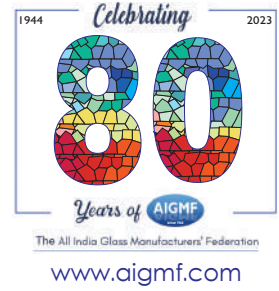


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Quarterly Journal of **The All India Glass Manufacturers' Federation**
Bi-lingual

Special Feature

- *Glass News*
- *World Environment Day celebrated at Ahmedabad*
- *World Soda Ash Conference 2023*
- *Durán International Symposium on Sustainable Glass Processing and Applications*
- *Revolutionising Glass Recycling in Malaysia*
- *Decarbonisation is not just about Ecology*
- *Microwave-assisted Glass Melting*
- *Solving the Challenge of Bubble Growth*

Events

- *Risk Management & Executive Committee and Annual General Meeting's at Delhi (August 26)*
- *4th glasspro & 7th glasspex at Mumbai (Sept 14-16)*
- *14th AIGMF International Conference on "Decarbonization for the Sustainable Glass Industry" at Mumbai (Sept 15)*



Neither as **Magnificent** as **glass**,
Nor as **Green** as **grass**.
As **vivid** as **light bars**,
As **glittering** as **night stars**.
Able to **Reflect own self**,
As **magical** as an **elf**.
Restricting houses from **heat gain**,
Protecting us even in **heavy rain**.
From **Shielding** the plants in a **Green house**,
To decorating an **Embroidered blouse**.
Thanks to the **rear mirror**,
For excluding our roads from **wear and tear**.
Thanks to the **memories lens captured**,
Revisiting them is what an **eye desired**.

'Spارش Tejwani'



AIGMF 1st Poem / Essay Writing Contest - Green as Glass or काँच और पर्यावरण (2022)
3rd Runner-up: Sparsh Tejwani (20 years)
4th Year student of Msc. Economics Honours + B.E. Electrical and Electronics, BITS Pilani, Rajasthan



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Ampoules: OPC, Break / Score Ring, Form:
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Syringes & Cartridges Range

Material: Type 1 Glass
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Quarterly Journal of the Glass Industry, published and printed by Vinit Kapur on behalf of The All India Glass Manufacturers' Federation from 812 New Delhi House, 27 Barakhamba Road, New Delhi - 110001 and printed by New United Process, A-26, Ph-II, Naraina Indl. Area, New Delhi-110028

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Complimentary copy for Members / Government Departments / NGO's and those connected with Glass Industry

Others: Price (excluding bank charges):

Indian Companies : ₹ 125 per copy

Annual Subscription ₹ 450

Foreign Companies : US\$ 25 per copy

Annual Subscription US\$ 80



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Quarterly Journal of **THE ALL INDIA GLASS MANUFACTURERS' FEDERATION**

Vol. 11 | No. 1 | April-June 2023

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From President's Desk

I feel sad to inform you that Prof. (Dr.) A. K. Bandyopadhyay, Ex-Principal, Government College of Engineering and Ceramic Technology, Kolkata and Member Editorial Board KANCH passed away on June 28 at Kolkata. Prof. Bandyopadhyay was 73 years old and was keeping unwell for the last few months. He was associated with KANCH since 2012.

Parallel to the Executive Committee and at the maiden meeting at Ahmedabad, the AIGMF program saw presentations on: Cullet Sorting Technologies, Air Quality in Glass Manufacturing Units and Hydrogen as feedstock for manufacturing of Clear Glass; thereby celebrating World Environment Day at Ahmedabad.



I am grateful to Mr. Purvish Shah, Hon. Treasurer AIGMF and Director Gopal Glass Works Ltd., for taking the lead of holding this special event on their successful setting up of a greenfield project on Solar Glass manufacturing at Gujarat under the name M/s Gobind Glass and Industries Ltd. Team Members of M/s Gopal Glass Works Ltd., made some excellent meeting arrangements at the DoubleTree by Hilton, Ahmedabad, which was appreciated by everyone.

Mr. Kartik Morar, V&K Recycling Co., an Affiliate Member of the AIGMF made the presentation on cullet sorting technologies by citing the proper case studies.

Mr. Deepak Gahlotw, Practicing Architect and Secretary of the Confederation of Construction Products and Services (CCPS) gave a presentation on air quality by showing photos of some of his PAN-India projects.

Mr. Gaurav Sharma, Technical Advisor, Green Hydrogen Development at Indo-German Energy Forum (IGEF), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GIZ office gave a presentation on Hydrogen set up for glass manufacturing units.

Select photos of the event and presentations are available on AIGMF website.

The next Executive Committee meeting along with AGM will be held at Delhi on August 26 at Lemon Tree Hotel at Aerocity. The program will cover presentations on RISK MANAGEMENT i.e., Employer-Employee Insurance by Life Insurance Corporation of India; and Energy Price Risk Management for Glass Companies by Multi Commodity Exchange of India Ltd. The event will also feature an annual AIGMF awards presentation as well as awards to be given to Youth for the annual outreach program on the topic 'Green Energy via Solar Glass.'

I invite all members to participate and be a part of some interesting discussions■

Sanjay Agarwal
President AIGMF and
Director, Kwality Glass Works, Firozabad

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GLASS News

CORNING AND SGD PHARMA ANNOUNCE JOINT VENTURE TO OPEN NEW GLASS TUBING FACILITY AND EXPAND ACCESS TO CORNING® VELOCITY® VIAL TECHNOLOGY IN INDIA

Corning Incorporated and SGD Pharma on June 8 announced a joint venture that includes the opening of a new glass tubing facility to expand pharmaceutical manufacturing in India and allows SGD Pharma to adopt Corning's Velocity® Vial technology platform.

Combining SGD Pharma's vial-converting expertise with Corning's proprietary glass-coating technology, the collaboration will enhance vial quality, improve filling-line productivity, and speed the global delivery of injectable treatments. SGD Pharma and Corning have broken ground on a new pharmaceutical glass tubing facility in Telangana, India. Together, the two companies will help drug makers respond to increasingly complex capacity and quality issues while meeting global demand for critical medicines.

"The partnership with Corning represents yet another step in our strategy to advance converting technology in the pharmaceutical industry and secure our supply chain. The introduction of Velocity Vials will contribute to the ongoing evolution of our offerings and services and will expand our portfolio of high-quality tubular glass packaging," said Mr. Olivier Rousseau, CEO SGD Pharma. "We

see an opportunity for the industry to improve drug filling quality and performance capabilities by transitioning to Corning's coated vial technology."

SGD Pharma joins a growing network of leading primary packaging manufacturers adopting Corning's cutting-edge coating technology. The joint venture expands Velocity Vials' manufacturing footprint, localizes its supply chains in India, and enables easier adoption of the technology by customers.

"Corning is advancing pharmaceutical glass technology to help our customers address their most pressing challenges – globally and locally," said Mr. Ron Verkleeren, Senior Vice President and General Manager of Corning's Life Sciences Market Access Platform. *"The joint venture with SGD Pharma supports our continued global expansion as we localize manufacturing for our customers. The collaboration also strengthens our leadership position in the industry and underscores our commitment to India's high-growth market."*

HEMAL THAKOR IS ONE OF TOP 100 GREAT PEOPLE MANAGERS

Mr. Hemal Thakor, Executive



SGD Pharma and Corning Incorporated on June 8 announced a new pharmaceutical glass tubing facility in Telangana under the joint venture, SGD Corning Technologies Pvt. Ltd. Telangana IT and Industry Minister Mr. K T RamaRao took part in ground-breaking ceremony of the new facility. The collaboration will combine SGD's Vial converting expertise and Corning's proprietary glass tubing technology.

Committee Member AIGMF and Chief Marketing Officer, PGP Glass Pvt. Ltd., was named as one of India's Top 100 Great People Managers by the Economic Times.

Mr. Thakor did his entire studies in Mombasa KENYA and on return to India did his Bachelors of Business Administration from Vallabh Vidyasagar in Gujarat. Later, he completed his MBA from SP Jain Institute of Management in Mumbai.

He joined Gujarat Glass Pvt. Ltd.,



(which was renamed as Piramal Glass Ltd. and now PGP Glass Pvt. Ltd.) in 1995 as a Management Trainee. Today, he has completed 28 years in the same company and Heads the Marketing function looking after verticals of Cosmetics, Food and Liquor.

WORLD'S BIGGEST GLASS COMPANIES RE-AFFIRM SUPPORT FOR GLASS FUTURES

The world's biggest glass companies have re-affirmed their commitment to reduce carbon emissions through continued support of Glass Futures as it opens the doors to its 165,000 sqft Global Centre of Glass Excellence.

Encirc, Guardian Glass, O-I Glass and Siemens were the 'founding members' of the not-for-profit when the idea of the Global Centre of Excellence was first conceived by Mr. Dave Dalton, CEO of British Glass.

They each invested in a powerful idea which has since attracted major government innovation funding and seen construction completion of the £54m Centre in St Helens near Liverpool.

Now, some 10 years after its conception, these founding Board Members continue to see the strong benefits from the ground-breaking research and innovation already being delivered by Glass Futures.

They are taking the first step towards reaffirming their long-term commitment to the organisation with plans for each to invest further funds on an annual basis. They will become new Strategic Members and invite others in the industry to join them.

Mr. Aston Fuller, General Manager



at Glass Futures said: *“To have our founders becoming new Strategic Members as we take over the completed Centre of Excellence is a testament to their ongoing vision and commitment over a decade.*

“Back then they were taking a punt on conversations about an idea. Something that could potentially benefit the whole sector in the long-term, but they (and us) had no way of knowing if we’d reach this point. But we have.

“Not only have we attracted funding for significant carbon emission reduction research trials using alternative fuels, but we’ve successfully built our new Centre.

“The dream is now a reality. And as we look towards our 30 tonne per day furnace and pilot line firing within the next 12 months, it’s only the beginning.”

To mark the next phase of Glass Futures, the organisation has launched the new level of Strategic Membership and updated its membership structure. It will operate on a credit-based system which guarantees members access to the facilities at the pilot plant on an annual basis.

Mr. Fuller added: *“We have a varied and supportive membership including*

many companies across the supply chain who have helped us get this far and as a not-for-profit organisation serving the energy intensive industries, our value is in our research and development into sustainable, low-carbon glass to support our members.

“Strategic Membership not only gives existing and new members more credits to carry out trials on our experimental furnace but also greater influence over collaborative project trials, with the potential to massively benefit organisations whose own strategic aims are led by reducing carbon emissions and environmental commitments to shareholders and customers.”

NEW PRESIDENCY ELECTED AT THE EUROPEAN CONTAINER GLASS FEDERATION ANNUAL GENERAL MEETING

FEVE – the European Container Glass Federation elected its Presidency team for the 2023-2025 term of office at its Annual General Assembly on Thursday 15th June.

Mr. Martin Petersson, CEO Ardagh Glass Packaging – Europe: one of the world's leading glass packaging manufacturers - has been elected President of the EU container glass federation.

Commenting on his appointment, Mr. Petersson said: *"I am honoured to take up this important role and look forward to contributing to FEVE's work in collaboration with FEVE members, staff, and the national associations. We have challenging and exciting times ahead of us, but we are in a strong position to reach our sustainability goals and strengthen our industry's Circular Economy model.*

He added: *"Glass is a material that has unique inherent sustainability benefits: it is a permanent material, endlessly recycled in a closed loop and it is inert, meaning that it protects the quality of products, it preserves their taste, and guarantees safety for consumers' health. It is also uniquely versatile in adding value and premium positioning to products. However, all these qualities are often taken for granted in the marketplace. We need to be more proactive in defending and promoting glass."*

Mr. Martin Petersson succeeds Mr. Vitaliano Torno, O-I Glass President Business Operations & O-I Europe, who led the association for the previous two years. *"Vitaliano did a great job in navigating the federation through recent years, marked by the global pandemic and unforeseeable market dynamics, but he also managed to maintain a united industry in shaping a common vision to face the major challenge of climate neutrality"*, commented Mr. Petersson.

The FEVE members also elected Mr. Michel Giannuzzi, Chairman of the Board of Verallia, as Vice-President. Mr. Giannuzzi commented: *"Our industry is at a crucial crossroad on the path to the future. We should not be afraid to invest in the sustainability assets of our business model to secure our future as packaging leaders. I am looking forward to supporting Martin and the sector over the next two years*

in the drive to address climate change and the sustainability agenda."

AIGMF AT GLASSPRINT 2023

GlassPrint 2023 conference and exhibition, a packed two-day



schedule of technical presentations and networking opportunities was held on April 25-26, 2023 at The Radisson Blu Scandinavia Hotel, Düsseldorf, Germany. The event saw an international audience of glassmakers, decorators, end-users, OEMs, suppliers and brand owners.

Decoration is a key process in the manufacture of architectural, automotive and hollow glass, and GlassPrint 2023 unveiled the latest trends and developments for enhancing end products, cutting production costs and making processes more efficient.

Mr. Rajesh Khosla, Sr. Vice President AIGMF and CEO / President AGI Greenpac participated as an active member from India.

Highlights of the program included: An extensive series of technical presentations by specialist speakers covering digital and screen processes that detailed the latest cutting-edge technologies for decorating all types of glass; A series of keynote speeches by industry figureheads from leading bodies such as BV Glas, FEVE, Glass for Europe and Messe Düsseldorf/glasstec; Networking events and a tabletop exhibition displaying the latest advances in inks, pre-press

technology, printing equipment and supplies.

The expanded conference programme was supported by intervals dedicated to the complementary tabletop exhibition

area, and at the end of the first day delegates benefited from networking with peers and suppliers during an evening dinner.

The event was co-organised by Glass Worldwide (*preferred international media partner of the AIGMF*) and The European Specialist Printing Manufacturers Association (ESMA).

SAD DEMISE OF PROF. (Dr.) A. K. BANDYOPADHYAY



Prof. (Dr.) A. K. Bandyopadhyay, Ex-Principal, Government College of Engineering and Ceramic Technology, Kolkata and Member Editorial Board, KANCH passed away on June 28 at Kolkata.

Prof. Bandyopadhyay was 73 years old and was keeping unwell for the last few months. He was associated with KANCH since 2012.

KARL LENHARDT - A PIONEER OF GLASS PROCESSING LEAVES THE STAGE

If there is a need for a prime example of the oft-cited success story “From a one-man business to a world market leader”, then one may gladly look back on the life’s work of Mr. Karl Lenhardt. The company founder and Managing Director of the former LenhardtMaschinenbau GmbH (now Glaston Germany GmbH) in Neuhausen-Hamberg in southern Germany has passed away at the age of 82.

“Glaston Corporation and employees mourn the loss of a down-to-earth, conscientious, responsible and visionary entrepreneur,” says Mr. Anders Dahlblom, CEO & President of Glaston Corporation. Mr. DietmarWalz, Senior Vice President of Glaston’s Insulating Glass Business Unit adds, *“With Karl Lenhardt, we are losing a personality for whom people were always at the center of his thoughts and actions. For him, the company’s success was based not only on his inventive thinking but predominantly on the personal commitment and expertise of his loyal, long-standing employees.”*

Mr. Karl Lenhardt’s motto was “An entrepreneur is one who takes action. When he took the courageous step into self-employment in 1966 at the age of 27, no one could have guessed that 36 years later, on the occasion of his retirement in 2002, he would hand over a medium-sized mechanical engineering company with 300 employees at the time, which is still considered one of the world market leaders in the field of glass processing. With his invaluable wealth of ideas, he is still considered one of the pioneers in glass processing today. The current process for manufacturing insulating glass for windows and facades was



developed by him. More than 150 patents were based on his inventive genius, including the TPS® technology he introduced to the market in 1995 and still the most flexible and sustainable insulating glass production technology worldwide.

Mr. Lenhardt has loved bearing responsibility for his employees, customers, business partners and his company all these years. It was not always easy for him to successfully assert himself in the interplay of circumstances. But his persistence in learning from mistakes and constantly improving, as well as his motivational skills, helped him develop the company successfully.

Glaston is the glass processing industry’s innovative technology leader supplying equipment, services and solutions to the architectural, automotive, solar energy, and display industries. The company also supports the development of new technologies integrating intelligence into glass. It is committed to providing its customers with both the best know-how and the latest technologies in glass processing, with the purpose of building a better tomorrow through safer, smarter, and more energy-efficient glass solutions. Glaston operates globally with manufacturing, services and sales offices in nine countries. Glaston shares (GLAIV) are listed on NASDAQ Helsinki Ltd.

GLASS FUTURES AND ITS MEMBERS TO CONTINUE LEADING THE DECARBONISATION OF ENERGY INTENSIVE INDUSTRIES THANKS TO £18M OF GOVERNMENT FUNDING

Glass Futures, a disruptive research technology organisation, will continue to find solutions for decarbonising energy intensive industries thanks to £7m funding and £11m for its members from the UK Government’s Department for Energy, Security and Net Zero.

The not-for-profit, which opened its new £54m Global Centre of Excellence in St Helens in June, will be involved in three projects to pave the way for the glass and ceramic industries to drastically cut carbon emissions.

Through investigations into 100 per cent hydrogen, low-cost biofuels and electrical boosting, Glass Futures will partner with its members across the ceramic and glass sectors to drive a smoother, faster transition from fossil fuels.

Electric boosting has been identified by British Glass as having the potential to reduce UK CO₂ by 56% annually. Innovation could offer up to 200 MWH load balancing capacity to the UK’s electrical grid providing increased energy resilience. This project will model and develop an optimised approach to deploying electric melting by exploring super boosted electric furnaces to hopefully pave the way for 40-50 per cent boost capability for conventional glass furnaces in the future. Thereby, providing a smoother, quicker transition to super-boost hybrid furnaces by 2040.

Glass Futures will install an electric-boost system onto its 30-tonne a day pilot plant in its Centre of Excellence

to assess melting efficiency and the impact of convection currents, product quality and seed count (the number of micro-bubbles) within glass. Guardian Glass, a founding member of Glass Futures, will run a series of models to understand the most beneficial positioning of electrodes for up to 60 per cent electric-boost. Encirc, another founding member of GLF, is working to develop automated techniques and control tools, which are capable of rapidly switching between combustion and electric.

The project will also involve network operators E.ON and National Grid to assess the timescales and costs of upgrading UK grid networks to enable glass plants to transition to electric-hybrid furnaces.

Building on research carried out by Glass Futures for the UK Government (due to be published shortly) that reveals lower cost, renewable, biofuels have the potential to switch UK glass and ceramic sites from natural gas, this project will explore a variety of economically and technology attractive biofuels for a range of industrial glass and ceramic furnace sites. Some of the world's largest glass manufacturers and Glass Futures members O-I, Ardagh and Encirc will trial biofuels on their glass plants. Pilkington UK, part of the NSG Group will also trial biofuels on their float glass plant and DSF refractory

manufacturer on their ceramics site with a furnace.

The availability, economics and sustainability of low-cost biofuels will be explored as well as compatibility with Carbon Capture, Usage and Storage (CCUS) technologies.

This project will demonstrate fuels that can provide a quick, economical route to decarbonising existing furnaces/kilns as well as a longer-term route to carbon negative industrial manufacturing using CCUS.

Following on from an IFS Phase 1 feasibility project which saw Glass Futures fire 100 percent hydrogen successfully on its combustion test rig, it will work alongside the British Ceramics Consortium including 16 partners across 8 sectors of the ceramics industry (clay brick, clay roof tiles, clay drainage pipes, table/giftware, wall/floor tiles, sanitaryware, refractories and technical/advanced ceramics) to demonstrate 100 percent hydrogen-firing technologies for the two main types of kiln used across 150+ manufacturing sites.

Most ceramic kilns are fired using fossil fuels, collectively emitting 1.2Mt of CO₂ per year, 60 per cent of which comes from the combustion of natural gas to heat kilns. As such hydrogen has the potential to reduce UK emissions by up to 780 kt CO₂ per year.

Mr. Richard Katz, CEO of Glass Futures, said: "Some ten years after the idea for Glass Futures was conceived it's fantastic to see such progression and the opening of our Global Centre of Excellence this summer. In addition, we have secured over £7m of funding directly and £11m for our members to really put our industrial scale test furnace to use. Without government funding like this much of our groundbreaking research to date wouldn't have been possible.

This new hydrogen project directly addresses the technological gaps we identified in the feasibility stage so we can now fully develop and assess the technical, economic, and environmental feasibility of hydrogen technologies.

Similarly, there is a need to investigate electric boosting and any short-term commercial benefits. The Glass industry operates furnaces that are continually running with long-operation lifetimes, there simply isn't the time or money to trial new fuel technologies that might not work.

This is the exact reason Glass Futures, and our new Centre of Excellence exists – to bring together glass and foundation industries, united by the aim of decarbonisation, with academia to trial innovative, technologies and solutions on an industrial scale."

He added: "And aside from our hydrogen and electric projects, demonstrating the



viability of low-cost biofuels will offer solutions to off-cluster manufacturing sites worldwide where the cost of developing the necessary infrastructure to provide low carbon fuels like hydrogen and electricity are likely to be prohibitive but there are large amounts of local bio-derived waste streams in abundance.”

BOROSIL RENEWABLES UNIT RAMPS UP GERMAN SOLAR GLASS CAPACITY

Borosil Renewables solar glass capacity of its German unit, GMB Glasmanufaktur Brandenburg GmbH, has increased to 350 tons per day (tpd) from 300 tpd, following the modification of its furnace.

The company said the life expectancy of the furnace has increased due to the modification. Due to the implementation of certain advanced processes and technologies during the cold repair, GMB’s production capacity has also increased from 300 tpd to 350 tpd. The manufacturer said it expects the modification to result in substantial savings in energy consumption.

In January, Borosil Renewables began expanding its solar panel glass manufacturing capacity in India to 1,000 tons per day by starting trial production at its third solar glass furnace, which has a capacity of 550 tons per day. With 1,000 tons per day of capacity, it can supply solar glass for 6 GW of solar module production per year.

The company’s other two furnaces in India have production capacities of 240 tons per day and 210 tons per day.

OPENING UP NEW OPPORTUNITIES WITH LAMINATED GLASS

“We saw the move into laminating glass as an exciting

opportunity to explore. It gives us an open door to many new areas, such as security, acoustic and decorative glass. After thoroughly reviewing six lines, we chose Glaston’s ProL lamination thanks to its convection heating and simplicity,” said Consolidated Glass Corporation’s Mr. Brad Bartley, General Manager, and Ms. Lindsey Merryman, Lamination Line Program Manager.

Consolidated Glass Corporation is no newcomer to diamond-standard interior glass nor making larger transitions to stay ahead of the game. Now being led by the founding family’s fifth-generation president, the company started in 1967 in New Castle, Pennsylvania, fabricating the then fashionable jalousie doors and windows formed with multiple parallel panes of glass. It made a significant expansion in 1994 with its first tempering furnace to supply store fixtures, high-end shower doors and enclosures.

In 2015, Consolidated Glass purchased its second tempering line, a Glaston RC Series, to be able to keep up its outstanding five- to ten-day lead times and push into the lucrative office partition market.

The same spirit of growth and

expansion into new glass processing areas led the company to venture into laminated glass in 2021. This meant a new 15,000 sq. ft. building and automated lamination line.

“We reviewed six different lines, comparing price and performance,” Mr. Brad recalls. “We were familiar with Glaston’s background and knew the technology they bring to the tempering world. That was important to us.” But what caught his attention most was the convection heating system used on the ProL line as opposed to the infrared (IR) heating systems that most competitors use.

“For me, just the simplicity was impressive. And when you’re investing that much in new technology, you want to know that the supplier is highly experienced in that area. I also spoke with close friends in the industry who praised Glaston’s lamination technology,” he says.

“Our entire team is very excited about the quality of laminated glass we have produced. It’s beautiful!” Ms. Lindsey said “We’ve got a lot of great people working with us who are definitely up for the challenge. They’re willing to learn and work hard. So, we’re getting used to the lamination line and are continuing to add to our knowledge each day.”



SPECIAL CORRESPONDENT KANCH PREM MALHOTRA CELEBRATES 52 YEARS IN THE GLASS INDUSTRY

Mr. PremKumar P Malhotra has served the Indian glass industry with grace and distinction over the last 51 years.

Over the last 5 decades he has worked on over a hundred Indian glass projects across all sectors. He has been instrumental in putting Indian glass technology on the world map as a leader. The level of automation in his projects have been second to none across the globe. His innovative designs have helped lower energy costs while also reducing capital expenses, hence improving the environment friendliness of the Indian glass industry.

At the age of 73, he is currently passionately executing 10+ active projects across India and overseas. In addition, he continues to mentor several folks in the glass industry to continue his legacy.

Mr. Malhotra represents Sanjin Bucher Emhart Glass in India that is 100% owned by Bucher Emhart Glass, world leader in manufacturing I S Machines and allied equipment for glass industry.

GLASS & GLAZING KNOWLEDGE FORUM (GGKF) MEET AT DELHI

The 11th meeting of the GGKF was held at the Muse Sarovar Portico, Delhi on July 8. The forum meets regularly under its united efforts to help Glass Fraternity work on the common issues, including the CSR objectives for the overall benefit of Industry and Society at large.

Centered around main discussions on the Training, Workshop's, National



Building codes; members were of the view to ascertain and establish a training center for Glass and Glazing at DELHI NCR.

The main vision of the Centre will be to up-skill the existing workforce to provide sustainable installation methodology with latest technology to efficiently utilize resources for the Construction, Products and Services mainly for the Glass and Glazing industry. Strengthening of Industry and Academic tie-up was also discussed.

GGKF comprises of the following industry associations: FOSG (*Federation of Safety Glass*), GSI (*Glazing Society of India*), CCPS (*Confederation of Construction Products and Services*), UWDMA (*uPVC Window & Door Manufacturers Association*), Glass Academy and AIGMF (*The All India Glass Manufacturers' Federation*).



HEINEKEN LANKA LAUNCHES ITS FIRST SCREEN-PRINTED & RETURNABLE GLASS BOTTLE IN ASIA PACIFIC

PGP Glass Ceylon PLC, the sole manufacturer of glass bottles for Food and Beverages in Sri Lanka and HEINEKEN Lanka Limited, a wholly owned subsidiary of HEINEKEN N.V., proudly announced a milestone for Sri Lanka's innovation and sustainability agenda with the launch of the 625 ml reusable bottle incorporating screen printing technology.

Launched in the presence of Her Excellency Ms. Bonnie Horbach, Ambassador of the Netherlands to Sri Lanka and the Maldives, the bottle is sourced and manufactured end-to-end in Sri Lanka, incorporating PGP's cutting-edge screen-printing technology, which is considered a first for HEINEKEN within the Asia Pacific region. The technology can reduce plastic or paper-based labelling, and consumers can be encouraged to participate in waste reduction efforts by having a returnable bottle.

Mr. Sanjay Jain, Executive Director/ COO PGP Glass Ceylon PLC, said, "We are happy to be associated with the launch of innovative product offerings capable of revolutionizing circularity and sustainability in Sri



Lanka. This collaboration showcases our commitment to innovative and sustainable packaging solutions, which is a long-standing need for the country, as we recognize the significance of contributing to responsible consumption in Sri Lanka. The investment required for screen printing technology on glass bottles is considerable. However, its positive effects on the planet are far-reaching. As a socially and sustainability-conscious organization, we are proud to do our part through a shared commitment to the national movement on uplifting its sustainable economy.”

Ms. Maud Meijboom-van Wel, Managing Director, HEINEKEN Lanka Limited, said, “As an innovative and pioneering company that is present in over 190 markets globally, our Brew a Better World vision for 2030 raises the bar and enables faster progress towards a net zero, fairer and healthier world. These ambitions are woven into EverGreen, our balanced growth strategy, and puts sustainability and responsibility at the centre of everything we do. In line with this vision, we have already installed a water treatment plant at our brewery and are also using renewable biomass energy as part of our net zero efforts. The launch of the reusable and screen printed 625 ml bottle for our flagship brand is our latest initiative, and I take this opportunity to appreciate PGP Glass Ceylon PLC for their trusted partnership and to

Her Excellency, Bonnie Horbach, Ambassador of the Netherlands to Sri Lanka and the Maldives for gracing us with her presence and support. “

Guest of honour, Ms. Bonnie Horbach, Ambassador

of the Netherlands to Sri Lanka and the Maldives, said, “Innovation in sustainability is always an exciting agenda for us, and there is no better time to act than the present. As Sri Lanka continues its momentum of economic recovery, it is equally important to achieve business excellence in sustainability and circularity. We continue the drive to promote responsible business conduct (RBC) as part of the European Union. Conforming to global sustainability standards will be mandatory in the upcoming years. Sustainable value chains will generate competitive advantages, and for Sri Lanka, early entry into this sphere could be the all-important difference manufacturers could make in outplaying the competition and staying ahead of the game. We appreciate the initiatives taken by PGP Glass Ceylon PLC and HEINEKEN Lanka Limited in this regard and look forward to further innovation in sustainability and circularity.”

PROF. ARUN VARSHNEYA DELIVERS THE NELSON W. TAYLOR AWARD LECTURE

Society of Glass Technology President Professor Arun Varshneya delivered the Nelson W. Taylor Award Lecture of the Penn State University on April 20. The Lecture was entitled, “Technical Glass Products in the Service of Humans”

Prof. Varshneya is also President of Saxon Glass Technologies, Inc. and Professor Emeritus of glass science and engineering, Alfred University.

The Nelson W. Taylor Lecture Series in Materials Science and Engineering honors the memory of Professor Nelson W. Taylor (1869-1965) who was head of Penn State’s Department of Ceramics from 1933-1943. During his tenure as departmental head, Dr. Taylor refined the ceramics undergraduate curriculum, strengthened the graduate program, expanded ties with industry, and was able to attract important scientists (for example Woldemar A. Weyl) to the faculty. He is recognized as the individual most responsible for establishing the College of Earth and Mineral Sciences as a major center for ceramics research. The Nelson W. Taylor Lecture Series was established in 1969, and has consistently attracted scientists of international prominence■



(News Source: AIGMF Research Team / World Wide Web)

The award memento depicts “Nittany Lion” which is the mascot for Penn State.

On the right is Professor Susan Sinnott, Head, Dept of Materials Science & Engineering at Penn State University presenting award to Prof. Arun Varshneya.

PREFERRED INTERNATIONAL JOURNAL

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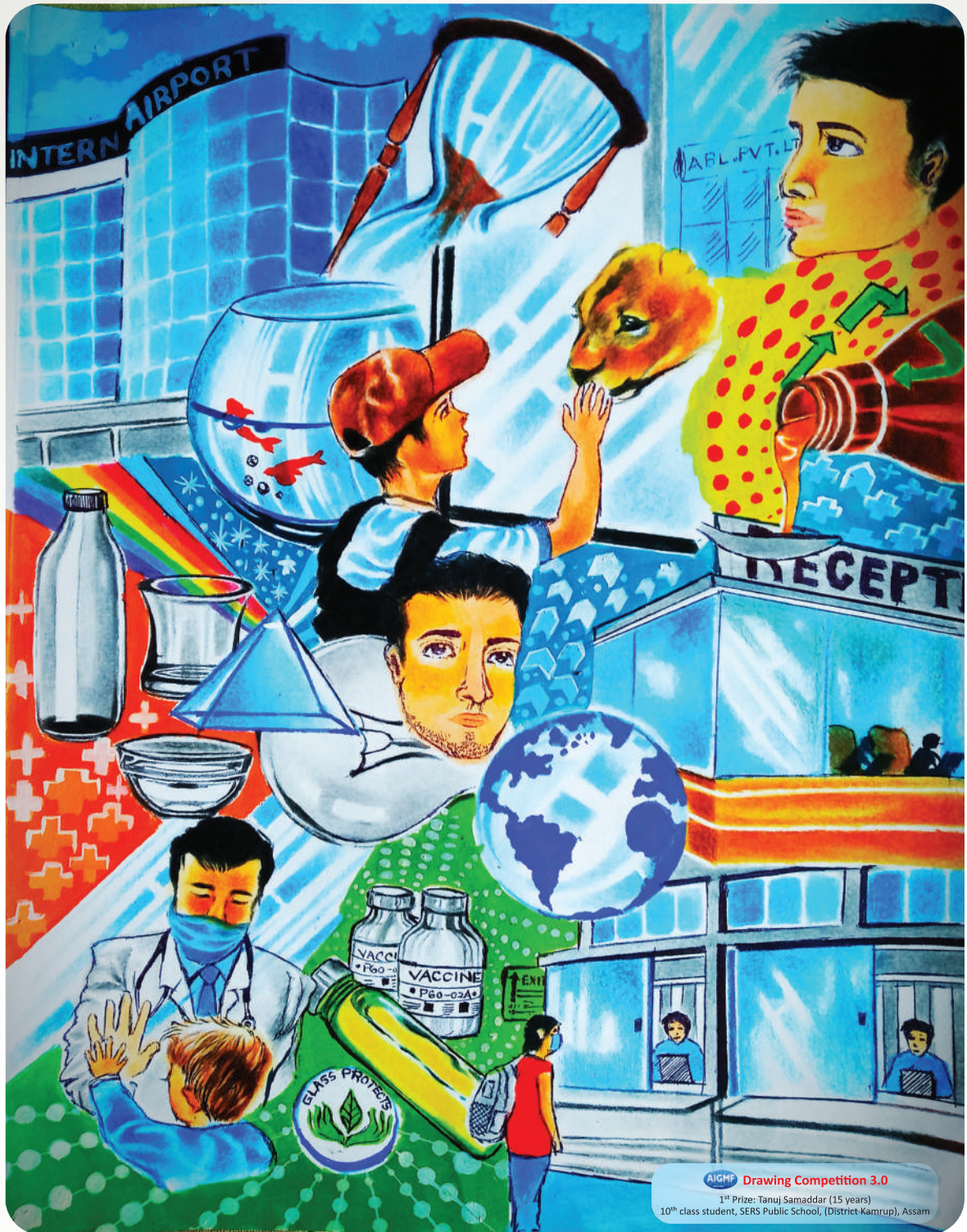


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'Glass Protects' ... says School Children ...



AIGMF Drawing Competition 3.0

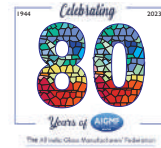
1st Prize: Tanuj Samaddar (15 years)
10th class student, SERS Public School, (District Kamrup), Assam

AIGMF - Catering to the needs of Glass Industry

The All India Glass Manufacturers' Federation

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World Environment Day celebrated at Ahmedabad



Parallel to the Executive Committee and at the maiden meeting at Ahmedabad, the AIGMF program saw presentations on: Cullet Sorting Technologies, Air Quality in Glass Manufacturing Units and Hydrogen as feedstock for manufacturing of Clear Glass.

President AIGMF Mr. Sanjay Agrawal thanked Mr. Purvish Shah, Hon. Treasurer AIGMF and Director Gopal Glass Works Ltd., for taking the lead of holding this special event on their successful setting up of a green field project on Solar Glass at Gujarat under the name M/s Gobind Glass and Industries Ltd. Team Members of M/s Gopal Glass Works Ltd., made some excellent meeting arrangements at the DoubleTree by Hilton, Ahmedabad, which was appreciated by everyone.

Mr. Kartik Morar, V&K Recycling Co., an Affiliate Member of the AIGMF made the presentation on cullet sorting technologies by citing the proper case studies.

Mr. Deepak Gahlowt, Practicing Architect and Secretary of the Confederation of Construction Products and Services (CCPS) gave a presentation on air quality by showing photos of some of his PAN-India projects.





Mr. Gaurav Sharma, Technical Advisor, Green Hydrogen Development at Indo-German Energy Forum (IGEF), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, GIZ office gave a presentation





on Hydrogen set up for glass manufacturing units.

To appropriately mark the event, glass jar bottles made out of 100% recycled glass at the recycling plant installed by M/s V&K Recycling at M/s Sunrise



Glass Industries Pvt. Ltd., were presented by Mr. Gaurav Thakkar, Mr. Hargun Bhambani and Mr. Kartik Morar to President AIGMF Mr. Sanjay Agarwal and Treasurer AIGMF Mr. Purvish Shah; as well as a bottle each was gifted to all participants.

The Members were served with an excellent variety of lunch and the program concluded with high tea.

A special Evening was organised at 'Vishalla' an Authentic village set up under Natural and Eco-Friendly Ambience with a restaurant serving



premium quality Gujarati cuisine over folk art & entertainment and a puppet show. Vishalla prides itself on its presentation of Indian culture and tradition in its village-like environment with its museum of old utensils known as Vechaar.

Vechaar is the only museum of its kind in the world, displaying such a precious collection of utensils. A walk around the hut-like museum makes one's heart skip a beat, marveling at the inimitable beauty of these utensils of old. These utensils have been handed down through the changing seasons and times, over the years.



It was decided that the next Executive Committee meeting along with AGM will be held at Delhi on August 26 ■





Select photos of the event and presentations are available at <https://aigmf.com/past-events.php>



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The All India Glass Manufacturers' Federation



RISK MANAGEMENT & EXECUTIVE COMMITTEE AND ANNUAL GENERAL MEETING'S

on August 26, 2023 at Lemon Tree Hotel, Aerocity, Delhi

1130 hrs	Registration: Tea/Coffee
	PRESENTATIONS ON RISK MANAGEMENT:
1200 hrs	Employer Employee Insurance <i>by:</i> Mr. Mahesh Tanwar, IRDA, AMFI, MDRT Qualifier Life Insurance Corporation of India
1220 hrs	Energy Price Risk Management for Glass Companies <i>by:</i> Ms. Ruchi Shukla Head Energy, Multi Commodity Exchange of India Ltd.
1240 hrs	Q/A session
1245 hrs	AWARDS GIVING CEREMONY: <ul style="list-style-type: none"> - Green Energy via Solar Glass - C K Somany Award for Innovation and Technology - Balkrishna Gupta Award for Exports
1300 hrs	Lunch
1400 hrs	Executive Committee Meeting (for AIGMF Members)
1430 hrs	Annual General Meeting (for AIGMF Members)

Program as on July 16

REGISTRATION PERFORMA (to be sent to info@aimf.com)

S. No.	Company / Organization	Participant/s (Name, Designation, Address, Mobile, E-mail)
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The All India Glass Manufacturers' Federation

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presents

14th International Conference on:

“Decarbonization for the Sustainable Glass Industry”

15 September 2023

at Dress Circle (above The Grande), Bombay Exhibition Center, Goregaon (E), Mumbai, INDIA

TIME (hrs.)	TOPIC/s	COMPANY	SPEAKER
1000	Registration / Tea / Coffee		
1045	Opening Address By Mr. Sanjay Agarwal , President AIGMF Introduction of Speakers and Need for Decarbonization By Mr. Dave Fordham , Publisher, Glass Worldwide magazine and Honorary Member AIGMF		
1100	Accelerating International Capability for a Circular Economy	GLASS FUTURES Ltd.	Mr. Neil Butler Global Innovation Lead
1120	The Future of Glass Furnaces in a Decarbonized world	FIC (UK) Ltd.	Mr. Steve Burns Technical Manager
1140	New Melting Technologies Require Updated Refractory Monitoring Methods	PANERATECH	Mr. Fred Aker Vice President
1200	All-electric forehearth and the role they play in a carbon neutral glass manufacturing industry of the future	ELECTROGLASS	Mr. Grahame Stuart Project Engineer
1220	In-Furnace Thermal Imaging for Process Optimization for Energy Reduction and Asset Protection	AMETEK Land	Mr. Neil Simpson Consultant
1240	Your Vision for Sustainable Glass Melting - Our Tools	EMISSION by SORG Group	Mr. Matthias Haas Associate Director
1300	QUESTION ANSWER SESSION Moderators: Mr. Dave Fordham & Prof. A S Rao , Head, Department of Applied Physics, Delhi Technological University and Member Editorial Board of KANCH (quarterly journal of AIGMF)		
1310	Wrap-up By Mr. Shreevar Kheruka , Vice President AIGMF and Vice Chairman & Managing Director, Borosil Ltd.		
1315	Presentation on glasstec 2024 By Mr. Lars Wismer , Director Occupational Safety & Health / Glass Technologies, Messe Düsseldorf GmbH		
1340	Vote of Thanks By Mr. Rajesh Khosla , Sr. Vice President AIGMF and CEO / President AGI Greenpac		
1345	Networking Lunch*		

*Participation is free, however, eco-kit bags, glass mementoes and lunch have a registration fee payable, with details given overleaf.

Program as on July 16



The All India Glass Manufacturers' Federation

in Partnership with:



PARTICIPATION: Free of charge

However, those requiring an official kit bag, glass mementoes and lunch may register under the following:

Delegation Fee	Indian Companies (Rs.)	Foreign Companies (US\$)
Main Delegate	4000	150
Other Delegates	2000	100
Corporate (Main delegate + 4 delegates)	10000	350

Cheque payable to "The All India Glass Manufacturers' Federation", at New Delhi may be sent to Secretary AIGMF, 812, New Delhi House, 27 Barakhamba Road, New Delhi – 110 001.

Payment can also be remitted through wire transfer. Our bank details are as under:

(Deposit cash or make NEFT- online payment)

Account No. : 0411156983
 Name : The All India Glass Manufacturers' Federation
 Bank : Kotak Mahindra Bank
 Branch : G-39, Connaught Circus, New Delhi
 IFSC Code : KKBK0000214
 Swift Code : KKBKINBBCPC

A copy of bank advice may please be sent to AIGMF Secretariat for reconciliation.

REGISTRATION PERFORMA

(to be sent to info@aigmf.com)

S. No.	Company / Organisation	Participant/s (Name, Designation, Address, Tel, E-mail)
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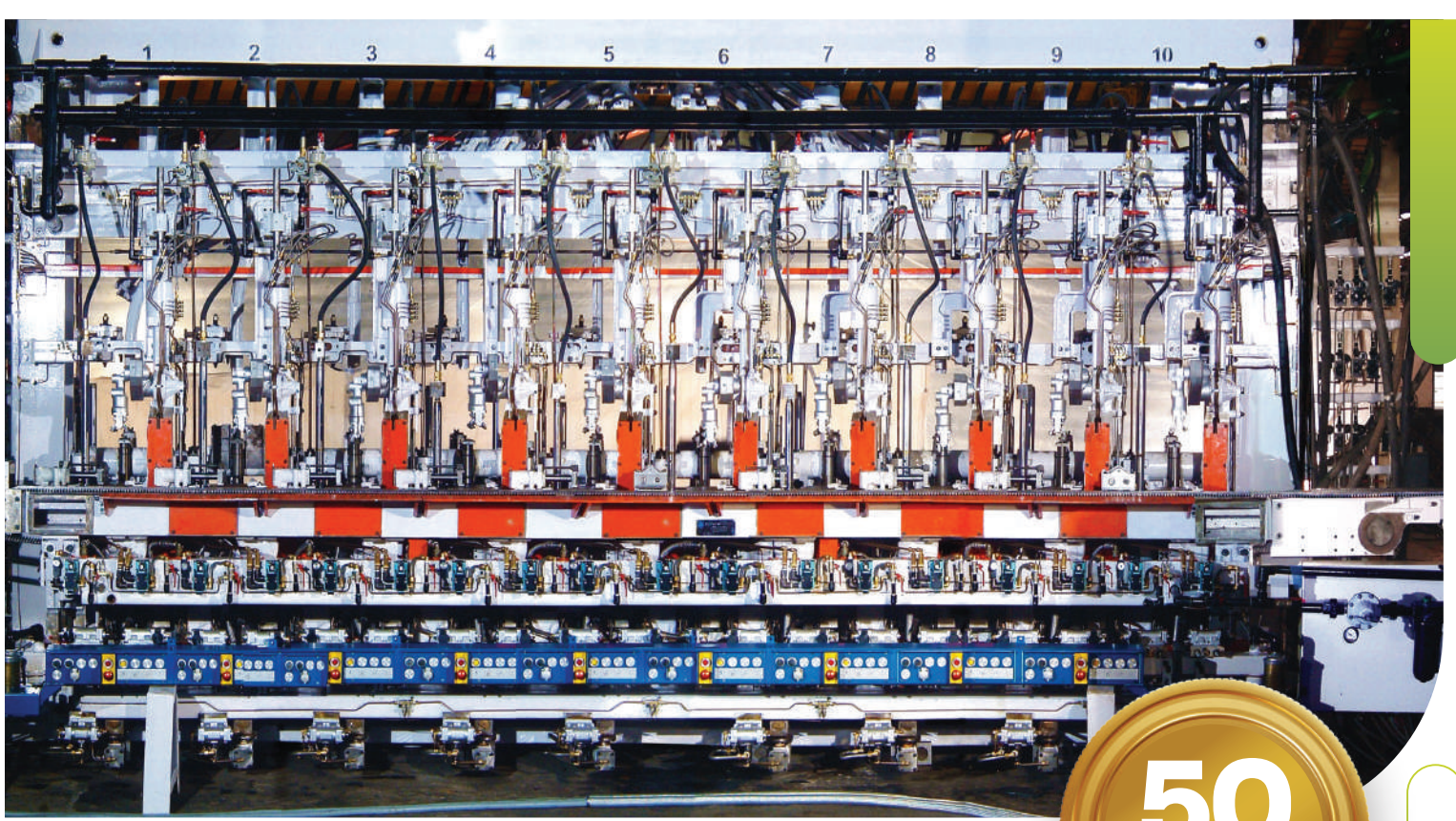


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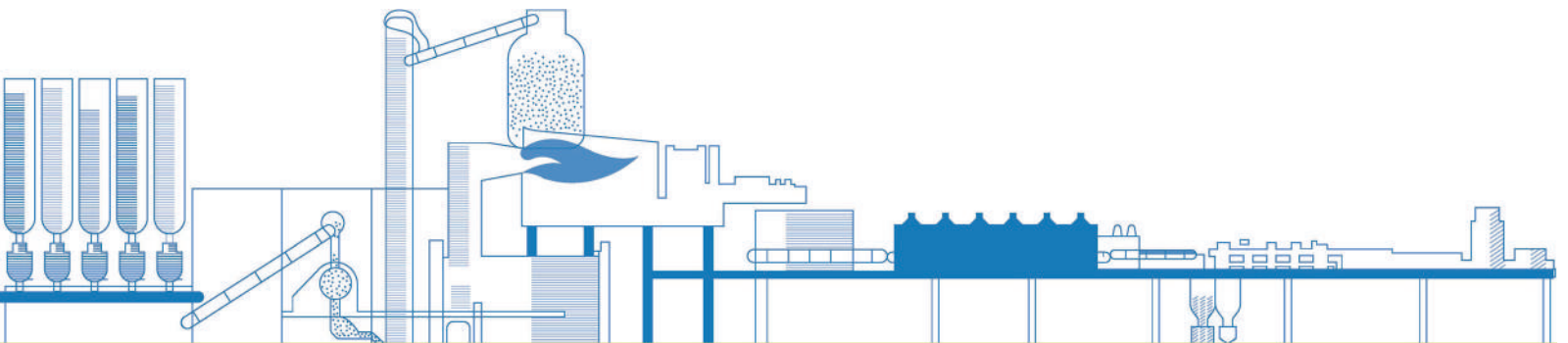
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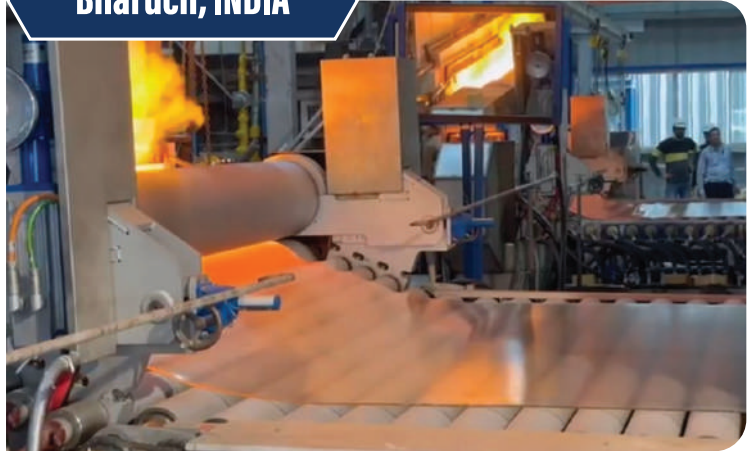
Our recent Expansions

With the commissioning of its Furnace # 3 having a capacity of 550 tons per day at Bharuch, Gujarat, Borosil Renewables Ltd's manufacturing capacity in INDIA has increased upto 1000 Tons per day.

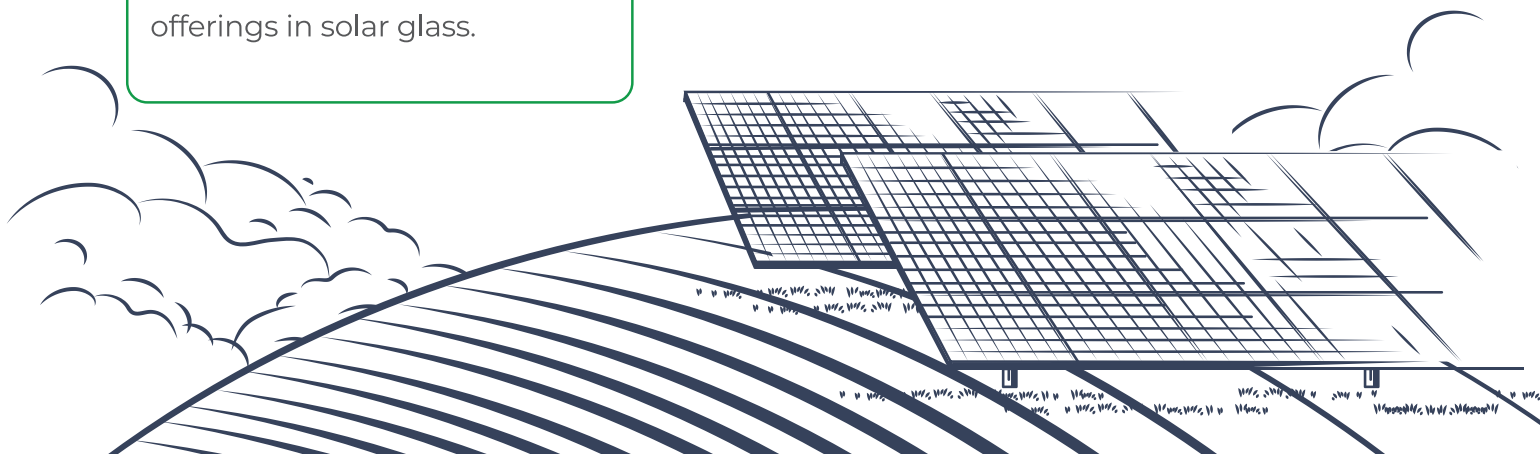
Our Solar Glass manufacturing capacity at GMB Glasmanufaktur Brandenburg GmbH in Tschernitz, GERMANY has now also been enhanced to 350 tons per day after a recent rebuilt of the furnace.

As such, our combined solar glass manufacturing capacity has reached to 1350 tons per day, (equivalent to around ~8 GW). With these increased production capacities, we will be able to serve effectively, our domestic and overseas customers in various glass sizes, glass thicknesses, and other value-added offerings in solar glass.

Bharuch, INDIA



Tschernitz, GERMANY



World Soda Ash Conference 2023

WORLD ECONOMIC OUTLOOK

The global soda ash market was extremely tight in 2022. Demand recovered post-pandemic but supply was constrained as capacity additions were delayed because of COVID-19. Production in Europe was repressed due to energy and raw material limitations while logistical issues impacted on supply in the US. Meanwhile, costs were extremely high, especially in Europe, following the impact on world energy prices of Russia's invasion on Ukraine. The situation is very different today. Soda ash is over supplied in most markets and spot prices are falling quickly in line as well with a drop in cash costs. Meanwhile, world economic growth is slowing, with soda ash demand also seeing some slowdown in certain sectors and/or regions.

GLOBAL SUPPLY

While soda ash demand growth is slowing, there is also a lot of new supply scheduled, mainly in China and in the US. After decades of dominating world capacity additions, primarily to meet rapidly growing domestic demand, in recent years there has been a net loss in Chinese capacity. Also, natural soda ash has only made up a small share of China's capacity total. In Q1 2023, China had a nameplate capacity of 30.3 million mt with the Solvay process accounting for 46% of the total, the Hou process 49% and natural soda ash 5%. But China's soda ash capacity is set to increase sharply, while the technology profile is also set to change. Inner Mongolia Berun Yingen is adding 5 million mt of natural soda ash capacity this year commencing with the 1st line in June. In addition, the company plans to add another 2.8 million mt by around 2026. There are also synthetic expansions underway in China, including some fairly large

projects. Based on all the scheduled expansions and closures China's total capacity will reach 42.5 million mt by 2027, with 34% the Solvay process, 44% the Hou process and 22% natural soda ash.

While the US is entirely based on natural soda ash and amongst the lowest cost producers in the world, it hasn't added any significant capacity in recent decades. This is set to change. By 2030, the US capacity is expected to increase by over 10 million mt. Genesis is adding about 1.1 million mt this year. The single biggest capacity addition though is scheduled by Sisecam with plans to build a 5.0 million mt greenfield plant by 2028. There are also expansions scheduled in other parts of the world. Inochem in Saudi Arabia is to start up in June; this 300,000 mt per year plant was initially scheduled for August last year. Ciner is expanding its capacity in Kazan, Turkey by about 1.0 million mt over the time period 2022-2025. There are plans to increase capacity in Kazakhstan and various expansion plans in India.

GLOBAL SUPPLY/DEMAND OUTLOOK

TRADE

Soda ash is often not consumed where it is produced. The US, Turkey and China are key exporters while South America and Southeast Asia are key importing regions.

In the wake of the COVID-19-led supply chain complications, and the ongoing war between Russia and Ukraine, global soda ash trade remains



robust. None-the-less, there were some residual supply chain issues last year and as a consequence the only significant increase in exports in 2022 came from China, exporting more than 2.0 million mt. China's ability to increase exports in the forecast years will be influenced by the success of the new Inner Mongolia plant and also what impact it has on some of the local high cost plants in China

SODA ASH DEMAND DISTRIBUTION

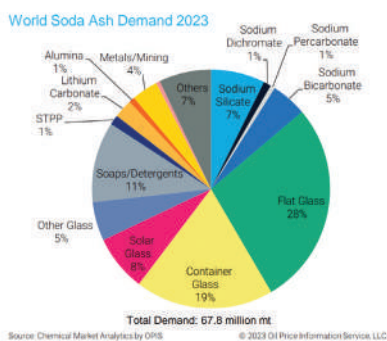
Soda ash demand is dominated by glass. On a global basis flat glass is the single biggest end use accounting for 28% of total world demand. In terms of demand growth environmental sectors are contributing very positively. In fact, solar glass is set to be the single biggest driver for soda ash demand by 2027. Lithium carbonate, a material used in some electric batteries, will also be an important demand driver. Flat glass will also remain an important driver for demand on a global basis, even though production growth in China is expected to slow.

For the most part of last year, global demand was strong. 2023 started off with some slow-down in demand in certain applications, and surplus stock was observed in many markets. For the remainder of the year, we are expecting that soda ash availability will continue to improve as new capacities

come on stream, especially in China, and as demand growth globally is subdued.

CHINA DEMAND OUTLOOK: Flat glass, which has been the key driver for soda ash demand in China, will remain an important demand driver, but we believe that solar glass will be the key demand driver going forward. There is also potential growth for soda ash for lithium carbonate in China, which we are projecting will average 19% per year between 2022-2027.

OTHER ASIA : Southeast Asia is a large developing market, but one that is entirely dependent on imports which last year totalled about 3.6 million mt. Northeast Asia, excluding China, is a mature market, with imports last year of about 1.3 million mt. After strong demand growth in 2022 and tight market conditions, the soda ash market in Other Asia has been fairly long since the start of this year, with reports of high stocks in the region. Total imports have seen a 14% decline so far this year. We expect that the market should remain well supplied for the remainder of the year. In terms of demand, the picture is mixed. Solar glass and container glass demand are observed to be good, while flat glass and detergents are weak.



INDIA: While the Indian market was fairly tight last year, some softness in demand was apparent ahead of most other regions, being visible since the second half of 2022. Consumers began this year carrying substantial stocks with surplus availability remaining throughout the first quarter. However,

it seems that the Indian market may have turned a corner. Demand for detergents, the single biggest end use in India, has already begun to improve. Container glass has been performing well and is likely to continue to do so. And while Indian flat glass producers have been impacted by growing imports from Asia, new float and solar lines are coming on stream this year and next year. Meanwhile, with a soda ash per capita demand level of only 3 kilograms per person, the long-term prospects are good.

WEST AND CENTRAL EUROPE: West Europe is a net importer of soda ash. Central Europe is a net exporter, mainly from Bulgaria. Soda ash was extremely tight in Europe last year. The market is much more balanced today. Demand for container glass, the single biggest application in West Europe, has been strong to date this year, however, the outlook for the rest of the year is cautious. None-the-less, a cullet availability issue has the potential to increase soda ash consumption. Flat glass demand has slowed since Q4 last year and is expected to remain fairly weak this year.

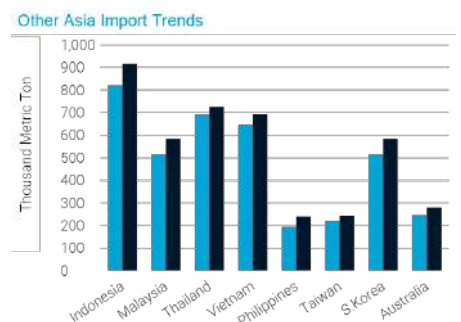
NORTH AMERICA: The US market is mature, although there is some growth potential which is mainly for lithium processing. In general, therefore as the US adds soda ash capacity it will primarily be destined for export. In 2022, US exports were restricted because of various plant problems and also domestic logistical constraints. Some restrictions on exports have remained to date this year.

SOUTH AMERICA: South America, is almost exclusively reliant on imports. Demand was extremely strong in 2022, with double digit growth. The market was extremely tight to the extent that it attracted imports from as far away as China, at very high prices. We see a very

different market dynamic to date this year. There are no longer any problems with availability and there is strong competition for market share amongst all key suppliers. While some softness in demand has been noted this year, none-the-less, the medium/long-term prospects are strong with lithium carbonate the single biggest demand driver.

MIDDLE EAST / AFRICA: Ciner is, as already mentioned, expanding its natural soda ash capacity in Turkey. However, there are also numerous glass projects scheduled for Turkey over the coming years which means that much of the new soda ash capacity being added will eventually be absorbed by the domestic market. Meanwhile, the new soda ash plant which is about to start up in Saudi Arabia will primarily serve the domestic market.

The African market has also switched from being very tight in 2022 to being oversupplied to date this year. There is new demand on the horizon in Africa, including for detergents, chemicals and glass. However, by 2027 per capita demand is not expected to alter significantly and Africa will continue to have the lowest soda ash per capita in the world.

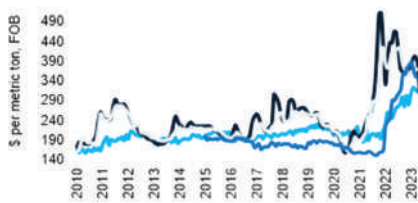


PRICES, COSTS AND MARGINS

Higher freight rates also contributed to cost increases for soda ash over the past 1.5 years. But container freights have started declining rapidly since the end of last year. Bulk freights started to decline much later and at a slower pace. We have though also

started observing decreases in the bulk market this year.

Soda Ash Export Price Comparison



Based on our forecast for energy prices, cash costs for producing soda ash seem to have peaked. The cost curve was extremely steep last year with a huge gap in place between the lowest cost producers in the US and the highest cost producers in Europe. Costs across the world are weakening this year but large deltas still remain between the regions. Even by 2027, while the gap in costs is expected to narrow, natural gas based production in Europe looks set to stay at a considerable premium.

The US is the biggest soda ash exporter in the world, Turkey is in 2nd place. China's export position is more volatile as its export volumes

can change significantly from year-to-year. The US tends to fix more annual soda ash prices and thus its prices tend to be fairly stable over the course of a year while China exports a lot of product on a spot basis, with Turkey somewhere in between. Therefore, monitoring both prices and availability from China is helpful to also understanding the underlying global market dynamics. In August 2020, in the midst of the pandemic, China's export prices average \$161 per mt FOB while by August last year prices increased to \$420 per mt FOB. This year we see a different market dynamic with spot export prices recently at \$260-290 per mt FOB. Even though producers' stocks remain relatively low in China there is a lot of nervousness about the imminent start-up of Inner Mongolia Berun.

SUMMARY & CONCLUSIONS

World operating rates may have peaked. However, the timing of the new projects will be critical in terms of the actual operational levels going

forward. In addition, our forecast doesn't include potential capacity closures, except for what's scheduled. It's very likely that the huge capacity addition in Inner Mongolia will force the closure of some small Hou based plants and/or some Solvay based plants that have problems disposing of calcium chloride. Synthetic plants in other parts of the world may also be vulnerable.

For a detailed overview of the global soda ash and allied industries join us at the World Soda Ash Conference in Athens, October 10-12th ■

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DURÁN INTERNATIONAL SYMPOSIUM

On Sustainable Glass Processing and Applications

This major symposium is in honor of the distinguished work and lifetime achievements of Prof. Alicia Durán, a very well-known professional with a deep impact on Sustainable Glass Processing and Applications.

Prof. Alicia Durán is a Research Professor of the Spanish Research Council (CSIC) Madrid, Spain. She received a degree in Physics from the Universidad Nacional de Córdoba (Argentina) and a PhD in Physics from Universidad Autonoma de Madrid (UAM), Spain.

Prof. Durán has directed 15 PhD thesis, 9 International and one Extraordinary Prize UAM and more than 40 MSci thesis. She has published over 270 articles in WOK/Scopus journals with more than 6900 citations and an H index (WOK) 50 (the highest index in Spain in Science Materials, Ceramics). She has published 14 books and 14 book- chapters and has given more than 40 international invited talks/keynotes from 2010-2022.

Prof. Durán became Associate Editor to Co-Editor in chief of International Journal of Applied Glass Science (IJAGS) in 2018, with Prof. Mario Affatigato as new editor-in-chief. The strategy included the design of special issues. In particular, Women in Glass in June 2020 that constitutes the first issue fully dedicated to women working in glass all over the world, gathering 17 papers from women working in 14 countries in a wide range of topics. The impact of this issue has been very important, taken as an example of how to promote the work of women in science and especially in the glass sector. The guest editors, Kathleen Richardson, Prof. Lili Hu and

Prof. Alicia Durán also reflect the goal of integrating West and East in the journal. A new special issue dedicated to FUNGLASS, the European glass project with the highest budget ever financed by the EU, was published in October 2021. A special issue focused on the Future of Glass, was launched for opening the International Year of Glass 2022, and Glass and Sustainability is the new project of special issue to appear in July 2024.

The International Year of Glass 2022 (IYoG2022) was an idea born in the US in the frame of the movement announcing the arrival of the Age of Glass. The special issue of IJAGS devoted to the Glass Age published the article: "Welcome to the Glass Age" by Prof. D. Morse, J. Evenson.

Prof. Durán, as President of the International Commission on Glass (ICG), accepted the challenge of presenting the IYoG to the United Nations, and getting the support of the Permanent Mission of Spain at the UN in New York. She has intensively worked as chair of this initiative receiving the support of more than 2500 institutions from 96 countries of the five continents. After a long route, writing different documents and advancing the support of other countries, the IYoG 2022 was finally approved by unanimity at the General Assembly of UN on May 18, 2021, with the explicit signature of 19 countries. Hundreds, thousands of activities were developed across the planet in all fields of glass: industrial fairs and congresses, courses and webinars, congresses and contests, and many art activities from more than 450 museums and artists gathering the IYoG. Welcome to the Glass Age was published in English and Spanish, as



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well as itinerant exhibitions, videos and magazines.

Prof. Durán is the leader of the research group Glass at the Institute of Ceramic and Glass, ICV (CSIC), nominated as Excellence group of CSIC, in the first top 10% of the 1650 research groups of CSIC (<http://glass.icv.csic.es/>)

The general objective of the research group Glass is the design, processing and characterization of glasses, glass-ceramics and sol-gel materials, going from the structural features to properties (optical, mechanical, chemical, thermal, electrical, etc.) and applications.

The research lines focus on topics going from basic research up to applications in the industrial glass sector and other final users of glassy materials. The main research lines are condensed in 3 topics, financed from different sources including R&D European programme, Spanish R&D programme as well as other international projects and contracts with companies: Glasses and glass-ceramics produced by melting, Sol-gel materials for sustainable applications and Industrial collaboration: energy saving, food safety and environmental issues.

Topics connected to energy and environment research were the aim

of most projects developed in the last 20 years, focused on Glass and Sustainability. Different materials and components for fuel cells (PEMFC membranes, sealing glasses and glass-ceramics for MCFC and SOFC), solid electrolytes and electrodes for Li-batteries, low temperature sealing in solar energy devices, come together with protective and environmentally friendly anticorrosive coatings, mesostructure coatings with photocatalytic activity for abatement of water or gas pollutants, solar cells and nano glass-ceramics with photonic applications produced by melting, sol-gel and SPS. Energy saving is an important issue with different approaches, from industrial glass furnaces to solar and heat control glasses for buildings.

Glass and Sustainability were also the driving force of research and topics developed across the planet during the IYoG, including glasses in biomedicine applications, renewable energies and glass, glass in buildings and transport, decreasing CO₂ emissions and foot print of glass processes, optical fibers and ICT or 5G, as well as protecting glasses and glasses in art for enhancing well-being. Education and promotion of equality are key tools to get these goals.

Prof. Durán was President of the International Commission on Glass (ICG) in 2018-2021, and Treasurer (ICG) 2002 - 2015.

She has received several Awards, including the Internacional Prize Vittorio Gottardi of ICG; Prize RAICES (ROOTS) of International Cooperation in Science and Technology, granted by the Ministry of Science, Technology and Productive Innovation of Argentina; Guest Professor Wuhan University of Technology, China; 49th recipient of the Phoenix Award and Glass Person of the Year 2019; Fellow of the American Ceramic Society. In 2022 she received the Prize to Research life SOCEMAT-Spanish Chapter American Ceramic Society; the Otto Schott Award 2022, the President's Award ICG,

instituted by ICG to relevant work for the association and was nominated Honorary member of The Worshipful Company of Glass Sellers of London.

A round table discussion open to everyone interested will be organized at a specific date and time during the symposium. It will be a platform for high level representatives of various industries, technologies, and academic disciplines to freely discuss and debate all topics of this symposium and identify positive and efficient pathways towards sustainability in industrial practices, technologies, and research.

The chairs of the symposium are an international team of well-known academics, industrial glass companies and executive of glass organizations: Dr. Sener Oktik (Sisecam, Turkey), Dr. Erik Muijsenberg (Vice President at Glass Service Inc., Czech Republic), Mr. Lucien Belmonte (Brazilian Association of Glass Industries, Brazil), Prof. Delia S. Brauer (Friedrich Schiller U., Germany), Mr. Bertrand Cazes (Glass for Europe), Prof. John Parker (U. of Sheffield, UK), Prof. Tanabe Setsuhisa (Kyoto U., Kyoto, Japan), Dr. Kerry Ward (Glass Manufacturing Industry Council, USA), Mrs. Urmilla Jokhu-Sowell (National Glass Association, USA) and Mr. Vinit Kapur (AIGMF, India).

The symposium is focused on glass, glass-ceramics and sol-gel materials and will cover the entire spectrum from basic research to applications in the industrial glass sector and other final users of glassy materials.

The topics of the symposium will cover but not limited to:

- Energy and environment
- Different materials and components for fuel cells (PEMFC membranes, sealing glasses and glass-ceramics for MCFC and SOFC)
- Solid electrolytes and electrodes for Li-batteries

- Low temperature sealing in solar energy devices
- Environmentally friendly anticorrosive coatings, mesostructure coatings with photocatalytic activity for abatement of water or gas pollutants
- Solar cells and nano glass-ceramics with photonic applications produced by melting, sol-gel and SPS
- Energy saving is an important issue with different approaches, from industrial glass furnaces to solar and heat control glasses for buildings
- Furnace technologies and challenges in neutral carbon glass production
- Big glass science
- ITC, Optical fibres, photonics
- Bioglasses, biomaterials of future
- Glass ceramics, applications, astronomy, glass sealing
- Sol-gel materials, coatings, corrosion protection, photonic materials
- Glass and sustainability as related to energy, buildings, transport
- Art in glass
- Glass education, publications and IYoG
- Glass in renewable energies

This symposium will be held as part of SIPS 2023, an annual multidisciplinary summit, organized by the not-for-profit corporation FLOGEN Stars Outreach (www.flogen.org), which is dedicated to achieving sustainability through science and technology applied in various fields. It incorporates summit plenary lectures from well-known speakers that address the link between various domains in the pursuit of sustainable development, as well as specific scientific symposia featuring specialized presentations in a specific domain, with the same goals in mind. The symposium and overall summit will be held in Panama from November 27th – December 1st, 2023, in Hyatt's Dreams Playa Bonita.

Please submit the abstract using

this link: https://www.flogen.org/sips2023//abstract_submission.php?p=35#top4

Other additional information about this symposium, SIPS 2023 can be found in the official invitation: https://www.flogen.org/sips2023//pdf/Glass_General_Author_Invitation.pdf

The papers will be double peer reviewed and published in the official Publication entitled: "Durán International Symposium on Sustainable Glass Processing & Applications" containing ISBN and ISSN numbers, and indexed by Google Scholar joining the existing 3000 SIPS articles (<https://bit.ly/3qRrdGt>). Furthermore, many papers will be subsequently published as part of a special volume of relevant Journal dedicated to this symposium.

If you prefer to deliver a presentation with a wider scope for one of the listed topics, or on a new specialized

topic of your choice, we would be pleased to take it into consideration for a possible nomination as an Invited or Keynote Lecture.

In this case, please send us an email at the same address, which should indicate your interest and include a draft abstract.

Pertinent information from our website:

- SIPS 2022 Video Synopsis of 23 minutes: <https://www.youtube.com/watch?v=kUyfcO6QbKY>
- Some videos from previous SIPS Symposiums are presented here: <https://flogen.org/?p=71>
- SIPS impressions over the years: <https://flogen.org/?p=110>
- Video impression over the years: <https://flogen.org/?p=79>
- Highlights of FLOGEN and SIPS activities <https://www.flogen.org/?p=105>
- Hall of Fame: <https://www.flogen.org/?p=92>

An overview of previous SIPS held at various locations all over the world (USA, Mexico, Turkey, China, Brazil, Cyprus, Thailand) can be found here: <https://flogen.org/?p=32&an=2002>

The symposium is the optimal conference to present your most recent work, listen to the latest achievements of your colleagues, and interact with well-known experts from diverse fields of industry, academia, and politics. We hope your participation will enable your organization to improve efficiency and implement the best sustainable research and industrial practices.

You are cordially invited to actively participate in this symposium by submitting and presenting a paper, or by attending the round table. We look forward to meeting you in Panama■

Program details at: https://www.flogen.org/sips2023//Alicia_Duran.php

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Revolutionising glass recycling in Malaysia

O-I BJC Malaysia launched the Glass Ambassador Programme last year to support and encourage sustainability across the supply chain and establish separation at source glass recycling in the region. O-I BJC's General Manager Jeffrey Newton and Procurement Manager Gaginthira Rao provided an exclusive insight to *Glass Worldwide* (preferred AIGMF international journal) into the programme and explained their objectives for its development and expansion going forwards.



Jeffrey Newton, General Manager, O-I BJC.

The product of a joint venture in 2010 between Owens-Illinois (O-I) and Thailand's Berli Jucker Public Company (BJC), O-I BJC Glass Malaysia operates from Johor Bahru (one of four plants across Asia acquired in the deal) in south Malaysia, manufacturing high quality bottles and jars in flint, amber and green glass. Running two furnaces and six

production lines employing Press & Blow, Blow & Blow and Narrow Neck Press & Blow technology, the 350-people strong business has won the support of multinational customers from the food and sauce, beverage, beer, liquor and pharmaceutical industries.

Glass ambassadorship

Aligned with a sustainability strategy that seeks to drive a circular economy with all the benefits surrounding glass packaging, working towards glass being the perfect choice for the most eco-friendly and sustainable packaging for the business and the planet, O-I BJC Glass Malaysia has targeted a number of initiatives aimed at growing and improving glass recycling. In May 2021 the company launched its 'Glass Ambassador Programme' focusing on increasing awareness around the circularity of glass, stimulating social impact, energising economic development, advancing manufacturing aptitude and achieving

a sustainable future. Glass Ambassadors promote the benefits of recycling glass, educating the public about O-I BJC's use of recycled glass to make new glass containers – a process that uses fewer raw materials and less energy, thereby reducing carbon emissions.

"The whole idea about the Glass Ambassador Programme is to connect and engage with all the stakeholders across the supply chain to improve glass collection, processing of the glass and delivery back to our furnace," explains Gaginthira Rao, Procurement Manager at O-I BJC and co-ordinator of the Glass Ambassador Programme. "Compared to some other countries, glass recycling in Malaysia is in its infancy, so we need to improve the collection system and divert the glass from going to landfill by engaging with local waste management companies and our customers, as well as recently with schools and government authorities."

O-I BJC is working with professional waste management provider to collect post-consumer glass within the community. This post-consumer container glass is carefully recycled into green, amber (brown) and clear (flint) glass, and foreign non-glass containments are removed to create furnace-ready glass.

"We have started initially with one waste management company covering one state in Malaysia, and gradually we are expanding into a few more," Mr Rao continues. "And we will keep going, also engaging with NGOs (non-profit ▶



O-I BJC's Glass Ambassador Programme aims to improve and increase furnace-ready glass by working with customers, associations, suppliers and local leaders in Malaysia.



The Glass Ambassadors promote the benefits of recycling glass, educating the public about O-I BJC Malaysia's use of recycled glass to make new glass containers.

organisations) for additional support. If we look into O-I's sustainability goals, using [a] high cullet percentage is one of our key objectives so we have to make sure we have enough supply in order to meet our sustainability goals and increase cullet use in production."

"The launch of the Glass Ambassador Programme received a lot of coverage in Malaysia," reports Jeffrey Newton, General Manager, O-I BJC. "It is a holistic programme around sustainability and glass recycling. Working with stakeholders (brand owners, waste management collectors, the processors and the authorities), we have started breaking down what activities each can do individually and together [for] different programmes. Some of the activities are based on specific programmes and others are more ad-hoc activities around how to increase recycling."

Internal engagement

In addition to educating communities and engaging with stakeholders, O-I BJC is communicating the message of the Glass Ambassador Programme to its own teams. "We launched a competition internally to reduce waste, how we can engage the community, how every contributor can make a change, why we should recycle, etc." reveals Mr Newton. "So we have started internally and externally boosting and shifting the mindset of sustainability and recycling. This is all under the umbrella of the Glass Ambassador Programme and it is a long-term strategy."

Under the '#WhyIRecycle' initiative, O-I BJC employees were encouraged to share their recycling testimonies (some of which appear on the company website¹), while O-I promoted the hashtag across its social media channels as a means of publicising 'stories about why we recycle and how we bring this vital practice to life each and every day'. Inviting followers to share their own 'why' and tag the company has elicited an enthusiastic response and prompted some interesting and inspiring answers.²

Student recycling contest

From September 2022 through to January 2023 O-I BJC Malaysia's Glass Ambassador Programme held its first student competition for glass bottle recycling through a strategic collaboration with integrated waste management provider, SWM Environment and with [the] support of Johor State Education Department, and the Johor Bahru City Council.

The Programme's intention was to reduce solid waste deposits in landfills by increasing public awareness of the benefits of glass bottle recycling for environmental sustainability and the circular economy, and the contest was run across 30 primary schools in Johor.

Employing training of trainers (ToT) sessions, the contest was designed to create a forum for sharing knowledge about sustainable waste management and glass bottle recycling practices and involving industry players and educators, with the schools functioning as small ambassadors for glass bottle recycling.

To encourage community involvement, O-I BJC supplied the participating schools with recycling bin facilities to assist recycling activities by students, teachers and parents, in addition to offering cash prizes as incentives, while SWM Environment awarded points via Kitarecycle, an app designed to incentivise recycling [with a points system] for more than 25 recyclable items.

"For schools this competition consists of a few sub-programmes – the first being train the trainers (training the teachers)," explains Mr Rao. "The second is a competition on the volume – who collects the most." The organisers anticipated collecting up to 10,000kg of used glass bottles for recycling. "The third one is a creativity poster competition," Mr Rao continued, "and the last one is a glass recycling corner. These different competitions provide opportunities to all the kids to win the different categories and keep them all ▶



motivated. The key of the schools programme is to drive awareness of glass being recyclable.”

“It’s one initiative of the Glass Ambassador Programme that we were excited to go ahead with because we are reaching and educating young generations,” adds Mr Newton. “Malaysia is the perfect touchpoint to launch this initiative to kids that are so eager and open to building a new future. We’ve initially targeted primary schools and have trained the teachers to be our ambassadors about the benefits of glass and also how to recycle and why to recycle. Kids also have a way of influencing their families as well!”

International experience

Jeffrey Newton joined O-I 2007, initially as a manufacturing trainee at O-I Peru and working his way up to Production Line Manager. In 2012, he left to work for Backus/AB InBev in the FMCG [fast-moving consumer goods] industry, returning to O-I in 2014 as an operation manager – this time in New Zealand, and going on to work in multiple manufacturing leading roles in Australia, Indonesia, and in a regional position within the Asia Pacific region (Asia and ANZ). A well-travelled Mr Newton was appointed General Manager of O-I BJC Malaysia in November 2020, bringing with him a wealth of experience regarding business practices and sustainability activities.

“There are benefits to being in different countries and being exposed to different states of sustainability around the world,” he reflects. “I remember starting at O-I Peru and they were very active in sustainability with many activities happening on that front; it provided me with good experience. I’ve also had the opportunity to work in very developed countries in terms of sustainability, like Australia and New Zealand, so you can benchmark different countries and the stages of their journeys towards sustainability

in the manufacturing process. That helps to bring different perspectives and co-ordination around the strategic approach that the company should be taking around sustainability. My experience has helped shape me towards prioritising sustainability as a way forward in the organisation and to build a circular economy to benefit the environment and the industry.”

Team effort

As a joint venture, O-I BJC’s sustainability efforts in Malaysia naturally benefit from both partners’ cumulative know-how and extended reach. “We are in a position where we can learn from both companies,” observes Mr Newton. “O-I puts a lot of effort into sustainability at a global level – we can reach out and learn best practices and try to integrate that into our business locally. The BJC group in Thailand is a very progressive company with a lot of sustainability activities and initiatives. Both companies are really aligned on sustainability as a way forward for glass and the future of the planet. We can engage and learn the best from both companies. We can benchmark and get more ideas. The local team is embracing what we want to do, especially as far as the Glass Ambassador Programme; all the stakeholders are involved in making this happen and we are linking with all partners directly or indirectly to drive recycling and improve sustainability. We can benefit from all ideas but in the end it is the local team working together with the Asia regional team that really makes the difference,” he underlines.

“Our colleagues in Singapore are very active in working with us and we are operating like one team on this front,” confirms Mr Newton. “We are [also] working with the global team and I can tell you that we are putting sustainability top of the agenda.”

The sky’s the limit...

“In addition to the Glass Ambassador Programme, we are always looking at different ideas around sustainability regarding emissions and technologies – that never ends,” says Mr Newton.

Does this include investment in technological advances to drive sustainability at the factory in Johor Bahru?

“In terms of actual technology, all I can say is we are actively looking at different solutions for more energy sustainable manufacturing,” he responds. “Lightweighting is always a way forward to reuse raw materials and energy...”

For now, O-I BJC is continuing to promote the benefits of glass recycling and a circular economy in the region, setting up a net of glass collection hubs and proactively collaborating with customers, associations, suppliers and local leaders in the communities where it operates. “With glass recycling and sustainability being put into action, that has meaning; this team is doing amazing work in transforming Malaysia on these aspects,” notes Mr Newton. “The global team is aware of what we are doing and is praising our efforts on sustainability.

“There is for sure plenty of potential moving forward and we will go faster and farther!” he enthuses. “We have had a very good start and the sky is the limit!” ●

1 <https://www.o-ibjc.com.my/glass-ambassador>

2 <https://www.o-i.com/whyirecycle/>

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Decarbonisation is not just about ecology

Originally published in *Glass Worldwide* (preferred AIGMF international journal), Vladislav Vorotnikov examines the effects of the current energy crisis and offers his opinion on the role that decarbonisation might play in the future of global glassmaking.



Vladislav Vorotnikov.

Soaring natural gas prices hit several European industries hard last year, triggering talks about speeding up green transition and beating ecological goals sooner than originally planned. For the glass industry, however, some important pieces of the decarbonisation puzzle are still missing.

Supplies of Russian gas – critical for the glass industry – were cut by more than 80% in 2022. As a result, wholesale prices of natural gas have surged as much as 15-fold since early 2021, with severe effects on the glassmakers. At the time of writing, European natural gas prices have fallen below their levels before the beginning of the Ukrainian crisis. Warm weather and alternatives to Russian natural gas are the key factors contributing to that downward price rally. Nevertheless, it seems too premature to judge that the energy crisis is over. Prices still remain high for the glass factories, and while manufacturers in other industries are increasingly looking into alternative solutions – primarily related to renewables, glass factories are short of options. Decarbonisation requires new ground-breaking technologies and state aid.

The European glass industry is continuing to invest in decarbonisation technologies and measures which contribute to decreasing their CO₂

emissions and the use of natural gas, commented Adeline Farrelly Secretary General of the Glass Alliance Europe and FEVE.

“In fact, switching to alternative energy sources to power furnaces – and preferably low-carbon ones for decarbonisation purposes – is potentially one of the most important ways for the European glass industry to limit the risk of gas shortages,” said Ms Farrelly.

However, implementing technical solutions will inevitably take time considering most substantial changes can only be undertaken when the furnace is brought to a cold [stop] at the end of its life and is entirely rebuilt. From a practical and economic perspective, these solutions also require the availability of abundant alternative energy sources to natural gas at competitive prices – for example: electricity, biogas or hydrogen – and massive investment, according to Ms Farrelly.

“We are asking the EU Commission and Member States to recognise that our industry operates in global markets and is exposed to global competition in Europe,” she noted. “The authorities should provide

the necessary framework conditions for decarbonisation solutions to be developed and deployed. They must create the infrastructure for the availability of low-carbon energy sources and ensure that they are accessible to our industry at a competitive cost.”

Otherwise, Glass Alliance Europe members believe, there is a significant risk that future investments take place where energy costs are lower and where strategic industries, such as glass, are shielded from the crisis.

Over the years, the technologies have remained a stumbling block for the decarbonisation efforts in the glass industry. There is still no silver bullet on the table, although some positive developments have been seen recently.

Is electricity a solution?

So far, the glass industry primarily runs on fossil fuel. In theory, electricity and hydrogen could become viable alternatives, but investors are cautious about experiments in this field, perhaps wary of a US glass manufacturer that tried to put the world’s largest electric-powered glass furnace in operation with the declared goal of making hollow glass production more eco-friendly. The operation proved unsuccessful and could have discouraged other glassmakers from even considering electricity as an alternative to fossil fuel.

The problem with the use of electricity is that modern factories need a glass melt with a hot surface, while a purely electrically resistance-heated glass melting furnace has a cold surface. In [traditional] glass factories, natural gas is burned to melt raw materials such as quartz sand and limestone at around 1,500°C.

Christiane Nelles, Energy Officer of the German ▶



Sources of CO₂ emissions in glass manufacturing are primarily high-temperature heat from fuel combustion for melting.

Federal Glass Association, believes that because of this, products with high internal quality requirements cannot be manufactured using purely electrical melting. And the list of challenges goes on.

"In addition, with high electrical power, the current densities at the electrodes are very high. The consequences can be flow disturbances and short circuits, or there can be local overheating in the glass tank," said Ms Nelles, adding that this was exactly what happened in the previous instance.

Hydrogen: more questions than answers

There are hopes that hydrogen could become a more promising option for the global glass industry in the years to come.

Japanese glass manufacturer NSG Group conducted a trial that managed to achieve a seamless transition between its current main fuel, natural gas, and hydrogen.

"The trial proved that hydrogen was as capable as natural gas in achieving excellent melting performance and that it could be possible to operate the furnace with vastly reduced carbon emissions. It is a key step in the group's plans to decarbonise," the company reported.

For the longer term, a stable supply of hydrogen made possible through a network of pipelines to key industrial sites could enable a full transition to hydrogen-fuelled glass-making, according to NSG.

On the other hand, there are several questions related to hydrogen use in glass production. First is whether hydrogen will be available in sufficient quantities to make the transition from natural gas smooth. Second is whether the use of hydrogen will be efficient. Almost all clean energy transition scenarios give hydrogen a key role in our future. However, as the industry has only just started to perk up, it is yet to be seen whether prices will still be attractive for glass manufacturers.

In addition, for the trial, NSG group delivered hydrogen to its industrial facility by truck. To make logistics costs reasonable, glass factories should be connected to hydrogen networks, which do not exist yet.

Some reports evaluating the future of the hydrogen industry assumed that it could be widely used in fields such as steel and chemical production. However, it remains controversial whether hydrogen should be used for heating beyond that, including at glass factories.

Furnace of the future passes into oblivion

In light of this, a part of the glass industry has set its sights on hybrid solutions run on a mix of electricity and green hydrogen. In 2021, a sectoral collaboration led by FEVE, the European Federation of glass packaging makers, began to research and evaluate the future of hybrid furnace technologies. In total, 19 European glass manufacturers planned to jointly build and operate an industrial-scale hybrid glass furnace that would be 80% electricity-powered. The remaining 20% would come from natural gas, which was planned to be gradually replaced by hydrogen.

The hybrid glass factory known as Furnace of the Future was to be built in Obernkirchen, Lower Saxony in Germany at a site owned by the Ardagh company. Replacing fossil-fuel energy sources with electricity and hydrogen would secure a 50% drop in CO₂ emissions.

Ardagh said that some European glass factories were already electric, but they were small-scale and employed exclusively to produce flint glass with virgin raw materials, therefore using very little or no recycled glass content. The new €50 million venture was designed for manufacturing

300tpd of any glass colour, using high levels of recycled glass.

However, the building of the Furnace of the Future was cancelled after the project was not awarded a grant by the EU Innovation Fund.

"Although the 19 companies volunteered to contribute financially to the project, the EU grant was still representing a significant contribution to the additional CAPEX and OPEX compared to a conventional furnace. Without the EU grant, the project cannot be pursued as initially planned," FEVE said in a statement on its website.

In a follow-up statement, FEVE added that the industry remained committed "to climate-neutral production and is now evaluating how to proceed with their decarbonisation efforts."

This process, however, is not expected to be fast. By 2025, all furnaces in Europe are [still] expected to be still conventional, as the first hybrid furnaces with hydrogen firing will appear only in the late 2020s, the Federal Association of the German Glass Industry (BV Glas) stated in its decarbonisation roadmap.

From 2030 it anticipated a shift to hybrid furnaces with hydrogen firing and the use of fully electric melting furnaces, while by 2045 [there would be] complete replacement of natural gas-fired melting furnaces.

This should entail a 75% drop in the CO₂ emissions of the German float glass industry. On the other hand, BV Glas expects manufacturing costs to rise by 70% in the following years, and the price hike caused by the Ukrainian crisis is not factored into this estimate.

At this stage, it is premature to bet on one or another decarbonisation solution as the supply of carbon neutral sources is not yet secured and solutions can also depend on regional parameters, said Ms Farrelly.

The European glass industry is now up against a significant challenge: to remain competitive, including in the export markets. Several other countries are scaling up their glass production, taking advantage of the access to cheaper fossil fuel and soft environment-protecting policies. It remains to be seen what role decarbonisation will play in global competition in the years to come. ●

About the author:

Vladislav Vorotnikov is an independent international journalist

Publishers' note

Recent articles in *Glass Worldwide* from a selection of leading furnace suppliers that presented melting solutions for consideration (including electric options) include:-

BDF Industries:
September/October 2021 p.82

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Microwave-assisted glass melting

Ralph Behrend, Valerie Grimm, Khaled Al-Hamdan and Hartmut Krause from TU Bergakademie Freiberg and Wolfram Winzer from JSJ Jodeit discuss the results of a study to use microwaves to enhance overall heat transfer into the glass melt batch (originally published in *Glass Worldwide*, preferred AIGMF international journal).

Fossil fuel is the main energy source for many high temperature processes, such as glass melting, ceramics burning and calcining processes. This makes them an important source of CO₂, which is known for its greenhouse potential. Under the Paris Agreement from 2015 and subsequent national legislation, these emissions have to be reduced by 90% until the year 2050. Two main routes are available to achieve that: substitution of fossil fuel with renewable green fuels such as hydrogen or biomass, or a switch to electric heating.

While conventional resistive heaters boast a very high efficiency in terms of energy conversion, the technology is somewhat limited in terms of energy transfer to the good. Heat flow is limited by the maximum temperature for the heating elements and approaches zero for very high temperatures. Inductive and dielectric heating suffers no such limitations and can be viable alternatives to combustion processes.

Glass melting was identified as a process which would potentially benefit from dielectric heating^[1,2]. Main limiting factors for melting capacity in conventional glass melting furnaces are heat transfer into the glass batch and finning time. Microwaves can, in theory, enhance overall heat transfer into the batch. This was tested for two systems: a small scale induction heated platinum glass melting furnace and a small-scale flatbed melter with conventional resistive heating.

This paper details the flatbed melter and shows initial results for energy consumption and melting rate.

Experimental set-up

The microwave setup is based on a 3kW microwave generator from Muegge (MH3000S Magnetron Head with 3kW maximum output at 2.45GHz powered by MX3000D microwave power supply) and a six-port-reflectometer from Muegge with integrated automated three stub tuner (Tristan, 6kW max. power). All equipment was based on WR340 waveguides. In addition, a circulator was placed between magnetron and reflectometer to act as safeguard against reflected microwave power. Between applicator and reflectometer a quartz windows was installed, shielding the microwave equipment from dust and other harmful substances. In addition, purge gas was used to continuously flush the waveguide. Cooling shoes were installed as a safeguard against heat from the glass melt.

A small-scale flatbed furnace was purpose-built for this set-up. The furnace consisted of two chambers, with a separating wall made from refractory above the melt. The first chamber was used for material input and microwave assisted melting, the second was used for fining. Three resistive heating systems were integrated: one below the bottom of the first chamber and one at the bottom of second chamber and

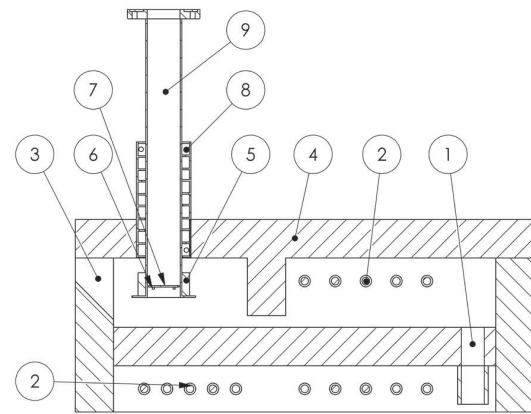


Figure 1: Sketch of a hybrid heated flatbed melter. Insulation and steel plating are not depicted for ease of understanding.

one above the melt in the second chamber. SiC-heaters were used; temperature was controlled by thermocouples placed directly below the heaters. The furnace was built from fused refractory bricks and insulation material and completely encased with steel sheets. Necessary holes for thermocouple wires and electric wires were sealed with aluminium foil, to prevent microwave leakage. The furnace was installed in a metal frame for better stability. Molten glass was removed through a drain made from fused refractory bricks.

The microwave applicator was a modified WR340 waveguide made from high temperature-resistant stainless steel (1.4841) with water-cooling and radiation shielding. The waveguide was placed directly above the melt and batch in the first chamber of the furnace. Distance between waveguide and batch material could be varied. Figure 1 also shows some details of the applicator. Radiation shielding was integrated by placing a silicon nitride plate over two support tubes made from aluminium oxide. The silicon nitride plate was designed to leave a small gap to the waveguide walls, enabling the purge gas from the microwave setup to exit into the process. This reduces dust build-up at the microwave outlet. Temperature was measured for each 'heating zone' via thermocouple.

Experiments were conducted by conventionally heating the furnace to 1,400°C. Glass batch was fed into the furnace until a steady glass melt flow was achieved at a fixed inclination angle. The inclination angle was not changed for the later experiments. Starting from steady state, new batch material was fed into the furnace and the microwave source was turned on. Owing to the set-up, a continuous material feed was not possible while the microwave source was active. New glass batch was charged in variable intervals while shutting down the microwave source and opening the metal casing of the furnace. Interval length and batch amount was adjusted to maintain the glass level in the melting area. Glass batch was positioned directly below

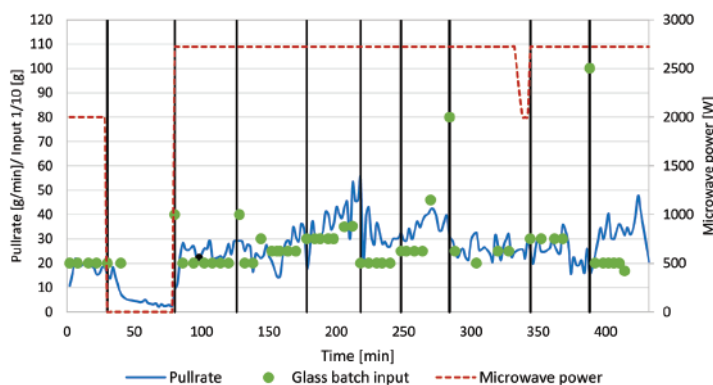


Figure 2: Pull rate, glass batch input and microwave power over time. Details on the glass batch used for each time segment are given in Table 1.

the microwave port, depending on the batch size material was distributed in order to prevent contact between microwave port and batch material. Molten glass was collected at the drain and the cumulative weight was measured every two minutes. Microwave input power and reflected microwave power were continuously measured by the six-port reflectometer. Microwave leakage was measured every five minutes at critical points of the furnace surface and within the vicinity of the furnace.

Experimental results and discussion

Table 1 details the used materials. During the whole process, fresh glass batch was fed into the furnace. Batch size and timing was chosen with regard to a constant melt level within the furnace. In segment 0 a generic container glass batch was used to compare the influence of microwave power settings. Compared to segment 2, using the same glass batch, a slight increase in pull rate is measured from on average 17.9g/min to 23.6g/min. This equals an increase of 32% and matches the increase of microwave power by 36%. A nearly linear relationship at higher power levels can be assumed. Best results were achieved with white glass batch and cullet (segment 4), with an increase by 55% on average compared to segment 2. This can be attributed to the reduced specific energy demand for melting batches with high cullet content.

While melting brown glass batch, arcing appeared more frequently, notably directly after charging. From

visual inspection, the brown glass batch did not melt as evenly as the white glass.

Reflected microwave power was close to zero; a calculated absorption of 99.9% was achieved. This is plausible, since the refractory materials absorb microwave power. Microwave leakage was within safety margins, but increased when most of the batch was molten. This was expected, since molten glass reflects microwaves to a certain extent. Combined specific energy consumption (microwave and resistive heating) was calculated to 1.3kWh/kg. Compared to around 1.1 kWh/kg for optimised industrial furnaces, these results are promising for a small-scale system. Once the system was in thermal equilibrium, resistive heating below the microwave port could be turned off without affecting the system. There were no noticeable interactions between microwaves and the resistive heaters.

Conclusion

This paper highlights a novel approach for microwave-assisted glass melting. A microwave-enhanced melting process in a resistive furnace has been demonstrated. Operator safety and equipment safety was good. The produced glass was of similar quality to conventional glass.

Hybrid heating was adapted to the conventional process. The microwave-resistive hybrid approach worked very well and from first results, a scale-up is feasible. Since a dedicated space for fining was

No.	Glass batch	No.	Glass batch
0	generic container glass batch	5	pelletised pure white glass batch
1	removal of remaining glass	6	pelletised white glass batch with cullet
2	generic container glass batch	7	pure brown glass batch
3	pure white glass batch	8	brown glass batch with cullet
4	white glass batch with cullet	9	pure C-glass batch

Table 1: Glass batches used for the flat bed melter

foreseen, melting rate could be increased without impact on glass quality.

The hybrid approach presents a viable option for the use of microwaves in glass melting and can increase throughput in existing plants with acceptable changes in process layout.

Acknowledgments

Parts of this research were carried out in the framework of the Central SME Innovation Programme (ZIM) under project number ZF 4522202GM8. It was supported by the Federal Ministry for Economic Affairs and Energy (BMWi) through the aIF (German Federation of Industrial Research Associations e.V.) based on a decision taken by the German Bundestag. ●

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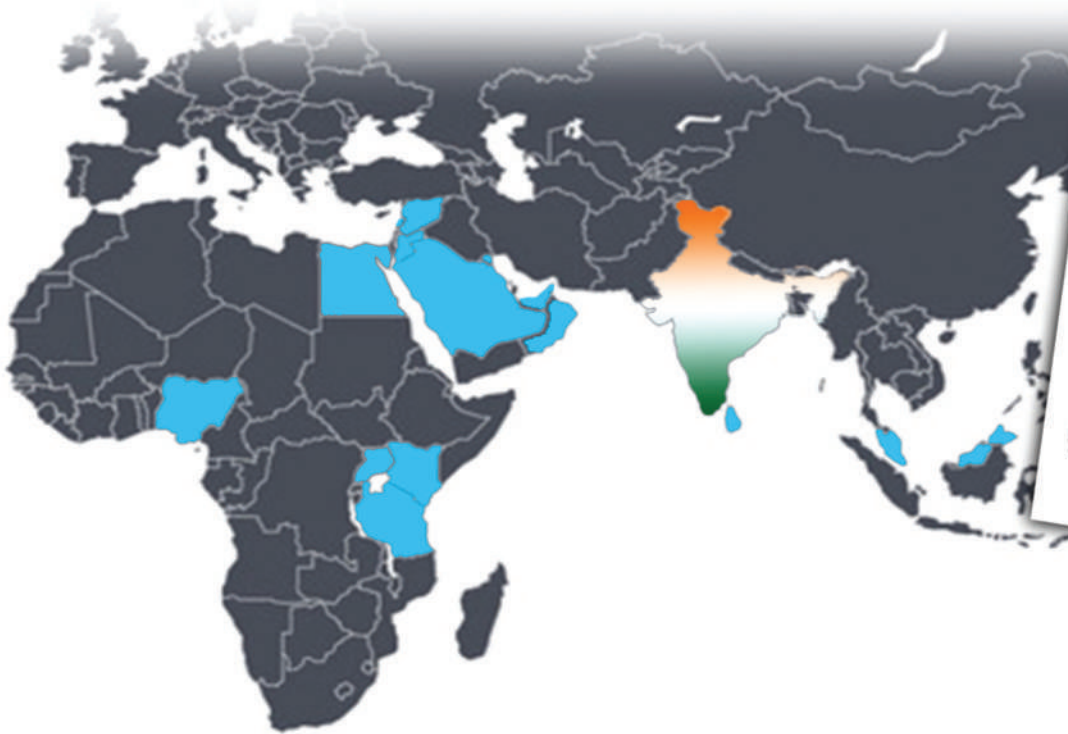
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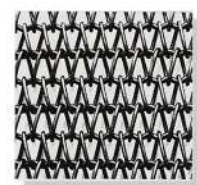
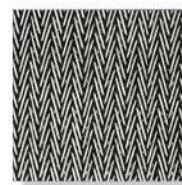
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Solving the challenge of bubble growth

Professor Sven Wiltzsch from the Nuremberg Institute of Technology shared with *Glass Worldwide* (preferred AIMF international journal) a hypothesis on the origin of the bubbles in the float bath area that could assist hydrogen combustion in float glass furnaces.

Vital for producing glass panels that help to generate renewable (solar) energy, the float glass industry is nonetheless challenged by the public requirement to reduce CO₂ to control the climate. As we know, reducing CO₂ during glass melting can be done by all-electric melting or by mixed melting with hydrogen and boosting. However, these technologies are not a solution for the float glass industry. On one hand, all-electric melting does not offer the required pull rate, flexibility, lifetime and quality; and on the other hand, hydrogen firing offers the risk of producing bubbles in the float bath area.

In this contribution to *Glass Worldwide*, I would like to discuss a hypothesis of the possible origin of the bubbles in the float bath area. Based on this hypothesis, float glass experts might adjust their production and thereby help to open the way for the application of hydrogen combustion in the float glass furnace.

Bubble nucleation

The main challenge of the float glass industry to apply hydrogen firing seems to be the origin of bubbles in the float bath area. Thus, we must consider the special scientific area of 'bubble nucleation'. Bubble nucleation means that there must be high gas pressure in the glass melt (just as in sparkling mineral water) to form new, very small seeds; and these seeds must grow to form critical bubbles.

A very high gas pressure in the glass melt at the relative low float bath temperatures is, frankly speaking, doubtful, because with exception of the water, all other gases are well-dissolved in the melt. Thus, there are mechanisms which form new seeds and/or allow new or older bubbles [to] grow. Such new seeds could be expected from mechanical interaction with the melt only (stirrer, cooler, tweek and casting of the melt on the tin bath at the lip stone area, especially at low melting rates) and should be mostly controlled by the operators on site.

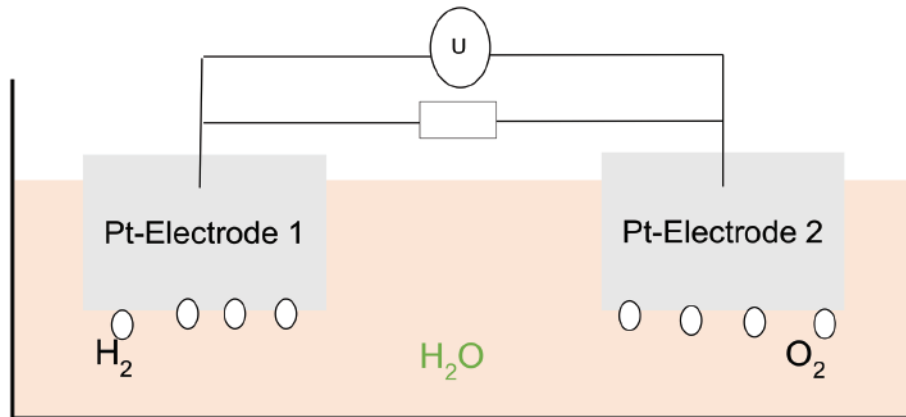


Figure 1: principal sketch of an electrochemical cell for the electrolysis of water in hydrogen and oxygen.

Bubble growth

I think we should focus our thoughts more on the term 'bubble growth' to find a possible solution. Under standard conditions of a gas (CH₄)-air-fired float furnace, we do not have arguable challenges with bubbles in the float bath even under such extreme reducing conditions as we find at the interface of the tin and the glass melt.

Obviously, the dissolved water in the melt coming from the gas (CH₄)-oxygen or hydrogen-air/oxygen is the enemy. However, the pressure of the dissolved water in the melt cannot be the problem itself (<1 bar). All fire fighters know that "water/steam and high temperatures are critical" e.g., due to water decomposition to H₂ and O₂, which would lead to a chance of oxyhydrogen reaction in the fire.

Water could decompose in the melt to hydrogen and oxygen from a theoretical point of view, too. Especially if we have a source of a direct voltage and therefore, we have a comparable electrochemical cell/electrolysis as can be seen in Figure 1.

Every glass technologist knows that a local concentration of hydrogen or oxygen will change the redox and the local gas pressures in a positive or negative way. Thus, the influence of a higher amount of water in the melt due to a different firing technology

(e.g., hydrogen firing) in connection with electrolysis of the dissolved water would be sufficient to explain a high change in the gas pressure of the melt leading to bubbles.

One could argue that we do not have electrodes in the float bath now. However, looking a little more deeply into the float bath, it is obvious that the glass melt and the tin form a short-circuited electrochemical cell (comparable to the situation of a platinum tube and the glass melt in glass conditioning systems of the special glass industry). Furthermore, every glass technologist knows that the glass melt has different temperatures at different voltages in connection to another metal due to the redox and the Seebeck-effect. Therefore, we should consider having an electromotive force (EMF) in the float bath due to the high temperature gradient along the float bath and this EMF might be our real challenge. If this hypothesis might be true, then all float glass experts know that a) the application of a meaningful counter EMF or b) to apply an outside voltage in order to shift the electrical potentials of the tin/glass melt to the desired direction would be sufficient to solve the challenge. ●

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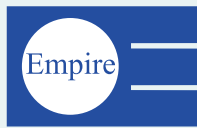
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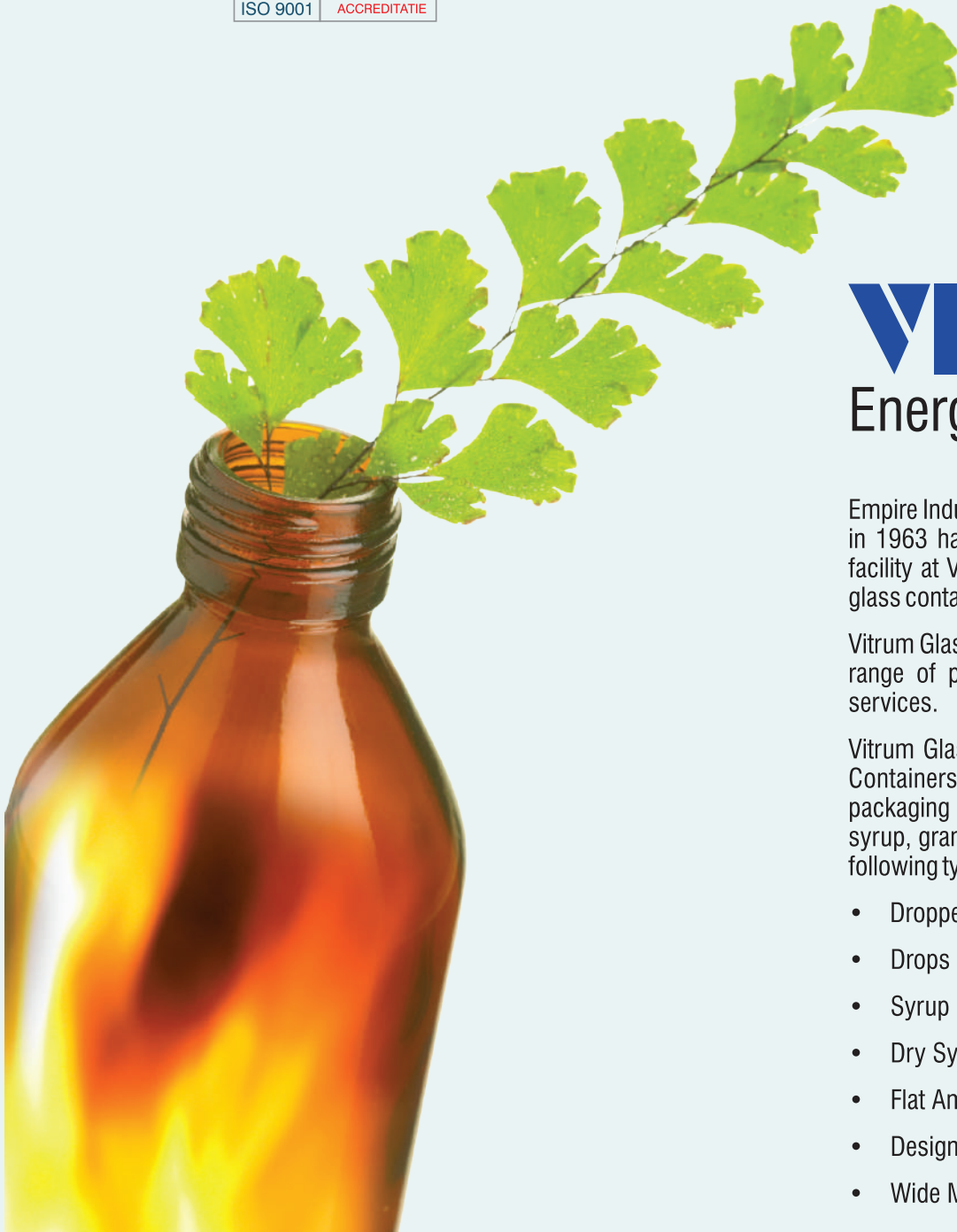
- Admission fee ₹ 5,000/-
- Annual subscription: ₹ 12,000 + GST as applicable
- Applicants for enrollment for a period of five years may pay a consolidated amount of ₹ 55,000 (including admission fee) + GST as applicable

Affiliate Members from countries other than India:

- Admission fee US \$ 200
- Annual subscription: US \$ 500 + GST as applicable
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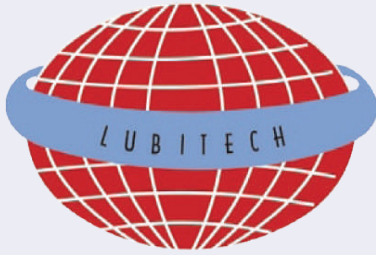
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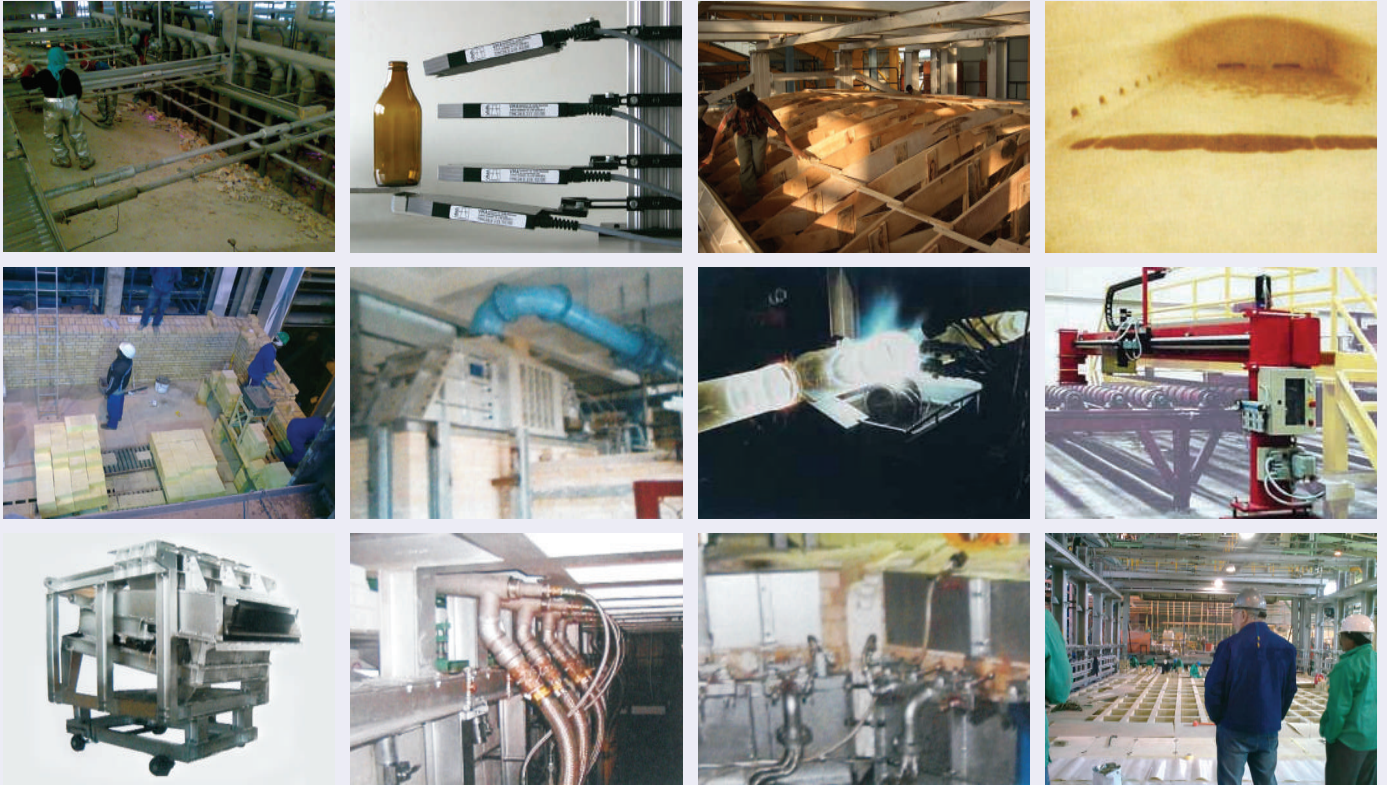
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In recognition of the tremendous contribution to Indian Glass Industry, The All India Glass Manufacturers' Federation (AIGMF) announces C K Somany Award for Innovation & Technology and Balkrishna Gupta Award for Exports.

C K Somany Award for Innovation and Technology will be given to an individual who has made significant contributions to the glass industry in the field or fields of manufacturing, product development, environmental factors, business performance/growth, research and development and/or science/technology.

Balkrishna Gupta Award for Exports will be given to an individual/firm by considering following factors: who have contributed towards identification or growth of new potential markets/volume of exports/reaching no. of countries or any other area showcasing valuable contribution in Glass Exports.

Winners

Year	CK Somany Award for Innovation and Technology	Balkrishna Gupta Award for Exports
2022	Mr. Eric L'Heureux, Schott Poonawalla Pvt. Ltd.	M/s Schott Poonawalla Pvt. Ltd.
2021	Mr. Udit Kapoor, Kapoor Glass India Pvt. Ltd.	M/s Borosil Renewables Ltd.
2020	Dr. Mukul Chandra Paul, CSIR-CGCRI	M/s La Opala RG Ltd.
2019	Mr. B L Kheruka, Gujarat Borosil Ltd. (Now, Borosil Ltd.)	M/s Firozabad Glass Shell Industries
2018	Mr. S K Jhunjhunwala, La Opala RG Ltd.	M/s Piramal Glass Pvt. Ltd. (Now, PGP Glass Pvt. Ltd.)

Referral applications can also be submitted by Regional Associations: U.P. Glass Manufacturers' Syndicate (UPGMS)- Firozabad; South India Glass Manufacturers' Association (SIGMA)- Hyderabad; Western India Glass Manufacturers' Association (WIGMA)-Mumbai; Northern India Glass Manufacturers' Association (NIGMA)-Bahadurgarh, Haryana and Eastern India Glass Manufacturers' Association (EIGMA)- Kolkata, who may give recommendation for giving an award to a likely individual.

AIGMF may consult Banaras Hindu University (BHU-Ceramic Glass Division), CGCRI (Central Glass and Ceramic Research Institute), CCPS (Confederation of Construction Products and Services) and FOSG (Federation of Safety Glass), for identifying suitable candidates for the award.

6th Awards in these categories would be given during the Annual General Meeting in Aug/Sept 2023.

The jury for the awards comprise of:

- Dr. K. Annapurna, Chief Scientist, Glass Division, CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI)
- Mr. Dave Fordham, Publisher, Glass Worldwide, London (UK)
- Mr. Sanjay Somany, Former President AIGMF
- Mr. P K Kheruka, Former President AIGMF and Chairman Borosil Ltd.
- Mr. Vinit Kapur, Secretary AIGMF

Applications are invited at info@aigmf.com from within India from all those connected with the glass industry who may submit a brief write-up/CV in support of their candidature latest by July 25, 2023.

Note: Glass Worldwide, Kanch and Glass News have the exclusive rights of announcing the winners; including winning interviews in print and on websites i.e. www.glassworldwide.co.uk / www.aigmf.com that could be followed by other magazines and websites ■



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