies for carbon reduction exist, in addition to those already discussed. These are:

1. Cold top all electric vertical melting (AEM)
2. Hydrogen combustion (replacing natural gas in regenerative or oxy-gas furnaces)
3. Horizontal hot top electric melting (H2EM), also referred to as hybrid melting
4. Horizontal hot top hydrogen electric melting (H3EM)

The question is: What is the best solution - not just now, but for 2030? 2050? After 2050?

HYDROGEN

Currently, truly green hydrogen produced by electrolysis using renewable electric energy is the first choice, but there is simply not enough available. Even with low electric pricing, hydrogen at 6€/kg is three times too costly to compete with natural gas. So, in most regions it would be uneconomical without a state subsidy. More research on hydrogen combustion is needed, specifically the effect on the molten glass and refractories of water concentrations approaching 100 percent in the combustion atmosphere. Certainly concentrations near 50 percent in the combustion atmosphere of oxy-gas furnaces created problems. Using electricity to break water into H2 and O2 by electrolysis is expensive and is only now reaching 70 percent efficiency levels. However, expectations are that investment costs should decline while efficiency continues to increase so that, as more renewable electricity becomes available, hydrogen will become affordable.

But why consider hydrogen? If electricity is used directly, the furnace melting efficiency is much higher than via the hydrogen route. An advantage of hydrogen is the possibility of storage for long periods, allowing long-distance transportation and creation of a buffer against supply hiccoughs. Storing electricity for similar times is simply not efficient. Unused batteries slowly lose power, while storing sufficient energy would require huge batteries. Different storage options are shown in Figure 5; some, such as hydropower, have been created but are not universally applicable - mountains and water reservoirs, as in Norway or Austria, being necessary. Energy

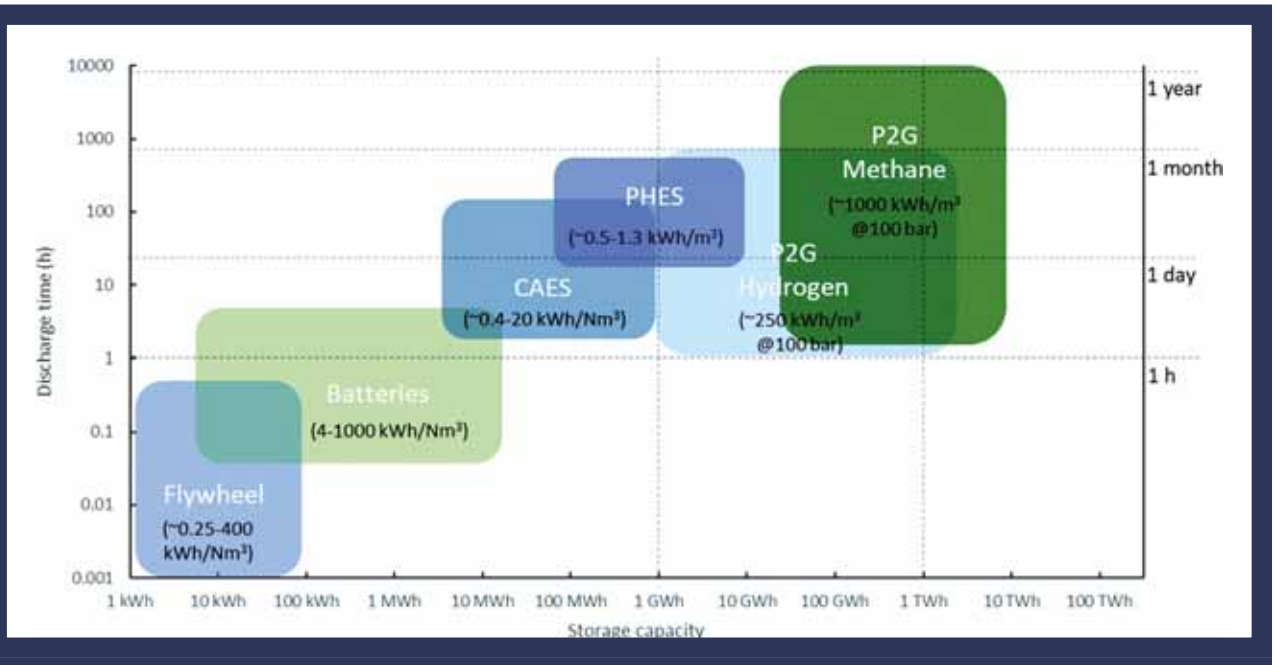

Figure 5. The capacity and discharge times for different storage technologies. Source RMIT

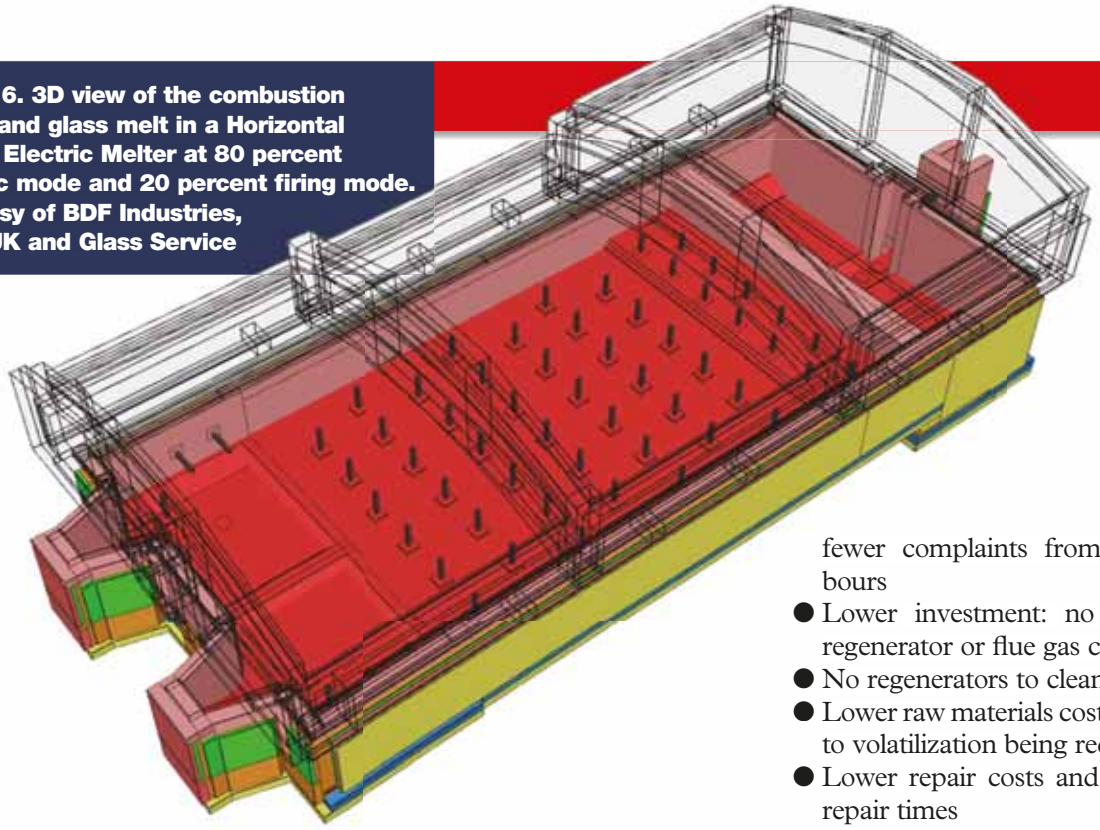

Figure 6. 3D view of the combustion space and glass melt in a Horizontal Hybrid Electric Melter at 80 percent electric mode and 20 percent firing mode. Courtesy of BDF Industries, F.I.C. UK and Glass Service

storage today is facilitated by methane which can be stored for millennia in caves with appropriate geology.

FlammaTec (part of GS Group) developed a Hydrogen burner for glass melting in 2018.

ALL-ELECTRIC MELTING

Electric melting has been a proven technology for over a century, so why not convert all furnaces to all-electric melting? Mainly because electricity typically costs three times as much for natural gas/kWh. While electric melters are twice as thermally efficient, they are more expensive to operate. Another obstacle remains. Most electric melters are producing less than 80 TPD. Only a handful in the entire world melt more than 100 TPD; and only two have produced 200 TPD - both were stopped due to production issues. All-electric melters greater than 200 TPD have diameters so large that maintaining a well-distributed insulating batch blanket across the melt surface is difficult although a key requirement for keeping the furnace operational. Should the batch cover disappear, the furnace loses heat from the top, the glass cools, melt quality and pull rate fall and production deteriorates. There is also limited long-term experience at that size of producing reduced coloured glasses or melting with high cullet levels.

HYBRID MELTING

Hybrid melting entered the glass dictionary in 2017, being mentioned by companies such as Glass Service, FIC, BDF Industries, Fives, Teco, Horn and Sorg. Previously discussion was limited, though hybrid melting simply means more than one heat source and has a long history. It is analogous to hybrid cars where the engine is the main power source, while the battery-driven electric motors can move the car short distances and add extra power during acceleration. Previously, electric boosting in glass production was often for 15-30 percent of the total energy input. Combustion is also used in hybrid melters (H2EM), but 50 percent or more energy comes from electric heating. The thermal efficiency of the electricity is 85-90 percent, while combustion is about 50 percent.

A smaller all-electric furnace (<4 TPD/m2) has the following advantages:

- No emissions (NOx, SOx) or particulate dust, so no filter or cleaning costs for waste gas
- No chimney stack and therefore fewer complaints from neighbours
- Lower investment: no crown, regenerator or flue gas channels
- No regenerators to clean
- Lower raw materials costs owing to volatilization being reduced
- Lower repair costs and shorter repair times
- Efficiency is less impacted by furnace size and capacity

Common disadvantages are:

- Less pull rate flexibility
- Shorter furnace lifetime (eight years for smaller furnaces 50-80 TPD)
- Limited experience of operators
- Dependent on electrical power stability)
- Proven melting only up to 55 percent cullet
- Limited experience with producing reduced coloured container glass (hybrid melting helps)

Hybrid melting removes some disadvantages:

- Shorter furnace lifetime (10-12 years)
- Less experience of operators (behaves more like a standard furnace)

Glass Service and FIC in cooperation with BDF Industries developed a Hybrid design in 2017. A flexible design independent of energy source, melting at times with 80 percent fossil fuel/H2 and 20 percent electric boost (at 3 MJ/kg), or conversely 80 percent boost and 20 percent combustion (at 2.5 MJ/kg). This should reduce the risks of adopting a new technology. Figure 6 shows the concept design of such a horizontal hybrid electric melter for container glass.

Renewable source	Electricity	Hydrogen electric	Hydrogen combustion
Renewable source	100%	100%	100%
Electrolyzer		70%	70%
Compressor		92%	92%
Transportation	92%	98%	98%
Transformer/fuel cell	95%	52%	
Heat losses effect (electrode holders, fluegas)	90%	90%	45%
Total	79%	30%	28%

Table 1. Comparison of electric melting efficiency versus hydrogen route

Hybrid electric melting and oxy-gas furnaces such as this one can break the magic energy barrier undercutting a specific energy consumption of 3 GJ/ton of glass (with 70-80 percent cullet).

Table 1 shows that using electric energy directly in the glass melt is much more efficient than hydrogen - whether by combustion or via the fuel cell. Direct efficiency is estimated to be 79 percent, whereas hydrogen reduces efficiency below 30 percent.

In float glass production it will also be possible to use much more electric heating or super boosting than what was common till now. A design by FIC UK which makes some first steps into this direction is shown in figure 7 with a 6 MW bottom melter boost installed in a conventional regenerative float furnace. To make the complete transition it may be more interesting to combine this also with oxy combustion and then at some point replace the natural gas to more Hydrogen and waste heat recovery. But the efficiency route using Electricity directly will always be higher.

CONCLUSIONS AND OUTLOOK

With the help of Industry 4.0 automation & renewable energy sources, the required 55 percent reduction of carbon emissions should be possible before 2030 through

- Improved glass recycling (in both amount and quality)
- Improved Model Based Predictive Furnace control (Dynamic balancing of Electric vs Combustion firing)
- Greater use of low-cost green electricity, in hybrid or all-electric furnaces, and
- the use of hydrogen for combustion or electricity generation.

Generating hydrogen using green electricity will become important after 2030. The 2050 goal of an 80 percent CO2 reduction will require large amounts of green electricity and a functioning hydrogen economy that can replace fossil fuels for glass production, as well as transportation to and from the factory. ■

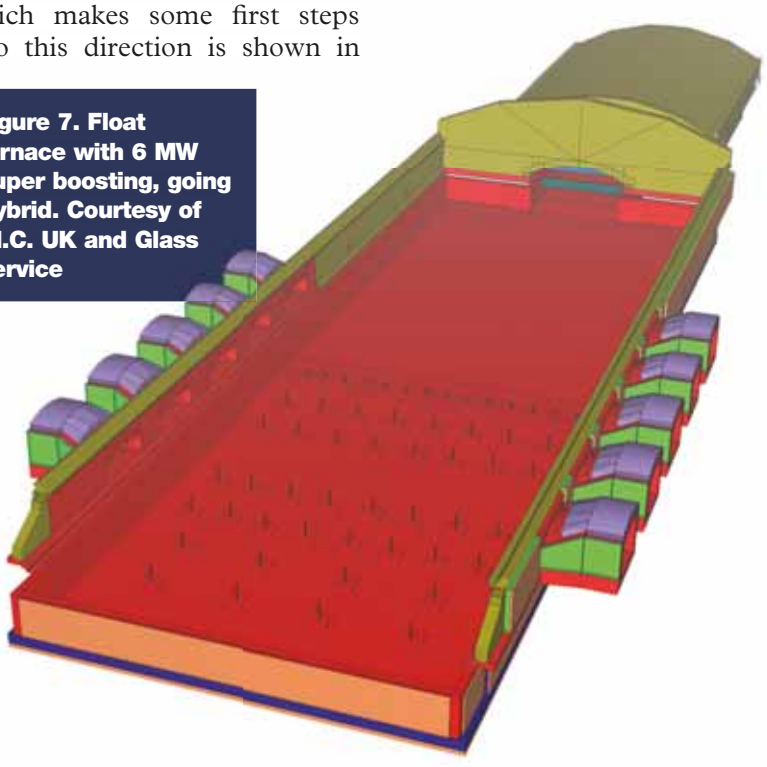

Figure 7. Float furnace with 6 MW Super boosting, going Hybrid. Courtesy of F.I.C. UK and Glass Service

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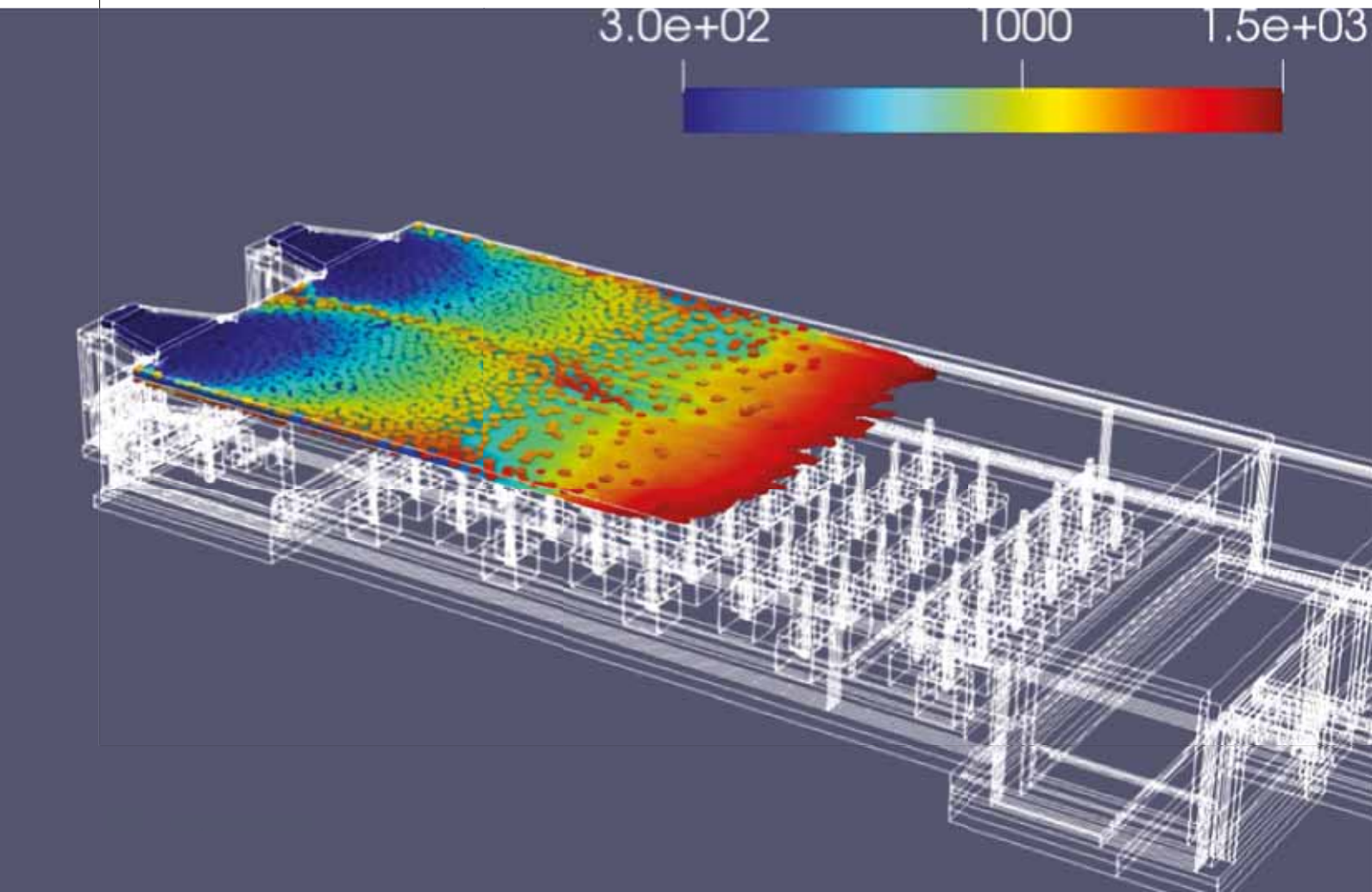
Hybrid furnaces: a BDF INDUSTRIES perspective

What makes BDF different from the other suppliers is the way it's been able to merge the smart engineering needed to face glass melting and conditioning with the industrial soul yielded by over a century of mechanic workshops. Today the glass melting market is divided into two main demands, namely that of pursuing the best available techniques respecting actual arrangement, unconnected to emission restriction, and that of battling now against time to manage the zero emission challenge by 2050 whilst working towards that goal.

BDF is following both paths - all with a view to claiming and retaining its position as one of today's top suppliers and even increasing it going forward. Here the company's strategy is to be focused and keen on Industry 4.0 as a tool for both improving performance and doing diagnostics. Indeed having diagnostic clout in these days of innovation can prove a game-winning factor in the choice among different solutions and technologies. The team at BDF is nonetheless mindful that this mission cannot suffice on its own as a strategy for CO2 reduction and that other technical solutions within our portfolio will also need to be presented.

BDF'S TAKE ON THE HYBRID FURNACE CONCEPT

In pre-pandemic times the world's container glass furnaces, considered from 80TPD to 550TPD, numbered 1163 (Glass Global 2019), categorised as follows:
18 (1,5 percent) fully-electric



Founded in 1906, BDF INDUSTRIES has focused throughout its long history upon covering the entire hot end of container glass plants. The company's first forehearth and furnace design dates back to 1953 – following which automation became a reality in the early 80s.

31 (2,6 percent) All Oxygen Melting AOM or oxyfuel
59 (5 percent) recuperative furnaces
196 (16,8 percent) regenerative cross-fired furnaces
845 (72,7 percent) regenerative end-fired furnaces
14 (1,2 percent) furnaces made with different technology than above

This data underscores the industry's need to leave the furnaces of the past behind -once for all- and to usher in an entirely new era in glass melting. Taking a small towards the future some groups are already switching to Oxyfuel or to fully-electric. However, these remain with solutions that are already proven in the market.

The CO2 reduction challenge in Europe has set the goal of zero Emissions to be achieved within 2050 - with an intermediate step in 2035. Though it has already been articulated, it's important to reiterate that this is 'only 2-3 furnaces away from now'. A common feeling about this ambitious goal is to consider achieving Power Grid Market capacity to only supply green, zero-CO2 electricity to the grid - at an affordable price and on the same date. This leads to the idea that the All-Electric Melting (AEM) furnace type can be the ideal solution. The pros of the AEM over the other possibilities are as follows:

- AEM is a proven solution on the market
- AEM is the most efficient Furnace type in terms of energy consumption
- By the above assumptions the CO2 goal remains easily achievable

TIRELESS ATTENTION TO COSTS

All notwithstanding, the entire scenario leaves space for certain questions concerning the OPEX burden of this project type, scalability to high pull furnaces and the possibility of producing reduced glass articles.

Cutting out an entire slice of the market hardly represents an uncomplicated way forward as a reduction in glass would only open a soft spot for the competition with

other food and beverage packaging industries like plastic, aluminium or paper. Another factor is that electricity costs could become a CAPEX and OPEX limitation, obliging the glass industry to forsake Europe. That would not come as good news, considering how related the industry is to transportation. Instead a wise approach to such a mammoth challenge is preferable, and here reaching this shared target one step at a time is where BDF sets its sights. The hybrid furnace offers precisely that step-by-step solution - not only in regard to the main question of CO2 reduction but also concerning the pull issue of scalability, flexibility around OPEX management and the added possibility of reduced glass manufacture.

HYBRID TO THE CORE

Having already been presented to various container glass producers, the BDF concept has been jointly developed with Glass Service in the Czech Republic and FIC has been modelled and designed for more than 15.000 hours since the first proposal was made back in 2017. Totally unassociated from the CO2 reduction strategy, BDF considered 2017 the Hybrid solution as a valid innovative proposal for a customer before R&D progressively took the lead in the interest of the market and consequently in company strategy. Now the company is practically overwhelmed by 'hybrid solutions' - also in daily advertising around cars, house design, tools, etc. Here's why following the project decisively has been a natural behaviour ever since. Indeed the hybrid furnace is deemed a good compromise step that can lead the way to both total electrification of melting - all the while remaining open to hydrogen combustion development.

KEEPING INDUSTRY CONVERSATIONS ROLLING

The active discussion BDF has had both with glass producers and other players within the industry over these years has helped the company to focus independently upon every small challenge while scouting for solutions that can adapt to the general consensus. BDF has also modelled and designed solutions that are based upon air-gas combustion, even if that concept resulted in less flexibility in fuel-boosting switching owing to air preheating.

OPEX cost flexibility comes from the possibility of oxyfuel combustion to use different ratios of fuel and electricity as the main melting factor for the glass. The outcome of the BDF experience is that the higher the goal of flexibility the greater the difficulties of design. A good compromise could be at about 40:60/60:40. Here the main technical challenge is crown temperature movement as it switches between different melting configurations. After its discussions with refractory manufacturers BDF remains confident about research

and choice modelled around the material over these years. This flexibility is especially crucial for the company's market because it affords glass manufacturers the possibility to control production costs while remaining competitive at sales - all with a shared and distributed benefit in terms of money-saving and sustainability.

The high pull is not a real issue for this type of furnace and it is also testable from real applications outside the container glass market. One of the fears of furnace operators is to deal with this heavy bottom boosting and still have a high percentage of cullet - with consequent iron contamination. BDF has a dedicated answer for this concerning the design but also the choice of material on this part of the furnace. Different manufacturers have brought issues like foaming and redox control to the company, prompting it to make some modest modifications to its design and models. In this way all the collective intelligence has been integrated into the concept - resulting in a very reliable and production-driven proposal.

Improvements to the electrode number, which can reach more than eighty depending upon furnace size, glass quality, and capacity, is a further challenge. Here too BDF has a strategy to reduce to the lowest both wear and any consequent maintenance load. Based upon the specific customer application, the company can tweak the hybrid concept in terms of geometry, electrodes and power distribution, as well as chemical batch characteristics. Based upon the specific input data, a new set of CFD simulations are then prepared and run to validate the final design.

Lastly, BDF is closely focused upon high automation and connectivity. Today the company has developed both and deployed them to offer quick and easy remote diagnostics and assistance to its installation - one more data collecting tool by which to improve the performance and robustness of BDF furnaces.

Here, in conclusion, the company's recipe for the future remains reliable and solid, based upon very high automation together with digital improvement - all to support the CO2 reduction solution within its portfolio. Though the main goal remains that of the Hybrid Furnace, BDF also has a solution for the conditioning zone which includes a full electric forehearth - free of electrode contact with the glass or in the combustion system and forming line. A path now well-traced - all proof, as proven by its history, that the company is no newcomer to this innovative approach to the container glass market. ■

INTERVIEW

Ardagh Glass Packaging Africa

With headquarters in Johannesburg, Ardagh Glass Packaging - Africa (AGP - Africa, formerly Consol Glass) is the market leader in South Africa, where it operates four major glass production facilities. Its African operations include facilities in Kenya, Nigeria and Ethiopia. The company serves a broad range of leading international, regional and domestic customers, principally in the beer, wine, spirits, food and non-alcoholic beverage sectors.

The acquisition offered a plethora of new market opportunities for Ardagh Group, which immediately began work to upgrade the facilities in expectation of rising demand.

At the time of the acquisition, Chairman and CEO of Ardagh Group, Paul Coulson said, "By combining Ardagh's global reach with Consol's know-how on the African continent, we are well-positioned to partner with our customers to meet the growing consumer demand in Africa for premium, sustainable glass packaging."

On completion of the acquisition, Mike Arnold stepped down as CEO of the business following a 20-year tenure in the role. Mike then became a director of Ardagh Glass Packaging Holdings Africa (Pty) Limited and serves as part of the Ardagh executive team responsible for growing the group's presence in Africa. Paul Curnow, previously CEO Designate, succeeded Mike Arnold as CEO. He also became a director of Ardagh Glass Packaging Holdings Africa (Pty) Limited.

Bruce MacRobert, the former Chairman of Consol, serves as Chairman of Ardagh Glass Packaging Holdings Africa (Pty) Limited.

In July, AGP – Africa announced the commission of a ZAR 1.5 billion (USD 95 million) extension of its Nigel production facility in Gauteng, South Africa. The investment would double the facility's capacity by incorporating a new furnace and production lines. The project boasted significant

In May of last year, Ardagh Group announced the acquisition of Consol Holdings Proprietary Limited, the leading producer of glass packaging on the African continent. The deal, valued at USD 1 billion, included the company's net debt and a further ZAR 3 billion (USD 200 million) investment programme additional capacity on the continent.

energy, water efficiency and environmental benefits, representing another important step in AGP – Africa's journey to de-carbonise the glass production process and reduce emissions.

AGP – Africa CEO Paul Curnow said, "We are proud to commission this significant capacity investment, which supports strong demand from our customers for sustainable, premium glass packaging. Completion of this project, on time and budget represents a tremendous achievement by our technical and operational teams. The outlook for premium, sustainable glass packaging remains positive and AGP – Africa expects to continue to invest in support of future market growth."

Then in November, the company announced a further extension of the Nigel facility. This third furnace immediately following the recently commissioned Nigel 2, will further grow the facility's capacity to provide sustainable glass packaging to support customers' current and projected demand growth over the next few years.

The N3 furnace is set to be a replica of the N2 expansion and similarly adds a new furnace and additional production lines. The capital investment further bolstered the government's economic recovery plans in Ekurhuleni, Gauteng, offering additional job opportunities and increased ancillary supply-chain benefits in the community.

Glass Machinery Plants & Accessories reached out to AGP – Africa to learn more about their progress and goals in the African glass market, and their representative obliged to this interview.

GMP&A: As you are in the process of building the largest

African container glass facility, what is the current demand for container glass in Africa? Do you see that demand growing? For which type is demand highest? (beer, wine, soft drinks)

AGP: The outlook for premium, sustainable glass packaging remains positive and Ardagh Glass Packaging – Africa expects to continue to invest in support of future market growth. Demand for sustainable packaging in Africa is growing strongly, supported by multiple factors, including rising income levels, favourable demographics, growing sustainability awareness, and a shift to one-way packaging.

Following completion, the Nigel production facility will be the largest glass container production facility in the Ardagh Glass Packaging – Africa network and on the African continent. The investments in the two extensions of Ardagh Glass Packaging – Africa's Nigel plant in South Africa are in line with Ardagh's commitment to invest in the growth of the South African glass industry and are backed by long-term customer contracts. The two additional furnaces will further increase overall supply in the South African market and effectively eliminate expansive glass imports.

The alcohol industry is Ardagh Glass Packaging – South Africa's biggest market, however, the company also serves a range of customers in the food, pharmaceutical, and non-alcoholic beverage categories.

GMP&A: How was the Covid period tackled and overcome?

AGP: Players in the South African packaging market had to curtail production which impacted essential stock builds ahead of peak trading periods.

While demand was only expected to recover very slowly over several years, the reality is that demand recovered much faster than expected as inventories were rebuilt, and at the same time, imported glass into the market was expensive and difficult to procure due to the global glass shortage and ongoing global logistics and supply chain disruptions. This meant the South African market was under pressure to recover supply across categories.

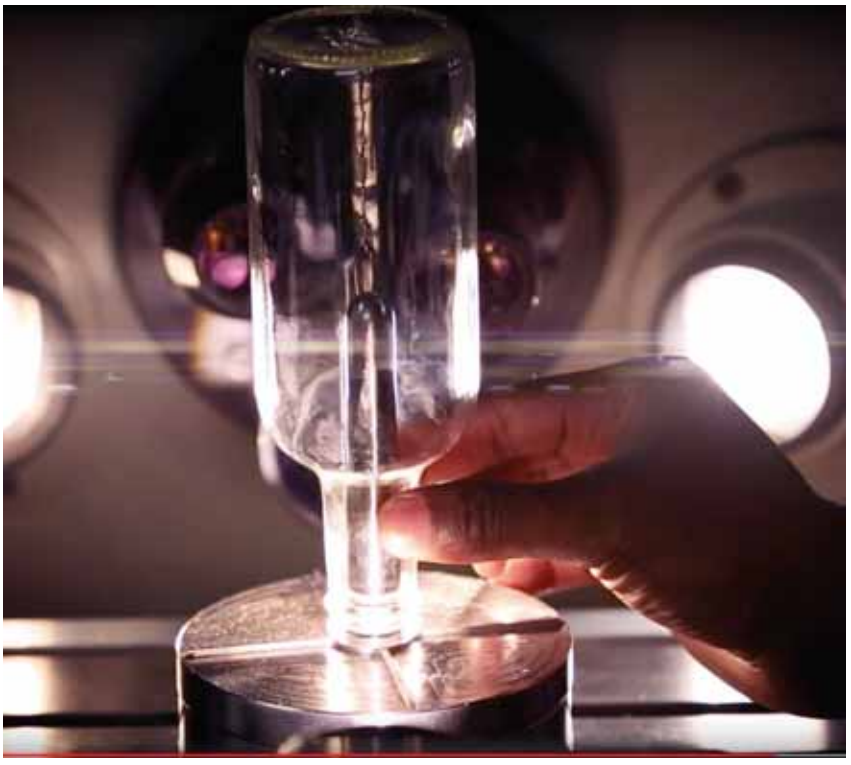
GMP&A: What does it mean to be part of a multinational like Ardagh? What changes?

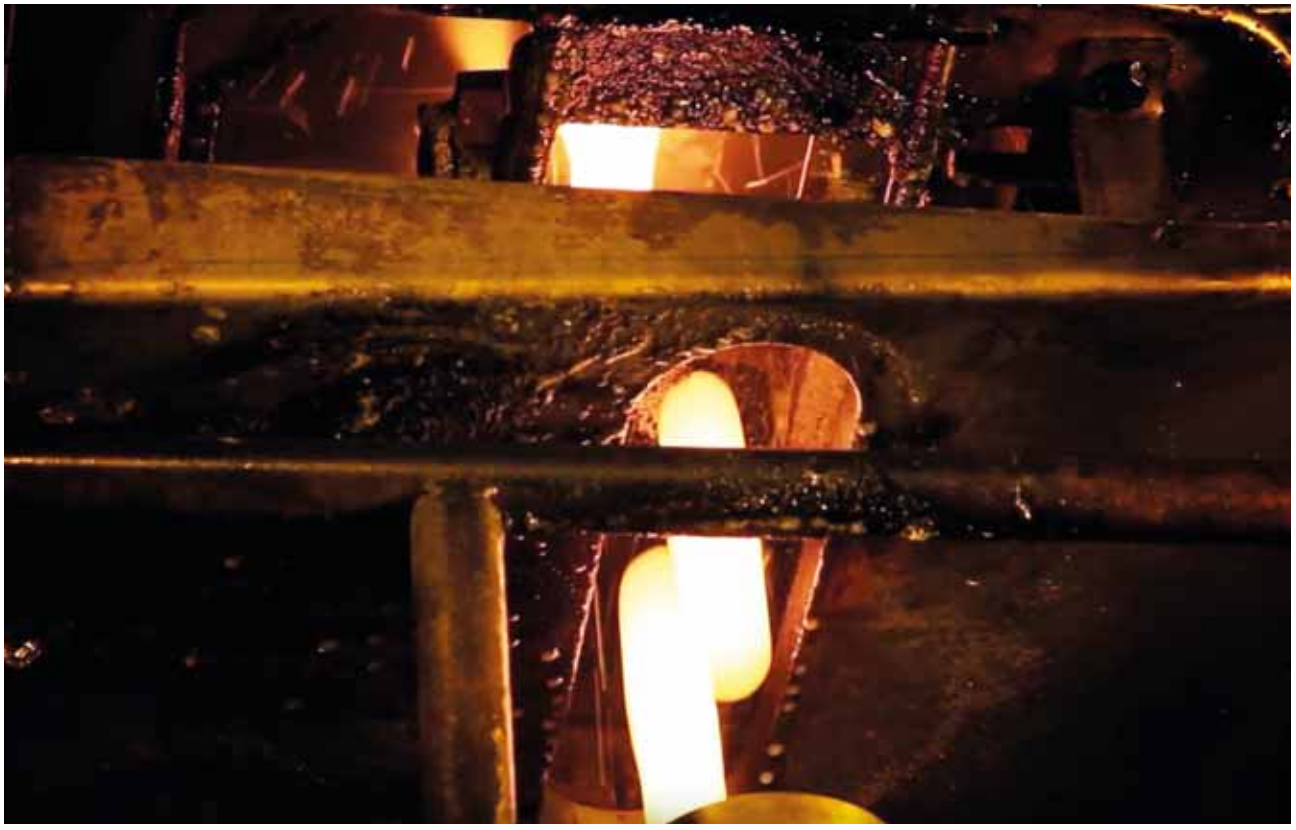
AGP: Our addition to Ardagh Group's family of businesses offered an excellent opportunity to expand Ardagh's global footprint onto the African continent. In turn, the transaction offered a significant opportunity for our growth and development and, by combining Ardagh's global reach with our know-how on the African continent, Ardagh Glass Packaging – Africa is now well-positioned to meet the growing consumer demand for premium, sustainable glass packaging in Africa.

Being able to tap into Ardagh Group's technical capabilities and global sourcing structure has already shown its benefits: the construction of the second expansion at our Nigel facility in South Africa is expected to be concluded ahead of lead times otherwise constrained by global supply-chain disruptions and equipment availability.

Ardagh's culture is grounded in core values which are very close to those that sustained Consol Glass for nearly 80 years. These values are the guiding principles that define how our employees work together, treat one another and collaboratively deliver on our strategic initiatives. These values demonstrate a tangible commitment by the company to conduct business with the highest standards of integrity, to raise the bar on performance every year, targeting continuous improvement, innovation and sustainability, and to forge relationships with our stakeholders based on mutual respect, integrity and transparency.

That same responsible behaviour is mirrored in the way the company manages its impact on the social and natural environments in which we operate and is reinforced in Ardagh's strong





commitment to sustainability.

GMP&A: After the addition of two new furnaces, what investments are foreseen immediately and in the near future?

AGP: Ardagh Group sees Africa as an important location for expansion and sees Ardagh Glass Packaging – Africa as the foundation pillar for that expansion. Ardagh Glass Packaging – Africa continues to assess market growth opportunities in all its markets and will look to support growth through investments where commercially feasible.

We will also continue to invest in technology and skills. Glassmaking is a skills-intensive industry with unique technical and engineering requirements. Our skills development programmes have been honed over the years to ensure a satisfactory pipeline of new skills into the business. Our capital investment programme likewise ensures that we have access to current, class-leading technology.

GMP&A: How strongly was the problem of energy costs felt, and how much did it affect?

AGP: Energy costs are a rising challenge across the globe and the issue is acutely felt in South Africa, where the performance of the state-owned electricity utility has had challenges.

These challenges, which our team has managed over the years, have necessitated the use of diesel-powered generation, which is expensive and environmentally costly. We remain hopeful that policy initiatives allowing for the adoption of renewable energy solutions by the private sector will ameliorate this situation. This will underpin confidence for future investments in the market.

GMP&A: Are experiments and alternatives foreseen (electric or hybrid ovens)?

AGP: Most large glass manufacturers in Europe and the United States have typically run their furnaces on natural gas. They are increasingly looking to augment and then replace natural gas with renewable-energy sources, which means conversion to electricity at the furnace stage.

But electrical furnaces pose significant technical challenges. Interestingly, Ardagh Glass Packaging – Africa is among the few glass manufacturers in the world with proven expertise in running electrical and hybrid furnaces. The traditionally limited availability of natural gas in South Africa has meant that several of the company's large furnaces have run either wholly or in part on electricity.

The future of zero-carbon glass in South Africa is dependent on the broader renewable energy discussion in the country, and the appetite from customers to support the effort. But Ardagh Glass Packaging - Africa is currently looking at building a test facility that would produce 100 percent zero-carbon glass within the next two years.

Once sufficient renewable energy is available, and suitable

energy-storage solutions are chosen, zero-carbon glass is a viable model, and one which Ardagh Glass Packaging – Africa is uniquely positioned to take advantage of.

GMP&A: What has been done to reduce CO2 emissions?

AGP: We recognise that emissions, ecology and social sustainability are closely linked and that the long-term economic performance of Ardagh has an impact on our employees, local communities, customers, suppliers, investors and other stakeholders. That's why we continually invest in systems and processes that improve the efficiency of our operations, reduce costs and increase competitiveness.

Ardagh Glass Packaging – Africa has decades of experience in the lightweighting of our products, which reduces the amount of cullet and raw materials used per container, and thus the associated impact in terms of carbon footprint.

We aim to keep energy consumption and emissions to a minimum, maximise our recycling rates, optimise the use of secondary packaging materials and manage waste appropriately by avoiding use of landfills and limiting water usage.

Our Nigel investments include an electrostatic precipitator (ESP), which substantially reduces particulate emissions. The new furnaces were designed to be as energy efficient as possible. A low-pressure air-compression system (used to form glass containers from molten glass) improves energy efficiency by as much as 20 percent. Our Bellville plant also has an ESP installed.

Ardagh has been consistently rated "A"- by the Carbon Disclosure Project (CDP) for climate change and water management, and "A" for supplier engagement.

Ardagh Glass Packaging – Africa will continue to focus on making our processes more energy efficient, to explore ways to augment our energy use with sustainable energy sources, and to remain cognisant of and alert to opportunities for emissions and energy reduction throughout our value chain.

GMP&A: Do you see new market prospects and future investments? (i.e. another opening or creation of new markets)

AGP: Consumer concerns around sustainability are on the rise, with more and more of us considering the impact of the products we buy and expecting businesses to do more to help us make responsible choices. Glass can help support an 'intentional living' lifestyle, as a natural, safe and sustainable packaging material with unparalleled credentials.

Ardagh Glass Packaging – Africa is continually evaluating new opportunities in the beverages and food industries targeting pack share gains from alternative packaging types. ■

Ardagh Glass Packaging

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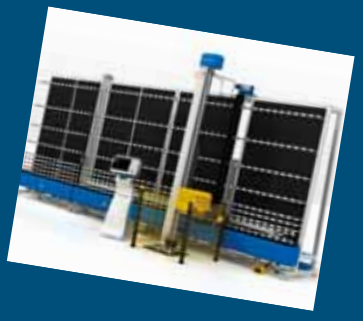

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The lightweight glass container industry in SOUTH EAST ASIA

Rajeev Jetley

The choice for lightweight glass containers has become popular in the container glass production industry over the last two decades. In this issue of Glass Machinery Plants & Accessories, we take a look at how the format started to become popular in Asian countries after having gained popularity in European countries over the first decade of 2000.

LIGHTWEIGHT CONTAINER GLASS PRODUCTION TECHNOLOGY

New production technologies make it possible to produce thin-walled lightweight glass containers. Instead of the traditional blow-and-blow process, container glass producers have adopted the narrow-neck-press-and-blow (NNPB) process. This technology guarantees that glass containers weigh significantly less while remaining as strong and stable as their heavier predecessors.

NNPB is a revolutionary process that not only controls

the distribution of glass inside the container, but also reduces the weight of glass by 33 percent without having any adverse effects on the performance of the glass containers. A number of container glass producers in South East Asia have adopted the NNPB technology to produce lightweight glass containers.

Adoption of NNPB technology leads to a reduction in the consumption of molten glass per bottle without compromising product strength. Facilitating superior glass distribution, this technology reinforces the bottle's resistance to pressure on the filling line. It also leads to a decrease in logistics cost and an increase in consumer acceptance of the bottles.

CONTAINER GLASS PRODUCERS IN SOUTH EAST ASIA

Comprising eleven countries, namely Brunei, Myanmar, Cambodia, Timor-Leste, Indonesia, Laos, Malaysia, the Philippines, Singapore, Thailand and Vietnam, South East Asia is a very diverse area covering a vast geographical spread of 4,545,792 square kilometres and a population of nearly 680 million. It is also one of the most dynamic areas of the world in economic terms - a factor which largely accounts for its growing international significance. The region represents a huge slice of total container glass production in Asia. A few countries, such as Thailand, Vietnam, Malaysia, Indonesia and the Philippines, enjoy the lion's share of container glass produced in the region.

Popularly known as ASEAN 5, the group comprises Indonesia, Malaysia, Thailand, the Philippines, and Vietnam account for about 90 percent of the total container glass production in the South East Asia region.

Thailand's Bangkok Glass Industry, Thai Glass Industry, Siam Glass, Indonesia's OI, PT Mulia Glass, Philippines San Miguel Yamamura Glass, and Malaysia's Thai Malaya Glass are some of the most important players in the container glass industry in the region. All the abovementioned container glass producers have adopted the production of lightweight glass bottles to varying degrees in recent years.

HEALTHY ECONOMIC SIGNALS

Container glass consumption is strongly correlated with economic growth. Indeed countries in the South East region clocked strong economic growth last year, signalling a prosperous period for the container glass industry in the region.

Indonesia's real GDP grew by 5.3 percent in 2022, boosted by strong domestic consumption, investment and exports. Not only. The country's investments are tipped to rebound thanks to recent legislation to stimulate them.

In Malaysia, real GDP grew by 8.7 percent in 2022, led by domestic consumption and services, though net exports made a

negative contribution to growth. In 2023, economic growth is expected to moderate to 4.0 percent due to the global economic slowdown and tighter monetary policy.

The Philippines' real GDP grew by 7.6 percent in 2022, driven by household spending, despite inflationary pressures and elevated interest rates. Exports may slow in 2023 due to the global economic slowdown, and tighter monetary conditions to cope with high inflationary pressures may pose a challenge for private consumption and investment growth.

In Thailand, real GDP grew by 2.6 percent in 2022, supported by private consumption and net exports. In 2023, growth is expected to accelerate to 3.8 percent due to a further rebound of private consumption and increased tourism, despite the global economic slowdown and weaker demand. The Thai government plans to focus on several industry clusters, such as agriculture and food; bioenergy, biomaterials and biochemicals; medical and wellness; and tourism and the creative sector.

Vietnam's economy grew by 8.0 percent in 2022, surpassing global growth rates, and is expected to continue its strong performance at 6.4 percent in 2023, boosted by foreign investment in manufacturing.

BG CONTAINER GLASS COMPANY

BG Container Glass Company (formerly Bangkok Glass) is the largest container glass producing company in Thailand. With five production facilities across the country, the company can produce 3,495 tonnes of glass containers per day for food and beverage industries.

BG Container glass's sales revenue in 2022 was THB 12,367M, which increased by THB 1,507M as compared to 2021, or 14 percent YoY. The increase came mainly from the domestic sales that increased by 11 percent YoY, which contributed to beer, soda & water, and spirits & wine. The export sales increased by 44 percent year-on-year, driven by soft drinks.

THAI GLASS INDUSTRIES COMPANY LIMITED

Thai Glass Industries Public Company Limited, known as TGI, is the leading glass container manufacturer in Southeast Asia and one of the biggest in Asia. With a combined production capacity of 3,300 tons per day, TGI operates three plants in Thailand, one in Malaysia and one in Vietnam.

Thai Glass Industries Co. Ltd was among the first batch of container glass producers in South East Asia to adopt the production of lightweight glass containers when the company installed an NNPB machine at furnace 4 at Bangplee plant in 2008. Since then, Thai Glass Industries has gradually increased the scale of

production of lightweight glass containers at its two locations.

TGI's products are sold through the Packaging Product Division of its parent company, Berli Jucker Public Company Limited (BJC). BJC is a leading commercial conglomerate, operating on its own behalf and for international principals, in manufacturing, marketing, sales, distribution and services. Through subsidiaries and joint ventures, BJC has some of the most efficient manufacturing operations in the region. TGI obtains full technical support from O-I (Owens- Illinois) North America, which is a global leader in container glass production.

SIAM GLASS

Siam Glass is Thailand's third largest glass container producer, with an installed capacity of 1600 tonnes per day of glass containers through four production facilities. Established in 1977, the company has a total of 11 production lines to produce glass containers in sizes from 15 ml to 750 ml.

Siam Glass Industry subsidiary operates a total of six glass melting furnaces at production sites in Rojana, Samutprakarn and Ayutthaya. These production facilities are equipped with NNPB technology to produce lightweight glass containers. The company has technology collaboration with Japanese container glass and technology supplier Nihon Yamamura Glass Co. Ltd.

PT MULIA GLASS

With an installed capacity of 220,825 tonnes per annum of container glass, PT Mulia Glass controls nearly 50 percent of the Indonesian container glass market. Established in 1989 in West Java to produce various types of glass products such as float glass, glass container, safety glass and glass block, PT Mulia Glass operates two furnaces and seven production lines.

The company mainly produces flint glass bottles for food and beverage segments. Mulia supplies glass containers to such well-known domestic food and beverage companies as PT Heinz-ABC Food Co; PT. Sinar Sosro, Coca Cola Beverage Indonesia, PT. Indofood, and PT. Unilever, among others.

OI- INDONESIA

Operating in Indonesia since 1973, OI Indonesia is a major container glass producer in Indonesia. The OI Jakarta plant currently consists of two furnaces and six machine lines, which produces around 2.3 million glass bottles per day for some

of Indonesia's leading food, beverage and pharmaceutical brands. Some of its customers include Multi Bintang, PT Asia Health Energy Beverage, PT Djojonegoro, PT Supra Ferbindo Farma and Ultra Prima Adadi.

Company's product portfolio is complemented by another two container glass manufacturing plants in neighbouring Malaysia and Vietnam.

SAN MIGUEL YAMAMURA GLASS

With an installed capacity of 1,500 tons per day, San Miguel Yamamura Glass is the largest container glass producer in the Philippines. It has more than 60 percent of the domestic container glass industry market share. The company operates two container glass plants at Cavite and Mandaue for beverage, food and pharmaceutical industries.

San Miguel Yamamur Packaging Corporation, the parent company of San Miguel Yamamura Glass, was established in 1991 as a joint venture between San Miguel Corporation and Japanese container glass producer Nihon Yamamura Glass. It produces and sells a variety of glass bottles, such as beer bottles, liquor bottles, condiments bottles, and beverage bottles.

Its parent company, San Miguel Corporation (SMC), is one of the Philippines' largest and most diversified conglomerates, with revenues that accounted for about 5.9 percent of the country's GDP in 2018 - all through its highly integrated operations in food and beverages, packaging, fuel and oil, power, and infrastructure.

SAN MIGUEL YAMAMURA HAI PHONG GLASS COMPANY LIMITED

San Miguel Yamamura Hai Phong Glass Company Limited is a leading container glass producer in Vietnam. With an installed capacity of 380 tonnes per day of glass containers, the company caters to beverages and food industries.

The company is a joint venture between Philippines' packaging company San Miguel Yamamura Packaging Corporation (SMYPC) and Hanoi Beer Alcohol and Beverages J.S Corporation (Habeco). San Miguel Yamamura Packaging Corporation (SMYPC) is a joint venture between two famous Asian groups, San Miguel from the Philippines and Nihon Yamamura from Japan. San Miguel is known as the Philippines' largest group - specializing in producing beverage, food and container glass packaging.

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BUCHER EMHART GLASS	www.emhartglass.com
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Iris Inspection Machines
Luben Glass
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