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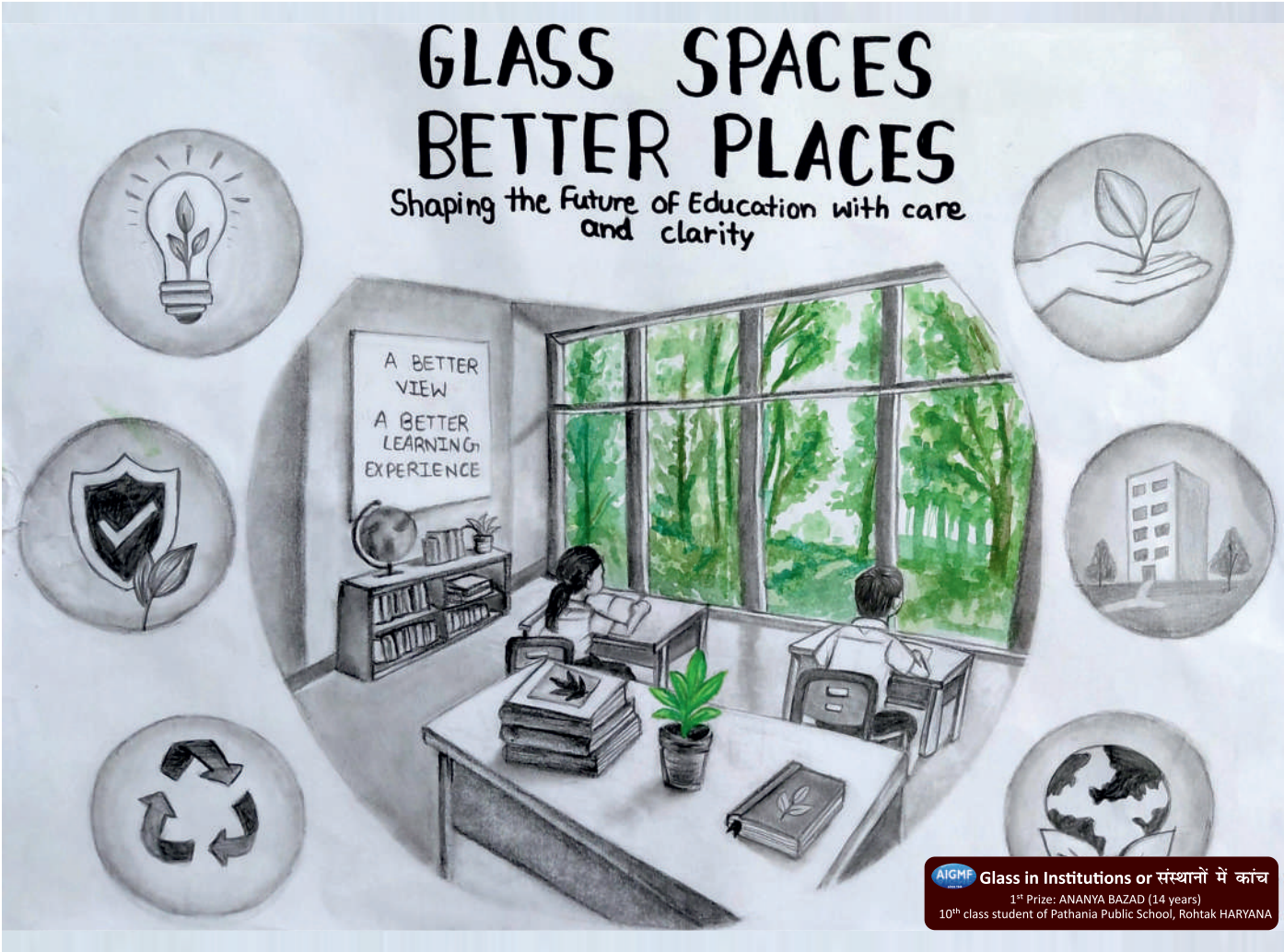
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Special Feature	
- Glass News - Workshop on Strengthening Container Glass - Youth and Glass Industry Stalwarts Honoured at the Annual General Body Meet of the AIGMF - Youth Upbeat on use of 'Glass in Institutions'	- Roundtable on Solar & Pattern Glass - Tomorrow's Glass Manufacturing Starts Today - Glass Conditioning and Colouring Forehearth (CFH) - Position Paper on a Harmonised Definition of Recycled Content in the Flat Glass Sector



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Tubular Glass Range

Material: Type I Borosilicate Glass
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Syringes and Cartridges in Clear Glass
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Vial Range: 1 ml – 30 ml for Parental & Diagnostics
HPLC Scientific Vials, Screw Neck /
Crimp Neck Press Fit, Blowback
Ampoules: OPC, Break / Score Ring, Form:
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Syringes & Cartridges Range

Material: Type 1 Glass
Syringes and Cartridges in Clear Glass
ISO 9001, EN ISO 13485, EN ISO 15378
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A collection of various glass bottles and containers, including perfume, oil, water, and a candle, arranged on a reflective surface. The items include a large clear water bottle, a small perfume bottle with a wooden stopper, a reed diffuser, a glass oil bottle with a metal spout, a bottle of white liquid, a tall clear bottle, a brown beer bottle, a blue pump bottle, a jar of coffee beans, a jar of fruit, and a lit candle.



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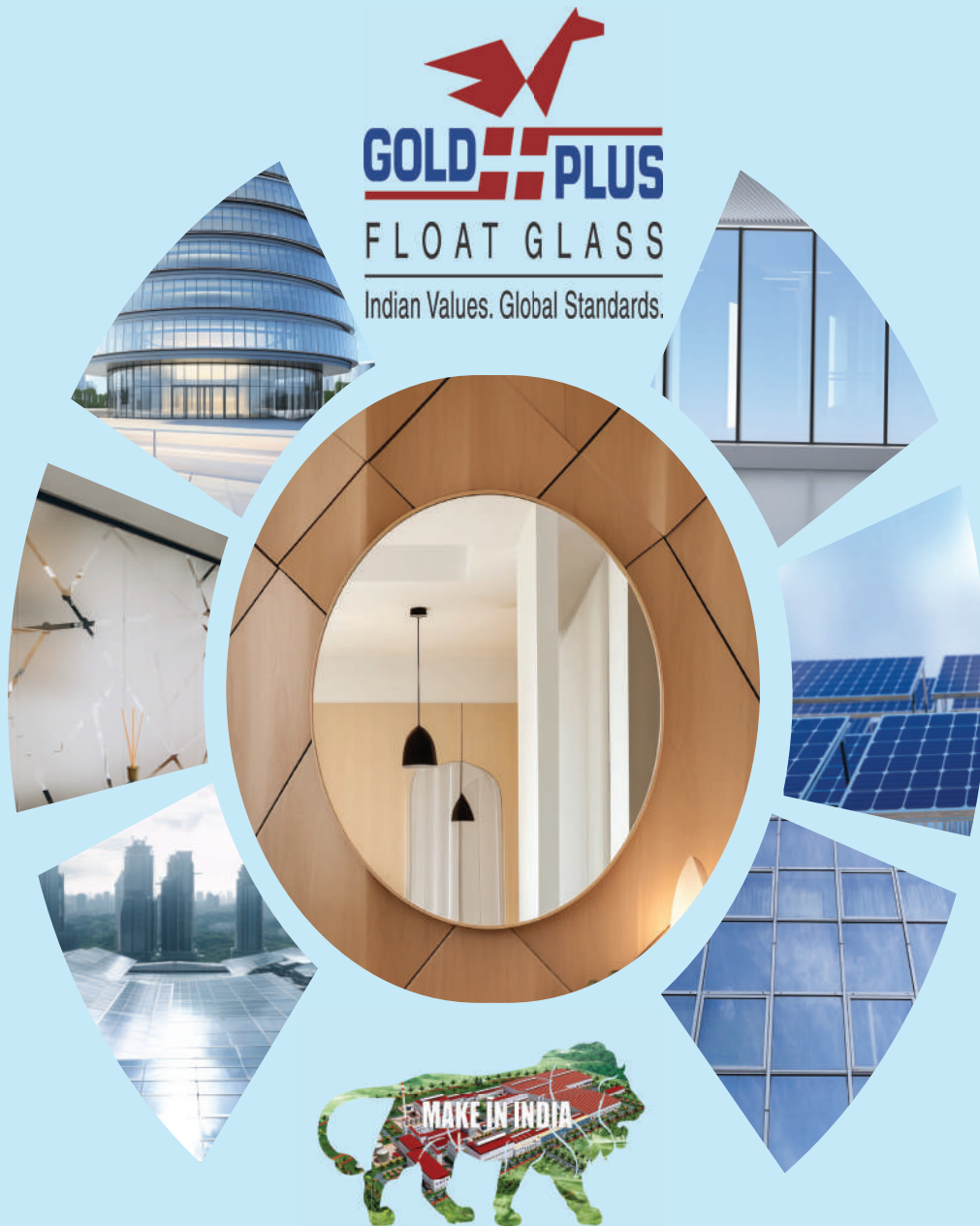
Quarterly Journal of **THE ALL INDIA GLASS MANUFACTURERS' FEDERATION**

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From the President's Desk

Parallel to the AIGMF's AGM and Ex Com meeting, a workshop on strengthening Container Glass was organised in association with the Indian Institute of Technology on Sept 19 at IIT Delhi. The event saw the participation from approx., 80 members, including research scholars, glass manufacturers, Industry bodies, affiliate members. The presentation on Innovations in Container Glass Manufacturing was given by Mr. Vincent Pang, General Manager, Bucher Emhart Glass, Singapore which was followed by Discussions and Q/A led by Mr. Shreevar Kheruka, President Designate AIGMF and Managing Director & CEO of Borosil Ltd.; Dr. K Annapurna, Former Chief Scientist, CSIR-CGCRI and Member Editorial Board of KANCH; Prof. N M Anoop Krishnan, Dept. of Civil Engineering and Yardi School of AI-joint appointment, IIT Delhi; Mr. Tushar Bandyopadhyay, Assistant Director, Indian Institute of Packaging, Delhi and Mr. Sanjay Somany, Former President AIGMF.



The program was organized to honour Youth winners who participated from India-wide schools and colleges in the annual contest on 'Glass in Institutions' or संस्थानों में काँच coinciding with International Youth Day on Aug 12. Online entries were invited from the age group between 7-24 years via essays, poems, drawings, paintings, photography, etc., resulting in over 2000 entries received from educational institutes across India and some foreign countries.

The Jury comprised of Mr. Gurmeet Singh, Chairman, Federation of Safety Glass (FOSG) and Managing Director, Gurind India (P) Ltd.; Mr. G N Gohul Deepak, Executive Director, Glazing Society of India (GSI); Mr. Dave Fordham, Member Editorial Board of KANCH (AIGMF's Glass journal), Former Publisher of Glass Worldwide magazine and Global Engagement Lead for Glass Futures (United Kingdom); and Mr. Vinit Kapur, Secretary of The All India Glass Manufacturers' Federation (AIGMF) who judged top 3 entries:

1st Prize (Rs. 25,000) was given to Ananya Bazad aged 14 years, 10th class student of Pathania Public School, Rohtak, HARYANA

2nd Prize (Rs. 15,000) was given to Deekshitha M S aged 23 years, 6th year Pharma D (Integrated) student of Annamalai University, Annamalai Nagar TAMILNADU

3rd Prize (Rs. 10,000 each) were given to:

- a) Shreya Tahlan aged 17 years, 12th class student of Bal Bharti School, Bahadurgarh HARYANA
- b) Shlok Gupta aged 14 years, 9th class student of PM Shri Kendriya Vidyalaya, Sattenapalli ANDHRA PRADESH

The annual 'CK Somany Award for Excellence' was given to Dr. K Annapurna, former Chief Scientist, Speciality Glass Division, CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata and Member Editorial Board of KANCH.

The 'Balkrishna Gupta Award for Exports' was bestowed to M/s SGD Pharma India Pvt. Ltd.

The 3rd 'Lifetime Achievement Award' was given to Mr. Jagdish Sarin of Ceracon Engineers Pvt. Ltd., New Delhi.

The event also saw the unveiling of the Calendar Glass Bottle 2027, specially designed by AGI glaspac using the recycled glass. The calendar bottles were gifted to all participants. As part of the glass promotion, the calendar glass bottle will be sent to key stakeholders e.g., Members of Parliament; Gol Secretaries; office of Chief Secretaries; LGs/Administrators; Chief Ministers; select Gol contacts; Trade Chambers; Education Secretaries; FOSG; AIGMF Members; Regional Associations; select Universities and Schools; Firozabad; CSIR-CGCRI; BHU; CDGI; General; Overseas Glass Associations and other contacts etc.

A roundtable on Solar and Pattern Glass was organised on July 27 at CGCRI Kolkata in collaboration with the Bureau of Indian Standards (BIS), the Glazing Society of India (GSI), and the Federation of Safety Glass (FOSG). Many glass manufacturers, processors, suppliers, government officials, related associations, international participants, research bodies, and media attended the event at CGCRI to discuss strengthening solar and patterned glass. Mr. Shreevar Kheruka, Sr. Vice President AIGMF and Managing Director & CEO of Borosil Ltd., delivered the keynote address on the overview of Solar Glass Manufacturing. Mr. Mohit Garg from the Chemical Department, Bureau of Indian Standards (BIS) gave an overview of Indian Glass Standards - Textured and Extra Clear Textured Glass as per IS 5437:2024, and Safety Glass Part 3 Solar Applications as per IS 2553 (Part 3):2026. Mr. Varun Gupta, Ex-Com Member AIGMF and Director at Triveni Renewables Ltd., gave a presentation on strengthening solar glass: developing unbreakable solutions. Mr. Purvish Shah, Hon. General Secretary AIGMF and Director in Gopal Glass Works Ltd., made a presentation on Pattern Glass applications: Toughening, Colourful, and Sustainable Partitions. Manufacturers sought CGCRI's help in moving forward in R&D facilities and need for the Testing ■

Rajesh Khosla

President AIGMF and CEO/President AGI Greenpac

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GLASS News

EMERGE RENEWABLES MARKS A HISTORIC MILESTONE WITH FURNACE LIGHT-UP OF NORTH INDIA'S FIRST DEDICATED SOLAR GLASS MANUFACTURING PLANT

Emerge Renewables proudly celebrated successful furnace light-up of its state-of-the-art solar glass manufacturing facility at Keshwana Industrial Area, Kotputli-Behrur in Rajasthan. This landmark event marks, commissioning of North India's first dedicated solar glass manufacturing plant, reinforcing India's vision of self-reliance in renewable energy generation, strengthening domestic solar panel supply chain, reducing dependence on imports and contribute to nation's clean energy ambitions.

Backed by 22 years legacy of Alstone Group and 14 years of Emerge Glass, Emerge Renewables, combines decades of expertise in glass manufacturing with cutting-edge technology to deliver world-class solar glass solutions, that meet global quality standards.

With manufacturing capacity of 300 Tonnes Per Day (TPD), 2.5 GW Per Annum, the facility is designed to produce high-performance solar glass to support India's rapidly growing solar industry; in glass thickness ranging from 1.80 mm to 5.00 mm.

New facility of Emerge Renewables shall help growth of Solar Panel



manufacturers with improvement in their efficiency and profitability, due to reduced lead time, less inventory, fast communication and problem solving resulting in excellent customer service, due to close proximity of Emerge Glass to highest growing areas in Renewable energy, value chain in North India. The project is launched in record time with capacity expected to be sold out due to the deficit supply of solar glass in North India for module manufacturers.

The solar glass project will augment turnover and profitability of Emerge Group, sustainably. New state of the art, 300 MT per day Solar Glass manufacturing facility, is one more step towards creating, first truly diversified glass company in India, melting approx. 1000 MT per day of glass to produce 210 MT per day of Sheet Glass of 1 mm to 10 mm thickness, 210 MT per day of Flint Glass bottles, 240 MT per day of Colour Glass bottles.



At the workshop on strengthening Container Glass held on Sept 19 at Indian Institute of Technology DELHI, Calendar Glass Bottle 2027 was unveiled by the outgoing President Mr. Rajesh Khosla, Former Presidents and Office Bearers.

Emerge Glass, with aggressive growth strategy, have mapped a corporate geographical diversification at Ongal in Andhra Pradesh to address, growing demand in South India and have planned, moving up the value chain, by targeting cosmetic packaging.

Emerge Renewables Furnace Light-Up ceremony symbolizes more than the beginning of production as it represents start of a new chapter in India's renewable manufacturing journey. The occasion was attended by company leadership, industry partners, customers, associates, and distinguished guests who witnessed this significant milestone.

"The successful furnace light-up marks the beginning of a transformative journey for EmERGE Renewables. This project reflects our vision of building world-class manufacturing capabilities that support India's clean energy ambitions. By combining the manufacturing excellence of EmERGE Glass with the innovation-driven legacy of the Alstom Group, we are committed to delivering high-quality solar glass that strengthens India's renewable ecosystem and contributes to a more sustainable future." said Mr. Sumit Gupta, Managing Director - EmERGE Renewables.

SGD PHARMA REAFFIRMS COMMITMENT TO THE DEVELOPMENT OF VEMULA VILLAGE

Reaffirming its commitment to

inclusive and sustainable community development, SGD Pharma's Managing Director Mr. Deepak Sood visited Vemula village to engage with the local community and understand its key development priorities. The visit focused on strengthening basic amenities, supporting education, and creating opportunities for the socio-economic development of local youth.

During the visit, held at the invitation of village Sarpanch (Head) Mr. Vadla Ravi Raja Chari, Mr. Deepak Sood announced the construction of a dining hall at the Zilla Parishad High School, Vemula village, with an investment of ₹20 lakh. The facility will provide improved dining amenities for students and contribute to creating a more supportive school environment.

He also expressed his support for exploring assistance towards the reconstruction of local temples and announced that employment opportunities would be facilitated for eligible local youth, particularly those with ITI and Diploma qualifications, subject to relevant opportunities and requirements within SGD Pharma.

Reaffirming the company's commitment to rural development through its CSR initiatives, Mr. Deepak Sood emphasised that meaningful and sustainable progress is best achieved through the collective efforts of community representatives, local authorities, and residents.

The village leadership and community members expressed their appreciation to SGD Pharma for its continued commitment to the development and well-being of Vemula village.

NEW OFFICE BEARERS AND EXECUTIVE COMMITTEE MEMBERS ELECTED

In the Annual General Meeting of the AIGMF held at IIT Delhi on Sept 19, following Office Bearers were elected:

- *President*
Mr. Shreevar Kheruka, Borosil Ltd., Mumbai
- *Sr. Vice President*
Mr. Mukesh Kumar Bansal, Sri Sitaram Glass Works, Firozabad
- *Vice President*
Mr. Purvish Shah, Gopal Glass Works Ltd., Ahmedabad
- *Hon. General Secretary*
Mr. Pawan Kumar Shukla, Schott Glass India Pvt. Ltd., Bharuch
- *Hon. Treasurer*
Mr. Manish Bansal, G.M. Glass Works No. 2, Firozabad

Following were nominated from Zonal Associations to represent them on the Executive Committee of the AIGMF for the Year 2026-27:

Eastern India Glass Manufacturers' Association (EIGMA)

Mr. Aman Gupta – Iconic Glass, Guwahati

Northern India Glass Manufacturers' Association (NIGMA)

Mr. Shailendra Kumar Misra - HNG & Inds. Ltd., Bahadurgarh

Mr. Sumit Gupta- EmERGE Glass India Pvt. Ltd., Delhi

South India Glass Manufacturers' Association (SIGMA)

Mr. Varun Gupta, Triveni Pattern Glass Pvt. Ltd., Andhra Pradesh





Mr. Deepak Sood, SGD Pharma, Telangana, Andhra Pradesh

U.P. Glass Manufacturers' Syndicate (UPGMS)

Mr. Ritesh Mittal - Meera Glass Industries, Firozabad

Mr. Anurag Mittal - Geeta Glass Works, Firozabad

Mr. Anurag Gupta - Om Glass Works (P) Ltd, Firozabad

Mr. Devansh Gupta - Firozabad Glass Shell Industries, Firozabad

Mr. Parag Gupta - Advance Glass Works, Firozabad

Western India Glass Manufacturers' Association (WIGMA)

Mr. G.K. Sarda - Empire Ind. Ltd., Vitrum Glass, Mumbai

Mr. Ashok Jain - Borosil Ltd., Mumbai

Mr. Sanjay Jain - PGP Glass (P) Ltd., Mumbai

Mr. Gaurav P Rathod, Cello Industries Pvt. Ltd., Mumbai

Mr. Sanjeev Kapoor, Kapoor Glass India Pvt. Ltd., Mumbai

Mr. Pawan Bhardwaj - Reliance Industries Limited (Solar value chain), Jamnagar

*The following were elected as **Co-opted Members** of the Executive Committee for the year 2026-27:*

Mr. Sanjay Somany - Former President AIGMF

Mr. Pradeep Kumar Gupta - Om Glass Works Pvt. Ltd. Firozabad

Mr. PK Kheruka - Borosil Ltd., Mumbai

Mr. Mukul Somany - Former President AIGMF

Mr. SC Bansal - Adarsh Kanch Udyog, Firozabad

Mr. SK Jhunjhunwala - La Opala RG Ltd., Kolkata

Mr. Raj Kumar Mittal, Mittal Group of Glass Industries, Firozabad

Mr. Bharat Somany, Former President AIGMF

Mr. Sanjay Agarwal, Kwaliti Glass Works, Firozabad

Mr. Rajesh Khosla, AGI Greenpac, Hyderabad

FEVE LAUNCHES GLASS PACKAGING CAMPAIGN

FEVE, the European Container Glass Federation, initiated a platform to strengthen consumer preference for glass packaging.

FEVE and the wider European container glass industry have launched a European brand and engagement platform called 'Glass is Love'.

The platform has a new digital ecosystem and one shared identity across Austria, Belgium, Croatia, Czech Republic, France, Germany, Italy, Poland, Portugal, Slovakia, Spain, Switzerland, and the United Kingdom.

The aim of 'Glass is Love' is to champion glass as the choice that protects what consumers love.

FEVE describes the platform as the idea that "choosing glass is choosing care – care for what is inside, for the people who use and enjoy it, for the experience around the product, and for what should last."

Mr. Carlo Pirrone, FEVE Secretary General, said: "Glass is Love is built on the foundation of a simple but strong idea: when something matters to us, how we protect it matters too.

"We want choosing glass to become a natural expression of that care – for the product, for its quality, for the experience it creates and for what lasts.

"And this cannot be achieved by the glass industry alone.

"Glass is Love is an invitation to our customers, partners, employees and the wider value chain to participate, contribute and help build greater value around glass together."

As well as increasing preferences for glass packaging, the platform also aims to create opportunities for brands, customers and organisations across the wider value chain to contribute to the movement through their expertise, innovation, stories, and experiences.

DADACHANJI GROUP LAUNCHES KAISHA PHARMA WITH 45-MN EUROS INITIAL INVESTMENT

The Dadachanji Group, whose promoters built pharmaceutical glass-packaging company Schott Kaisha before exiting the venture in 2021, has launched Kaisha Pharma, marking its return to the segment with an initial investment of €45 million as it targets Indian and global pharmaceutical and biotechnology companies.

Kaisha Pharma will manufacture primary pharmaceutical packaging

products, including ampoules, vials, prefilled syringes and cartridges, along with ready-to-use (RTU) platforms for vials, syringes and cartridges.

The company is also developing specialty containment solutions for biologics, advanced therapeutics and sensitive drug formulations.

The new venture builds on the promoters' 35-year history in pharmaceutical glass packaging. It has been founded by the entrepreneurs who had earlier established one of India's largest tubular glass packaging companies, according to the group.

"Our vision is to create a truly global company that combines entrepreneurial agility, technical excellence, and an unwavering commitment to customer success," said Mr. Kairus Dadachanji, Managing Director of Kaisha Pharma.

The company is setting up a manufacturing complex spread over more than 300,000 square feet, equipped with integrated production lines, camera-based inspection systems, and analytical and testing laboratories.

The Dadachanji Group said *Kaisha would also draw on its other businesses*

to offer services spanning primary packaging, automation, machinery and fill-finish support systems.

Global markets will be a key focus for the new venture. Kaisha Pharma is setting up an international business development office in Europe, which will serve as a hub for customer engagement, technical collaboration and market development in the region.

The group said the €45-million deployment forms part of a larger multi-million-euro investment commitment towards expanding infrastructure, manufacturing capacity and operational capabilities.

ŞİŞECAM INVESTS IN INDIAN MAGNETRON SPUTTERING COATER

Şişecam will introduce a magnetron sputtering coater as part of its new coater facility in Halol, Gujarat, India.

The new facility will enable Şişecam to produce glass solutions tailored to the Indian market.

The flat glass market in India has witnessed expansion driven by the booming construction, automotive

and white goods sectors.

Energy-efficient glass solutions have gained prominence, aligning with India's green building norms and energy efficiencies targets.

Technologies such as magnetron sputtering coating have enhanced product performance, making India a key player in the global glass manufacturing landscape.

Key product features at the facility include:

- Energy-efficient and green rated glass – Designed to reduce energy consumption and adhere to international green building standards across India, Europe, and beyond.
- Enhanced performance and durability – Engineered to withstand diverse climatic conditions while durable coatings support wider applications with ease of handling and processibility.
- Aesthetic and functional wellness – A fusion of design and functionality, ensuring superior aesthetics while promoting well-being in modern living spaces.
- Diverse colour options and expansive product basket – Providing architects and designers with a variety of choices for residential and commercial projects
- R&D backing – Leveraging Şişecam's 25 research laboratories worldwide, the products are developed to cater to the unique needs of Indian consumers.

Şişecam has invested in three new coater lines in Bulgaria, Italy, and Türkiye. India will be the company's fourth investment.



Welcomed Mr. S C Bansal (3rd from right), Former President AIGMF (2012-14) at the Glass promotion meeting on July 15 at the AIGMF Secretariat



GLASSMAKERS URGED TO ACT NOW TO PREPARE FOR THE FURNACE OF THE FUTURE

Manufacturers from across the flat and container glass sectors came together at Glass Futures' Global Centre of Excellence for a practical event focused on one question: what steps can glassmakers take today to improve furnace performance and prepare for the future?

Hosted by Air Products, a global leader in industrial gases and the world's largest hydrogen supplier, and Glass Futures, the event explored how manufacturers can maximise efficiency, reduce reliance on fossil fuels and strengthen resilience, while beginning to plan for longer-term technologies and regulatory change. Through demonstrations, discussions and hands-on sessions, attendees were able to see technologies in action, challenge ideas and share experiences with industry peers – and most importantly, consider what new technologies and fuels would work for their specific furnace needs.

The key message of the event was that manufacturers should act now and not wait for a single future solution. While technologies that work with alternative fuels, such as hydrogen, are expected to play an important role in the years ahead, there are opportunities available

today to improve furnace efficiency, optimise performance and better prepare operations for the future.

Combining Air Products' expertise in industrial gases and combustion technologies and decarbonisation solutions with Glass Futures' unique capability to test and scale innovative solutions in a real-world environment, the event was designed to help manufacturers understand which actions can deliver value now, and which technologies may shape the next generation of glassmaking.

Mr. Petr Tlamicha, Combustion Segment Manager Europe and Africa at Air Products said: *"Manufacturers want to cut carbon emissions and make their operations more efficient, but they also need confidence that changes will work in practice without compromising furnace performance, product quality or value for money. Every operation is different, which is why access to the right expertise and practical experience is so important. Events like this help manufacturers better understand their options, identify where the greatest opportunities lie and move forward."*

Mr. Aston Fuller, General Manager at Glass Futures reiterated: *"Innovation only matters if it works in practice. That's why Glass Futures exists to de-risk and support the adoption of new technologies, providing manufacturers with the opportunity to test ideas, see*

solutions in action and learn alongside industry experts. Together, they can make better-informed decisions, and we can support organisations to move forward with greater confidence in their furnace optimisation plans."

To find out more about Air Products, please visit <https://www.airproducts.co.uk/> and for Glass Futures please visit <https://www.glass-futures.org/>

SAINT-GOBAIN AND AGC TO BUILD WORLD'S LARGEST ELECTRIC FURNACE, CUTTING EMISSIONS 50%

Saint-Gobain and AGC Group are partnering to deploy what they describe as the world's first large-scale hybrid electric furnace for flat glass production, at Saint-Gobain's plant in Avilés, Spain. Construction is expected to begin in January 2027, with production resuming in the second half of 2027. The furnace is projected to avoid approximately 80,000 tonnes of CO₂ equivalent emissions annually, roughly a 50 percent reduction compared with a conventional gas furnace, while cutting natural gas consumption by about 265 gigawatt-hours per year, an 80 percent reduction relative to a standard gas furnace.

Flat glass manufacturing requires melting raw materials at extremely high temperatures, a process that has

historically relied almost entirely on burning natural gas, since achieving and sustaining the intense, consistent heat glass melting requires has been technically difficult to replicate through electric heating at the scale and reliability commercial glass production demands. That reliance on gas combustion has made glass manufacturing one of the more stubbornly hard-to-decarbonise industrial processes, comparable to steel and cement production, where the process heat requirement itself, not just the electricity used elsewhere in the facility, is the dominant source of emissions.

Achieving 75 percent electrification of the melting process represents a genuine technical breakthrough against that backdrop, since it means the majority of the intense heat required for glass melting will come from electricity rather than gas combustion, a significant departure from an industry where electrification has typically been limited to smaller, auxiliary applications rather than the core melting process itself.

The release cites two distinct percentage figures that describe different things: an approximately 50 percent reduction in CO₂ equivalent emissions, and an 80 percent reduction in natural gas consumption. That gap

between the two figures is informative rather than contradictory: it indicates the furnace will still rely on some gas combustion for the remaining 25 percent of the melting process not covered by electrification, and that even fully electrified processes carry some residual emissions depending on the carbon intensity of the electricity supply and other process-related emissions sources within glass manufacturing that electrification of the furnace alone does not eliminate.

That distinction is why Saint-Gobain specifically notes the furnace will be powered by low-carbon electricity secured through renewable energy supply agreements the company has separately contracted in Spain, since the emissions benefit of electrifying a furnace depends directly on how clean the electricity actually is; electrifying a furnace powered by a carbon-intensive grid would deliver a smaller emissions benefit than the same electrification paired with genuinely low-carbon power.

GLASS AND GLAZING SECTORS UNITE TO SUPPORT UK GOVERNMENT'S REINDUSTRIALISATION AMBITIONS

The UK glass and glazing sectors

have committed to working in partnership with Government to help turn its ambitions for reindustrialising Britain into investment, skilled jobs, stronger supply chains and sustainable economic growth.

At a Parliamentary Reception hosted by Lord Foster of Bath at the House of Lords, the UK Glass & Glazing Collective brought together industry leaders, parliamentarians and policymakers to explore the contribution the sectors can make to the UK's future growth and industrial renewal.

Reflecting the importance of the glass and glazing sectors to the Government's reindustrialisation agenda, Mr. Blair McDougall MP, Minister for Reindustrialisation, said in a statement:

"The UK has shaped the world's glass industry for centuries, from generations of skilled workers to breakthroughs like Pilkington's float glass process which changed how glass is made everywhere.

"I don't underestimate the challenges that you face; the rising costs of doing business, new policy costs including extended producer responsibility and global uncertainty. My officials are working closely with you and with colleagues across government to understand these pressures and, more



L-R: Mr. Brian Scott-Picton (Glass Sellers), Mr. Tim Simmons (GGF), Mr. Richard Katz (Glass Futures), Lord Foster of Bath, Mr. Chris Beedel (GGF), Mr. Matthew Demmon (Glass Sellers), Mr. Stuart Hakes (Society of Glass Technology), Mr. Nick Kirk (British Glass), Mr. Dave Fordham (Glass Futures) and Mr. Justin Kelly (Glass Futures).

importantly, to consider what can be done.

"I want all our foundation industries to survive, so it will be my pleasure to work with you openly and collaboratively on the priorities that matter to you."

The Minister also highlighted the Government's recent action on industrial energy costs. Eligible glass businesses already benefit from the British Industry Supercharger, with network charging compensation increasing from 60% to 90% from April, helping to reduce electricity bills for major glass producers and support their international competitiveness.

From next April, the British Industrial Competitiveness Scheme is expected to cut electricity costs for eligible firms by around £35 to £45 per megawatt hour used, providing further support for the sector's growth and resilience.

Mr. Justin Kelly, CEO of Glass Futures, emphasised the importance of a shared approach to reindustrialisation:

"Reindustrialisation will not be delivered by Government alone, nor by industry acting alone. It will require a shared mission, sustained over many years."

"Our offer is to invest, innovate, decarbonise, train the next generation and strengthen British supply chains – helping ensure more of what Britain needs is invented, developed and made here."

Mr. Chris Beedel, representing the Glass & Glazing Federation, focused on the role the sectors can play in improving the performance of Britain's homes and buildings:

"The Glass & Glazing Federation and the UK Glass & Glazing Collective stand ready to work with Government, Parliament and partners across industry to turn that opportunity into reality."

"Together, we can help families live in warmer, safer and more affordable homes, build a truly circular economy

and support British manufacturing."

Mr. Dean Butler, President of British Glass, highlighted the economic contribution of UK glass manufacturing, which operates 19 sites, directly employs around 6,000 highly skilled people and generates approximately £2.3 billion in turnover and £750 million in GVA:

"We welcome the Prime Minister's commitment to reindustrialisation and look forward to working with Government on this ambition. The UK must be the best place to invest in glass manufacturing."

The UK Glass & Glazing Collective brings together the British Glass Manufacturers' Confederation, Glass & Glazing Federation, Glass Futures, Society of Glass Technology and Worshipful Company of Glass Sellers of London. The five member organisations jointly organised the Parliamentary Reception, representing the breadth of the UK's glass and glazing sectors.

The Collective is seeking to work with Government on five practical priorities: enabling a competitive

buildings and retrofit; and reforming recycling legislation to maximise glass recovery and strengthen the circular economy.

The Collective will continue to engage with Government on these priorities as part of its commitment to supporting the UK's wider reindustrialisation objectives.

NATIONAL SKILL DEVELOPMENT WORKSHOP ON ENERGY EFFICIENCY AND QUALITY ASPECTS OF ARCHITECTURAL GLASS, PROFILES AND GLAZING SYSTEMS

The Bureau of Indian Standards (BIS), CSIR–Central Glass and Ceramic Research Institute (CSIR–CGCRI), and the Glazing Society of India (GSI), in association with the Federation of Safety Glass (FOSG), successfully organized the Two-Day National Skill Development Workshop on Energy Efficiency and Quality Aspects of Architectural Glass, Profiles, Sealants and Glazing Systems on July 23–24, 2026 at the CSIR–CGCRI, Kolkata.



transition to net zero; levelling the playing field on energy and investment; reforming Packaging Extended Producer Responsibility (pEPR) to support glass packaging; driving demand for UK-manufactured glazing and insulation through high-efficiency

Prof. (Dr.) Bikramjit Basu, Director, CSIR–CGCRI, welcomed the participants and inaugurated the workshop with his Welcome and Inaugural address. He emphasized the importance of innovation, standardization, and skill development

in advancing India's architectural glass and glazing industry and said that the workshop would provide complete insights and knowledge on the glass and glazing systems.

This was followed by an Overview of the Workshop by Mr. Antony John, Director, Schueco International R&D. GSI on behalf of the entire Architectural Glass and Glazing Industry honoured the Scientific Excellence of the nation, "Dr. K Annapurna, Chief Scientist, CSIR – CGCRI" for her contributions and support given to the Glass and Glazing Industry. Mr. G N Gohul Deepak, Executive Director, Glazing Society of India, delivered the Vote of Thanks.

A special plenary session by Mr. Mohit Garg, Member Secretary, CHD 10, Bureau of Indian Standards, highlighted the ongoing initiatives in the national standardization for architectural glass and presented on the list of standards developed by BIS for Architectural Glass in India.

Over the two days, participants attended a series of technical sessions delivered by eminent experts from CSIR–CGCRI, GSI and leading glass and glazing industry organizations. The sessions covered Heat Treated Glass by Dr. K Annapurna, Chief Scientist, CSIR–CGCRI; Energy-Efficient Coated Glass by Dr. Kashik Biswas and Dr. Anal Tafader Principal Scientist, CSIR–CGCRI; Specialty Glass by Mr. U Gopinath Manager- Sustainability Saint Gobain Pvt. Ltd.; Laminated Glass by Ms. Sheetal Khanna General Manager - Gold Plus Glass Industries; Insulated Glazing Units (IGUs) by Mr. Shailesh Ranjan Head – Business Asahi India Glass Ltd.; Structural Aspects of Architectural Glazing Systems by Mr. Antony John Technical Director, Schueco International R&D; Aluminium Profiles by Mr. Satish Kumar Chief Executive Officer,

Procural India; uPVC Profiles by Mr. Ayush Didwania Channel Partner – East Deceuninck India; Sealants for Glass and Glazing Systems by Mr. Ravishankar S Principal Scientist- Dow India; and Testing of Glazing Systems Mr. Abdul Samad General Manager- Winwall Façade Technology India. The presentations focused on the latest technologies, manufacturing processes, quality requirements, performance evaluation, and the application of relevant Indian Standards.

A major highlight of the workshop was the extensive Hands-on Training and Demonstration Sessions conducted at the Architectural Glass Research and Testing (AGRT) Facility of CSIR–CGCRI. Participants gained practical exposure to Glass Melting Processes, Float Glass Testing, Energy Performance Evaluation of Coated Glass, Processed Glass Testing, Sealant Application on Double Glazed Units (DGUs), Aluminium and uPVC Profile Systems, and Application and Quality Testing of Sealants. Experts from CSIR–CGCRI, Dow India, Procural India, Deceuninck India, and the Glazing Society of India demonstrated advanced testing equipment, laboratory procedures, and industry best practices, enabling

participants to connect theoretical concepts with practical applications.

The workshop also included a visit to the Refractory Laboratory at CSIR–CGCRI, providing participants with an opportunity to explore advanced research facilities and gain insights into specialized testing infrastructure and ongoing research activities.

The workshop was attended by 45+ professionals from the glass manufacturing, processing, façade and fenestration industries, quality assurance and quality control teams, builders, developers, consultants, researchers, and academia. The feedback from the participants was excellent.

HALDYN GLASS AND HORN STRENGTHEN THEIR PARTNERSHIP, ENGINEERING GROWTH AND DELIVERING EXCELLENCE

Building on the success of its existing two furnaces F3 and HHFG-I, Haldyn Glass Limited announced the expansion of another furnace F4 from 160 TPD to 215 TPD, further strengthening its long-standing partnership with HORN, a global leader in glass melting technology.

Backed by an investment of ₹170 crore



and scheduled for commissioning by June 2027, the expansion will increase production capacity by more than 34%, while enhancing operational efficiency, process reliability, lightweighting through 4 NNPB lines and manufacturing flexibility. In addition, the upgraded furnace is designed to support Haldyn's carbon reduction goals through improved energy efficiency and optimized melting performance, helping lower the plant's overall carbon footprint.

Designed to meet evolving market demands, the upgraded furnace will produce a diverse range of glass products, including amber, green, premium flint, and commercial flint glass, reinforcing Haldyn's commitment to innovation, excellence, and more sustainable glass manufacturing.

"This expansion is more than an increase in capacity—it is an investment in innovation, efficiency, and a lower-carbon future for glass manufacturing."

AIMF AT THE WORLD SODA ASH CONFERENCE 2026

AIMF supported the event as a Media Partner.

Mr. Purvish Shah, Vice President of AIMF and Director in both Gopal Glass Works Ltd. and Gobind Glass and Industries Ltd. (which manufactures pattern and solar glass), gave a presentation on "Solar Glass Prospects in India and Its Impact on World Markets".

The World Soda Ash 2026 Conference, hosted by Chemical Market Analytics by OPIS, a Dow Jones company, recently concluded in Valencia, Spain, bringing together more than 250 delegates from across the global soda ash industry. Held

from September 29 to October 1, the conference centered on this year's theme, "Shifting Sands vs. Structural Reset: Finding the New Baseline," providing a forum for industry leaders to assess the forces reshaping the market and discuss strategies for navigating an increasingly dynamic operating environment.

Over the three-day program, discussions focused on the structural changes transforming the global soda ash market. Key topics included evolving demand dynamics, particularly the growing contribution of solar glass and energy storage applications; shifting global trade flows; and the implications of changing public policies and regulatory frameworks. The conference also emphasized the rapid expansion of global production capacity, focusing particularly on China's growing

influence across supply, investment, and downstream production, as well as the potential market impact of new investments emerging across Africa and the Middle East.

The conference featured a strong lineup of industry experts who offered perspectives on these developments and their implications for the soda ash value chain. Speakers included Mr. Yan Guohui, General Manager, Process & Digitalization Center, Shandong Haihua Group Co., Ltd.; Mr. Sameer Rupani, Global Chemicals Commercial Vice President, Şişecam; Mr. Rajesh Kamat, Chief Strategy and Projects Officer, Tata Chemicals; Mr. Purvish Shah, Director & Executive Director, Gopal Glass Works and Gobind Glass & Industries; and Mr. Mohamad Agung, Director of Development, PT Pupuk Kalimantan Timur.





Ananya Singh of Neerja Modi School Udaipur (India) proudly holds a calendar glass bottle 2026 as her consolation prize for participating in the annual youth contest- 'Glass in Institutions'.



Kapoor Glass India Pvt. Ltd., at CPHI Milan 2026, a global meeting point for the pharmaceutical industry that brings together the companies, technologies, innovators and decision-makers shaping the future of pharma. The event took place from October 6–8, 2026 at Fiera Milano, Italy, attracting over 62,000 pharmaceutical professionals and 2,400+ exhibiting companies.

सुप्रीम कोर्ट से ग्लास उद्योगों को बड़ी राहत।

सुप्रीम कोर्ट ने फिरोज़ाबाद के ग्लास उद्योगों के पुराने विस्तार से जुड़े वर्ष 2020 से लंबित आवेदनों का निस्तारण कर दिया है। न्यायालय ने उद्योगों के खिलाफ कोई प्रतिकूल आदेश पारित नहीं किया और न ही किसी प्रकार की कार्रवाई के निर्देश दिए हैं। इससे करीब छह बरों से चली आ रही कानूनी अनिश्चिता समाप्त हो गई है, जिसे फिरोज़ाबाद के ग्लास उद्योगों के लिए महत्वपूर्ण राहत माना जा रहा है।

- वर्ष 2020 से लंबित आवेदनों का निस्तारण
- उद्योगों के खिलाफ कोई प्रतिकूल आदेश नहीं
- भविष्य में विशेषज्ञ आधारित व्यवस्था के तहत लिए जाएंगे निर्णय
- उद्योग जगत में राहत की भावना

न्यायालय ने स्पष्ट किया है कि भविष्य में उद्योगों की स्थापना, विस्तार एवं स्थानांतरण से जुड़े मामलों पर पूर्व निर्धारित विशेषज्ञ आधारित व्यवस्था के तहत निर्णय लिया जाएगा।

जानकारों के अनुसार, इस फैसले के बाद उद्योगों में राहत की भावना है और इसे फिरोज़ाबाद के लाखों कारीगरों व श्रमिकों के लिए सकारात्मक संकेत माना जा रहा है। मामले में उद्योगों की ओर से वरिष्ठ अधिवक्ता अक्षय देव, अधिवक्ता विवेक

पाठक और अधिवक्ता श्वेता शर्मा ने पक्ष रखा। उनकी प्रभावी पैरवी के बाद यह महत्वपूर्ण राहत मिली है।

स्वच्छ वायु सर्वेक्षण में फिरोज़ाबाद को देश में दूसरा स्थान।

कांच नगरी फिरोज़ाबाद देश के सबसे प्रदूषित शहरों में शामिल रहे शहर ने वायु गुणवत्ता में सुधार की लंबी छलांग लगाई है। तीन से 10 लाख की आबादी वाले देश के 130 शहरों में दूसरा स्थान मिला है। केंद्र सरकार द्वारा नेशनल क्लीन एयर प्रोग्राम (एन-कैप) के तहत सूची जारी की गई है। इस उपलब्धि के लिए भारत सरकार के पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय द्वारा नई दिल्ली के गंगा आडिटोरियम में मेयर और नगर आयुक्त को सम्मानित किया गया।

केंद्र सरकार द्वारा शहरों को प्रदूषण मुक्त बनाने की दिशा में पहल की जा रही है। एन-कैप योजना से नगर निकायों को वायु प्रदूषण घटाने के लिए करोड़ों का बजट दिया जा रहा है। नगर निगम प्रशासन द्वारा अधिक प्रदूषण वाले क्षेत्रों (हाट-पाट) में वायु की गुणवत्ता में सुधार के लिए मुख्य मार्गों को विकसित करने के साथ पौधे रोपित कराए गए। सुरक्षा के लिए ट्री गार्ड भी लगाए। दो दर्जन से अधिक स्थानों पर मियावाकी पद्धति से घने जंगल उगाने का कार्य किया गया है। साथ ही हाईवे सहित मुख्य मार्गों पर मशीनों से सफाई कराई जा रही है। गर्मी के दिनों में दो वाटर स्प्रिंकलर मशीनों से पानी का छिड़काव कराया जाता है, जिससे धूल न उड़े। इसका असर दिखने लगा है।

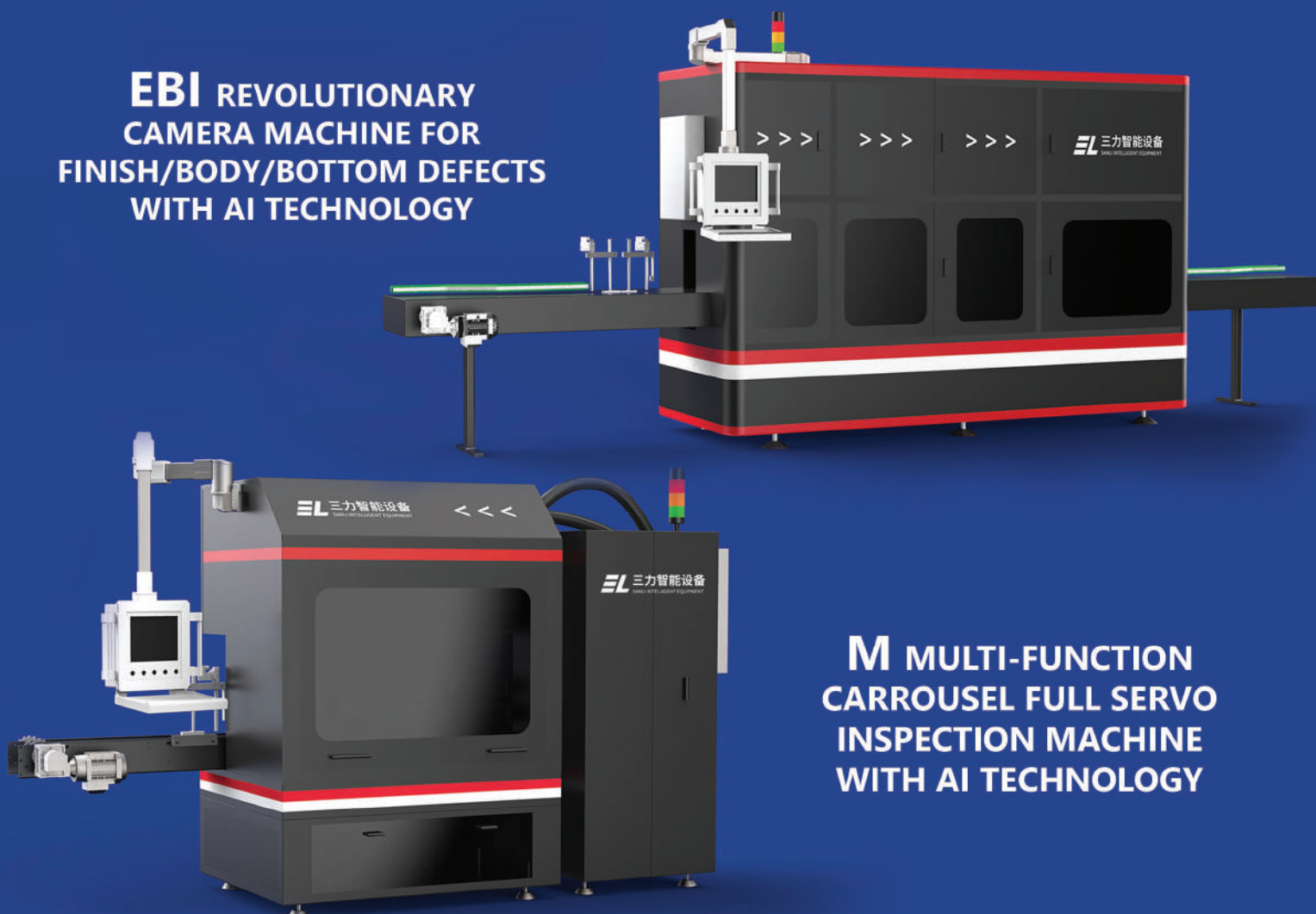
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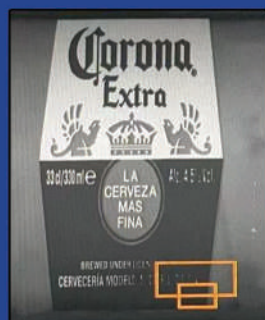
सुप्रीम कोर्ट में सुनवाई के बाद राहत मिलने पर वरिष्ठ अधिवक्ता अक्षय देव, अधिवक्ता विवेक पाठक और अधिवक्ता श्वेता शर्मा अन्य सदस्यों के साथ।

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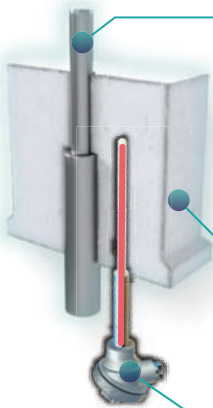
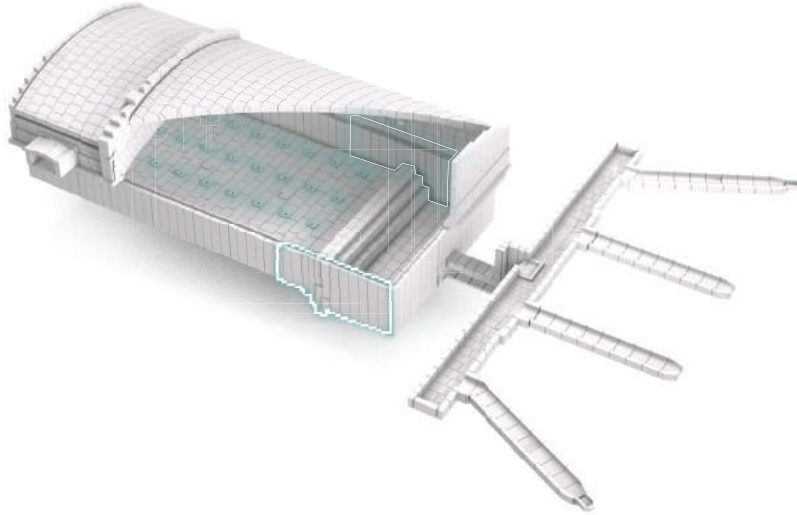
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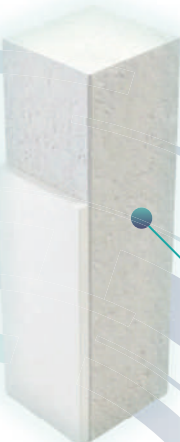
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Workshop on Strengthening Container Glass

(Sept 19, IIT DELHI)

Parallel to the AIGMF's AGM and Ex Com meeting, a workshop on strengthening Container Glass was organised in association with the Indian Institute of Technology on Sept 19 at IIT Delhi.

The event witnessed approx., 80 participants, including research scholars, glass manufacturers, industry bodies, and affiliate members.

After the display of the Touring Exhibition- 'Glass or Class' the Opening Remarks on IT and AI support was delivered by Prof. Jayant Jain, Dean-Corporate Relations, IIT Delhi.

This was followed by a talk on 'How to make India a Glass Hub' by Mr. Rajesh Khosla, AIGMF President and CEO of AGI Greenpac.

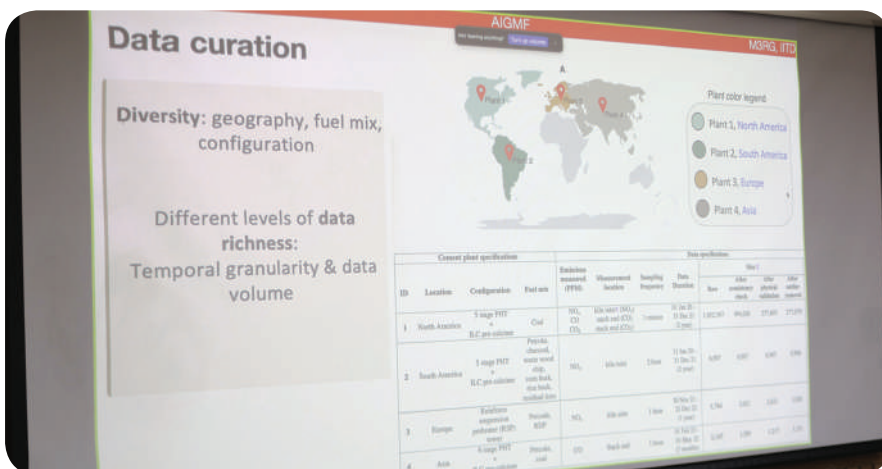
Prof. N M Anoop Krishnan, Department of Civil Engineering and Yardi School of AI (joint appointment), IIT Delhi gave a very interesting presentation on AI in Glass Strengthening.





For the promotion of sustainable packaging material glass, a PPT was given on Container Glass for Health and Environment by Mr. Tushar Bandyopadhyay Assistant Director, Indian Institute of Packaging, Delhi.

The main presentation on 'Innova-



tions in Container Glass Manufacturing' was given by Mr. Vincent Pang, General Manager, Bucher Emhart Glass, Singapore. This was followed by Discussions and Q&A led by Mr. Shreevar Kheruka (President Designate AIGMF and Managing Director





& CEO of Borosil Ltd.); Dr. K Annapurna (Former Chief Scientist, CSIR-CGCRI and Member Editorial Board of KANCH); Prof. N M Anoop Krishnan (Dept. of Civil Engineering and Yardi School of AI-joint appointment, IIT Delhi); Mr. Tushar Bandyopadhyay



(Assistant Director, Indian Institute of Packaging, Delhi); and Mr. Sanjay Soman (Former President AIGMF) ■

Select photos and presentations are available under past events at www.aimf.com





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Youth and Glass Industry Stalwarts Honoured at the Annual General Body Meet of the AIGMF

(Sept 19, IIT DELHI)

At the Annual General Meeting of The All India Glass Manufacturers' Federation (AIGMF), Youth and Industry Members were felicitated at the Indian Institute of Technology (IIT Delhi), on Sept 19, 2026.

A special session on container glass strengthening was also organised where Youth winners were honoured who participated from India-wide schools and colleges in the annual contest on 'Glass in Institutions' or संस्थानों में कांच coinciding with the International Youth Day on Aug 12. Online entries were invited from the age group between 7-24 years by means of essays, poems, drawings, paintings, photography, etc., where over 2000 entries were received from educational institutes from India and some foreign countries.

The Jury comprised of Mr. Gurmeet Singh, Chairman, Federation of Safety Glass (FOSG) and Managing Director, Gurind India (P) Ltd.; Mr. G N Gohul Deepak, Executive Director, Glazing Society of India (GSI); Mr. Dave Fordham, Member Editorial Board of KANCH (AIGMF's Glass journal), Former Publisher of Glass Worldwide magazine and Global Engagement Lead for Glass Futures (United Kingdom); and Mr. Vinit Kapur, Secretary of The All India Glass Manufacturers' Federation (AIGMF) who judged top 3 entries:

1st Prize (Rs. 25,000) was given to Ananya Bazad aged 14 years, 10th class student of Pathania Public



School, Rohtak HARYANA
2nd Prize (Rs. 15,000) was given to Deekshitha M S aged 23 years, 6th year Pharma D (Integrated) student of Annamalai University, Annamalai Nagar TAMIL NADU

3rd Prize (Rs. 10,000 each) were given to:

- a) Shreya Tahlan aged 17 years, 12th class student of Bal Bharti School, Bahadurgarh HARYANA



b) Shlok Gupta aged 14 years,
9th class student of PM
Shri Kendriya Vidyalaya,
Sattenapalli ANDHRA
PRADESH

The annual 'CK Somany Award for Excellence' was given to Dr. K Annapurna, former Chief Scientist, Speciality Glass Division, CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata and Member Editorial Board of KANCH.



The 'Balkrishna Gupta Award for Exports' was bestowed to M/s SGD Pharma India Pvt. Ltd.

The 3rd 'Lifetime Achievement Award' was given to Mr. Jagdish Sarin of Ceracon Engineers Pvt. Ltd., New Delhi. The previous winners are listed at www.aignmf.com



Dr. K. Annapurna who worked as Scientist G at Specialty Glass Division, CSIR-CGCRI since 1996 and since then has played a leading role in the Research and Development of specialty glasses, focusing on strategic applications and process technologies. As Principal Investigator or Co-Investigator, Dr. Annapurna has successfully handled around 23 research projects and has been pivotal in establishing an architectural research and testing facility, now recognized as testing center by BIS. The chalcogenide glasses developed were validated at IRDE, Dehradun as highly suitable for thermal imaging.





These Chalcogenide glasses have been used to fabricate thermal imaging cameras and field tested by BEL. Several industries like BEL, Stellar Optics, Analinear systems have shown interest in transfer of this technology.

"With profound thanks to the Jury Members, I am deeply honoured and humbled to receive the prestigious C. K. Somany Award for Excellence from the AIGMF. I consider this recognition not merely a personal achievement, but a tribute to the collective efforts of my colleagues, students, collaborators and the institution with which I have had the privilege of working. I accept this award

with great gratitude, humility and a deep sense of responsibility." said Dr. K Annapurna, recipient of CK Somany Award for Excellence.

M/s SGD Pharma India Pvt. Ltd. is a trusted global supplier of pharmaceutical glass packaging solutions, serving pharmaceutical customers across multiple international markets with a strong export presence and long-term partnerships with leading pharmaceutical companies across the globe.

"This award is a reflection of our team's commitment to excellence, our customers' trust, and our shared vision of taking Indian manufacturing excellence to the global stage. We remain dedicated to delivering high-quality pharmaceutical packaging solutions that support healthcare worldwide while contributing to India's export growth. We also acknowledge AIGMF's contribution to the glass industry through its tireless efforts, not only in bridging the gap between the industry and the authorities but also in working with academia to spread awareness on glass." said Mr. Deepak Sood, Managing Director, SGD Pharma India, on receiving the Balkrishna Gupta Award for Exports.

Mr. Jagdish Sarin is the founder and

President of Ceracon Engineers Pvt. Ltd., based in New Delhi. After graduating in Ceramic Engineering from Indian Institute of Technology, BHU in 1972, he worked with Refractory Manufacturing units and gained valuable experience on the factors affecting life of Refractories in Glass Melting Furnace. With the Liberalisation of Imports in 1991, he started M/s Ceracon Engineers to bring Global technology for the benefit of indigenous Glass Industry. He filled this gap by bringing in Foreign Technology for various areas of Glass making. To initiate manufacture of Lightweight bottles and Narrow Neck Press and Blow process, he introduced high quality Plunger Mechanisms. He has been an advocate for modernizing the glass manufacturing ecosystem in developing markets, encouraging the adoption of Narrow Neck Press and Blow (NNPB) light weighting techniques, higher furnace efficiencies, increased line speeds, and automated quality control, inspection equipment, energy saving systems, electric boosting systems, Furnace Design and Development and Turnkey Glass Plants etc.

Later, he expanded Ceracon's



3rd Prize received on behalf of Shlok Gupta from the outgoing President AIGMF



operations to cover glass plants across neighbouring and regional markets, including the Gulf region, West Asia, Africa, Pakistan, Sri Lanka, Saudi Arabia, Dubai, Oman, Kuwait, and Israel. With over five decades of experience in the glass industry, he has played a pivotal role in bridging international glassmaking technology with the Indian and regional markets.

"To receive the Lifetime Achievement Award from AIGMF is a privilege that words cannot fully capture. For over eight decades this institution has been nurtured by the true titans of our industry, and to receive recognition for a lifetime of work from such an august body is the greatest milestone of my professional life. For more than five decades my journey has been driven by a singular passion: to push

the boundaries of what is possible and elevate Indian glass manufacturing to global standards. None of this was walked alone, and I particularly thank Mr. Sanjay Somany for his invaluable guidance and mentorship over the years. We stand at the threshold of a new era driven by green energy, automation and sustainable manufacturing; glass is the material of the future and India is perfectly positioned to lead the global supply chain. To the next generation of engineers, innovators and entrepreneurs: do not fear change, embrace it, keep investing in modern technologies and never compromise on quality." said Mr. Jagdish Sarin, recipient of the Lifetime Achievement Award.

The jury for the awards comprised of Mr. Dave Fordham, Member Editorial Board of KANCH (AIGMF's

Glass journal), Former Publisher of Glass Worldwide magazine and Global Engagement Lead for Glass Futures (United Kingdom); Mr. Amit Malhotra, President of Confederation of Construction Products and Services, Treasurer of uPVC Window & Door Manufacturers Association and Managing Director of McCoy Silicones Ltd.; Mr. Pawan Kumar Shukla, Treasurer AIGMF and Managing Director, Schott Glass India Pvt. Ltd.; and Mr. Gurmeet Singh, Chairman, Federation of Safety Glass (FOSG) and Managing Director, Gurind India (P) Ltd.

The cash prizes for the winning students were sponsored by Schott Glass India Pvt. Ltd., producing Type I pharma tubing primarily meant for Glass Vials which were supplied worldwide for packaging the COVID vaccination; SCHOTT has more recently added syringe and cartridge glass tubing, reinforcing its commitment to the 'Make in India' initiative and positioning the company as Asia's largest producer of syringe and cartridge glass tubing. Top 200 entries were sent a specially designed Glass Mementos and the winning entries can be viewed at www.aignmf.com ■

Select photos are available under past events at www.aignmf.com



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Youth Upbeat on use of 'Glass in Institutions'

More than 2000 students from schools and colleges across India and some foreign countries in the age group between 7-24 years participated by means of poems, drawings, photography, etc., in The All India Glass Manufacturers' Federation (AIGMF) Annual Youth contest on 'Glass in Institutions' or संस्थानों में कांच।

1st Prize (Rs. 25,000) was given to ANANYA BAZAD aged 14 Years, 10th class student of Pathania Public School, Rohtak HARYANA

2nd Prize (Rs. 15,000) was given to DEEKSHITHA MS aged 23 Years, 6th year student of Pharma (D) Integrated, Annamalai University, Annamalai Nagar TAMIL NADU

3rd Prize (Rs. 10,000 each) were given to:

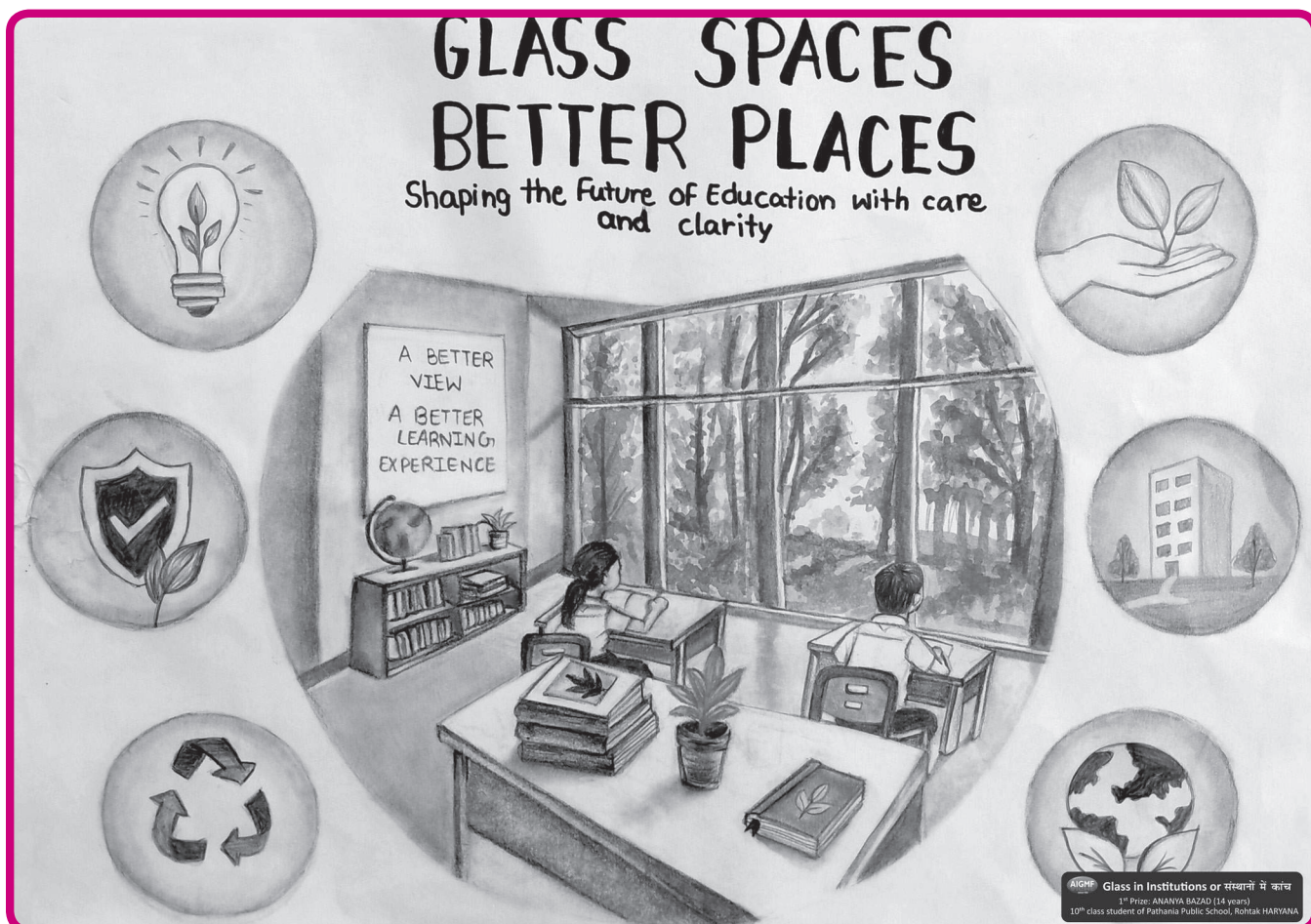
- a) SHREYA TAHLAN aged 17 years, 12th class student of Bal Bharti School, Bahadurgarh HARYANA
- b) SHLOK GUPTA aged 14 years, 9th class student of PM Shri Kendriya Vidyalaya, Sattenapalli ANDHRA PRADESH

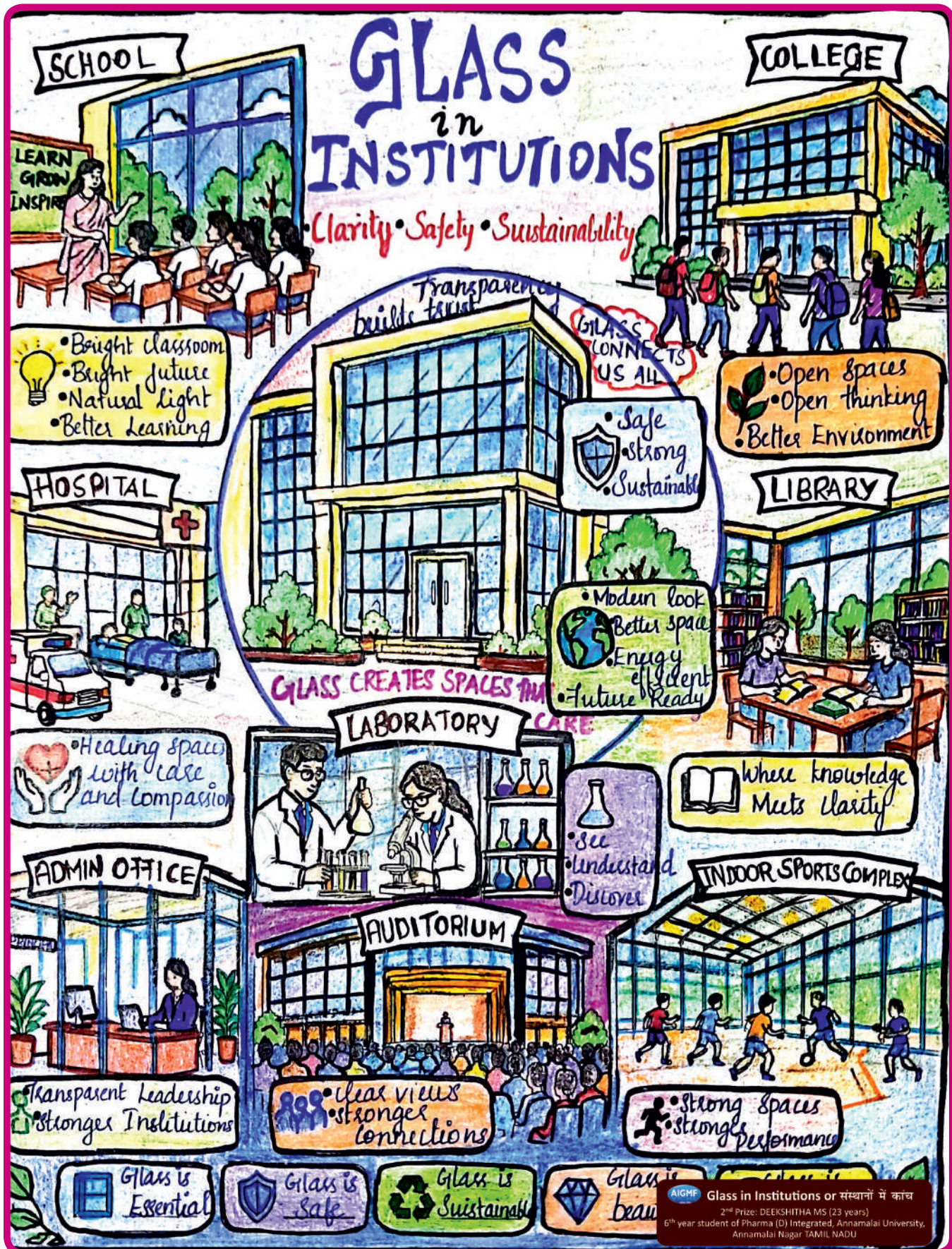
The Jury comprised of Mr. Gurmeet Singh, Chairman, Federation of Safety Glass (FOSG) and Managing Director, Gurind India (P) Ltd.; Mr. G N Gohul Deepak, Executive Director, Glazing Society of India (GSI); Mr. Dave Fordham, Member of the Editorial Board at KANCH, Global Engagement Lead at Glass Futures, St. Helens (UK) and former publisher of

Glass Worldwide, London (UK); and Mr. Vinit Kapur, Secretary of The All India Glass Manufacturers' Federation (AIGMF).

"Year on year, the competition has garnered greater traction, with entries received from multiple countries. The competition evolved as a sustainable initiative of AIGMF, one that inspires and encourages the youth of the Nation to understand and cherish the significance of Glass in their lives." said Mr. G N Gohul Deepak, Executive Director, Glazing Society of India (GSI).

"The quality and quantity of entries in the 'Glass in Institutions' competition was extremely impressive, demonstrating a heartwarming level of passion, creativity





and attention to detail from the younger generation. Sincere congratulations not only to the worthy winners, but to every

entrant who took part and is helping communicate the many qualities of Glass” said Mr. Dave Fordham,

Member of the Editorial Board at KANCH, Global Engagement Lead at Glass Futures, St. Helens (UK) and



of the German technology group SCHOTT AG. SCHOTT is one of the world's leading manufacturers of special glass tubing, FIOLAX® established and long-standing experience since 1911. Most recently, SCHOTT, a global pioneer in specialty glass announced the addition of syringe and cartridge glass tubing reinforcing SCHOTT's commitment to the 'Make in India' initiative. This strategic action positions the company as Asia's largest producer of syringe and cartridge glass tubing.

Mr. Pawan Kumar Shukla, Managing Director of Schott Glass India Pvt. Ltd., and Hon. Treasurer AIGMF congratulated the winning students and said that the brilliant ideas shared by the young minds will help to create more eco-friendly living societies ■

Top 200 entries will get specially designed Glass Mementos. Winning entries can also be viewed at www.aigmf.com

former publisher of Glass Worldwide, London (UK).

"Glass is an integral part of any institutional building which has been wonderfully showcased by the young participants who have made phenomenal efforts in order to make an excellent presentation which is highly appreciated. They were so well expressed that it became a challenge to rate them and select the winners. A pat on the back of all the talented and enthusiastic entrants. Well done! Keep it up". said Mr. Gurmeet Singh, Chairman, Federation of Safety Glass (FOSG) and Managing Director, Gurind India (P) Ltd.

"The nos. and quality of entries depict that the Youth has a large role to play in educating the general masses on the use of green building material 'Glass' for healthy living" said Secretary of The All India Glass Manufacturers' Federation (AIGMF) Mr. Vinit Kapur.

The cash prizes for the winners were sponsored by Schott Glass India Pvt. Ltd, a 100% subsidiary

कांच: विज्ञान की चमकती गाथा

(विषय: संस्थानों में कांच)

मिलाया जब सिलिका में रेत और चूना
बना एक पारदर्शी अदभुत नमूना।
अन्दर का, बाहर का सब है दिखाता
प्यारा पदार्थ ये कांच है कहलाता।।
कहने को ठोस है पर अनिश्चित आकार
न किस्टल-सा जमा है न द्रव-सा व्यवहार।
अणुओं की बिना क्रम वाली सजावट,
फिर भी मजबूती की अदभुत बनावट।। (१)

कांच पारदर्शिता का है उतम प्रतीक,
प्रकाश जाता आर-पार बिना कोई लीक।
अपवर्तन के नियम का पालन ये करता
स्नेल के नियमों पर जीवन भर रहता।।
फिजिक्स के मिस्ट्री या बायो की लैब हो
कंप्यूटर स्क्रीन हो मोबाइल या टैब हो।
सबको बनाता है अपना ये कांच
सबको बचाए ये, न आने दे आंच।। (२)

बीकर हो टेस्ट-ट्यूब, ब्यूरेट या पीपेट,
सबको बनाने में कांच ही है फेवरेट।
एसिड हो बेस हो सबको ये सहता,
सारे प्रयोगों का साथी ये बनता।।
विशेष तरह कांच है बोरोसिलिकेट,
सहता ये उच्चताप क्वालिटी सीकेट।
गर्म हो या ठंडे हो सबका सहे वार,
सारी प्रयोगशाला का कांच है आधार।। (३)

माइक्रोस्कोप की स्लाइड कांच से है बनती
वाच ग्लास कवर ग्लास की दुनिया है तनती।
सेल हो वायरस हो या बैक्टीरिया या टिशू,
कांच ही सारा है जो बताये सबका इशू।।
कांच खिड़कियों से छनकर आता उजियारा,
लाइब्रेरी में पढ़ने का माहौल बने प्यारा।
प्रकाश-संश्लेषण-सा के जैसा हो यह काम,
जान के पौधे को मिलता नया आयाम।। (४)

ऐनक पहनकर जो पढ़ता है विद्यार्थी,
कांच ही लेंस है जो बनता है साथी।
उत्तल-अवतल का करते उपयोग,
जीवन को समतल सा करने का योग।।
ऑप्टिकल फाइबर की क्रांति है आई
सूचना सम्प्रेषण की गति बहुत बढ़ाई।
इंटरनेट की डोर से पूरी दुनिया को बांधा है,
कांच को जो फाइबर है वो रिश्ते का धागा है।। (५)

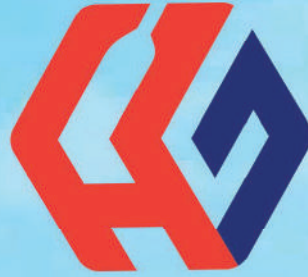
सोलर के पैनल में भी कांच का है आवरण,
मदद करे मानव की ऊर्जा संरक्षण,
नव्यकरण ऊर्जा का यह सर्वोत्तम है साधन,
पर्यावरण रक्षा का सर्वोत्तम माध्यम।।
टूटे से दिल सा ये टूटा हुआ कांच,
फिर से जुड़ जायेगा न ओएंगी आंच।
थोड़ी सी गर्मी से पिघलाकर जोड़ो
नई नई रचना से रिश्ते तुम जोड़ो।। (६)

ऊर्जा बचाए, प्रदूषण घटाए ये कांच
ग्रीन पस्यूर की राह दिखाए ये कांच।
जीरो वेस्टेज का एक साधन है कांच,
बेहतर भविष्य का एक सपना है कांच।।
कांच की पारदर्शिता, उसकी हठता, और विज्ञान,
कांच में निवास करे त्रिगुण महान।
बिल्डिंग की शोभा, विद्यालय की खिड़की और दवार
कांच रहे इस दुनिया के विकास का संसार।।
आज हम सब मिलकर चलाते हैं अभियान
कांच का उपयोग करे बढ़ाये विज्ञान और प्रकृति का मान।
कांच-सा धवल उज्ज्वल हो मानव का विचार,
विकसित भारत की संकल्पना हो सम्यक साकार।। (७)

AIGMF Glass in Institutions or संस्थानों में कांच
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Roundtable on Solar & Pattern Glass

(July 27, CGCRI- Kolkata)

Parallel to the AIGMF Executive Committee Meeting, a roundtable on Solar and Pattern Glass was organised on July 27 at CGCRI Kolkata in collaboration with the Bureau of Indian Standards (BIS), Glazing Society of India (GSI) and Federation of Safety Glass (FOSG).

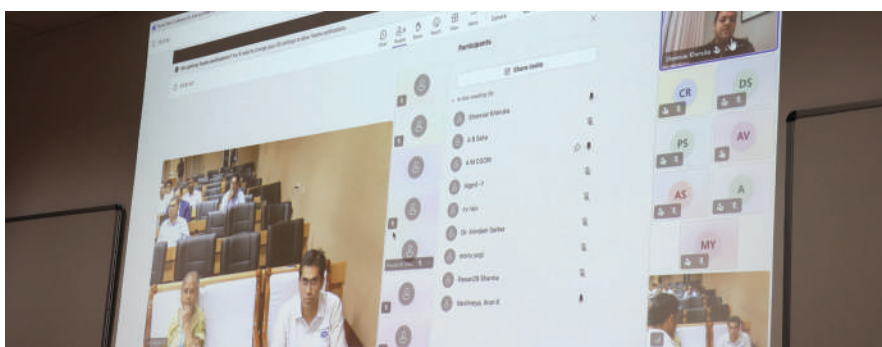
Many glass manufacturers, processors, suppliers, government officials, related associations, international participants, research bodies, and media attended the CGCRI event to discuss strengthening solar and patterned glass.

A keynote address was delivered on the overview of Solar Glass Manufacturing by Mr. Shreevar Kheruka, Sr. Vice President AIGMF and Managing Director & CEO of Borosil Ltd.

Mr. Mohit Garg from the Chemical Department, Bureau of Indian Standards (BIS) gave an overview of Indian Glass Standards - Textured and Extra Clear Textured Glass as per IS 5437:2024, and Safety Glass Part 3 Solar Applications as per IS 2553 (Part 3):2026.



Felicitating Dr. K Annapurna, Chief Scientist, Specialty Glass Division CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata and Member Editorial Board of KANCH on her retirement from CGCRI by AIGMF, Glazing Society of India and the BIS.





Mr. Varun Gupta, Ex-Com Member AIGMF and Director at Triveni Renewables Ltd., gave a presentation on strengthening solar glass: developing unbreakable solutions.

Mr. Purvish Shah, Hon. General Secretary AIGMF and Director

in Gopal Glass Works Ltd., made a presentation on Pattern Glass applications: Toughening, Colourful, and Sustainable Partitions.

Manufacturers sought CGCRI's help in moving forward in R&D facilities and need for the Testing.



After the Q&A, Secretary AIGMF, Mr. Vinit Kapur spoke on the next steps and about the recently conducted workshop on Security Glasses on March 27; as well as the upcoming workshop on strengthening Container

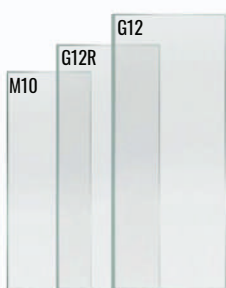


Glass slated to be held on Sept 19 at IIT Delhi. He mentioned that these workshops will become a part of 16th AIGMF International conference on 'Developing an unbreakable Glass solutions' to be held parallel to the glasspex and glasspro INDIA exhibitions in 2027■

Select photos and presentations are available under past events at www.aigmf.com



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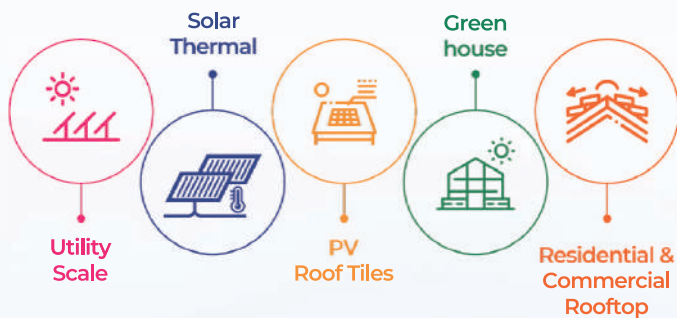


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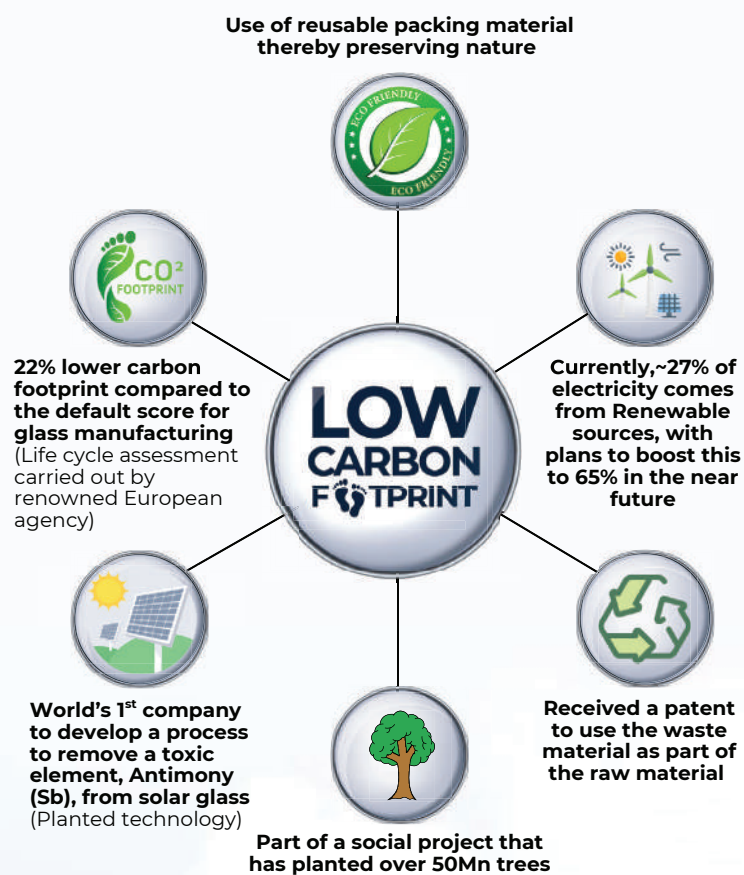
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This is an appeal...

Kanya Maha Vidyalaya, Jalandhar (a heritage institution) needs to purchase a school bus to transport women students of under-privileged families from nearby villages to the KMV and back safely.



My wife Darshana and I had an opportunity to visit the KMV in January 2025 following the Kolkata ICG. Under the leadership of its Principal, Dr. Atima Sharma, we saw dedicated teachers and motivated students. Over the past 1-1/2 years, I have been reviewing their curriculum enhancement needs in terms of glass properties characterization equipment, online lectures on advanced glass topics, internships, and building self-confidence. The glass physics faculty, Drs. Gopi Sharma and Neetu Verma, are genuinely dedicated towards bringing the girls to higher standards of education and research in glass. The young ladies must be prepared well to meet tomorrow's challenges of career paths in the Indian glass industry.

My sincere thanks to Borosil, CGCRI and Gold Plus Group who have come to help with strengthening of KMV curriculum by giving internship opportunities, sponsoring glass factory visits, and assistance with conducting demanding glass research experiments focused on sustainability. Thank you very much.

The fundraising target for the purchase of the school bus is approximately Rs. 20 lakhs. "Charity must start from home". Even though I may be a USA citizen now, I still am focused on India. Out of that conviction, my wife and I decided to make a pledge to donate several tuition assistance scholarships and professional travel bursaries for the women engineers in their glass program. From all industry standards, Rs. 20 lakhs is a "small" amount. Yet, unfortunately, we now live in an era where cash transfers, even donations, between USA and India are riddled with complexity and come under heavy Govt scrutiny at both ends.

I propose raising the funds under CSR initiative under the auspices of the AIGMF locally who may setup a separate bank account and then donate all proceeds to the KMV through a Memorandum of Understanding ideally by or on the Women's Day on March 8, 2027.

Please help! Please contact The All India Glass Manufacturers' Federation (AIGMF) President Mr. Shreevar Kheruka or Mr. Vinit Kapur, Secretary at info@aigmf.com

Jai Hind and Thank you.

Arun K. Varshneya

PhD, HonFSGT

2022-2025 PRESIDENT, THE SOCIETY OF GLASS TECHNOLOGY

COURTESY PROFESSOR OF MANAGEMENT, ALFRED UNIVERSITY

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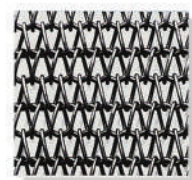
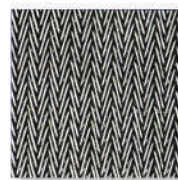
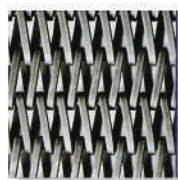




Mr. M.D. Farooq, the founder of Umda Engineering, brings to the table more than 35 years of expertise in the manufacturing industry. Starting from humble beginnings, today more than 350 of Mr. Farooq's Lehr machines are successfully installed around the world.

Mr. Farooq is best recognised as one of the co-founders of TNF Engineering, a company known across the industry as not only the leading manufacturers of Metallic Wire Conveyor and Lehr belts but also of Glass Plant Equipment. This mantle of superior performance and expertise has now been passed on to Umda Engineering.

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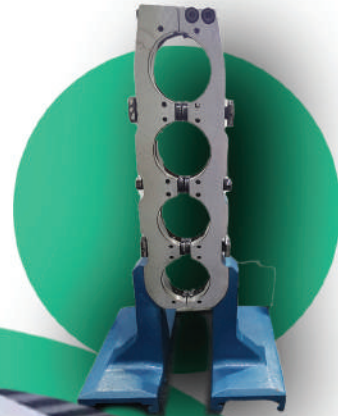
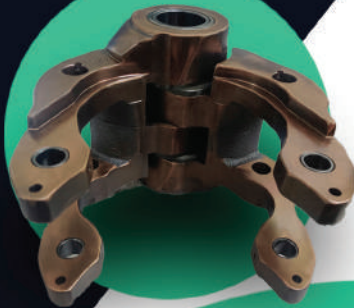
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Tomorrow's Glass Manufacturing Starts Today

Glasstec is one of the most anticipated events in the glass industry, bringing together glassmakers, technology providers and experts from around the world. From innovative new developments to continuous improvements of established solutions, Heye International is excited to showcase its latest advancements at the show in Düsseldorf.

HEYE FUSION: EVERYTHING IN ONE PLACE

Heye Fusion is Heye's new all-in-one user interface and a new generation of machine interaction for glass manufacturing. True to its name, Heye Fusion brings together machine controls and process information in one intuitive user environment. By fusing all essential production insights into a single platform, Heye Fusion creates greater transparency, simplifies daily operations, and enables faster, more informed decision-making. The result is a seamless user experience that helps operators stay connected to every aspect of the production process.

SIMATIC® MOTION CONTROL: READY FOR THE NEXT GENERATION

Heye is introducing its latest Siemens-based motion control platform, demonstrated live on a takeout and invert mechanism. Built on SIMATIC® technology, the solution combines proven motion performance with a future-ready automation architecture. As Siemens' strategic platform for future motion control solutions, SIMATIC® brings control, drives,



safety, and diagnostics together in one integrated engineering environment. The result is greater flexibility, easier service, and a solid foundation for the connected production environments of tomorrow.

PRECISION STARTS AT THE FEEDER

A further highlight at Heye's exhibition stand will be the next evolution of the Dual Motor Shears, featuring enhanced adjustment capabilities, improved process control and new closed-loops.

Redesigned Shear Arm

A key enhancement is the redesigned shear arm concept with an innovative gob guide, providing greater precision in gob positioning during gob cutting. The gob guides can now be adjusted electrically via a dedicated operator panel instead of manual adjustment handles. This provides operators with a safer and more convenient solution by eliminating the need for manual adjustments directly at the shears.

Closed-loop Option

In combination with Heye GobMaster,

the Dual Motor Shears enable automatic closed-loop control of the gob form. GobMaster continuously monitors the gob form, calculates the required corrections, and directly transmits the target positions of the gob guides to the control panel.

This ensures stable gob positioning and form, contributing to improved container quality and greater stability throughout the forming process. Electrically actuated adjustment and automated angle correction further reduce the need for manual intervention on the working platform, contributing to safer operation and improved process stability.

HEYE SMARTLINK – DATA AND CLOSED-LOOPS

Connecting sensors and managing large data volumes is becoming standard for the smart glass plant of the future. This was the motivation for Heye to develop the Heye SmartLink concept, consisting of different innovative sensors, compatible beyond Heye. On the one hand, external sensors such as cameras can be connected to the Heye infrastructure, while on the

other hand the SmartLink datastream module acts as a data gateway, enabling the rapid and secure transfer of data from the forming process.

Versatile Applications

As an open interface concept, SmartLink enables the integration of a wide range of camera-based applications. Examples include a fire camera solution supporting plant safety and Heye VisionLoop, a camera solution positioned directly behind the IS machine to provide early insights into container defects and production deviations.

FLEXIBLE HOT END REJECTION FOR RETROFIT

This technology is designed to improve line stability and prevent disruptions before they impact production performance. One of the key capabilities of the system is the reliable detection and removal of fallen containers. Containers that have tipped over on the conveyor can quickly lead to jams, production interruptions and increased waste. By automatically identifying and removing these containers, the Hot End Rejector helps maintain a smooth and uninterrupted production flow.

Monitoring Ware Spacing

Another innovative feature is minimum ware spacing monitoring. Containers that are standing too closely together can create handling challenges and increase the risk of them sticking together. The system continuously monitors container spacing and automatically rejects containers when predefined minimum distances are not maintained, helping ensure stable transport conditions throughout the line.

Retrofit Option for any IS Machine

The system has been developed with

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maximum flexibility in mind and can be integrated into any IS machine configuration, also as retrofit option.

UNLOCKING CLOSED BLANK MOULD SWABBING

At glasstec 2026, Heye will also highlight the latest development in automated blank mould lubrication: the new spray tool for swabbing in closed* blank moulds for the Heye BlankSideRobot. The new spray tool will be presented alongside the established spray tool for open blank mould swabbing.

New Spray Tool

The new spray tool provides an even more consistent spray pattern. It is equipped with extended spray nozzles, covering the vast majority of the article range and ensuring effective lubricant distribution even in deeper mould geometries. It retains the proven non-destructive magnetic coupling system of the open mould spray tool.

Neck Ring Swabbing

In addition, the new spray tool offers neck ring swabbing functionality, identical to the existing solution for open blank mould swabbing, providing a comprehensive approach to automated mould lubrication.

New Safety Feature

The design has been further optimized to match all movement profiles. The breakaway magnetic system ensures that, in the event of unintended contact between the invert and the swabbing tool, the front section of the spray tool safely disconnects. A safety tether prevents uncontrolled dropping into the machine, significantly reducing the risk of tool



damage and robot downtime.

Further optimisation of the internal piping design results in a cleaner and more compact layout with fewer connection points. This reduces the risk of sediment accumulation, simplifies maintenance, and reduces connection complexity.

With this development, the Heye BlankSideRobot can now perform both swabbing methods – in open or closed moulds – offering greater flexibility to meet individual customer production requirements.

AND WHAT HAS HAPPENED IN INSPECTION SO FAR?

Visitors to the Heye booth will experience how the latest advances in artificial intelligence are transforming container glass inspection. Heye will present several new developments for the first time, demonstrating how AI can solve long-standing production challenges in smarter, faster, and more reliable ways than ever before.

From accurate container identification and the interpretation of complex codes to intelligent defect detection and performance optimization of existing equipment, these innovations open up new possibilities for quality assurance and production efficiency. By continuously learning from real



production data, they enable more consistent inspection results, faster decision-making, and greater process transparency.

One of the key benefits is the ability to reduce the effort and complexity associated with job changes and product changeovers. By automating tasks that previously required manual intervention and adjustment, manufacturers can shorten changeover times, minimize the risk of human error, and achieve stable inspection performance more quickly after a product switch.

What sets these solutions apart is their practical focus. They have been developed in close alignment with the needs of glass manufacturers and are designed to deliver tangible benefits on the production floor. The result is improved product quality, higher equipment availability, reduced manual intervention, and greater operational efficiency.

RETROFIT: EXTENDING PERFORMANCE, PROTECTING INVESTMENT

From hot end to cold end, Heye's retrofit solutions help manufacturers modernize existing equipment without the need for a complete replacement. At the hot end, the Section Box Exchange upgrades IS machines with the latest technology

to improve efficiency, productivity, and operational reliability. Additional assessments of feeder and ware handling equipment can uncover further opportunities for automation and quality improvements.

When it comes to inspection, Heye's retrofit programs offer a cost-effective alternative to buying an entire new machine. This enables manufacturers to bring existing inspection equipment up to modern standards while protecting previous investments.

With upgraded control systems, enhanced safety features, and certification-focused modernization packages, retrofit solutions improve inspection performance, support HACCP compliance, and help extend the service life of valuable equipment. Customers benefit from increased reliability, improved operational safety, and reduced lifecycle costs without the need for a complete machine replacement.

To meet growing market demand, Heye has recently expanded its retrofit portfolio to include CO and MI machines. These upgrades provide access to the latest inspection technologies, improved fault detection capabilities, and enhanced safety standards, allowing operators to achieve higher performance from equipment already in production.

PEOPLE MAKE THE DIFFERENCE

Technology alone does not create results. People do. Through Technical Assistance, Heye experts work side by side with customers to improve processes, enhance performance, and unlock production potential. At the same time, the HiSKILLS Campus provides practical training programs for hot end and cold end applications, ensuring that operators, technicians, and engineers have the knowledge needed to turn innovation into lasting success. **WE ARE GLASS PEOPLE!**

At Heye, the future of glass manufacturing is not a vision. It's a reality. Stay curious and discover it at glasstec 2026, booth I4E03.

ABOUT HEYE INTERNATIONAL

Based at Obernkirchen, Germany, Heye International GmbH is one of the container glass industry's foremost suppliers of production and inspection technology, high performance equipment and production expertise. Our mechanical engineering has set industry standards for more than six decades, significantly contributing to our customers' success. Heye's vision is to ensure highly cost-effective, sustainable and safe operation of glassworks worldwide to further strengthen the position of glass as the packaging material of the future. We consider glass as the purest and most natural packaging on our planet. Our actions are driven by experience, courage and passion. Thus, we make a positive impact on the environment and health, fostering a sustainable future. Today. Tomorrow. Together■

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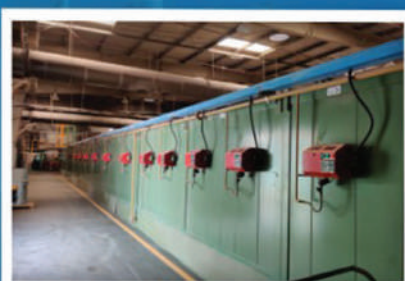
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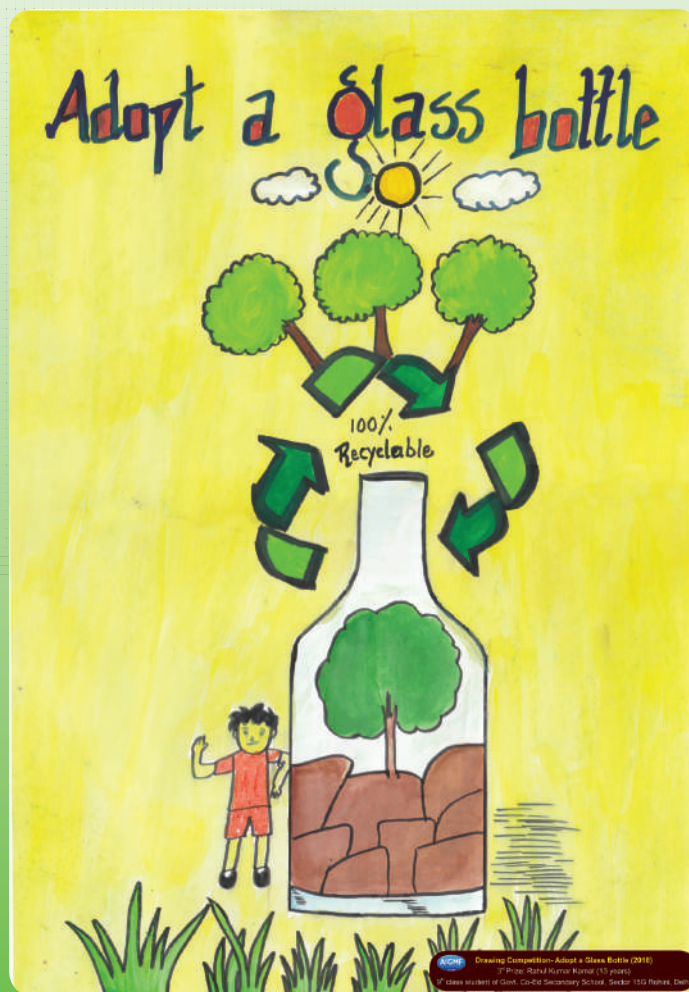
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Excellence in Container Glass Manufacturing

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Written By **Er. Ashoka Rao Manikala**
(Former President Operations PGP Glass and AGI Greenpac)

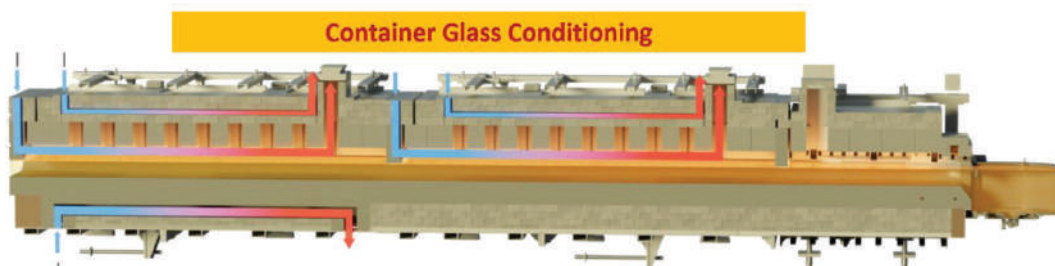
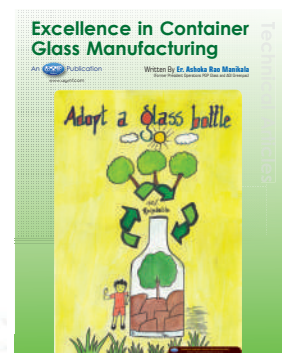


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Glass Conditioning and Colouring Forehearth (CFH) (chapter 4 of 15)



In this chapter from the book on "Excellence in Container Glass Manufacturing", we will learn in details about Glass Conditioning and Colouring Forehearth (CFH).

Glass conditioning is an important process in glass manufacturing. Properly conditioned glass will help in uniform glass distribution, accurate control of weight and minimum forming defects in bottles. The molten glass exiting the throat must reach the spout with precise characteristics in terms of temperature, thermal & chemical homogeneity. Hence there is a direct impact of glass conditioning on bottle production. In this chapter, we will learn the following:

1. Glass conditioning principle
2. Working end and forehearth design criteria
3. Forehearth efficiency calculation
4. Operation & Maintenance
5. Trouble shooting of forehearth
6. Colouring Forehearth (CFH)

1. GLASS CONDITIONING PRINCIPLE

Glass conditioning is a technique to get desired glass for forming at required temperature consistently with good thermal homogeneity, at a shortest time after setting the required

temperature in forehearth, with minimum / optimum energy utilised. A forehearth is required to deliver homogeneous glass at required temperature at the spout. More the stable and homogeneous glass, better the gob weight control. Correct glass temperature measurement and good control will result in higher forming efficiency with minimum bottle defects. Hence a good understanding of forehearth operation principles will help the operation team to quickly get homogeneous glass and achieve high forming efficiency.

Now let us understand more commonly used parts in glass conditioning.

1.1 Working End (WE) or distributor

There have been many designs of WE / distributors. Before 1980s, there was large refiner attached to the

furnace for refining and then distributing glass to forehearths. Today, refining is taking place in furnace itself and refiner is replaced with simple distributor / working end (working chamber).

There are different designs as shown in Figure 4.1 as (a), (b) and (c). In fig (a), there is half circular distributor after the throat to distribute glass. This concept is used generally in table ware production factories where press machines are installed close to each other or in small container glass factories to produce bottles. The advantage of this design is that same hot glass is available for all forehearths from furnace and also the area required for forehearths installation is lesser. However, disadvantage is that it is difficult to get desired temperatures for higher draw forehearths but possible with extra-large/long forehearths to control the glass temperature. Figure (b) shows large working end with possibility of having separate zones for heating &

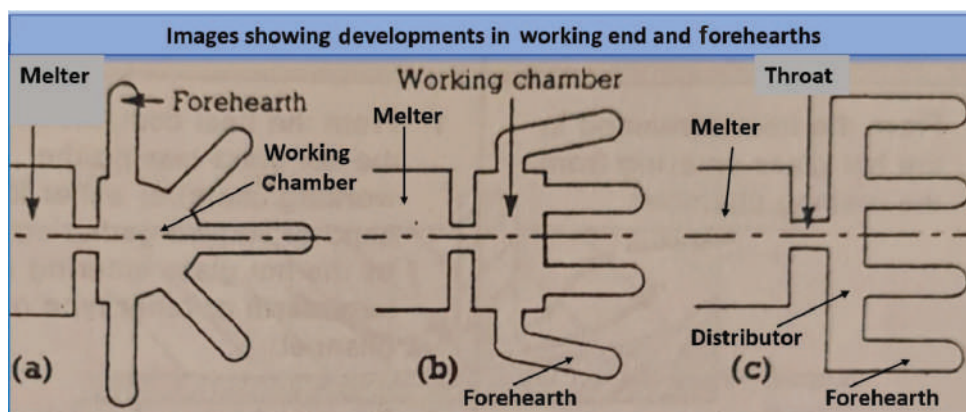


Figure 4.1

cooling of glass before entering the forehearth and to meet the factory layout requirements. This will have better temperature controls. Figure (c) is the present concept adopted in most glass companies having several independent zones in working end to get the desired forehearth entry glass temperature. The WE firing is done normally with gas but sometimes, high quality fuel oil/ kerosene oil, too is used.

1.2 Alcove: The Forehearth are connected to WE directly or with a bend as shown in below image Figure 4.2 for the two end forehearth. The portion of forehearth with bend is known as ALCOVE. The alcove design plays important role as it makes glass to flow smoothly without glass getting stagnant or generating cold glass (cold glass will lead to bubbles and blisters formation in glass). The alcove should have adequate burners all along the length to avoid formation of cold glass.

1.3 Forehearth: For glass people, forehearth operation is somewhat difficult to understand and operate. In many factories, forehearth operation is a neglected area whereas it is very important process for achieving highest production efficiency. Design and operation of forehearth is very important and it should satisfy following conditions:

- Achieve the desired temperature in shortest time after the job change.
- Able to condition the glass for the designed draws quickly as per the production requirements / standards.
- Able to maintain good thermal homogeneity in all gobs continuously.
- Weight variation in gob to

gob is very minimal (± 1 gm for 50 gm bottles & above, for small wares, ± 0.5 gms) and also the glass level to be consistently maintained.

- To adjust heating and cooling automatically for designed (limits) variations in furnace draw, glass level, temperature, changes in fuel properties and changes in environmental properties (summer, winter, night, daytime).
- To get the same quality of glass (no changes in bubbles, blisters, stones, colour, seeds) from WE & forehearth (not for colour forehearth) during forehearth operation.

The forehearth are generally having 2 cooling / heating zones and one equalising zone as shown in Figure 4.2.

Figure 4.3 shows impact of temperature in each zone on the glass at equalising zone (bottom, middle, top temperatures of glass at 3 areas of glass- right, centre and left at end of equalising zone measured using three tri-level thermocouples- total 9 points).

Please note that the FH entry temperature and zone 1 set

temperature will have impact on the bottom glass temperature in Eq. zone; zone 1 and zone 2 set temperatures will have impact on middle temperature; zone 2 and Eq. zone set temperature will have impact on top glass temperature in Eq. zone.

Rear Zone or Zone 1: It is the first zone after the connecting block from distributor or after the alcove. This zone will have direct cooling, indirect cooling and heating provisions. Approximately 50% of required cooling of glass (50% required temperature drop from entry to spout) is achieved in this zone.

Middle zone or Zone 2: This is the 2nd zone or the zone between rear and equalising zone. This zone will have indirect cooling and heating provision. Approximately 35% of total temperature drop in FH is done in this zone.

Front zone or equalising section: This is the final heating zone where very close to equal temperatures in 9 points of Tri-level thermocouple is to be achieved. This has only heating zone and approximately 15% of drop in temperature is achieved here.

Feeder: Sometimes word feeder is confusing. Some people call FH as feeder, some call spout as feeder. Technically, feeder is referred to the

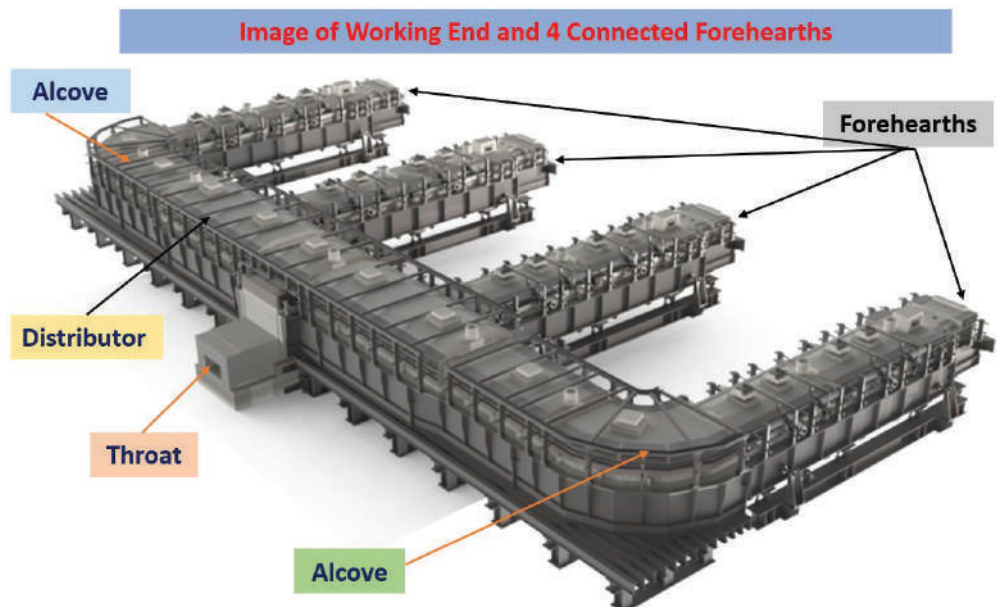


Figure 4.2

Forehearth Zones and Impact of Temperature on Thermal Homogeneity of Glass in Eq. section

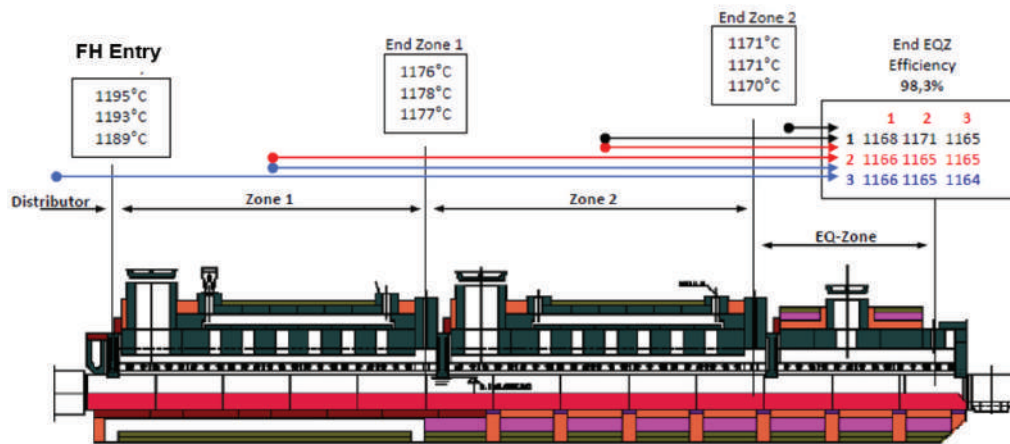


Figure 4.3

mechanism, attached to the exit of a forehearth, to form gob to produce articles, as shown below.

1.4 Glass Conditioning Principle:

To get the desired gob temperature to form consistent bottle quality, heating & cooling of glass coming from melter to be performed such that the entire gob has uniform temperature across all sections and same condition is continued for the entire operation with minor adjustments, if needed. Hence understanding the heat transfer principle is very important for both forehearth designers and operators. Figure 4.4 shows types of heat transfer and adoption of these types suitably to get uniform gob temperature is essential.

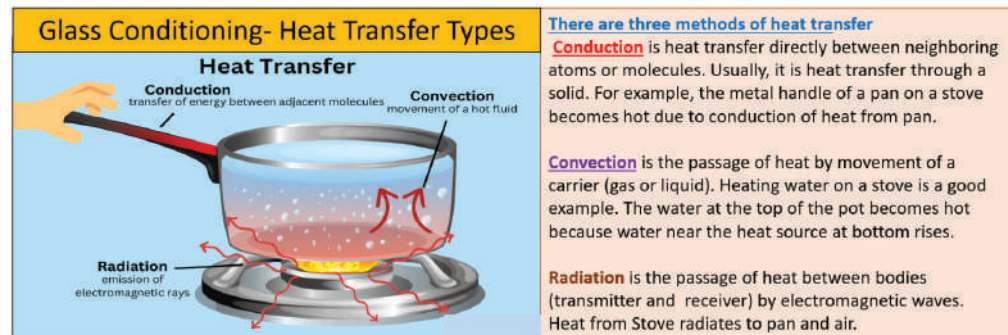
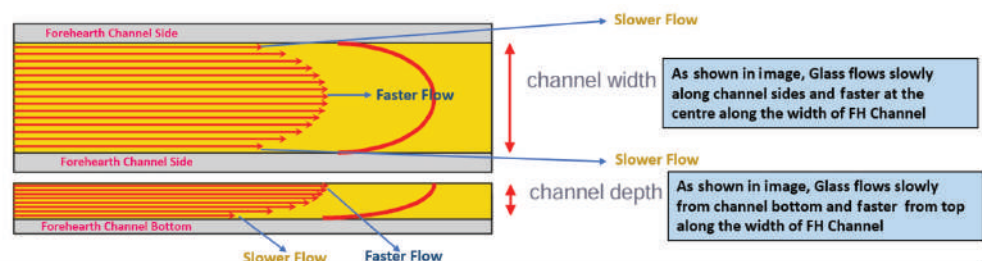


Figure 4.4



Flow Pattern in Forehearth:

Glass near to sidewalls and bottom :

- Flows more slowly because of friction, results in increased heat loss and drop in temperature
- Has a longer residence time
- Higher loss of temperature because of more heat loss
- Increases in viscosity because of lower temperatures
- Flows more slowly and with higher viscosity

Glass at centre of sidewalls and top :

- Flows Quickly because of no or less friction, results in less heat loss and less drop in temperature
- Has a lesser residence time
- Lesser loss of temperature because of minimum heat loss
- Decrease in viscosity because of higher temperature
- Flows more faster and with lower viscosity

Figure 4.5

1.5 In Forehearth, following glass flow patterns taking place while glass is flowing from entry to exit as in Figure 4.5

2. WORKING END / DISTRIBUTOR AND FOREHEARTH DESIGNS

Considering the flow pattern

channels and remove heat from centre of FH.

2. To minimise the heat loss from bottom glass compared to top glass in channel.

3. To design the forehearth to get maximum thermal homogeneity of glass in spout.

4. To provide adequate cooling and heating to get proper temperature of gob at minimum and maximum tonnage draw required by manufacturing facility, for various temperature & draw conditions.

5. To design the FH such that proper glass depth is obtained in spout with minimum weight variation in gobs, consistently.

Hence, four important design elements to be critically considered while designing forehearth are:

1. Residence Time
2. Heating & Cooling Requirements
3. Head Loss
4. Automation

Now, let us look at the above factors, one by one.

2.1 Residence time: It is the time required for the glass to flow from entry to exit. For forehearth, it is the time required for the glass to flow from Entry to the feeder Spout.

Importance of residence time: It is an important factor to be considered while designing the forehearth. Based on the production requirement, the FH designer will calculate the residence time for minimum draw and maximum draw. If the residence time is low, then the glass cannot be cooled to the required level leading to poor glass conditioning and difficulty in forming. If residence time is high, then the glass on the top & bottom can lose heat and too much heating may be required resulting in poor glass conditioning. So, residence time, proven practically adequate, to be considered while designing forehearth.

Proven residence time: For flint glass, 40 to 120 minutes is the ideal residence time and for other coloured glass, it is 50 to 120 minutes.

Residence time calculation: consider a forehearth as shown in Figure 4.6.

The residence time in minutes is calculated by volume of glass in the forehearth (Length x Width x Depth all in mtrs.) x glass density (2.5 approx.) divided by draw in tons / minute.

Example: If FH width is 800mm, length is 6000mm & glass depth is 150mm and draw is 36 T/day, then the residence

time is: $(0.8 \times 6 \times 0.15 \times 2.5) / (36 / 1440) = 72$ minutes.

Min and Max. draw for above FH, for flint glass: Minimum residence time is 40 minutes for flint glass. Then, the maximum draw can be: $[(0.8 \times 6 \times 0.15 \times 2.5) / (40 / 1440)] = 64.8$ T/Day (TPD).

Similarly, maximum residence time is 120 minutes. Then, minimum draw can be: $(0.8 \times 6 \times 0.15 \times 2.5) / (120 \times 1440) = 21.6$ TPD

Min. and Max. draw for above FH, for colour glass: For colour glass, the residence time is 50 to 120 minutes. For 50 minutes residence time, the Max. draw is 51.84 TPD and Min. draw @ 120 Minutes, residence time is 21.6 TPD.

One should understand the concept of residence time in forehearth to operate the same within the recommended limits to get better glass conditioning.

2.2 Heating & cooling requirements

Cooling is important under following conditions:

- a) When draw is maximum in particular forehearth, for the required Gob Temperature, the cooling requirement is Maximum.
- b) Under the above condition, it is further more important, at maximum Entry temperature (FH entry temperature).
- c) Also, cooling requirement is peak, for the lowest gob temperature, under above circumstances.

The cooling requirement will again vary based on glass colour. For flint glass, the cooling is the highest whereas for amber it is approximately 15% less, for green 25% less and for dark colours 35% less.

Hence, the cooling capacity is to be designed for following consideration.

- a) The maximum entry temperature
- b) The minimum Gob temperature
- c) The glass colour
- d) The maximum tonnage

Distributor design plays important role in forehearth design. For the maximum riser temperature (Figure 4.7), the maximum forehearth

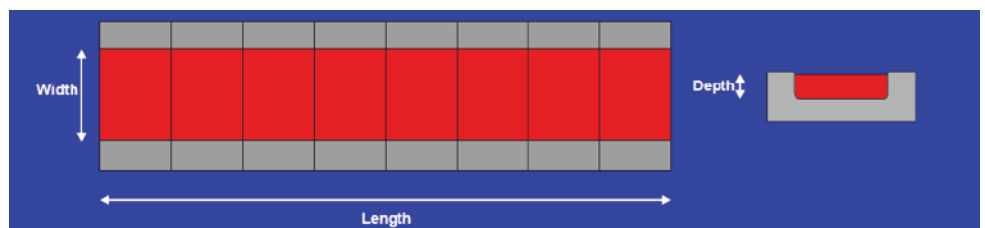


Figure 4.6

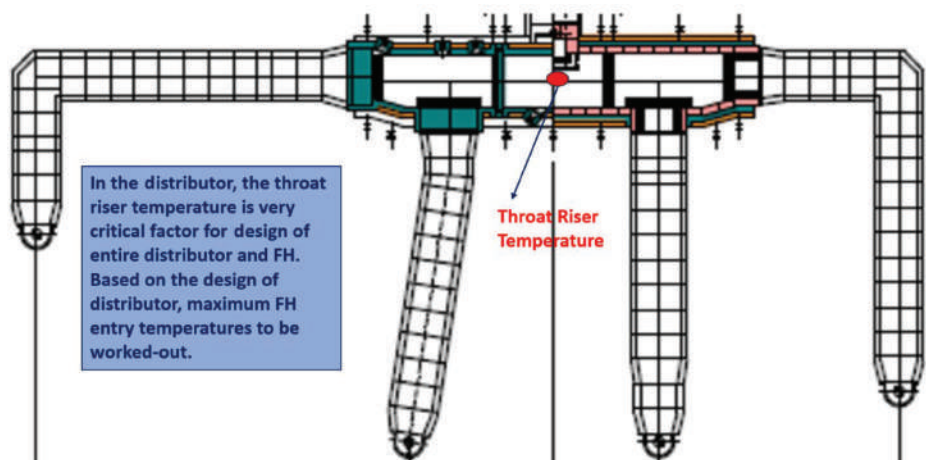


Figure 4.7

entry temperature to be calculated and then the cooling requirement for forehearth to be worked-out. The cooling should be such that, it shouldn't create glass quality issues like generation of bubbles & blisters, cold glass etc.

After calculating the forehearth maximum entry temperature, the cooling requirement is calculated for maximum draw and minimum gob temperature (FH exit). It should be also noted that, the cooling cannot be applied equally in every zones to achieve good thermal homogeneity of glass. General principle or thumb rule is that 50 to 65% of cooling is done

in first zone, 25 to 35% in 2nd zone and 15 to 25% in conditioning zone, as shown in Figure 4.8.

We shall discuss about the means to achieve the cooling, types of cooling etc., later in this chapter.

Heating requirement is also very important requirement in forehearth conditioning. As explained in 1.2, the glass is losing heat more at sides and bottom of channel and hence to balance the cooling losses, heating the glass at sides is important to get homogenised glass in gob. If no heating is introduced, the gob will have hot glass at centre and cold all along it, as shown below. If the heating & cooling

are properly applied, the gob will have uniform glass temperature across all the sections of the gob shown in Figure 4.9.

Heating load to be calculated considering the requirement of minimum draw & maximum gob temperature requirement (gob or exit temperature) and also the heating load required during no load conditions, when there are cases of interruptions. Forehearths and WEs are generally designed to heat the glass to keep the loss of heat under control but not to increase the glass temperature like in furnace.

2.3 Head loss consideration:

Head loss is not understood by many glass personnel and it results in many glass quality defects. If head loss is not considered in forehearth, following issues may arise:

- Insufficient glass in spout
- Frequent gob weight variation
- Sudden variation in glass temperatures
- Glass flowing over channels can take place often resulting in damage to forehearth and glass quality issues

In Figure 4.10, one can see the loss in glass levels at entry and exhaust, when FH channel top levels are same at entry and exit.

Head loss is the function of following factors:

- Width, length and glass depth
- Type of glass, glass property, glass colour
- Glass temperature
- Glass draw

Proper design of forehearth considering above factors is very essential to get consistent

Example- Cooling case : Total reduction from entry of FH to FH exit = 28°C (1193-1165). Zone 1= 15 °C(54%), Zone 2= 7 °C(25%), Conditioning Zone- 6 °C (21%)

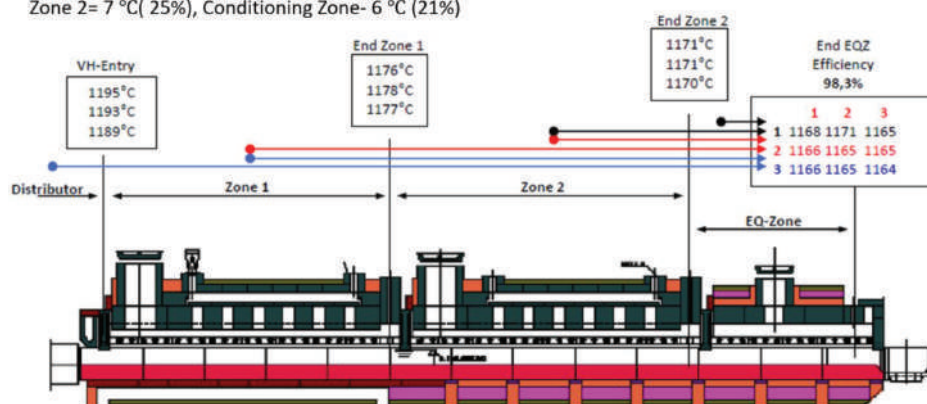


Figure 4.8

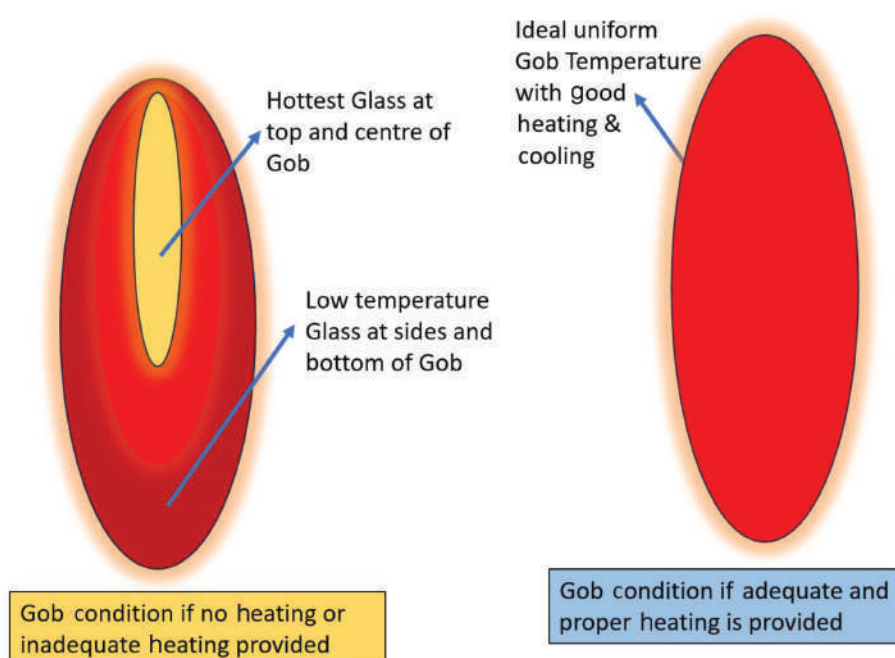


Figure 4.9

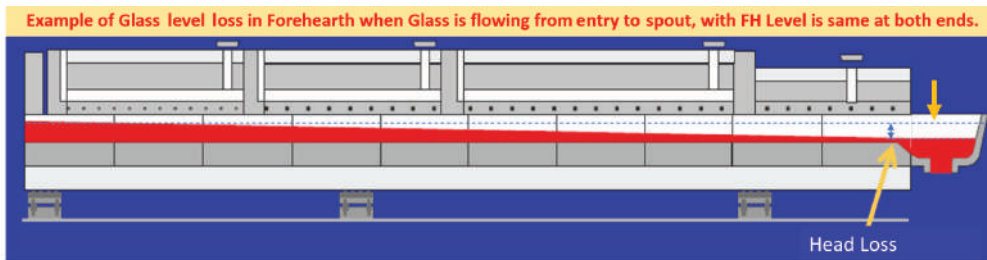


Figure 4.10

gob weight in forehearth. Generally, designers recommend following actions to take note of head loss:

- Sloping the Forehearth:** PSR recommends 19mm sloping of Forehearths, based on their experience. However, it can vary depending upon design. Too much sloping can lead to glass overflowing the channel sides when the draw is lower. Adjustable sloping system is provided in all FH designs to change the glass levels as per production requirement. However, it should be noted that, frequent adjustments can disturb the channel joints and FH life can be severely impacted refer to Figure 4.11.
- With proper input of draw & temperatures from glass factory, while designing the FHs, the length, width and depth of FH can be calculated to minimise the head loss.
- For colour glass, many glass producers prefer glass depth of 125 to 135mm to get good glass homogeneity. Under this

circumstance, designers select wider FH channels and large spouts, to minimise the head loss.

2.4 Automation: Considering the importance glass bottle quality requirement, difficulty in manual operation, changes in properties of glass / fuel / environmental conditions, good automation is the only solution to achieve good homogeneity of glass in forehearth. Level of automation is to be discussed with production team to establish the requirement for designing the control systems. As the homogeneity of glass is the main factor along with minimum energy consumption, automation which can greatly influence them, should be incorporated. However, the automation level should be user friendly and cost effective. The automation level can be increased or decreased during the design of FHs and also can be upgraded at later stages as per requirement. Considering the AI and data analytics requirements, the data measurement points may be suitably designed. The minimum automation requirements are: automatic heating & cooling to

get the set temperatures at desired speed, continuous & accurate measurement of temperatures at various zones, heating & cooling percentage indication, homogeneity measurement etc.

2.5 Forehearth Heating and Cooling systems

Heating and cooling are vital actions taking place in forehearths and working end. For long period, direct heating using LPG/NG by fine gas burners were the common practice but now electric heating is gaining importance due to its better performance. Heating requirement may be increased or decreased by varying the % of firing automatically to get the desired temperature. While calculating the heating load, the number of burners & burner size is decided based on draw, entrance glass temperature, required exit glass temperature and heat loss in various zones. For cooling, many designers have different systems like direct cooling, indirect cooling and indirect bottom channel cooling. Let's now delve into heating and cooling systems in detail.

2.5.1 Heating / combustion system: Following Figure 4.11 shows the heating burners and cooling arrangements in Forehearth.

Head Loss can be partially solved by sloping the Forehearth. Forehearths can be sloped according to the draw, glass properties but adjusting it frequently can create problems in channel joints. There are adjustable screw jack system to reduce or increase slope. FH designer PSR, recommends 19mm slope, as shown in this image.

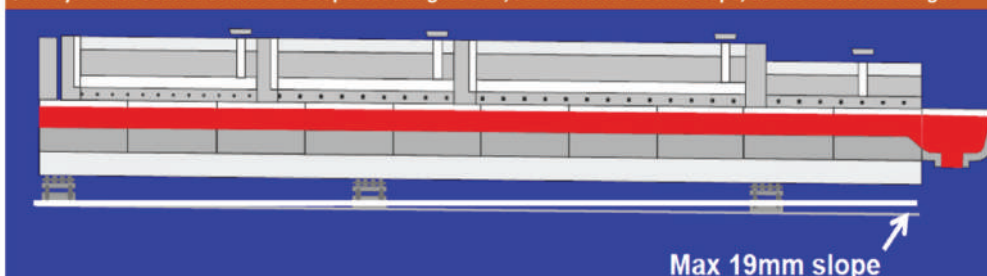


Figure 4.11

The combustion system consisting of gas rig with necessary controls & combustion air blowers, fuel & air mixers, mixers to burner manifold piping, Burner manifolds and pencil burners. All necessary safety systems should be incorporated in it to avoid any back fire from burners.

Nearly all gas fired forehearths have premix 'pencil' burners at 4-1/2" centres. They all operate with a minimum fire manifold pressure of about 3/4" WC. In forehearths & WE, premixed burner system is used. A pre-mix system has the air and gas mixed in the appropriate proportions before reaching the burner (Nozzle mix systems). The Figure 4.12 shows typical air-fuel mixing unit of SORG design, which accurately maintains the required air to fuel ratio for minimum to maximum firing range.

For NG, the air fuel ratio recommended is 10:1 (19.1% O₂ in Mix) and for LPG, it is 25:1 (20.1% O₂ in mix). However, based on fuel characteristics and production requirements, the air to fuel ratio can be adjusted.

The following figure shows the burner manifold and comparison of heat-input for various burner nozzle sizes & manifold pressure.

For good glass conditioning, the range of manifold pressures recommended during normal operation of forehearth is highlighted in the Figure 4.13.

The following Figure 4.14 shows typical NG flows for 100 Burners of different sizes at different manifold pressure. This table will be useful to calculate the NG required for the forehearths and WE.

The forehearths and WE operate with certain minimum manifold pressure to avoid back pressure. The control valve is operated from fully close to fully open range and minimum firing is achieved by providing a small bypass across the controller. The minimum manifold pressure is generally 5

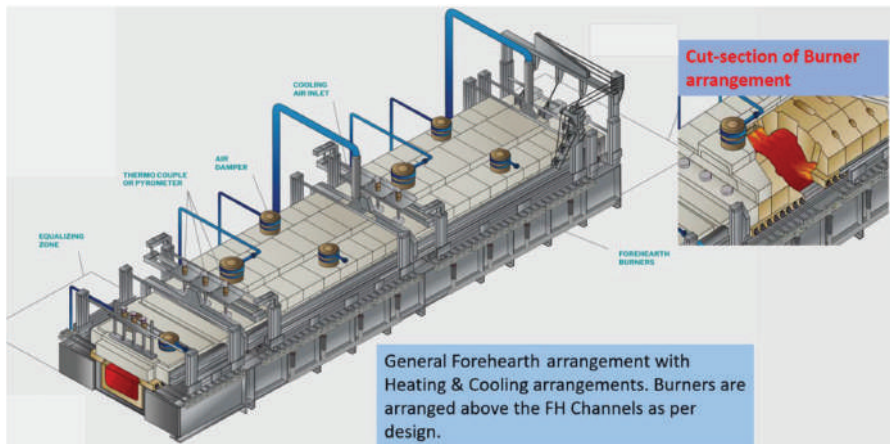


Figure 4.12

Mixer - SORG (Air & Fuel Mixing)

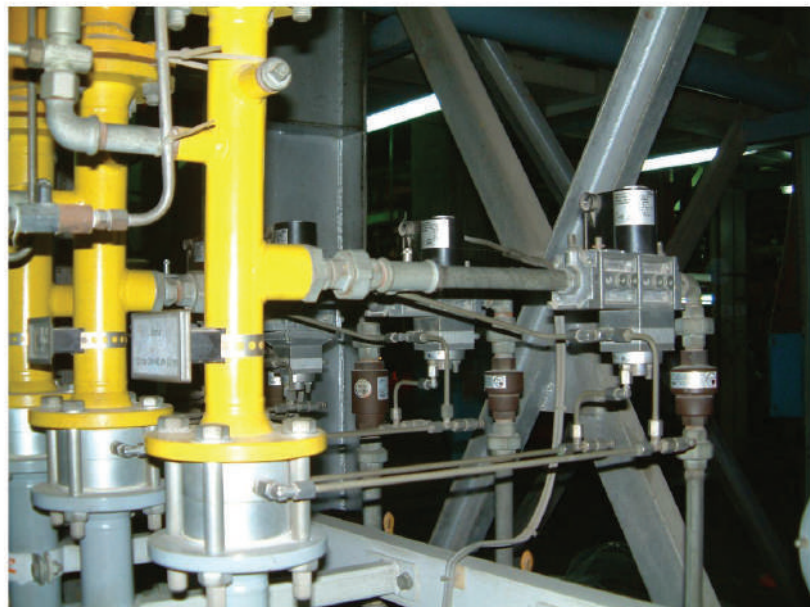


Figure 4.13

mbar to 8 mbar, (it is determined by nozzle dia., to ensure no backfiring), however it can be set as per the requirement by operating team.

Now a days, electric heating in forehearths is also introduced independently or in combination with NG/LPG heating. There are two



Heat Input is the function of Burner Nozzle Dia. & Pressure. As shown in chart, for 0.20 sm³/h(NG) heat input, the manifold pressure required are 1.5"WC for 0.250" dia.burner, 10mbar for 5mm dia.burner and 14mbar for 4.5mm dia.burner.

Typical Maximum Fire Pressures					
Forehearth Burner Nozzles Diameters and Manifold Pressure Comparison Table					
	0.250" dia	5mm dia	4.5mm dia	Heat Input	
	"WC	mbar	mbar	Nat Gas	LPG
				sm ³ /h	
	0.75	5	7	0.14	0.06
	1.5	10	14	0.20	0.08
	2	13	17	0.23	0.09
	2.5	16	24	0.26	0.10
	3	20	28	0.29	0.11
	4	25	37	0.33	0.13
	6	38	57	0.41	0.16
	8	50	70	0.47	0.19
Suggested Manifold Pressure Target Equalising					
Suggested Manifold Pressure Target Cooling Zones					

Figure 4.14

types of electric heating system in forehearths, one as boosting system typically used in conditioning zone and other one used in entire FH & WE as heating media along with or without NG/ LPG.

The electric forehearth heating, also called forehearth boosting, is used to improve the glass quality / homogeneity. With specially designed molybdenum forehearth electrodes, the power will be inserted into the glass. For easier installation, the molybdenum electrodes are available with or without coating. Typical electric boosting system is shown in Figure 4.15 (System by HORN).

The forehearth electrodes are installed in the equalising section of the forehearth. A standard boosting installation consists of four electrodes per side / eight per forehearth, upon customers' request, other quantities are also possible. The electrodes have a diameter of 45 mm and the installation holes are cooled via air (cooling water is not necessary). The electrical boosting system is recommended for glasses with low thermal conductivity (amber & green).

- For multi gob production (TG / QG ...) with high TH (Thermal Homogeneity) index requirement
- For press & blow forming processes
- For high flexible FH systems with a wide pull range and often job changes
- Improve the TH index from existing FH installations with inadequate performance

2.5.2 All Electric Heated Forehearth: M/s Electroglass is supplying such all electric fired forehearths. Figure 4.16 shows the arrangement of electrodes in forehearth.

With improved technologies, now one

Typical Natural Gas Flows

NG Flow in standard cubic feet/Hr (1scfh=0.02832 Sm ³ /hr @ 15°C (59°F))			
Typical (100 burners)	Nat. Gas Flow scfh	Nat. Gas Flow scfh	Nat. Gas Flow scfh
Manifold Pressure	Nozzle Dia. 0.185"	Nozzle Dia. 0.213"	Nozzle Dia. 0.250"
0.5"WC	224	297	409
0.1"WC	317	421	580
2.0"WC	450	597	822
4.0"WC	639	848	1,168
8.0"WC	913	1,210	1,667
16.0"WC	1,314	1,742	2,400

Figure 4.15

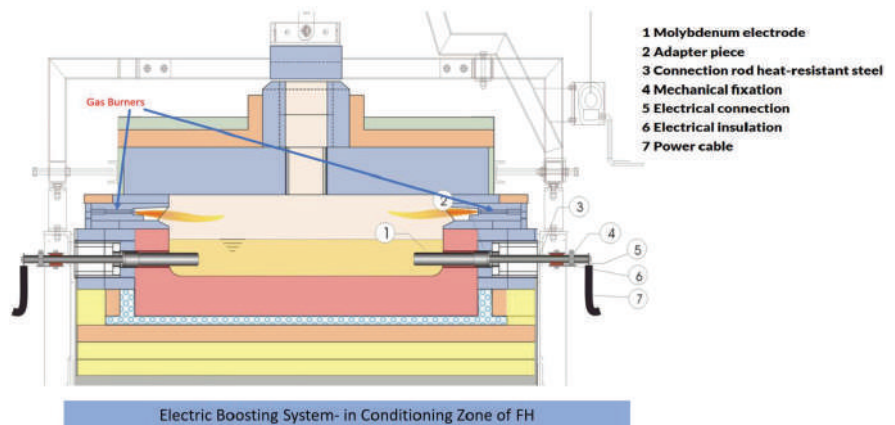


Figure 4.16

can have heating in forehearths using NG/LPG, electric or in combination of these systems. To get better TH, many new designs are still evolving.

2.6 Cooling system

Normally, cooling is introduced in working end (distributor) and cooling sections of forehearths. It is not recommended in equalising section.

There are different types of cooling systems in forehearth. They are:

- Direct top cooling
- Indirect top cooling
- Indirect bottom cooling
- Combination of all above types

2.6.1 Direct top cooling system: This is very quick and effective system to cool glass. It should be properly controlled to avoid glass quality issues

like formation of bubbles & blisters due to heavy sudden cooling (refer Figure 4.18).

2.6.2 Indirect cooling: The following Figure 4.19 shows indirect air-cooling system, where the cooling of glass is done by removing the heat from the passage area (chamber) inside the superstructure of the forehearth. As the cold air cools the super structure and gets hotter while passing through the channel, makes the glass to release more and more heat to the channel by radiation. This creates cooling of glass. The cooling can be increased or decreased by increasing or decreasing the cooling air flow.

2.6.3 Indirect bottom cooling: Forehearth glass also can be cooled by bottom cooling as shown in Figure 4.20. This type of cooling is generally

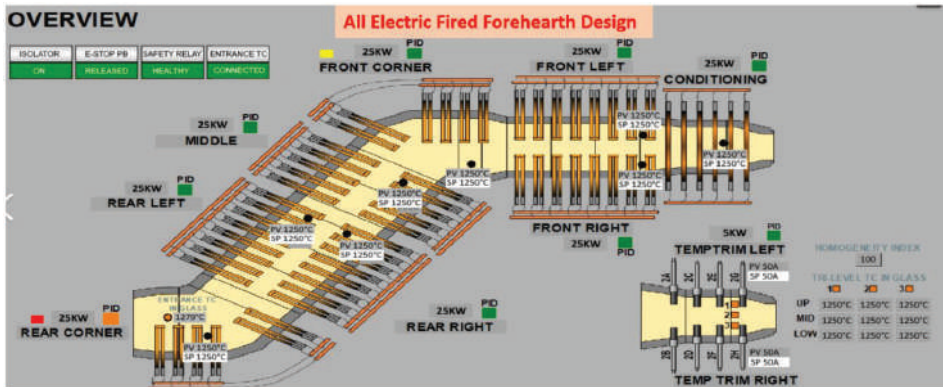


Figure 4.17

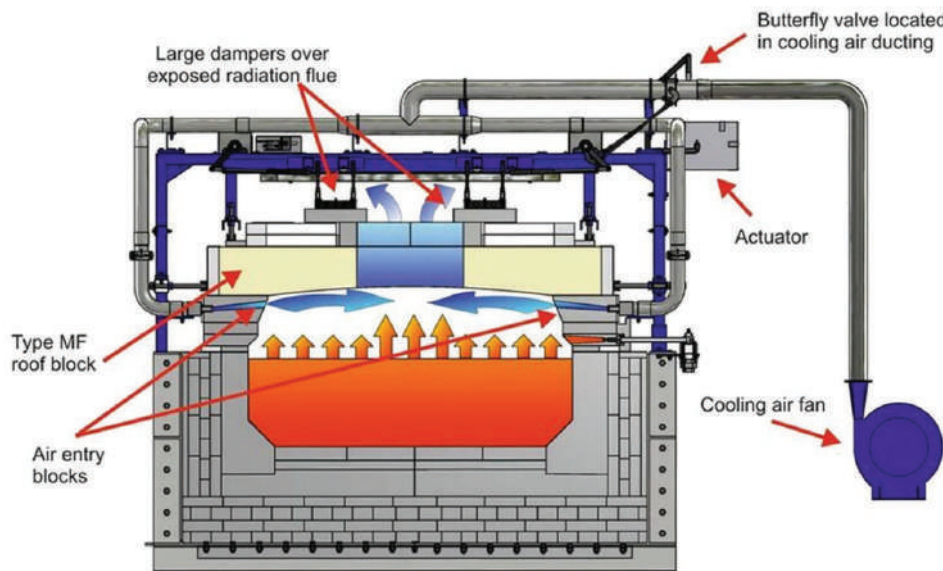


Figure 4.18

applied in Rear zone of the forehearth only. This type of cooling is useful for high tonnage to get better thermal homogeneity (TH).

2.6.4 Combination Cooling: For effective cooling, combination of direct, indirect & bottom cooling is adopted. Considering the draw,

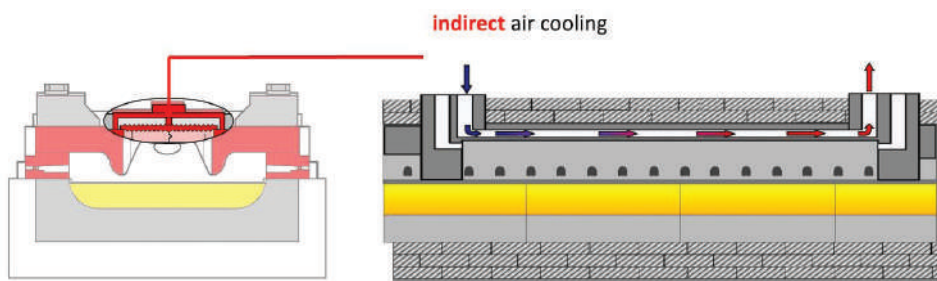


Figure 4.19

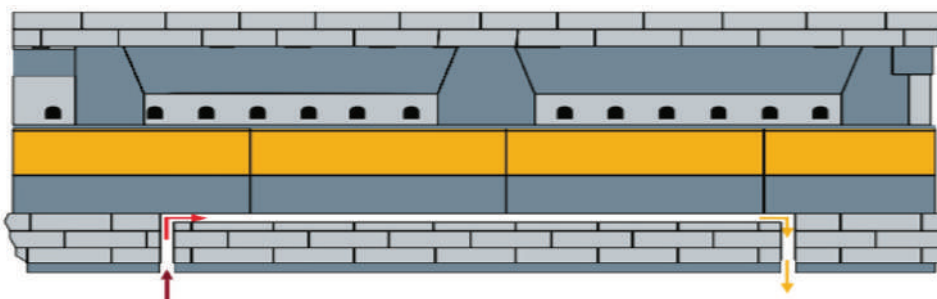


Figure 4.20

glass properties, temperature etc., the usage of cooling can be applied accordingly and it can be controlled automatically by increasing or decreasing the cooling air flow. Figure 4.21 shows the combination cooling.

2.7 Forehearth selection guidelines:

Forehearth should run in minimum heating and cooling for higher TH. With higher cooling and higher heating, the glass conditioning may not be very effective and may lead to lower TH. If a forehearth is selected for very high range of pulls, it will be highly inefficient at lower pull range. Hence, for achieving better result, proper selection of forehearth is very important. The high pull limit of a FH is set by its cooling capacity. At the high pull limit, a small increase in pull results in unacceptable glass conditioning (gob becomes too hot). Low pull limit is set by insulation and heating capacity of forehearth.

As this limit approaches, the glass homogeneity & quality deteriorates.

Following guidelines may be considered for selection of forehearths:

2.7.1 Forehearth Width Selection Guide:

Following Figure 4.22 indicates FH width vs. glass pull.

2.7.2 Spout selection Guide for Forehearths:

Type of spout vs. draw, ref Figure 4.23

2.7.3 Metering spout has many advantages

Besides regulating glass flow, metering spout forms gobs of consistent weight, shape and temperature. The spout throat and advanced orifice ring have an elliptical shape as in Figure

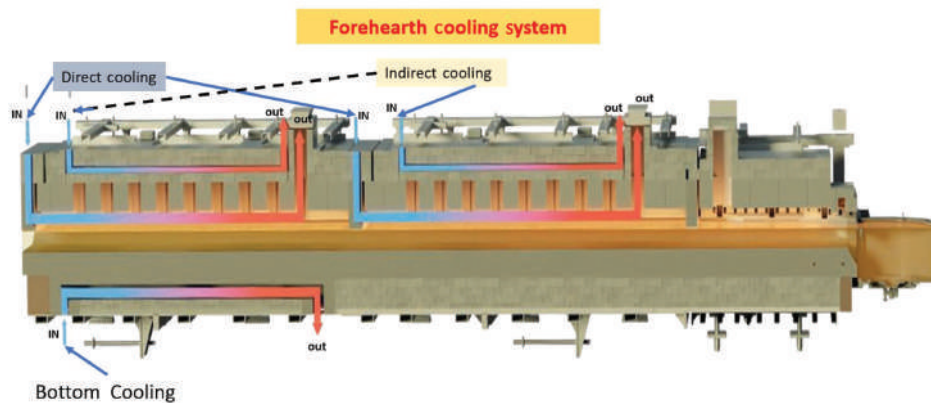


Figure 4.21

Forehearth Width selection chart

Width	Spout	Pull T/day
26"	144 Std	9 - 18
	144 Deep	8 - 32
	81 Std	10 - 35
	81 Deep	27 - 55
36"	81 Deep	35 - 70
	503	40 - 80
42"	503 & 515	45 - 90
		55 - 100
48"	515	60 - 130
54"	585 Std	90 - 180
	585 Deep	100 - 120

Figure 4.22

Spout selection chart

Spout Type	Spout Width	Glass Depth	Pull T/day
144 Std [81 Std Casing]	14"	6"	4.5 - 18
144 Deep [81 Deep Casing]	14"	9"	8 - 32
81 Std	18"	6"	10 - 40
81 Deep	18"	9"	27 - 68
503 [555/503]	22"	10"	45 - 90
515 [555/515] [503 Casing + Spacer]	24"	12"	90 - 136
585 Std	28"	12"	130 - 180
585 Deep	28"	14"	150 - 200
Metering Spout, which is developed recently available for 81, 503, 515, 555 and 585 Spouts			

Figure 4.23

4.24. This shape provides equal flow to each orifice. The heat baffle directs downward the spout fire coming through the tube vent holes. Deflecting the spout fire downward provides better gob temperature control. Benefits of installing metering spouts are:

- Reduced gob weight variations - cut to cut and orifice to orifice
- Gob temperature is more uniform- cut to cut and orifice to orifice
- Improved gob shape and gob bowing reduced (double and triple gob)
- Improved life of orifice ring and tube
- Orifice ring cooling eliminated

2.7.4 Some of the universal forehearth features are shown in Figure 4.25

Recommended Forehearth and working end design requirements:

For smooth operation of the Forehearth & distributor, following are the minimum requirements, to consider.

- Install one independent heating & cooling zone in riser with in-glass temperature measurement.
- Have one heating & cooling zone for each forehearth entry in distributor with auto controls.
- In rear zone, have auto heating and cooling (direct, indirect and bottom cooling) with provision to control cooling (direct, indirect and bottom) and trilevel temperature measurement at the centre of the zone exit.
- In middle zone, have auto direct and indirect cooling with provision to control each of them and trilevel temperature measurement at the centre of the exit of the zone.

- In conditioning zone, have three tri- level temperature measurement systems with auto heating control. Electric

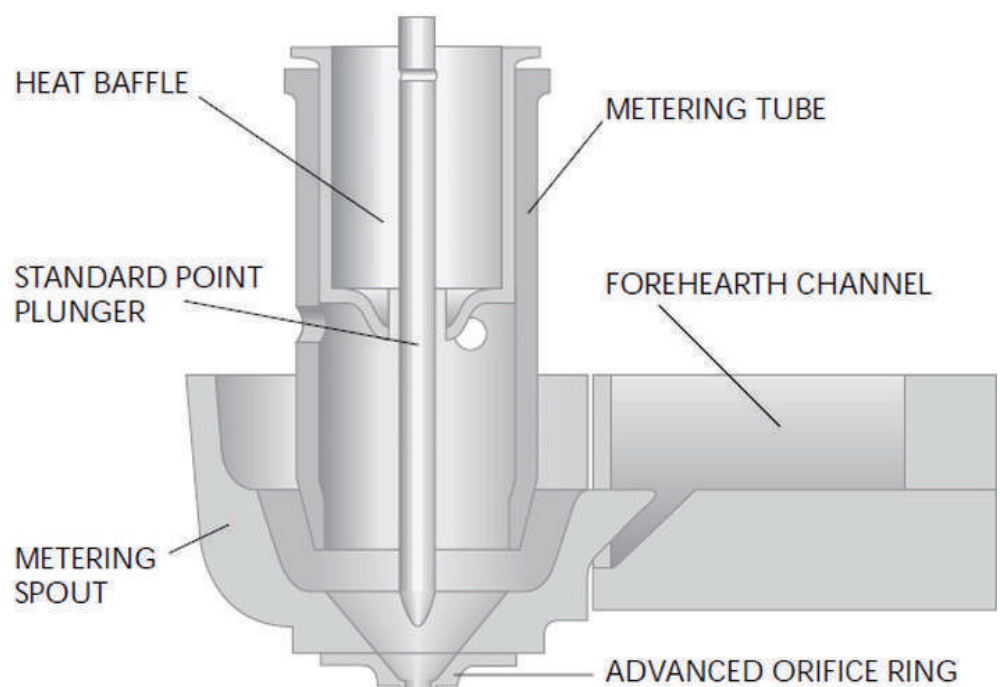


Figure 4.24

Universal Forehearth Features

- **4' long Equalising** [or 6' for coloured glass and high pull forehearths]
- **Two Cooling Sections**
- **Profile Channel** [Glass contact material AZS. Fused Alumina often used where higher glass quality is required]
- **Substructure Insulation** [Bottom - 1000W/m², Sides – 800W/m²]
- **Pre-mix Burners** [4-1/2" centre burner nozzles]

Figure 4.25

boosting recommended for improving thermal homogeneity. Recommended TC requirements are shown in Figure 4.26.

- Thermal homogeneity index to be calculated and monitored automatically. Suitable SCADA or any other good system should be installed for automation and monitoring.
- Stirrers in conditioning zone is advised. it will increase TH index

near to 100%.

- Conti-drain or Vari-drain is recommended in conditioning zone. This will be useful for avoiding cat-scratch defect in speciality bottles. Also suitable to maintain draw in particular forehearth, especially in speciality glass production. Images of Conti-drain (SORG) and Vari-Drain (HORN Glass) are shown in Figure 4.27.

- With the automation and digitisation demand increasing for quality, it is better to go for good AI system with data monitoring. It will enhance performance, quality & ease of operation.

- Energy consumption metering and analysis details for each FH and WE will help to monitor the Energy consumed.

- SORG make OMT (Oxygen Metering Trim) system may be installed to control air- fuel ratio automatically.

- Install test burner in every zones to check the flame condition manually.

3. FOREHEARTH EFFICIENCY OR THERMAL HOMOGENEITY CALCULATION

It is important to have three Tri-level thermocouples (TC) in equalising section to have better monitoring of glass temperature for higher forming efficiency. Forehearth efficiency indicator or TH indicator is a good indicator of glass homogeneity. However, forehearth efficiency is not an end in itself; it is a useful tool at best. Production efficiency is a more appropriate measure.

3.1 Equalising section thermocouple locations

The usual position for these thermocouples is in a plane 10" to 14" back from the edge of the final channel block before the spout.

Whilst the centre thermocouple is on the centreline of the forehearth, there is no commonly accepted position for the side tri- level thermocouples. The reason for this is understandable in view of the different shapes of the transition channel block. However,

Recommended Temperature Measurement Points

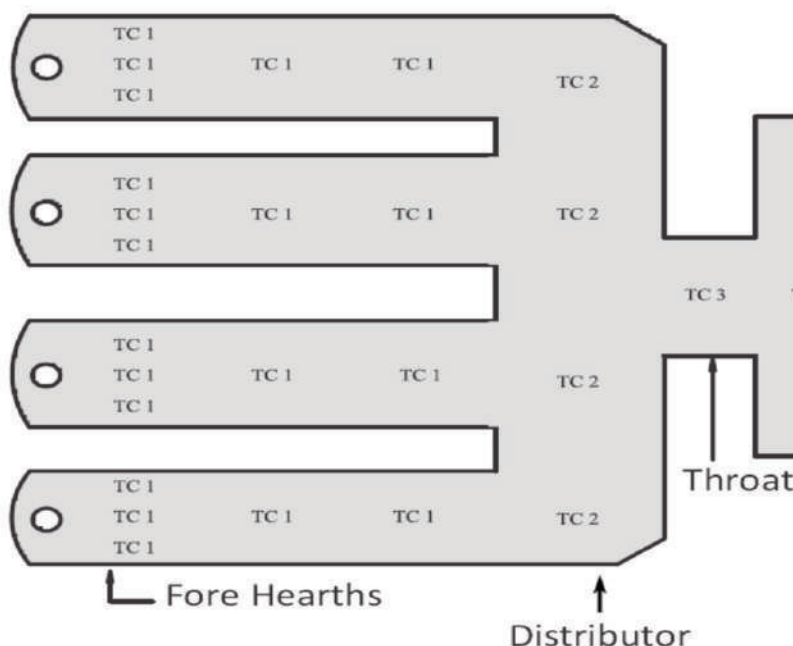


Figure 4.26

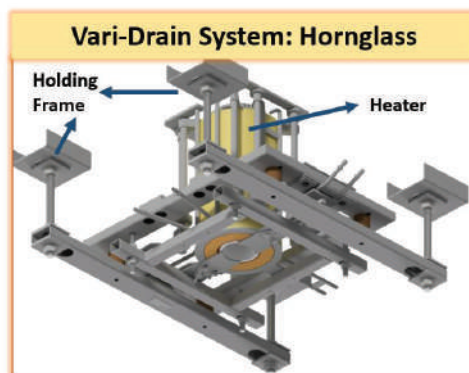


Figure 4.27

the position of the side thermocouple relative to the channel side is critical if a comparison of forehearth efficiencies between forehearth is to be made. For this reason, it is not usually useful to compare the forehearth efficiencies of forehearth unless the equalising/spout set-up is identical. Indicative distances from the centreline for the side thermocouples are 6" for 26", 10" for 36" and 12" for 42" and wider forehearth. Care must be taken to ensure the thermocouple does not interfere with the channel side profile because this will result in the side thermocouples being raised relative to the centre thermocouple.

Clearly, arrangements where the side thermocouples are closer to the centre will result in 'higher' forehearth efficiencies when compared with a similar forehearth where the side sensors are placed further apart. Hence, while comparing the thermal efficiencies of different forehearth, the position of thermocouples is also to be taken into account.

3.2 Forehearth efficiency calculations

It is generally accepted that the most important source of glass for the gob comes from that triangular section as shown in Figure 4.28, between the centre top and the bottom sides. This is not to say that

the middle and top side glass is unimportant, it is just less important. It is also common, particularly in forehearth with electric side heating or independent side to side firing, to accept that side glass temperatures of up to around 5°C higher than the centre are desirable. However, it must be stressed that the most important requirement for consistent gobs is consistent glass. It is almost certainly better to strive for less homogeneous but consistent glass than glass with a higher but varying forehearth efficiency.

There are different approaches to forehearth efficiency calculations and it is not particularly important which method is used. Some methods only use the three centre and the bottom side thermocouples others use all nine thermocouple readings. It is also

possible to use only two tri-levels by assuming that the missing side readings are identical to the installed side. If a side offset temperature is desired, the offset needs to be taken into account in the calculation.

In essence, the calculation is a sum of the six sides to centre temperatures differences, and three top to bottom temperature differences as in Figure 4.29. For calculations involving only two tri-level thermocouples and/or those ignoring the side top and middle measurements, the appropriate differences are duplicated so that there are a total of six side differences and three top to bottom differences. The forehearth efficiency is formed by subtracting from 100 the result of the sum of the differences multiplied by 100 but divided by a centreline temperature. Taking account of the desired side offset temperature might enable the calculated forehearth efficiency to approach closer to 100%.

9 (A to F) Forehearth Temperature Differences in Figure 4.29

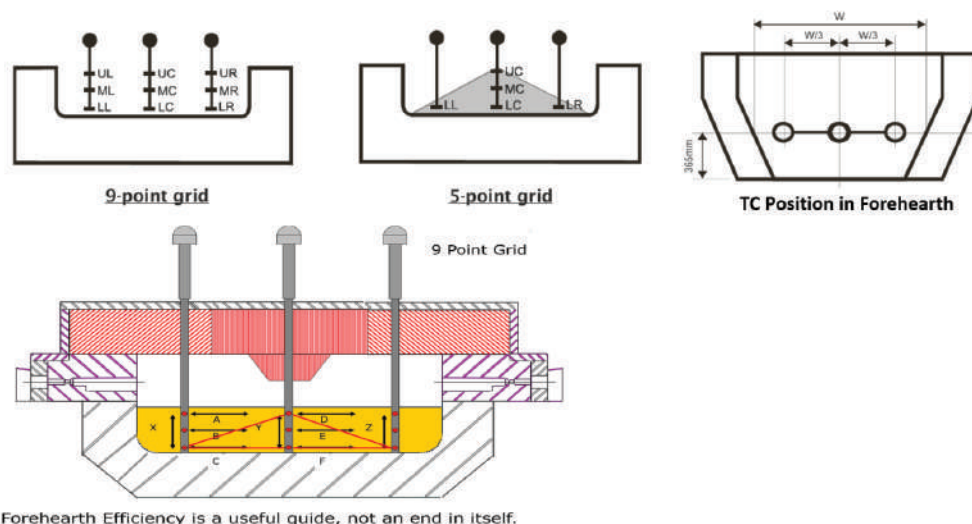
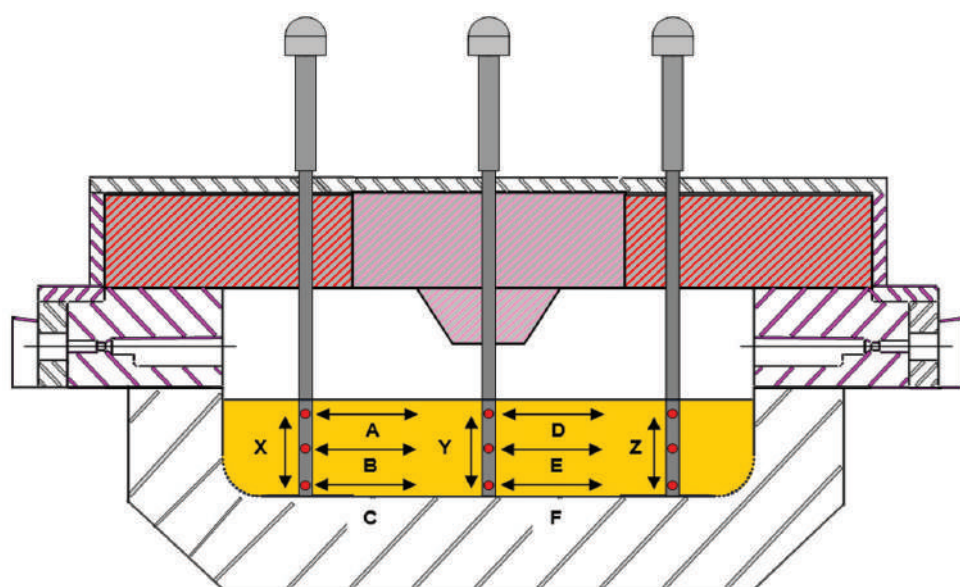


Figure 4.28



Temperature Differences

Figure 4.29

as it has direct bearing on forming efficiency.

4.1 Forehearth operation

- Forehearth operation starts from the start of FH & WE heat-up. Following important guidelines to be followed:
- Ensure that the FH & WE construction is done as per the design & construction standards. Important parameters like FH centre lines, FH levels and clearance between joints to be thoroughly checked & ensured.

Notice that the various methods give slightly different values for the forehearth efficiency. It is the change in the calculated value that is used to access the improvement or otherwise in glass conditioning with setpoint changes. For flint, forehearth efficiencies over 95% are usually achievable whereas with the darker glasses the value is more likely to be in the range 90% to 95% unless electric side heating is installed. The decision to try to improve glass homogeneity should be based on the results of the forming process; not the absolute result of the forehearth efficiency calculation.

4. FOREHEARTH OPERATION AND MAINTENANCE

It is very important that the forehearths are operated well to get good glass homogeneity and also maintained well to get good results, consistently. In many glass companies, forehearth operation & maintenance is the most neglected area where as it is a very important function to get highest forming efficiency. Dedicated staff should be given the responsibility to operate & maintain the forehearths

Example 1: Nine Points with a side offset of 2°C

	Left Side	Centre	Right Side
Top	1164	1160	1163
Middle	1162	1163	1164
Bottom	1160	1162	1161

		Difference	Value	Value with Offset
1	Left Side Top to Bottom (X)	1164-1160	4	4
2	Centre Top to Bottom (Y)	1160-1162	2	2
3	Right Side Top to Bottom (Z)	1163-1161	2	2
4	Top Left Side to Centre (A)	(1164-2)-1160	2	4
5	Middle Left Side to Centre (B)	(1162-2)-1163	3	1
6	Bottom Left Side to Centre (C)	(1160-2)-1162	4	2
7	Top Right Side to Centre (D)	(1163-2)-1160	1	3
8	Middle Right Side to Centre (E)	(1164-2)-1163	1	1
9	Bottom Right Side to Centre (F)	(1161-2)-1162	3	1
	Total		22	20

$$\text{Forehearth Efficiency} = 100\% - [22 \times 100] / 1162 = 100 - 1.89 = 98.1\%$$

Example 2: Five Points with a side offset of 2°C

	Left Side	Centre	Right Side
Top	(1164)	1160	(1163)
Middle	(1162)	1163	(1164)
Bottom	1160	1162	1161

		Difference	Value	
2	Centre Top to Bottom (Y)	1160-1162	2 x 3	6
6	Bottom Left Side to Centre (C)	(1160-2)-1162	4 x 3	12
9	Bottom Right Side to Centre (F)	(1161-2)-1162	3 x 3	9
	Total			27

$$\text{Forehearth Efficiency} = 100\% - [27 \times 100] / 1162 = 100 - 2.32 = 97.7\%$$

Example 3: Six Points with a side offset of 2°C

	Left Side	Centre	Right Side
Top	1164	1160	(1163)
Middle	1162	1163	(1164)
Bottom	1160	1162	(1161)

		Difference	Value	Value with offset
1	Left Side Top to Bottom (X)	1164-1160	4 x 2	8
2	Centre Top to Bottom (Y)	1160-1162	2	2
4	Top Left Side to Centre (A)	(1164-2)-1160	2 x 2	4
5	Middle Left Side to Centre (B)	(1162-2)-1163	3 x 2	6
6	Bottom Left Side to Centre (C)	(1160-2)-1162	4 x 2	8
			Total	28

$$\text{Forehearth Efficiency} = 100\% - [28 \times 100]/1162 = 100 - 2.41 = 97.6\%$$

- c) Before heat-up, ensure that the entire FH is thoroughly cleaned & vacuumed to avoid any contamination issue in operation.
- d) Proper heat-up as per heat-up procedure to be done. Use of expert agencies in heat-up is recommended for control of expansion, temperature monitoring & recording and draining.
- e) Operate the FH within the design limits (draw & temperature) to get better TH.
- f) Plan job changes for the month with draw changes in upward or downward trend so that there are minimum changes in draw, temperature, orifice ring size, gob conversions, plunger changes etc. Avoid drastic changes as glass condition may take very long time for stable operation. Also, drastic changes may lead to cold glass formation, bubbles & blisters formation and glass level issues in forehearth.
- g) Proper orifice ring change procedure, tube and plunger changing procedures to be followed to get quicker glass conditioning. Procedure is explained in glass forming chapter.
- h) When there are unavoidable drastic changes, start adjusting temperature one hour before job change. If there is orifice ring change, plunger change and tube change, then increase temperature by 20 to 30 degrees in zones before 30 minutes of job change so that during stoppage of glass draining, glass is not getting too much cold. However, the changes made should be communicated to forming operators so that they can take care of any changes by close monitoring.

4.2 Forehearth operation suggestions for different Glasses

Conditioning and glass colour

The dark coloured glasses are much more difficult to condition than flint or light green glass. This is due to the transmission properties of the glass and its effect on radiation heat transfer. It is much easier to chill coloured glasses on the top surface. Because of this poorer radiation heat transfer, dark green and amber glasses have a relatively larger heat loss from the sides and bottom. It follows that a particular forehearth in flint will have a wider operational pull range than in dark green.

4.2.1 Conditioning of amber glass

When amber glass enters the forehearth, the bottom glass tends to fall in temperature because heat is removed by conduction through the channel walls at a faster rate than can be initially replaced by radiation heat transfer from the burners at a moderate manifold pressure. Thus, the manifold pressure in the rear zone of forehearth is increased to improve the radiation heat transfer to the bottom glass. A typical manifold pressure for a low-pressure firing system is in the range 2½" to 3½" WC. Significant cooling wind is only necessary in the rear forehearth when the temperature of the bottom glass at forehearth entry is such that heat loss through the channel wall is insufficient to reduce the temperature enough for satisfactory gobs. This is usually necessary at higher pull rates. The burner manifold pressure still needs to be reasonably high to ensure that the sidewall temperature loss is not too great, say 2" to 3" WC.

This approach usually results in the middle and top glass attaining temperatures higher than necessary. Now, as the glass enters the middle zone of forehearth, cooling wind is necessary to be applied to reduce the temperature of the slightly over-heated top and middle glass. It will still be necessary to maintain sufficient burner manifold pressure to prevent excessive heat loss from the channel side walls. A typical manifold pressure for a low-pressure firing system is in the range 1½" to 2" WC. At lower pulls, the cooling wind will need to be reduced or even turned off and higher manifold pressures will be required in both the front and rear forehearts.

In the equalising section where there is usually no forced cooling, the burner manifold pressure has to be set to achieve an equalisation between the top, middle and bottom

glass temperatures. About 1" WC is suggested as a minimum manifold pressure for normal operation to reduce heat loss from the side glass.

The purpose of spout firing is to provide sufficient heat to prevent the build-up of cold glass inside the tube and on the feeder plungers. A manifold pressure in the range 1" to 2" WC is usually adequate. It is important that the spout firing does not interfere with the equalising firing and this means that there should not be a large difference in manifold pressures in these zones. Altering the exit area of the equalising section exhaust flues by offsetting the chimney cap might be necessary.

With amber, glass depths in the equalising section of 4¾" to 5¼" are becoming more accepted.

4.2.2 Conditioning of flint (and light green glass)

With flint, the bottom glass tends to lose less temperature than amber glass because the transmission properties of flint make radiation heat transfer significantly more efficient. The heat loss by conduction remains much the same as with amber. This means that, if cooling wind is required, it can be applied in the rear zone of forehearth. A typical manifold pressure for a low-pressure firing system with cooling wind in operation is in the range 1½" to 2½" WC. Clearly, higher manifold pressures will be required if no cooling wind is necessary and the pull rate is such that heat lost through the channel becomes more significant.

There is often little or no cooling wind applied in the middle zone of forehearth unless the pull rate is particularly high. As most of the necessary cooling has taken place in the rear zone of forehearth, the top and middle glass might be again over cooled. The burner manifold pressure has to be re-adjusted to

obtain the correct temperatures as the glass enters the spout. Typically, the manifold pressures are similar to, or slightly lower than, those in the rear zone of forehearth.

The operation of the equalising and spout zones is rather independent of glass colour; see Amber discussion earlier.

With Flint, glass depths in the Equalising section of up to 5½" are usual.

4.2.3 Conditioning of emerald and dark green glass

The approach to conditioning the darker green glass is similar to that for amber glass. The major difference is that these glasses have even poorer transmission properties than amber. Consequently, the opportunity for over-cooling the top glass to such an extent that this chilled glass almost prevents radiation heat transfer and channelling of the middle glass builds up to destroy all efforts at conditioning. This is a particular problem at high pull rates where a large quantity of heat has to be removed from the glass. Notice that, as the top glass becomes colder, the heat loss of glass at the spout increases dramatically.

Thus, it is very important to minimise the use of cooling wind in these cases.

It is often necessary to endeavour to reduce throat and distributor temperatures if at all possible. Lower furnace exit temperatures are becoming a more common strategy for handling the darker glasses.

As with amber glass, running at shallower glass depths usually simplifies the glass conditioning problem. With the darker colours, glass depths in the equalising section of 4½" to 5" are becoming more accepted.

4.2.4 Examples of glass conditioning cases

Correction using the centre equalising tri-level reading.

Example 1: A FH has flint glass draw of 75 tonnes per day and centre equalising tri-level temperatures in degree Celsius are 1175 (top), 1165 (Middle) and 1150 (bottom). Improve the Glass Condition.

Action: As mentioned earlier, to alter the bottom glass temperature, will require a temperature change in the rear zone of forehearth or even the distributor. Since this will almost certainly over-heat or over-cool the top glass, it will be necessary to redress this over-correction in the middle zone of forehearth. To alter the middle glass, it will be necessary to change the set point(s) in the Middle Zone of Forehearth and the top glass temperature is changed in the equalising section. It is important to realise that changes made in the forehearth will take time to be reflected in the equalising thermocouples. Forehearth residence time is a useful indicator of the time lag between making an alteration in the rear zone of forehearth and the effect of the change being observed in the equalising thermocouples. About half this time is the lag for changes in the middle zone of forehearth to reach the equalising thermocouples and a quarter of this time for equalising section changes.

In the above example, it was necessary to increase the bottom glass temperature by 40°C. The actual change required in the rear forehearth set point was 40°C and an even larger change would have been necessary if the pull rate was lower. To take into account the over-heating of the top glass as a result of the change in the rear zone, an increase was made to the flow of cooling wind. The burner manifold pressure was held at 1¾" WC. The result, after

adjusting the temperature and cooling in rear zone was:

	Before	Desired	Achieved
Top	1175	1160	1160
Middle	1165	1160	1161
Bottom	1150	1160	1159

Example 2: A FH has amber glass draw of 80 tonnes per day and tri-level temperatures as in Figure 4.30 with homogeneity of 81%. Glass depth is 5¾". Improve the Glass condition.

80 tonnes per day Amber, Equalising Tri-level Temperatures as following Forehearth Efficiency - 81%			
	Before		
	Left	Centre	Right
Top		1161	
Middle		1162	
Bottom	1123	1163	1130

Figure 4.30

Action: Reduction in glass level in FH. This is often the most effective method of improving glass conditioning, particularly for darker glasses where the cooler side glass is a common problem. Reducing the glass depth improves both the heating and cooling efficiency.

Heat transfer by radiation from the hot roof refractory into the side glass and from the cool roof refractory along the centre-line is much more effective with reduced glass depth. Thus, less cooling wind is required and this tends to allow an even higher manifold pressure to be used. Radiation heat transfer is a function of the fourth power of the radiating and absorbing material temperature and the transmissivity of the materials. With refractory, the transmissivity is such that radiation or absorption occurs almost exclusively at the surface, however with molten glass heat, radiates through the glass even though the surface glass still radiates rather more than deeper glass.

	Before			Achieved		
	Left	Centre	Right	Left	Centre	Right
Top		1161			1159	
Middle		1162			1158	
Bottom	1123	1163	1130	1144	1160	1150

Figure 4.31

Although a gross over simplification, flint that is 5½" deep behaves in a similar manner to 4¾" of amber and 4" of dark green glass.

The changes brought about to the glass conditioning in the example above result from altering the glass depth from 5¾" to 4¾". It should be noted that glass head loss is more severe with a shallower glass depth. With forehearth running a wide range of pull rates there are various mechanical arrangements possible to simplify the task of altering glass level at job change. Usually this is not necessary for forehearths running a narrow range of tonnages.

The result was that after the glass depth reduction, forehearth efficiency reached to 93% (forehearth efficiency - before 81%) and temperatures were as in Figure 4.31.

Example 3: 80 tons per day amber, equalising tri-level temperatures as in Figure 4.32

80T per day Amber Forehearth, having Equalising tri-level temperatures as below with Forehearth Thermal Homogeneity of 79%			
	Before		
	Left	Centre	Right
Top		1160	
Middle		1155	
Bottom	1120	1156	1115

Figure 4.32

Action: Electric side heating

Forehearths running darker glasses often have four or six 32mm diameter molybdenum electrodes

installed in each side of the Equalising section. Each side has its own single phase, centre tap transformer with about 4kW power per electrode. Alternate electrodes have a common transformer connection. For automatic control, a thyristor is used and the control temperature sensor is usually the appropriate bottom side thermocouple. The operating voltage is usually less than 50V and the maximum current per electrode should not exceed 50A.

The electrodes are installed about 210mm apart, 60mm from the channel floor and have an emersion length of 100mm. The centre tap of the transformer can be used to apply a dc bias (about 1.5V at 30mA) through a choke to an earth electrode in the distributor if blister generated by the electrodes becomes a problem in flint glass. Ensure that there is no physical interference between the electrodes and the side thermocouples.

The installation of electric side heating is quite common in forehearths with coloured glasses supplying forming machines producing light weight containers. Although the efficient use of electric side heating may result in a reduction in burner manifold pressures, it is unlikely to reduce operating costs. Initial electric heating installations resulted in premature failure of the channel refractory around the electrode but such failure is no longer a problem. Pre-installation sealing of the electrodes with sodium silicate and careful heat-up has reduced the incidence of electrode failure. Continuous

current and voltage monitoring can help detect electrode failure. Once installed, electrodes usually require at least a small power input to counteract the heat loss induced by the electrode itself. Undoubtedly electric side heating is very effective in many situations, but it appears to break the generally accepted rule that the glass should be allowed to 'rest' in the equalising section.

After switching on the electric side heating in conditioning zone, the result was achieved as shown in Figure 4.33, with 98% thermal efficiency.

4.3 Maintenance

The following is a list of maintenance items and suggestions, why they should be performed. Depending on the requirements of a particular plant, it is possible to establish time intervals in which maintenance should be performed.

- a) Removal of all build up on the exterior of the forehearth should be performed at least once in three months or more often depending upon environment. This build-up of dust and swab dope is a fire hazard. An industrial vacuum cleaner with a stainless-steel drum and hose will remove this build up effectively and quickly.
- b) The skimmer (and baffle/mantle blocks) block must remain about 1/2" above the glass surface. Keeping such a distance is a reasonable compromise between a useful isolation of combustion products and refractory contamination of the glass that may arise from actual emersion. Until it has been determined how rapidly the skimmer block will wear, it should be checked carefully at least once a month. The skimmer should be placed against the back of the cooling

After switching on the Electric side heating in Conditioning zone, the following result was achieved, with 98% Thermal Efficiency.

	Before			Achieved		
	Left	Centre	Right	Left	Centre	Right
Top		1160			1154	
Middle		1155			1155	
Bottom	1120	1156	1115	1150	1154	1149

Figure 4.33

- section, not against the mantle block. The gap between the mantle and skimmer block should be sealed with firebricks. This operation should have been done when the forehearth was commissioned, but can be easily accomplished while in operation. This precaution will prevent debris from falling in from the top.
- c) All burners should be lined up with the burner blocks horizontally and vertically. The expansion should be allowed for at start-up and then accurately realigned after the forehearth reaches operating temperature. Because steel and refractories expand at different rates, burners must be offset before the startup. When properly offset, burners will need very little attention after the forehearth is heated. The burners can be realigned while the forehearth is in operation. Miss-aligned burners can cause inconsistent heating and breaking of the burner blocks.
- d) Joints between burner blocks should be sealed with mortar, thus preventing outside atmosphere from entering the forehearth. Outside atmosphere upsets the control and decreased fuel efficiency.
- e) Burner nozzles should be cleaned at least every three months. A small amount of build-up on or in a burner nozzle drops the heating capacity drastically, causing less efficiency and uneven heating. Back-firing can be caused by partially blocked burner nozzles. Burners can be cleaned while the forehearth is in operation by using the individual burner manifold isolation valves.
- f) Combustion air and cooling wind filters should be changed or cleaned every 30 days or sooner depending on plant conditions. A blocked combustion air filter starves the burner system of air, causing inconsistent firing. Dirt also can work its way through the filter and start to block the burner nozzles, mixers and air valves. A dirty cooling wind filter tends to reduce cooling capacity.
- g) The air/fuel ratio should be checked periodically—make the initial check using the test burner. Once set correctly, the air/fuel ratio is unlikely to change significantly. It is important to check the ratio at minimum fire and maximum fire because to ratio must be consistent over to entire operating range. A poorly set air/fuel ratio results in excessive fuel usage and unsatisfactory control response. A reliable gas analyser can be used to set air/ gas ratios but experienced use of the test burner is usually adequate.
- h) All control valves should be checked every three months or based on requirement, for

smooth operation. The linkages should be checked to insure correct high and low fire limits.

- i) Flue damper and/or exhaust blocks should be cleaned off at least once a month to reduce build-up from restricting the escape of combustion gases and avoid material dropping into the glass and causing cord, streaks or blister.
- j) Check the torque on the clamp screws for the refractory superstructure at least twice a year. The first check should be made approximately one week after the forehearth has reached operating temperature. The torque should be checked frequently during any period (such as draining and refilling for colour change, spout change, etc.) when the forehearth is being heated or cooled significantly. Careful attention will assure that the roof blocks remain in their installed level position. Torque of 10ft lb [14Nm] is appropriate. Over tightening could cause the screws to bend.

5. TROUBLESHOOTING GUIDELINES

Some of the guidelines for troubleshoot the problems that may result from forehearth operation are listed below.

Equalising centre bottom glass too cold:

- Raise temperature set point in rear forehearth cooling zone.
- Reduce the amount of bottom cooling if it is being used.
- Forehearth entry centre bottom glass too cold.

Raise temperature set points in the distributor.

- Raise temperature of glass entering the throat.
- Reduce the amount of bottom cooling if it is being used.
- Firing in cooling section continuously at maximum manifold pressure:

Check temperature sensor operation.

- Check air/gas ratio.
- If occurring in rear zone, forehearth entry temperature too low.
- If occurring in front zone, raise temperature in rear cooling zone.

Firing in cooling section continuously at minimum manifold pressure:

- Check temperature sensor operation.
- Temperature set point may be too low.
- Increase upstream control zone temperature setpoint.
- Incoming glass temperature and/or pull rate exceeding forehearth capacity.
- Lower temperature setpoints in the distributor.
- Lower temperature of glass entering the throat.

Firing in equalising section, both or either side, continuously at maximum pressure:

- Air/Gas ratio out of calibration.
- Increase front cooling control setpoint.
- Check temperature sensor operation.
- Reduce RPM of revolving tube if above 3 RPM. Monitor gob weight.

Firing in equalizing section, both or either side, continuously at minimum pressure:

- Reduce front cooling control setpoint.
- Reduce RPM of revolving tube if above 3 RPM. Monitor gob weights.
- Check temperature sensor operation.

Rear forehearth top cooling on maximum speed:

- Forehearth Entry glass temperature too high.
- Check temperature sensor operation.
- Increase setpoint temperature if forehearth set-up allows.

Excessive temperature oscillation around setpoint in combustion zones

- PID loop settings are not correct (all heating PID parameters should be similar)
- Combustion control mechanical system valve, linkage or motor not functioning properly.
- Purge air (if using infrared sensors) should be checked for quantity, quality and pressure.
- Instrumentation problem.

Combustion temperature does not reach setpoint at maximum valve opening.

- If manifold pressure is not at its maximum when control valve is at its maximum opening, check for dirt accumulation in mixer.
- Burner nozzles partly blocked.
- Adjustable sleeve within adjustable port valve not set for correct maximum operating pressure.
- Control valve port size reduced by accumulated air or oil contamination.
- Control linkage from control

valve to motor not set correctly for maximum valve opening.

- Combustion blower output is being restricted.
- Combustion blower filter needs to be cleaned.
- Temperature of incoming glass too low.

Top cooling zone has excessive temperature oscillations around the setpoint:

- PID loop setting not correct. (All cooling PID parameters should be similar.)
- Check temperature sensor operation.
- Instrumentation problem.

Benefits of colouring forehearths are:

- Wide range of colouring possibilities.
- Forehearth colour transitions are shorter compared to furnace colour transitions. In colouring forehearths, flint to colour transition time is 2 to 8 hours and colour to flint transition is 6 to 10 hours, whereas furnace colour transitions are very much higher (up to 2 to 4 days).
- Increased flexibility and productivity. Required colour bottles can be produced in coloured forehearth and normal

flint glass bottles can be produced in other forehearths parallelly.

- Leads to reduced inventory costs as only the particular forehearth can be converted to colour bottles production of required quantity and other FHs can produce normal flint bottles.
- Lower energy costs.

Colouring Forehearth system:

Following Figure 4.36 shows the colour forehearth arrangement.

Colour Forehearths have following sections:

- Preheat zone (thermal conditioning)

Traditional Color Production

6.0 COLOUR FOREHEARTH

Traditional forehearths are used for conditioning the glass coming from furnace. Whereas, colour forehearths are used for producing special-coloured glasses in forehearth by adding colouring frits or colour concentrates into the flint glass in forehearth.

The traditional colour glass like amber, green or other light green colours, is produced in the furnace as shown in Figure 4.34. The entire furnace & forehearths are producing same colour bottles in all lines.

In colour forehearth, the speciality colour glass is produced in one or two forehearths, as shown Figure 4.35.

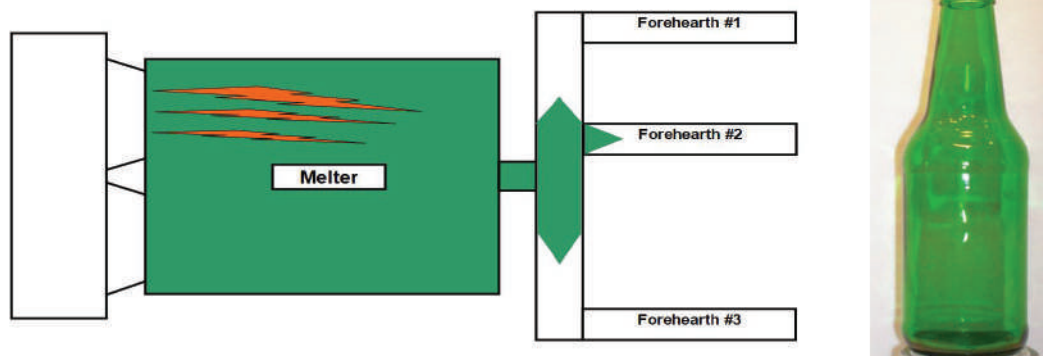


Figure 4.34

Forehearth Coloring

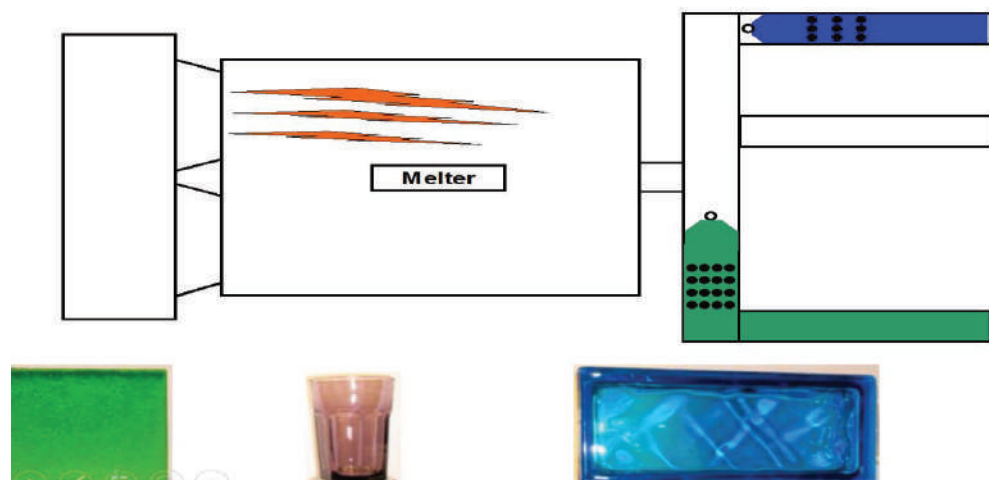


Figure 4.35

2. Melt zone (control temperature & O_2)
3. Stirring zone (blending of colour and glass)
4. Glass conditioning FH zones

General Colouring FH layout

The Figure 4.37 below shows general colour forehearth arrangement. Colour forehearths are generally require 4 to 6 meter extra length to accommodate preheating, dosing, melting and stirring zones. Exact layout of colour Forehearth depends on desired glass pull, desired colours, glass depth limitations and space/layout limitations.

Figure 4.38 shows the additional zones required in colour forehearths, compared to normal forehearths.

The Colour Forehearth Equipments are:

1. Frits hopper / storage silo system
2. Frits weigh & delivery system
3. Frits feeding into FH System
4. Stirring system
5. Temperature control system
6. Stirrer speed and direction

Colour Forehearth can be installed in Alcove of last Forehearth or in straight Forehearths with increased length for colour frits melting, mixing and normal Glass conditioning sections (as normal FH)

A corner can be easily integrated in the colouring area to save space

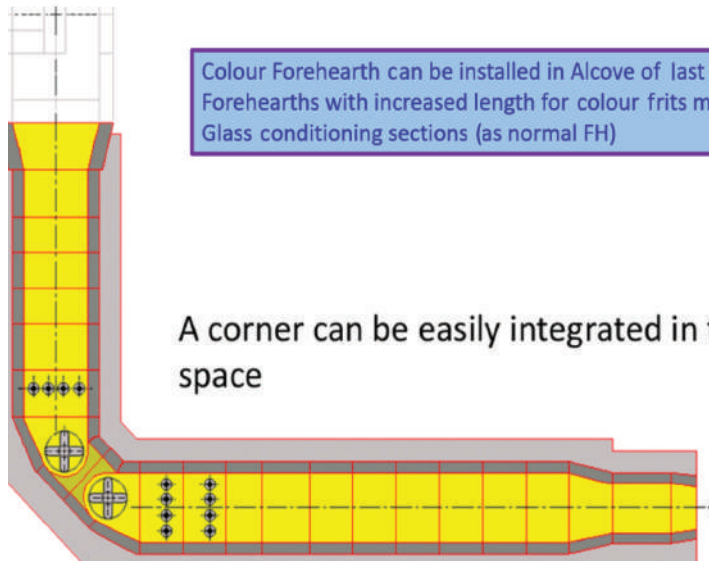


Figure 4.37

control system

7. System- fault alarm system

The overall colour forehearth system is as shown in Figure 4.39

Colour Forehearth operation

Procedure: The general colour conversion procedure from flint to colour, colour to colour and colour to flint are described below. They can vary based on draw, colour, CFH system and site conditions.

a) Flint to Colour Conversion

Increase temperature to the required setting for colour FH, before 2 hrs. of job change. Ensure O_2 setting for combustion as per recommendation for particular colour glass production.

Measure correct draw for colour

glass production in forehearth.

Start feeding colour after Job change as per recommended feed rate. Maintain correct air pressure under feed tube.

Before the feeding the colour frits, ensure that all temperature parameters are obtained.

Ensure that the colour frit is floating for few minutes on glass for oxidation to happen near the frit dosing area.

If colour is more yellowish, reduce oxygen or reduce air under feed tube. If it is less yellowish, increase oxygen in melting area and reduce temperature by 5-10°C.

If colour streaks are observed, increase stirrer speed.

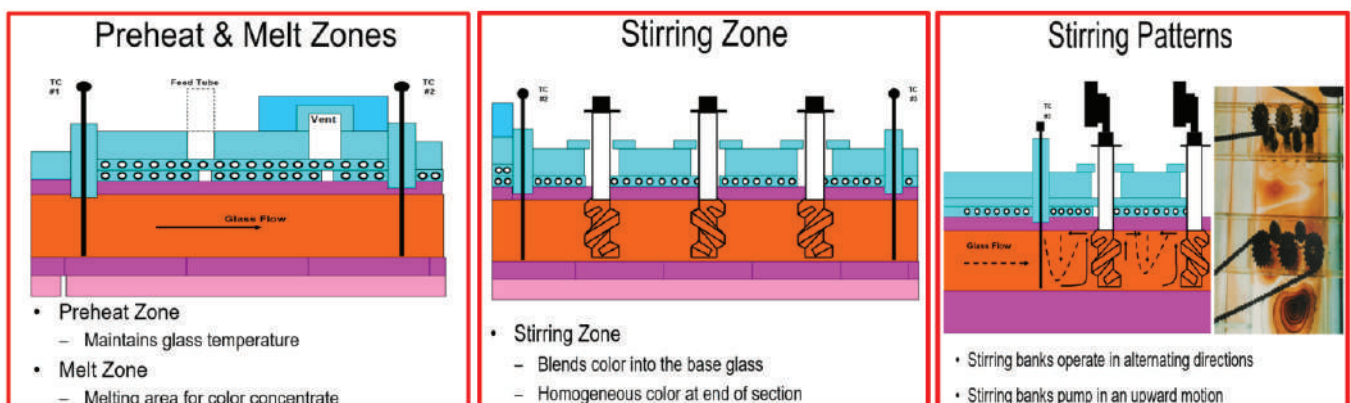


Figure 4.38

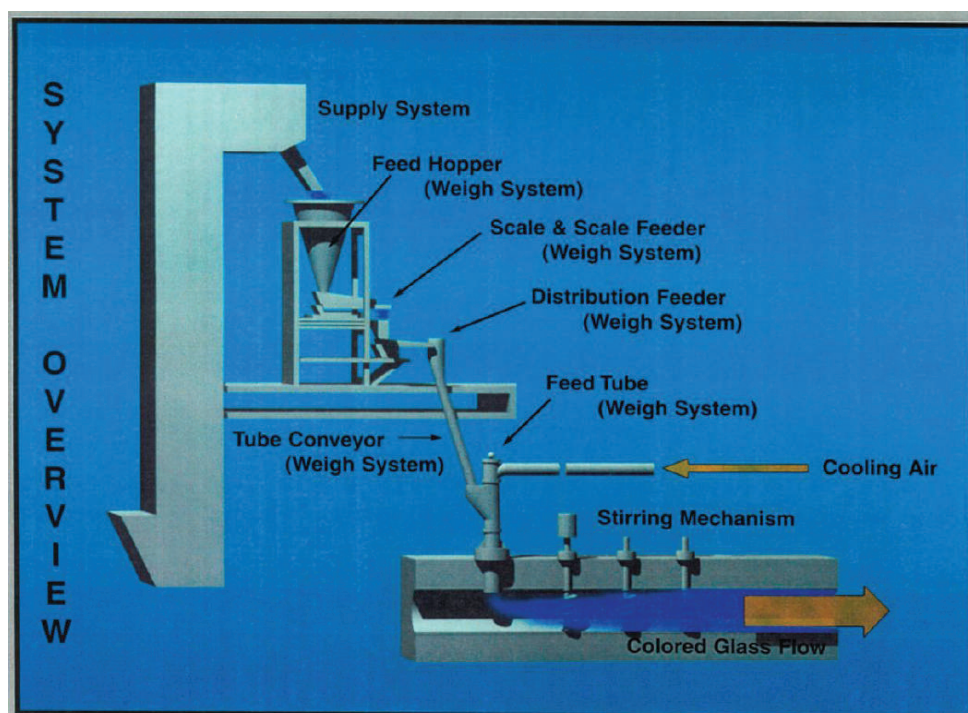


Figure 4.39

the supplier of the colouring forehearth system. M/s SORG, HORN, PSR and FERRO can supply the colour FH system.

General Colourants are:

Chrome oxide
Nickel oxide
Cobalt oxide
Copper oxide
Manganese dioxide
Selenium
Neodymium
Erbium
Iron oxides

Addition of Metal Oxide Frits / Colourants in Glass:

The Figure 4.40 shows the resultant colours by addition of oxides of metals.

Fine tune colour after stable operation by increasing or decreasing the dosage.

b) Forehearth- Colour to Colour change

When changing FH colour to different colour, plan colour change from lighter to darker colours.

If the colour is totally different, stop feeding colour 4 hrs before job change. Increase all zone temperatures by +20°C to flush old colours.

Then start feeding colour as per flint to colour conversion procedure.

c) Forehearth- Colour to Flint change

Stop Feeding the colour frits 4 hrs. before job change.

Increase temperature by 20°C compared to the running job temperature. Use compressed air for flushing the feeding area using 15mm Dia.SS Pipe. Use 2 Bar air pressure. Drain the glass till clear flint.

Then reduce temperature to the required setting by setting back O₂ as per normal FH setting.

Colour forehearth operation and maintenance has to be performed as per the procedure provided by

The colour forehearts are easy to install, if planned during furnace rebuild or new furnace construction. As colour forehearts are expensive and running cost is very high, proper evaluation is to be done for assessing the requirement ■

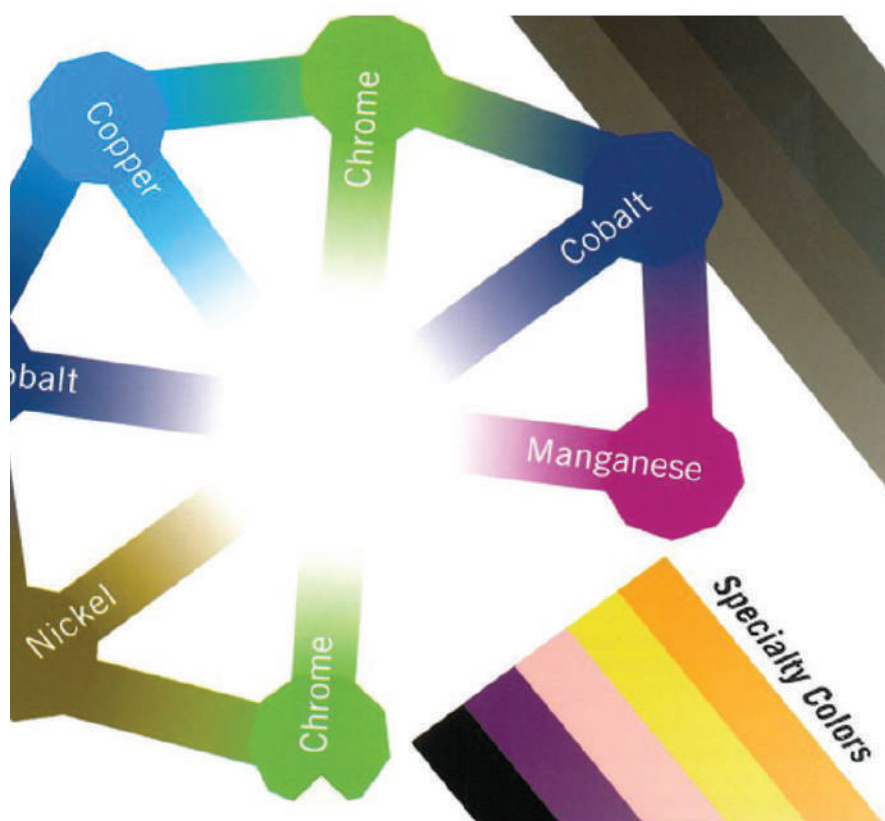


Figure 4.40



Membership of the Federation

Members of the Federation are classified into two categories; manufacturers of primary glass articles are enrolled as **Ordinary Members** of the Federation and suppliers to the glass industry viz., suppliers of machinery, raw materials, consultants and others connected with the glass industry are enrolled as **Affiliate Members**.

Foreign Companies supplying machinery etc., to the glass industry are also enrolled as **Affiliate Members**.

Membership forms can be downloaded from www.aigmf.com/membership.php

Members of the Federation are enrolled on the recommendation of Zonal Associations viz.:

- Eastern India Glass Manufacturers' Association (EIGMA)
- Northern India Glass Manufacturers' Association (NIGMA)
- South India Glass Manufacturers' Association (SIGMA)
- Uttar Pradesh Glass Manufacturers' Syndicate (UPGMS)
- Western India Glass Manufacturers' Association (WIGMA)

ADMISSION FEE ANNUAL SUBSCRIPTION

Ordinary Members:

- Admission fee ₹ 5,000/-
- Annual subscription: Single Unit: ₹ 40,000 + GST as applicable
- More than one Unit: ₹ 1,60,000 + GST as applicable
- Applicants for enrollment for a period of five years may pay an amount of ₹ 1,80,000 for a single Unit and ₹ 7,50,000 for more than one Unit + GST as applicable

Affiliate Members:

- Admission fee ₹ 5,000/-
- Annual subscription: ₹ 16,000 + GST as applicable
- Applicants for enrollment for a period of five years may pay an amount of ₹ 70,000 + GST as applicable

Affiliate Members from countries other than India:

- Admission fee US \$ 200
- Annual subscription: US \$ 500 + GST as applicable
- Applicants for enrollment for a period of five years may pay an amount of US \$ 1,800 + GST as applicable

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Company	Products / Services
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The Backbone for Glass Manufacturers

■ Turnkey Projects for glass plants involving:

- Selection of site
- Plant layout
- Furnace design, selection of refractory & steel structure
- Furnace building, commissioning & maintenance
- Selection & commissioning of combustion system, instrumentation & allied equipment
- Selection of raw material
- Designing of fully automatic batch house and cullet handling system.
- Selection, installation and commissioning of production machinery and annealing lehrs
- Installation and commissioning of quality control equipment and packing machinery

- **Furnace design, building, maintenance, modification and modernization**
- **Conversion of combustion system**
- **Furnace audits for reducing fuel consumption and predicting furnace life**
- **Energy efficiency improvement using mathematical models**



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Position Paper on a Harmonised Definition of Recycled Content in the Flat Glass Sector

as presented by 

[www.glassforeurope.com](https://glassforeurope.com)

<https://glassforeurope.com/wp-content/uploads/2026/08/Glass-for-Europe-Position-paper-on-recycled-content-definition-20260731.pdf>

Glass can theoretically be infinitely recycled.

In order to harvest this potential, Glass for Europe's members strive to implement circularity into their processes, where feasible. Significant efforts have been performed by EU flat glass manufacturers in order to improve glass cullet collection and recovery.

Introducing glass cullet in the furnace brings significant advantages: it reduces the use of virgin raw materials, it lowers the energy consumption needs, and it decreases greenhouse gas emissions.

Recycled content of flat glass is therefore a crucial notion for reducing carbon emissions strategies. As such, it requires an unambiguous definition, outlining its elements and its calculation methodology. The purpose of the present position paper is to provide such a harmonised definition for the European flat glass sector.

Glass for Europe is the trade association for Europe's flat glass sector. Flat glass is the material that goes into a variety of end products, primarily in windows and facades for buildings, windscreens and windows for automotive and transport as well as solar energy equipment, furniture and appliances. Glass for Europe brings together multinational firms and thousands of SMEs across Europe, to represent the entire building glass value-chain. It is composed of flat glass manufacturers, AGC Glass Europe,

Guardian, NSG Group, Saint-Gobain Glass, and Şişecam, and works in association with national partners gathering thousands of building glass processors and transformers all over Europe.

RECYCLED CONTENT DEFINITION In standards

According to section 7.8.1.1 of the standard EN ISO 14021:2016 Environmental labels and declarations:

Recycled content is defined as proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials contribute to recycled content.

Pre-consumer material is defined as material diverted from the waste stream during a manufacturing process. Reutilisation of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it is excluded from pre-consumer material.

Post-consumer material is defined as material generated by households or commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose.

Applied to flat glass sector (see also Annex I)

Furnace process cullet

Furnace process cullet refers to cullet generated by a glass melting furnace

for quality rejects or other reasons (i.e., edge trims, geometrical losses, etc.) during a production period or during a non-production period (i.e. crushing, colour transition, furnace draining), through any furnace exit (forming exit, furnace drain-out during production or at furnace emptying), capable of being re-introduced in a glass melting furnace on the same or another manufacturing site with no other treatment than crushing and/or standard magnetic/metallic separation.

It is suitable for re-introduction in a glass melting furnace on the same or another manufacturing site.

Furnace process cullet covers material rejected and taken out at the float line stage, as well as potential cullet transferred from line 1 to line 2 on the same site. All such rejects are however remelted to ensure material efficiency and avoid waste.

For better clarity, in the rest of the document, the denomination 'furnace line rejects' is used when considering the cullet output of the furnace production line, and 'furnace process cullet' when these rejects are re-introduced in the melting process.

As furnace process cullet is reintroduced in the process that generated it, this cullet is excluded from pre-consumer material as defined in EN ISO 14021:2016.

Pre-consumer cullet

In the flat glass sector, pre-consumer cullet is any cullet which results from

industrial operations starting with stacking of glass after its exit from the glass melting furnace and ending at the stage where the product achieves finished-product status. This includes cut-offs, losses during coating, laminating, bending and other processing steps, including the manufacture of insulating glass units or automotive windscreens. This cullet may or may not need beneficiation before being recycled into a glass furnace. Cullet collected from glass processing line on the same manufacturing site as the glass melting furnace is pre-consumer cullet. Cullet collected from third-party glass processing companies is also considered pre-consumer cullet.

Pre-consumer cullet is considered as pre-consumer material as defined in EN ISO 14021:2016 and is taken into account in recycled content.

Post-consumer cullet

Post-consumer cullet refers to cullet originated from finished products before, during or after their use at the consumer market.

It includes returns or breakages of finished products from the transport and distribution chain as well as all material coming from glass recycling collection schemes such as glass from construction and demolition waste or from end-of-life vehicles, etc.

Post-consumer cullet is considered as post-consumer material as defined in EN ISO 14021:2016 and is taken into account in recycled content.

Other recovered materials used in the flat glass sector

In addition to cullet, other recovered materials can be used in the flat glass sector in substitution of virgin raw materials. Because these other recovered materials may have a

content which may be lost during combustion in the furnace, their contribution in the recycled content calculation shall be taken into account considering their loss on ignition (generally referred as LOI, here *lign*).

Loss on ignition measures the ratio of mass loss that a material undergoes when it is heated to a high temperature to initial mass. This mass loss can be attributed to the release of volatile substances such as water, carbon dioxide, organic material and other gases. This ratio is a figure between 0 and 1.

CALCULATION METHODOLOGY

Recycled content in flat glass products must be calculated according to following formula:

$$R_c = \frac{m_{c,pre} + m_{c,post} + m_{orm}(1 - l_{ign})}{m_{tmg} - \text{MIN}(m_{fpc}; m_{lr})}$$

where:

R_c	is recycled content in %
$m_{c,pre}$	is mass of pre-consumer cullet entering the melting furnace in t
$m_{c,post}$	is mass of post-consumer cullet entering the melting furnace in t
m_{orm}	is mass of other recovered material entering the melting furnace in t
l_{ign}	is LOI of other recovered materials during combustion in the melting furnace, as nondimensional number between 0 and 1
m_{tmg}	is mass of total melted glass in t, which is split between the mass of packed glass and the mass of furnace line rejects at the exit of the melting furnace
m_{fpc}	is mass of furnace process cullet entering the melting furnace in t
m_{lr}	is mass of furnace line rejects generated at the exit of the melting furnace in t

Detailed explanation:

According to ISO 14021, the recycled content is defined as the mass of recycled material in a product. For float glass, we consider this to be the mass of recycled material in the packed glass divided by the mass of packed glass.

The mass of packed glass produced during the basic glass production is determined by the yield of the melting furnace process. It corresponds to the difference between the mass of the

melted glass and the mass of furnace line rejects. From a manufacturing point of view, the objective is to reduce as much as possible the furnace line rejects generated and to reintroduce them directly as furnace process cullet. Usually, mass of furnace process cullet is equal to mass of furnace line rejects.

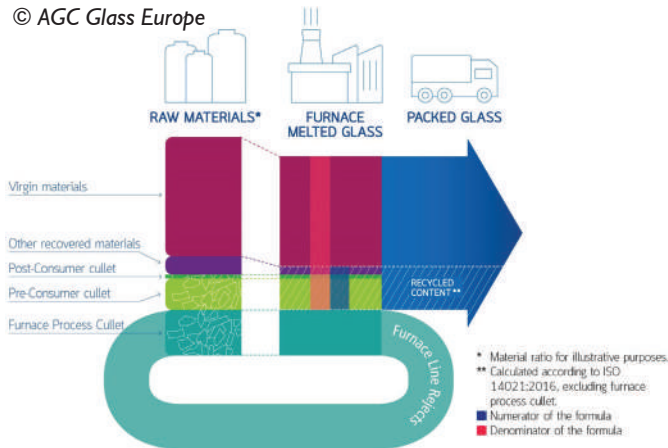
Beside this usual situation, one should pay special attention to the two specific situations where the mass of furnace process cullet reintroduced in the furnace is bigger or smaller than the mass of the line rejects.

In practice, it is not always feasible to reintroduce cullet from furnace line rejects instantly: some incidents or specific practices on the furnace production line can lead to variations of rejects production or rejects reintroduction over time. Then,

for a given type of product and a given period, the furnace line rejects generated and reintroduced as furnace process cullet during the manufacturing of this product are not always balanced. This leads to 3 different cases: the mass of furnace process cullet can be equal, superior or inferior to the mass of furnace line rejects (refer to the visuals below).

- If $m_{fpc} = m_{lr}$: The whole quantity of cullet from the melting process is neutral in the balance of input

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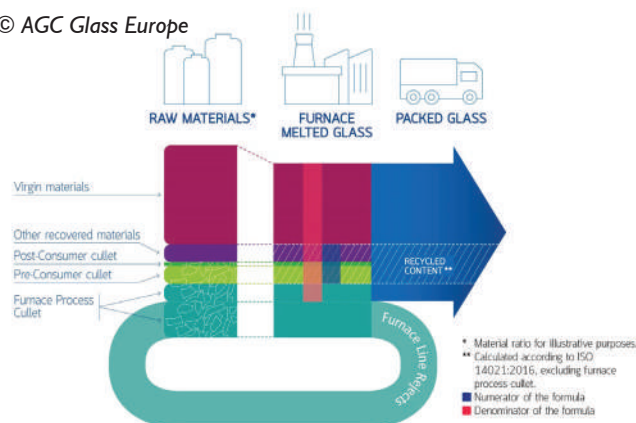
and output flows. The recycled content, which corresponds to the mass of recycled material in the packed glass divided by the mass of packed glass, is calculated as follows:

$$R_c = \frac{m_{c,pre} + m_{c,post} + m_{orm}(1 - l_{ign})}{m_{tmg} - m_{lr}}$$

$$= \frac{m_{c,pre} + m_{c,post} + m_{orm}(1 - l_{ign})}{m_{tmg} - m_{fpc}}$$

- If $m_{fpc} > m_{lr}$: A 'surplus' of furnace process cullet is used as input, in addition to the amount of furnace line rejects that turns in loop. This 'surplus' of furnace process cullet is coming from the manufacturing of another type of product produced in the plant, is coming from another furnace or was generated during a previous time period. Nevertheless, as this 'surplus' has been generated by a melting furnace, it must not be considered as recovered material when reintroduced in

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this process. This surplus contributes to the mass of packed glass and should therefore not decrease the mass of glass on which the recycled content is calculated. Thus, the recycled content is calculated as follows:

$$R_c = \frac{m_{c,pre} + m_{c,post} + m_{orm}(1 - l_{ign})}{m_{tmg} - m_{lr}}$$

If $m_{fpc} < m_{lr}$: Some furnace line rejects cannot be reintroduced as furnace process cullet (e.g. quality does not allow for use in the furnace). In such case, the recovered material is split over the packed glass and the line rejects lost as waste or by-products (fraction of the line rejects which is not reintroduced in the furnace as furnace process cullet). As there is no preferential allocation of the recovered material in the packed glass, the recycled content is calculated over a volume equal to the sum of packed glass plus the lost line rejects, that is to say the melted glass minus the line rejects reintroduced in the furnace as furnace process cullet.

$$R_c = \frac{m_{c,pre} + m_{c,post} + m_{orm}(1 - l_{ign})}{m_{tmg} - m_{fpc}}$$

One shall also note that the formula considers cullet as made of glass only. It may happen that the cullet source includes minor organic materials that will be lost during the melting process. This is usually what happens

when recycling laminated glass: in the formula, one shall use the mass of glass only, and not include the mass of interlayer, otherwise, the LOI of this material would have to be applied.

Note: While striving to keep the best possible record of the various flows, if companies are unable to segregate the mass of furnace production cullet from the mass of pre- and post-consumer cullet entering the melting furnace, manufacturers can use best available knowledge and engineering estimates to determine the mass of each type of cullet.

POST-CONSUMER RECYCLED CONTENT:

It is possible to consider only post-consumer recycled content by using the same calculation, by considering only post-consumer materials.

PROCESSED GLASS PRODUCTS

EN ISO 14021:2016 applied to processed glass products like laminated glass or insulated glass units results in the recycled content being calculated by making the sum of each part's recycled content multiplied by its mass fraction:

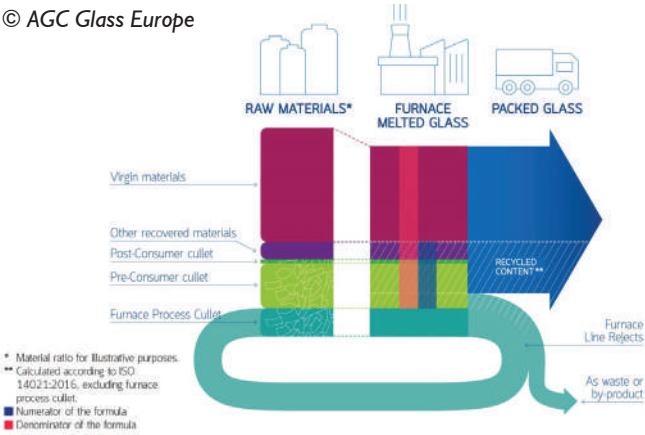
- Laminated glass: the recycled content is the sum of the mass fraction of glass multiplied by the recycled content of glass and the mass fraction of interlayer multiplied by the recycled content of the interlayer.

$$R_c = \frac{(R_{c, glass} \cdot m_{glass} + R_{c, PVB} \cdot m_{PVB})}{(m_{glass} + m_{PVB})}$$

- Insulated glass unit: the recycled content is the sum of the mass fraction of glass multiplied by the recycled content of glass and the mass fraction of each of the other components multiplied by its recycled content (spacer bar, sealant, etc.).

$$R_c = \frac{\sum (R_{c,i} \cdot m_i)}{\sum m_i}$$

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**ANNEX II:
RELEVANT
LEGISLATION
AND
STANDARDS**

On waste:

(1) DIRECTIVE 2008/98/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of

19 November 2008 on waste and repealing certain Directives (“WFD”): concepts and definitions related to waste management, including the

definitions of waste, recycling, and by-product

(2) COMMISSION REGULATION (EU) No 1179/2012 of 10 December 2012 establishing criteria determining when glass cullet ceases to be waste under Directive 2008/98/EC of the European Parliament and of the Council

On Product Category Rules (PCR for EPD):

(3) EN 15804:2012+A2:2019/AC:2021 Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

(4) prEN 17074:2025 Sustainability of construction works – Environmental product declarations - Product Category Rules for flat glass and channel shaped glass products

(5) PCR for Glass products used in automotive and transport industry: 2023, written by Saint-Gobain

On recycled content:

(6) EN 45557:2020 - General method for assessing the proportion of recycled material content in energy-related products

On Product labelling:

(7) EN ISO 14021:2016 Environmental labels and declarations – Self-declared environmental claims (Type II environmental labelling)

(8) EN ISO 14025:2010 (WI=CSS26023) - Environmental labels and declarations - Type III environmental declarations - Principles and procedures ■

Where i refers to the different components (glass, PVB, spacer bar, sealant, etc.) and m_i and R_{ci} are respectively the mass and the recycled content of component i .

Annex I: Limits between different cullet types within the boundaries of flat glass production process (FprEN 17074:2026 (E))

Furnace process cullet	Pre-consumer cullet (flow)	Post-consumer cullet (flow)
1 – Basic glass production	2 – Storage	11 – Transport
	3 – Transport	12 – Storage
	4 – Production of intermediate glass product when relevant	13 – Distribution network
	5 – Transport	14 – Transport
	6 – Storage	15 – Installation
	7 – Distribution network	16 – Use
	8 – Transport	17 – Deconstruction
	9 – Production of finished glass product	18 – End of life
	10 – Storage c	
NOTE: Lines above describe successive steps of glass production and glass processing. Some steps can be omitted or repeated depending on the production flows.		
^a Stacked glass that is further rejected due to defects coming from production condition is furnace process cullet, e.g. punctual defects, optical distortion.		
^b The cullet delimitation follows criteria for pre-consumer and post-consumer cullet given in EN ISO 14021:2016 and EN 45557:2020.		
^c To avoid the additional cost of a separate stock and recycling treatment of the cullet coming from overstock, obsolete inventories and finished products that have not been placed on the market, these finished products are sometimes put together with the cullet collected from used glass products. In such a situation, there is generally no possibility to distinguish the flows and this cullet may be counted as post-consumer cullet for practical reasons.		
^d Cut-to-size glass product is not always a finished product. Some manufacturers produce cut-to-size glass that is further processed by other manufacturer(s). When it is not a finished product as defined in 3.8, it is to be considered an intermediate product (see 3.7) and its overstock, obsolete inventories and breakages would represent a pre-consumer cullet.		

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