Vol. 8 | No. 3 | October - December 2020

Kañch

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Quarterly Journal of **The All India Glass Manufacturers' Federation**

Bi-lingual

Special Feature

- *Glass News*
- *Key Highlights of Union Budget of India 2021-22*
- भारत सरकार का केंद्रीय बजट: 2021–22
- *Glass in Modern Architecture*
- *Some Aspects of Laminated Glass*
- *Enamel-based Digital Printing on Hollow Glass*
- *The Future of Skilled Trades is Digital*
- *The Glass Plant of the Future*
- *A 25% Improvement is Possible!*
- *Innovating Greener Glass Manufacturing Technologies*
- *Multiple Furnace Projects Completed during Covid-19 Crisis*

Main Events: 2021

- *China Glass 2021 at Shanghai New International Expo Centre, China (May 6-9)*
- *glasstec 2021 at Dusseldorf, Germany (Jun 15-18)*
- *Glasspex and Glasspro India at Mumbai (Sept 23-25)*
- *14th International Conference of the AIGMF at Mumbai (Sept 23)*

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

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Contents

From President's Desk	5
Advertise in Kanch	6
Glass News	7
Key Highlights of Union Budget of India 2021-22	14
भारत सरकार का केंद्रीय बजट: 2021-22	16
Glass in Modern Architecture	19
Some Aspects of Laminated Glass	23
New Members	29
Membership of the Federation	29
Enamel-based Digital Printing on Hollow Glass	31
The Future of Skilled Trades is Digital	34
List of Advertisers	36
The Glass Plant of the Future	39
A 25% Improvement is Possible !	43
Innovating Greener Glass Manufacturing Technologies	47
Multiple Furnace Projects Completed during Covid-19 Crisis	50
in Kanch Werben	51

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From President's Desk

Starting April, AIGMF was able to meet 7 times virtually in the Pandemic conditions. Coordination continued with the DPIIT, Ministry of Commerce, Ministry of Finance DGAD, Ministry of Transport, MNRE, Ministry of Environment, BIS with matters related to the industry seeking support, relief, etc.

The AIGMF 2021 calendar on the theme 'Glass Protects' was officially released at the virtual Executive Committee Meeting held on Oct 31. The calendar carries select drawings from the 3rd *'Drawing/Painting Competition', wherein over 3000 students (7-16 years) participated online from across India. Top 3 winners were given cash prizes. And, later the entire project was converted into the 2021 Calendar as part of an educational process.* Wall and Table versions of the calendars were distributed to AIGMF Members/Regional Associations/Stakeholders: All Members of Parliament/Govt. of India Secretaries/office of Chief Secretaries/LGs/Administrators/CMs/select GoI contacts/Trade Chambers/Education Secretaries/FOSG Members/Firozabad/CGCRI contacts/Glass Associations Worldwide/General etc. Soft copy is available at www.aigmf.com

Federation bid farewell to Dr. K Muraleedharan, Director CGCRI at the virtual Executive Committee Meeting held on Oct 31, which also happened to be his retirement day at the CGCRI. Office Bearers appreciated the support and confidence shown by Dr. Muraleedharan in the activities of the Federation which even got better with CGCRI's collaboration.

AIGMF participated as a supporting association and promoted Virtual Conference on Glass Problems within India. Owing to Pandemic, the 81st Conference on Glass Problems, which was originally scheduled to take place on October 26-29 in Columbus, Ohio, USA, was replaced with a virtual conference between October 26-30. Being accessible via the internet, it allowed participants access to the world's leading technical experts addressing current problems in glass manufacturing. The program also provided an exhibiting platform for solution providers to communicate with the industry.

At glasstec Virtual, AIGMF participated at the Glass Association's Summit powered by Glass Worldwide. Presentations were made by Mr. Sanjeev Oberoi (Executive Director AIS) on Float glass segment on Oct 20; and Mr. Sanjay Somany (Former President AIGMF and CMD HNG) on Container glass segment on Oct 21. Both sessions were followed by a panel discussion.

AIGMF also participated as a supporting association at the World Soda Ash conference which was held online for the 1st time owing to the Pandemic situation. I was fortunate to have participated as one of the Panellists in Session 4: Prospects for Glass; and presented a Summary Overview of Glass Outlook for India on Oct 20.

Presentations and select photos of all events are available at https://aigmf.com/past-events.php

With the start of COVID-19 vaccination drive in India, we have initiated the planning process to conduct the physical Executive Committee Meetings with an option for Members to also connect via virtual mode. A list of tentative meeting dates have been drawn for 2021; and we seek support and suggestions of all Members.

I take the opportunity to wish everyone a happy, healthy and prosperous new year 2021■

President AIGMF

and Vice - President, HNG & Inds. Ltd.

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GLASS News

DR. SUMAN KUMARI MISHRA HAS TAKEN OVER AS DIRECTOR CENTRAL GLASS & CERAMIC RESEARCH INSTITUTE

Dr. Suman Kumari Mishra is a materials scientist specialized in advanced materials processing, material properties and applications. She obtained her PhD from the Indian Institute of Technology, Kharagpur and had since then served as Scientist with the CSIR-National Metallurgical Laboratory (CSIR-NML), Jamshedpur rising to the level of Chief Scientist. During her stint at NML, she has served as the Head of Corrosion & Surface Engineering; Analytical Chemistry; and Human Resources Divisions of the Institute and has been Professor and Dean of Engineering Sciences with the Academy of Scientific and Innovative Research (AcSIR) for several years.

Dr. Mishra has published more than 100 scientific articles in SCI journals; contributed 7 book chapters; 13 patents; transferred 2 technologies and handled around 25 sponsored projects as PI or Co-PI. Apart from this, she has several conference presentations and has delivered numerous invited lectures. She has guided 7 PhD students and several students for their graduate and postgraduate dissertations. She is in the Editorial Board of the Defence Science Journal and also has been a member of the International Editorial Board of the IIM Universities Press.

In recognition to her scientific contribution, Dr. Mishra was elected as a Fellow of the National Academy of Sciences of India in 2018; awarded the Best Metallurgist of the Year Award by Ministry of Mines, Government of India in 2012; elected as Fellow of the Indian Institute of Ceramics in 2007; bestowed with the Vasvik Award in women category and received the MRSI Medal in 2004; awarded the CSIR Raman Fellowship in 2002 and the CSIR Young Scientist Award in Engineering Sciences in 1999, to name a few. She was also recipient of the University Gold Medal of Ranchi University in 1985 for ranking 1st in the batch.

AIGMF is looking forward to working with Dr. Mishra and her team in the areas of Academic, Research, Publications, etc.

AIGMF 2021 CALENDAR ON THE THEME 'GLASS PROTECTS'

President Mr. Bharat Somany released AIGMF 2021 calendar on the theme 'Glass Protects' at the virtual Executive Committee Meeting held on Oct 31.

To commemorate International Youth Day, AIGMF invited online entries from children between 7-16 years to participate in the 'Drawing Competition 3.0', wherein over 3000 students participated from across India. On Sept 15, 2020, Chief Guest Prof. Alicia Durán (Research Professor

CSIC-Spanish National Research Council) and President of the International Commission on Glass, Madrid, SPAIN unveiled a touring exhibition on 'Glass Protects'.

Top 3 winners were given cash prizes. And later the entire project was converted into the 2021 Calendar.

Being the National Apex Body of the Glass Industry, the AIGMF undertakes socially responsible steps as a voluntary service to society, thereby bringing increased awareness of Glass being a safe and 100% recyclable packaging and building material.

As part of an educative process, Wall and Table versions of the calendars were distributed to AIGMF Members/Regional Associations, Stakeholders: All Members of Parliament/Govt. of India Secretaries/ office of Chief Secretaries/LGs/ Administrators/CMs/select GoI contacts/Trade Chambers/Education Secretaries/All FOSG Members/ Firozabad/CGCRI contacts/Glass Associations Worldwide/General etc.

Soft copy of the calendar is available at www.aigmf.com

2ND ICG-CGCRI TUTORIAL

The International Commission on Glass (ICG) and CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata, India jointly organized the 2nd ICG-CGCRI Tutorial 2021 on Glass in virtual mode through MS Teams during January 18 - 27, 2021. This tutorial aimed to cover a wide spectrum of topics related to glass science and technology including fundamentals of thermodynamics, melt flow dynamics, mechanical behaviour, characterisation techniques, nucleation kinetics, atomistic simulation and so on for developing an insight into the processing-structure-property correlations for glass and glass-ceramics for the benefit of the glass researchers across the globe.

The first ever ICG-CGCRI Tutorial that was organized by CSIR-CGCRI, Kolkata in 2017 had generated an overwhelming response and motivated ICG to grant permission to CSIR-CGCRI to conduct such tutorials every four years. The website for the Tutorial (www.icg-cgcri-tutorial2021.com) was launched on 1st December 2020 in virtual mode by Prof. Reinhard Conradt, Vice-President, ICG who delivered his Presidential address. Dr. K Muraleedharan, Former Director of CSIR-CGCRI and Mr. Ashim Kumar Chakraborty, Former Chief Scientist and Director, (Acting) of CSIR-CGCRI, Prof. J. M. Parker (Sheffield University, Sheffield, UK), Mr. Sitendu Mandal (Chief Scientist & Organizing Secretary of ICG-CGCRI Tutorial 2021), and other distinguished dignitaries from the Glass community also participated in the website-launching program.

On 18th January, 2021, the ICG-CGCRI Tutorial 2021 was formally inaugurated by Dr. Suman Kumari Mishra, Director, CSIR-CGCRI in presence of Dr. Dipayan Sanyal, Chief Scientist, CSIR-CGCRI, Prof. Alicia Duran, President, ICG, Prof. Reinhard Conradt, Vice President, ICG, Prof. J. M. Parker, Advisor, ICG-Education, Prof. Ana C. M. Rodrigues, Chairperson, TC-23 (ICG-Education) and several other eminent academicians and experts of the Glass Science & Technology Community. Prof. Dipankar Banerjee, Chairman, Research Council, CSIR-CGCRI and Prof. Alicia Duran, President, ICG graced the event as Chief Guest and the Guest of Honour, respectively.

Mr. Sitendu Mandal, Chief Scientist, CSIR-CGCRI and Organizing Secretary of ICG-CGCRI Tutorial 2021 delivered the formal vote of thanks to all the dignitaries, guests, participants and other members of this 2nd ICG-CGCRI Tutorial 2021 including the local organizing committee members for their wholehearted support, active participation in making this inauguration event a grand success.

A total of 23 lectures were delivered during the Tutorial by stalwarts such as Prof. R. Conradt (UniglassAC GmbH, Aachen, Germany); Prof. J. M. Parker; Prof. A. Duran; Prof. M. K. Choudhary (MKC Innovations LLC and The Ohio State University, USA); Prof. John C. Mauro (PSU, USA); Prof. R. Vacher and Prof. B. Hehlen (University of Montpellier, France); Prof. P. Florian (CEMHTI-CNRS, France); Prof. A. Varshneya (Saxon Glass Technologies, Alfred, USA); Prof. R. J. Hand (Sheffield

Dr. Suman Kumari Mishra, Director, CSIR-CGCRI inaugurating the 2nd ICG-CGCRI Tutorial 2021

Mr. Sitendu Mandal, Chief Scientist, CSIR-CGCRI and Organizing Secretary of Tutorial 2021 delivering the vote of thanks

University, UK); Prof. A. Takada (Asahi Glass Yokohama – Japan); Prof. E. D. Zanotto (Federal University of São Carlos, São Carlos, Brazil); Prof. S. Tanabe (Kyoto University, Japan); Prof. A. R. Boccaccini (University of Erlangen-Nuremberg, Germany); Prof. Ana C. M. Rodrigues (Federal University of São Carlos, Brazil) and other distinguished experts from R&D Institutes, academia and Industries.

Eminent panelists delivering their speech on "Career Opportunities in Glass Research"

The topics covered in this Tutorial were multi-faceted and included fundamentals of glass, thermodynamics, energy demands and heat-transport phenomena of glass melts/glass formers, the structural and aspects of glasses/glass-ceramics, bioactive glass and glass-ceramic, optical and redox chemistry of glasses including conducting glasses and advanced testing and characterization techniques to evaluate various properties of glasses, glass-ceramics and other glass based composites for advanced applications, the futuristic glasses, etc.

Twenty three lectures were spread out over 15 different sessions, which were chaired by eminent scientists, academicians and industrialists from India.

In addition, 11 student's projects were also included. Participants were handpicked to explore the new horizons of glass sciences and to address vital issues in connection with glass science and technology. Students were instructed to work in a group so that they could develop mutual understanding and collaborative spirit. The endeavor was a success and the participants carried out the project work very meticulously. New ideas emerged for future technologies related to application of glass in frontier areas. Results were evaluated by the eight-member judges panel consisting of eminent personalities from India and abroad. Total three prizes were awarded after evaluation of the project presentations by the jury members.

The Tutorial program concluded with Panel Discussion and Valedictory Session. The panelists were Dr. (Mrs.) Suman Kumari Mishra (Director, CSIR-CGCRI), Dr. Manoj Kumar Choudhary (Former President, ICG); Mr. Pradip Kumar Kheruka (CMD, M/s Borosil Glass Works Ltd., Mumbai); and Prof. Arun Kumar Varshneya (President, Saxon Glass, USA).

The Panel Discussion began with Mr. Sitendu Mandal welcoming all the panelists. Dr. Atiar R. Molla, Organizing Joint Secretary, ICG-CGCRI Tutorial, CSIR-CGCRI, moderated the session. Panelists analyzed the highlights of the preceding days and discussed the career opportunities for glass researchers in the context of projected future developments.

Dr. (Mrs.) Suman K. Mishra made the introductory remarks. She spoke about the career opportunities for the next generation emphasizing that glass and ceramic researchers have huge scope and excellent career opportunities across the globe for development of new materials that cater to the demands of society. There is scope for entrepreneurship for various end applications of glasses including the areas like biomedicals, building/structural, coatings on glasses for various functionalities and so on.

Dr. Manoj K. Choudhary also talked on career prospects/opportunities for researchers working on glass science & technologies and the grand challenges in global context. He concurred that glass is a subject that offers opportunities in all sectors such as environment, energy, even safety.

Mr. Pradeep K. Kheruka commented that scientists are developing new products which are of enormous interest. He mentioned that his company has atleast 30 problems which researchers or academicians can take up.

Prof. A. K. Varshneya talked about the life saving applications of glasses his company Saxon Glass is producing and such glasses can be developed in India and commercially produced.

Various important issues were discussed. Mr. Kheruka stressed on the need for deep involvement of researchers and academicians to solve problems faced by the glass industry.

Dr. Mishra, on behalf of CSIR-CGCRI took up the challenge to solve some

of the reported problems to be taken up after this event.

All the speakers and participants appreciated the online mode of conducting the Tutorial in pandemic times.

The valedictory session rang down the curtains on the event. During this session there were insightful deliberations by Dr. Sanyal, Dr. Choudhary, Prof. Conradt, Prof. Parker, Prof. Rodrigues, Prof. E. D. Zanotto, Director, CERTEV, Brazil, and Prof. Varshneya among others. All the dignitaries commended the efforts made by CSIR-CGCRI to ensure the success of the event.

The ICG-CGCRI Tutorial 2021 concluded with formal vote of thanks to all dignitaries, participants and others, by Dr. Atiar R. Molla, Organizing Joint Secretary, ICG-CGCRI Tutorial.

Mr. Sitendu Mandal announced the formal closure of this tutorial with the hope of hosting the next International Congress on Glass: (ICG-2025), to be held at CSIR-CGCRI, Kolkata, India in 2025.

AGI GLASPAC BEGINS WORK ON NEW PLANT; EXPECTS 18% TOPLINE GROWTH BY FY23

AGI glaspac, a leading global manufacturer of integrated container-glass, has inaugurated its new plant and announced that with the manufacturing of speciality glass, the company foresees topline growth of not less than 15-18 per cent by 2022-23.

The company raised an investment of ₹220 crores to manufacture special glass for premium segments, such as cosmetics, perfumery, personal care, carbonated water and high-end spirits. These special glasses require an additional layer of printing decoration, design and detailing work. AGI glaspac aims to attract further investment to complete the work.

For the printing, design and decoration of the speciality glass, AGI glaspac plans to engage with start-ups.

The company has been serving its clients in the liquor, wine, food, chemicals and pharma industries worldwide with commercial and Type-1 glass for over 40 years. The addition of clear speciality glass will add a new customer segment to its portfolio.

Team Emerge getting ready for Conatiner Glass Manufacturing at their newly set up plant, after Pooja Ceremony (inauguration) on January 14 at RIICO Industrial Area, Rajasthan

Mr. Rajesh Khosla, President & CEO of AGI glaspac, said, *"The pandemic has resulted in geopolitical disengagement with certain countries. It will leave the glass industry with a huge void and a shortfall of suppliers or importers in the future. We believe that it is a huge opportunity for Indian manufacturers and start-ups for various industries to increase exports and reduce imports. It is a golden opportunity to raise the bar in the international markets for the 'Made-in-India' products. AGI glaspac's entry in the new segment of manufacturing speciality glass is a strategic decision. It will allow us to cater to the much-expected rise in the global demand after the pandemic subsides."*

The first phase of investment of ₹220 crores will go towards four levels of expenses — civil construction of the plant, machinery and a new furnace, utilities and finally a new team for the development of the newly-launched AGI Speciality-Glass Division. The company will engage more than 4,600 people, including direct and indirect employees. The total strength of the team is 14,700, which should grow to 19,300 by end 2022.

Mr. KT Rama Rao, Telangana Industry Minister, tweeted, *"Happy to welcome new investments from the HSIL Group into its glass business, AGI glaspac. Many thanks to good friend and Managing Director of HSIL Limited Mr. Sandeep Somany for his continued support towards the Telangana state."*

Early this year, the company had announced a geographical expansion with an estimated investment of ₹700

crores in the eastern part of India. However, due to the pandemic, the expansion plans have been put on hold.

AGI glaspac, the packaging products division of HSIL Ltd, was established in 1972. It is one of the leading container-glass manufacturers in the country. It has two facilities, one at Hyderabad and the other at Bhongir, Telangana. The company manufactures high-quality glass containers to meet the stringent and demanding quality standards of the packaging needs of the food, pharmaceuticals, soft drinks, spirits, beer, wine and other industries. It has an in-house design studio, mould manufacturing and applied ceramic labelling (ACL) facilities.

With the Hyderabad and Bhongir facilities put together, AGI melts around 1,600 tonnes of glass per day. It has four furnaces.

Apart from the host of the multinationals that comprise a part of AGI's Indian market, it has a large customer base in North America, Europe, Africa and the APAC regions.

FAREWELL TO DR. K MURALEEDHARAN, DIRECTOR CGCRI

Federation bid farewell to Dr. K Muraleedharan, Director CGCRI at the virtual Executive Committee Meeting held on Oct 31, which also happened to be his retirement day at the CGCRI.

President Mr. Bharat Somany thanked Dr. Muraleedharan for CGCRI's support, services, and providing venue to the AIGMF whenever required. Mr. Somany said that under Dr. Muraleedharan's tenure, in the last 5 years AIGMF was very fortunate to have worked closely on some of the important events i.e., ICG related programs at CGCRI, AIGMF Executive Committee meetings, Publications support for Kanch and Glass News, propagating use of glass packaging, glasspex exhibition, Glass Awards, painting competition, etc.

President and Office Bearers appreciated the support and confidence shown by Dr. Muraleedharan in the activities of the Federation which even got better with CGCRI's collaboration. Mr. Somany on behalf of the Industry wished Dr. Muraleedharan all the very best for his next assignment in Kerala.

A small token of appreciation in form of a glass artefact (courtesy of Sri Sitaram Glass Works, Firozabad) was given to Dr. Muraleedharan.

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

WORLD SODA ASH CONFERENCE ONLINE

AIGMF participated as a supporting association in the World Soda Ash conference which was held online for the 1st time owing to the Pandemic situation.

President Mr. Bharat Somany was one of the Panellists in Session 4: Prospects for Glass and presented a Summary Overview of Glass Outlook for India on Oct 20.

Presentation and select photos of the event are available at https://aigmf.com/past-events.php

SCHOTT GLASS INDIA INAUGURATES NEW GLASS MELTING TANK, PRODUCTION CAPACITY TO INCREASE BY 25%

SCHOTT AG, a global leader in pharmaceutical glass manufacturing, has inaugurated a new melting tank in its Gujarat-based facility with an approximate investment of EUR 25 Million. The new tank would help increasing the plant's production capacity by 10,000 tonnes to reach an annual capacity of 40,000 metric tonnes.

SCHOTT AG has been a frontrunner in the global fight against Coronavirus, with commitment to provide its specialised pharma glass used for storing billions of COVID-19 vaccines. The melting furnace has been constructed within a span of one year, to enable a 25% increase in the facility's overall production capacity, to support the pharma industry that is facing a huge demand surge for pharma packaging products.

SCHOTT Glass India's MD, Mr. Pawan Shukla shared, *"India has stepped up as a responsible leader in the global fight against Coronavirus. SCHOTT remains committed to ensure that there is adequate supply of its high-quality pharma glass for the Indian pharma industry. Moreover, as SCHOTT's manufacturing hub in Asia, we have taken up the responsibility to cater to our clients in India as well as in neighbouring countries."*

The melting tank is a part of the company's commitment to invest over EUR 47 million in its Indian facility, and to double its capacity of producing the highly specialised FIOLAX® tubing material for both domestic and export demands. Despite the pandemic induced lockdown, SCHOTT employees and engineers continued working at the Jambusar facility to enable the construction of the new tank in the defined time frame.

The expansion has resulted in additional employment of over 120 skilled workforce, taking the overall count to 420 employees.

German Project Engineer and Expert for Melting Technology, Mr. Norbert Osterhage, who was overseeing the project, chose to stay in India during the lockdown to ensure that the melting tank is operational in time, especially now as quality glass vials and syringes have become need of the hour for COVID-19 treatment.

"All players within the global pharma supply chain have a key role to play in the ongoing fight against Coronavirus. SCHOTT is already providing its glass to majority pharma packaging leaders for storing COVID-19 medication, and delivering glass vials to three out of every four COVID-19 vaccine projects undergoing various phases of testing. Our Indian facility is an integral part of our pledge to cater to any requirement of the pharma industry in a sustainable manner,"* said Dr. Patrick Markschläger, Executive Vice President, SCHOTT AG, Business Unit Tubing.

SCHOTT's specialised glass tubing, FIOLAX® is the gold standard for pharmaceutical packaging for over a century. The material is best suited for potential COVID-19 vaccines and existing medications, as it avoids the interactions between containers and the drug formulation, that can limit its effectiveness.

SCHOTT KAISHA EXPANDS ITS VIAL PRODUCTION CAPACITY WITHIN RECORD TIME TO GEAR UP FOR COVID-19 VACCINE

Pharma-packaging market leader, SCHOTT KAISHA, has announced an immediate investment of INR 105 crores (~EUR 12 million) into its existing facilities to increase its vial production by 300 million pieces. The decision comes at a time when drug manufacturers around the world are undergoing COVID-19 vaccine trials. Such complex medications are stored in Type I glass vials, which are produced at SCHOTT KAISHA facilities in Gujarat and Daman.

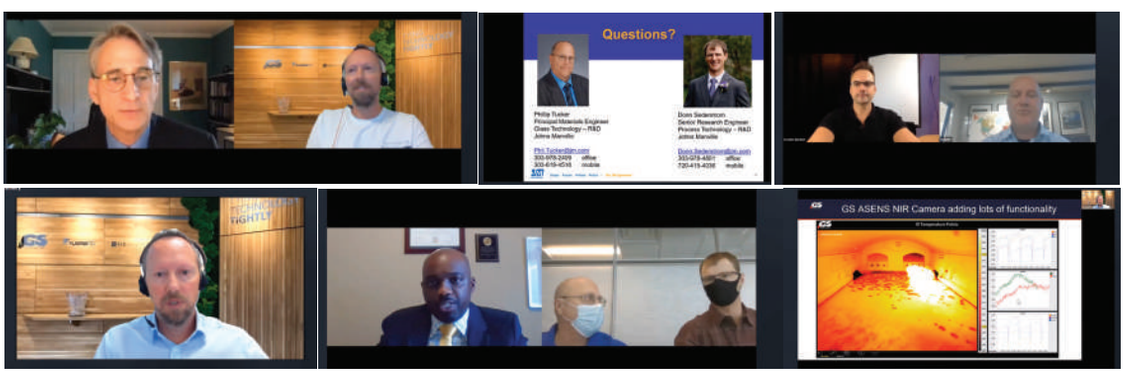
The Indo-German venture with the international technology group, SCHOTT AG, plans to complete this production ramp-up within a record time of 12 months. A long-term investment plan and consistent infrastructure growth over the years has helped the company expand its production capabilities quickly.

Over the last 3 years, it had invested approximately INR 434 crores and set up two new plants in Umarsadi, Gujarat and Baddi, Himachal Pradesh. With the recently opened facility in Umarsadi, SCHOTT KAISHA was already manufacturing over 3 billion pieces of ampoules, vials, syringes, and cartridges annually. The company is providing vaccine vials to all the key vaccine developers in the country as well as manufacturers abroad.

Mr. Rishad Dadachanji, Director, SCHOTT KAISHA shared, *"Pharma companies all around the world are working relentlessly to find an effective vaccine for COVID-19. As a front-runner in the pharma packaging segment, we are committed to support the vaccine developers with the best packaging solutions. We are closely working with all our clients to supply them with vials and syringes for their vaccine trials and are continuously assessing their requirements to stay ahead of the curve."*

With the looming demand surge for vaccine vials, the pharma industry relies on quality products for storing their complex drug formulations with minimal threat of contamination. SCHOTT KAISHA has been a pioneer in the Indian market to provide customisable solutions to leading pharmaceutical players all over the world. It has always given preference to a 'quality by design' approach, benchmark manufacturing and quality control processes using breakthrough inspection technology, combined with best-in-class components

VIRTUAL CONFERENCE ON GLASS PROBLEMS



Owing to Pandemic the 81st Conference on Glass Problems, which was originally scheduled to take place on October 26-29 in Columbus, Ohio, USA, was replaced with a virtual conference between October 26-30. Being accessible via the internet, it allowed participants access to the world's leading technical experts addressing current problems in glass manufacturing. The program also provided an exhibiting platform for solution providers to communicate with the industry.

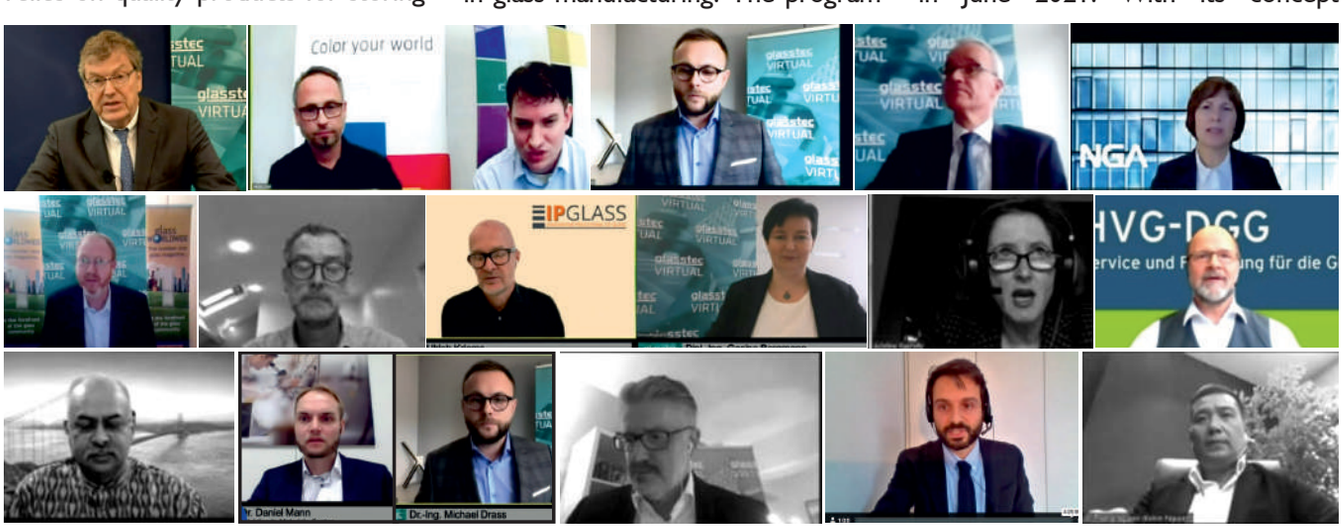
The Virtual Conference on Glass Problems was organised by the Glass Manufacturing Industry Council (GMIC), which is the American trade association bridging all segments of glass manufacturing and Alfred University, the USA's leading glass research institution. It was endorsed by the American Ceramic Society. Glass Worldwide was the official journal.

AIGMF participated as a supporting association and promoted the program within India.

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

GLASSTEC VIRTUAL

glasstec VIRTUAL from Oct 20-22 successfully bridged the gap between now and the forthcoming glasstec in June 2021. With its concept



comprising digital knowledge transfer, novel presentation possibilities for exhibitors as well as additional virtual networking options, it has convinced the international glass sector.

"With glasstec's virtual portfolio Messe Düsseldorf shows that it can succeed in bringing together industries worldwide, not only at physical events but also with digital formats. This means it continues to position itself once more as a No. 1 destination for global communication business contacts," says Mr. Erhard Wienkamp, COO Messe Düsseldorf.

"During the pandemic period, this solution enabled us to offer the industry an additional platform to intensify and expand international contacts. Now the focus is entirely on preparing glasstec, which will be held here in Düsseldorf from 15 to 18 June 2021," notes Ms. Birgit Horn, Project Director glasstec.

AIGMF participated at the Virtual Glass Associations Summit powered by Glass Worldwide. Presentations were made by Mr. Sanjeev Oberoi (Executive Director AIS) on Float glass segment on Oct 20; and Mr. Sanjay Somany (Former President AIGMF and CMD HNG) on Container glass segment on Oct 21. Both sessions were followed by a panel discussion. The participation at glasstec virtual was free.

Presentations and select photos of the event are available at https://aigmf.com/past-events.php ■

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KEY HIGHLIGHTS OF UNION BUDGET OF INDIA 2021-22

The Union Minister for Finance & Corporate Affairs, Ms. Nirmala Sitharaman presented the Union Budget 2021-22 in Parliament on Feb 1. Following are the key highlights:

- The Urban Swachh Bharat scheme will be implemented with an outlay of over ₹1.4 lakh crores.
- A new centrally funded scheme, PM Swasthya Yojana, with an outlay of ₹64,180 crores will be launched in addition to the existing schemes to develop primary, secondary and tertiary healthcare. FY22 outlay (budget estimate) for health and well-being is up 138%, at ₹2,23,846 crores. Of this, ₹35,000 crores will be spent on Covid-19 vaccine. Government committed to spending more, if needed.
- Aim to complete 11,000 kms of national highway infrastructure this year.
- ₹1.10 lakh crores outlay for railways, of which ₹1.7 lakh crores is for capital expenditure. Railway to monetise dedicated freight corridors.
- Pipelines of GAIL (India) Ltd, Indian Oil Corporation, HPCL will be monetised.
- Gas pipeline project to be taken up in J&K.
- Government to provide ₹2 lakh crores to states and autonomous bodies to meet capital expenditure.
- Central fiscal funding for Kochi Metro, Chennai Metro, Bengaluru Metro, Nagpur Metro and Nashik Metro projects.
- ₹3.05 lakh crores outlay for power sector. Government proposing to create a framework to give consumers, alternatives to choose from more than one power Distribution Company.
- Government proposes investor charter across financial products.
- Disinvestment target for FY22 at ₹1.75 lakh crores.
- Two PSBs and one general insurance company to be divested.
- Barring four strategic areas, PSUs in other sectors will be divested.

- Fiscal deficit estimated at 9.5% of GDP for 2020-21. Fiscal deficit for 2021-22 at 6.8% of GDP.
- Social security benefit to be extended to platform and gig workers. Government proposes portal to collect info on gig-workers, building and construction workers, among others.
- Government to increase maximum threshold paid-up capital of small companies from ₹50 lakh to ₹2 crores and increase the threshold of maximum turnover from ₹2 to ₹20 crores.
- Dividend payments to REIT (estate investment trusts) and InvIT (infrastructure investment trusts) exempt from TDS.
- To further ease filing of IT returns, details of capital gains and interest from banks, post offices, etc., will be pre-filled.
- Govt proposes to make income tax appellate tribunals faceless; to set up national income tax appellate tribunal centre.
- Late deposit of employee's contribution to PF by employers will not be allowed as deduction to employer.
- Advance tax liability on dividend income shall arise only after payment of dividend.
- PLI launched to create manufacturing global champions across 13 sectors with amount committed nearly ₹1.97 lakh crores in next 5 years starting FY 2021-22.
- FDI limit in Insurance sector increased from 49% to 74%.
- MSMEs:
  - Collateral free loans for businesses.
  - Disallowing global tenders of up to ₹200 crores.
- An initiative is underway, in partnership with the United Arab Emirates (UAE), to benchmark skill qualifications, assessment, and certification, accompanied by the deployment of certified workforce. The Government also has a collaborative Training Inter Training Programme (TITP) between India and Japan to facilitate transfer of Japanese industrial and vocational skills, technique, and knowledge and the same would be taken forward with many more countries.
- PPP mode to be utilised for managing operational services of major ports.
- ₹2,217 crores for 42 urban centres to tackle air pollution.
- Voluntary scrapping policy for vehicles announced. Fitness test after 20 years for personal vehicles; after 15 years for commercial vehicles.
- National Research Foundation with outlay of ₹50,000 crores over 5 years.
- Exemption from filing income tax returns for senior citizens (75 years and above) who only have pension and interest income. The paying bank will deduct the necessary tax on their income.
- Additional deduction of ₹1.5 lakh shall be available for loans taken up till 31 March 2022 for purchase of affordable house.
- Increase in limit for tax audit for persons who carry out 95% of their transactions digitally.
- Increase in duty on solar inverters and lanterns to promote domestic production.
- Eligibility for claiming tax holiday for start-ups proposed to be extended by one more year.
- Hydrogen energy mission will be launched.

भारत सरकार का केंद्रीय बजट: 2021-22

केन्द्रीय वित्त मंत्री श्रीमती निर्मला सीतारमण ने संसद में वित्त वर्ष 2021-22 का केंद्रीय बजट पेश किया। प्रमुख योजनाएँ इस प्रकार हैं:

- स्वास्थ्य सेवा के लिए 2.23 लाख करोड़ का एलान।
- स्वास्थ्य क्षेत्र को गति देने के लिए देश में बनाए जाएंगे 75 हेल्थ सेंटर, कोरोना वैक्सीन को विकसित करने के लिए 35 हजार करोड़ के पैकेज का एलान।
- उत्पादन से जुड़ी प्रोत्साहन योजना (पीएलआई)।
- 13 क्षेत्रों में पीएलआई योजना के लिए अगले पांच वर्षों में 1.97 लाख करोड़ रुपये की व्यवस्था।
- आत्मनिर्भर भारत के लिए विनिर्माण वैश्विक चैंपियन बनाना।
- रेलवे के लिए 1,10,055 करोड़ का प्रावधान।
- सड़क परिवहन मंत्रालय के लिए 1,18,101 करोड़ का प्रावधान।
- राष्ट्रीय अनुसंधान फाउंडेशन के लिए पाँच वर्ष में 50,000 करोड़ रुपए का परिव्यय।
- सरकार एक पोर्टल बनाएगी जो विशेषकर असंगठित क्षेत्र के मजदूरों के लिए होगा। बिल्डिंग कंस्ट्रक्शन में लगे मजदूरों के लिए फूड, हेल्थ और हाउसिंग स्कील शुरू होगी।
- रियायती दर पर सभी को घर देने के योजना के तहत ऋण के तौर पर ली गई 1.5 लाख रुपए तक की राशि के ब्याज पर मिलने वाली छूट की सीमा को भी बढ़ाने का प्रस्ताव किया गया है।
- तांबे, सोना-चांदी पर कस्टम ड्यूटी कम की गई है जबकि मोबाइल उपकरणों, कॉटन, कुछ आटो पार्ट्स और सोलर इंवरटर पर इसको बढ़ाया गया है।
- 75 वर्ष की आयु के ऊपर के लोगों को टैक्स में पूरी तरह से छूट दी गई है।
- फेसलेस निर्धारण और फेसलेस अपील की शुरूआत।
- डिजिटल लेन-देन के लेखा परीक्षा की सीमा 5 करोड़ रुपये से लेकर 10 करोड़ रुपये तक बढ़ाई, उन लोगों के लिए जो 95 प्रतिशत लेन-देन डिजिटल माध्यम से करते हैं।
- हाईड्रोजन ऊर्जा मिशन लांच किया जाएगा।
- बड़े पत्तनों की प्रचालन सेवाओं के प्रबंध के लिए पीपीपी मोड का उपयोग किया जायेगा।
- टियर 2 के और टियर 1 के परिधीय शहरों के लिए मेट्रो लाइट और मेट्रो नियो।
- इंजीनियरिंग के स्नातकों और डिप्लोमा होल्डरों के लिए नेशनल ऍप्रेन्टिशिप ट्रेनिंग स्कीम का पुन: सुयोजन।
- कौशल विकास और इसके मान्यता के क्षेत्र में संयुक्त अरब अमीरात और जापान के साथ भागीदारी।
- एक देश एक राशन कार्ड योजना लागू होगी।
- बीमा क्षेत्र में 74 फीसदी तक एफडीआई का प्रस्ताव।
- वायु प्रदूषण से निपटने के लिए 2,217 करोड़ रुपये का आवंटन किया गया है।
- पुरानी कारों के स्क्रैप प्रदूषण पर लगाम लगाई जाएगी।
- इंफ्रा सेक्टर में वित्तमंत्री ने 100 फीसदी विदेशी निवेश का प्रस्ताव रखा है। उनका कहना है कि इस पर आने वाली शिकायतों को दूर किया जाएगा। वित्तमंत्री ने कहा है कि सरकार नोटिफाइड इंफ्रा डेट फंड बनाएगी जो जीरो कूपन बॉन्ड जारी करेगा।

पहली बार जनपद के निर्यातकों को मिला ईपीसीएच में अहम स्थान

फिरोजाबाद। जनपद में प्रथम बार यहीं के निर्यातकों को एक्सपोर्ट प्रमोशन काउन्सिल फॉर हैन्डीक्राफ्ट (ईपीसीएच) में स्थान देकर पदाधिकारी बनाया गया है। नवनिर्वाचित पदाधिकारियों ने एसोसिएशन का आभार व्यक्त किया है।

जनपद के गिलास मैन्युफैक्चर एंड एक्सपोर्ट एसोसिएशन के अध्यक्ष मुकेश कुमार बंसल टोनी, उपाध्यक्ष राजेंद्र गुप्ता एवं सचिव सरवर हुसैन को डायनेमिक मेंबर ऑफ सेंट्रल रिजन कमेटी ईपीसीएच चुना गया है। इसके अलावा फिरोजाबाद में पहली बार है कि जिला फिरोजाबाद से ईपीसीएच को मनोनीत करना। नविता अहमद मुरादाबाद को सेंट्रल रीजन कन्वेयर नियुक्त किया गया है कमेटी ऑफ एडमिनिस्ट्रेटीव सीओए एक्सपोर्ट प्रमोशन काउंसिल फॉर हैंडीक्राफ्ट्स द्वारा चयन प्रक्रिया अपनाई गई। फिरोजाबाद के गिलास मैन्युफैक्चर एंड एक्सपोर्ट एसोसिएशन के पदाधिकारियों के मनोनयन पर जलमंत्री, रतनलाल कटारिया, सदर विधायक, मनीष असीजा, राकेश कुमार सीएमडी ईपीसीएच, राकेश रावत, ऑल इंडिया ग्लास मैन्युफैक्चरर फेडरेशन के पूर्व अध्यक्ष राजकुमार मित्तल शहर के सभी निर्यातकों ने शुभकामनाएं दी। मुकेश बंसल टोनी ने राकेश कुमार, एक्सपोर्ट प्रमोशन काउंसिल फॉर हैंडीक्राफ्ट्स के महान निर्देश का इस मनोहन के लिए आभार व्यक्त किया।

कोरोना संकट से उबरने लगा ग्लास एक्सपोर्ट

कोरोन काल में कांच नगरी का ग्लास एक्सपोर्ट काफी संकट से गुजर रहा था। कुछ सहुलियत से उबरने लगा है। हालांकि शहर के निर्यातकों को अभी और सहूलियतों की दरकार है, जिससे पूरी तरह संकट खत्म हो जाए।

ग्लास एक्सपोर्ट को बढ़ावा देने के लिए निर्यातकों को सरकारी मदद की दरकार है। जिससे उन्हें निर्यात कारोबार को आगे बढ़ाने में राहत मिल सके। शहर के निर्यातकों की माने तो काँच नगरी से होने वाला ग्लास एक्सपोर्ट


राकेश कुमार, महानिदेशक ईपीसीएच


मुकेश बंसल टोनी


राजेंद्र गुप्ता


सरवर हुसैन

का सालाना कारोबार करीब दो हजार करोड़ का है। जो कि कोरोना काल में विदेशी कारोबारियों द्वारा माल के ऑर्डर रद्द कर दिये जाने और स्थानीय स्तर पर आ रही समस्याओं के चलते 50 फीसदी तक सिमट कर रह गया है।

निर्यातकों को कोरोना काल में सरकार द्वारा अपना कारोबार करने की छूट भले ही दे दी गई है लेकिन सरकार से शहर के ग्लास एक्सपोर्टरों को निर्यात कारोबार को आगे बढ़ाने के लिए किसी तरह की मदद नहीं मिल सकी है। जिसके चलते निर्यातकों को अनेक मुश्किलों से जूझना पड़ रहा है। निर्यातक चाहते हैं कि भारत सरकार ग्लास एक्सपोर्ट को आगे बढ़ाने के लिए विशेष राहत पैकेज प्रदान करे तो उनका कारोबार तरक्की की राह पर आगे बढ़ सकता है। तभी निर्यात को बढ़ावा मिल सकेगा और विदेशी पूंजी भारत में आ सकेगी।

निर्यातकों ने दिए कई अपने सुझाव: शहर के निर्यातकों ने सरकार से मदद की गुहार लगाई है। निर्यातकों का कहना है कि यूरोप सहित विश्व के कई देशों में जैसे कि पोलैंड, चेकोस्लोवाकिया जैसे देश कांच के प्रमुख रूप से उत्पादक एवं निर्यातक है। इन देशों में कांच के निर्यात पर नाजुकता छवि पूर्ति नामक कंपनसेशन सरकार द्वारा दिया जाता है।

इसी तरह भारत सरकार हमारे कांच के निर्यात उत्पादों पर 10 प्रतिशत कंपनसेशन प्रदान किया जाए। निर्यातक कहते हैं कि निर्यात करने वाले कांच के माल के लिए आधुनिक टेक्नोलॉजी की मशीनें हमारे पास उपलब्ध नहीं है। भारत सरकार ऐसी आधुनिक मशीनों की उपलब्धता सुनिश्चित कराए। साथ ही इन मशीनों को विदेश से आयात करने पर इस मशीन की खरीद पर 50 प्रतिशत का अनुदान दिया जाए। जिससे जो आइटम निर्यात नहीं होते है वह भी निर्यात होने लगे। कांच नगरी से जो ग्लास आइटम निर्यात किए जाते हैं, इन उत्पादों की गुणवत्ता जांचने के लिए प्रयोगशाला अंतराष्ट्रीय स्तर की हो। साथ ही निर्यात होने वाले उत्पादों की टेस्टिंग के बिल पर 50 फीसदी की छूट दी जाए। निर्यातक कहते हैं कि हमारे यहाँ नेचुरल गैस एवं पेट्रोलियम प्रोडक्ट जीएसटी से बाहर रखे गए है। जिन पर केंद्रीय उत्पाद शुल्क, सीमा शुल्क एवं 10 प्रतिशत वैट कर के रूप में सम्मिलित होता है। यानी कि निर्यात के लिए जो कांच बनाया जाता है उसकी कीमत का 40 प्रतिशत खर्चा गैस व तेल पर आता है। भारत सरकार इसे गंभीरता से लेते हुए टैक्स को कम करें। निर्यातकों का कहना है कि कांच की सोलर पैनल प्लेट भारत में 95 प्रतिशत तक आयात की जाती है। सरकार इसका उत्पादन करने के लिए निर्यातकों को प्रोत्साहित करें। इससे हम निर्यातक इसका उत्पादन कर सके। अभी तक हो रहे कांच की सोलर पैनल प्लेट के आयात को हम निर्यात में बदल सके।

ग्लास एक्सपोर्ट को बढ़ावा देने के लिए भारत सरकार को विशेष राहत पैकेज घोषित करना चाहिए तभी हम निर्यातकों को राहत मिल सकेगी इस संबंध में हमने अपनी मांग पत्र एक्सपोर्ट प्रमोशन काउंसिल को भी भेजी है।

–मुकेश बंसल टोनी, चेयरमैन
ग्लास मैन्युफैक्चरर एवं एक्सपोर्ट एसोसिएशन एवं कोषाध्यक्ष, ऑल इंडिया ग्लास मैन्युफैक्चरर्स फेडरेशन

कोरोना महामारी का प्रतिकूल असर हमारे ग्लास एक्सपोर्ट कारोबार पर पड़ रहा है। जिसके चतले हम निर्यातकों को अनेक मुश्किलों का सामना करना पड़ रहा है। भारत सरकार को हमारी मदद करने के लिए ठोस पहल करनी चाहिए। सरकारी मदद मिलने पर ही हमारा कारोबार तरक्की कर सकेगा।

–सरवर हुसैन, *ग्लास एक्सपोर्टर*

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

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Glass in Modern Architecture

Global population is growing alongside increasing urbanisation and construction activities. Even today, modern architecture could not do without the material that is glass and its many innovative properties. Held in Düsseldorf from 15 to 18 June 2021 glasstec will pick up on the latest glass trends related to shapes, formats and structures.

Cities are growing worldwide. Even today, the earth is populated by just under 8 billion people. By 2050 this figure will have risen to some 9.7 billion people, according to various projections. Most of this population will live in parts of the world that are generally referred to as growth regions, i.e. in Asia, Latin America as well as the African continent; and most people will be living in cities and megacities, according to these estimates. Over the coming years there will be some 600 cities with over a million inhabitants*, many of these in Asia. This not only presents architects with enormous challenges. In this connection glass will be of major importance as a construction material; but glass must be multi-functional.

* Note on Megacities

The term megacity is often used with reference to urban development. By megacities we generally mean metropolitan areas with over 10 million inhabitants – as many people as the current population of such countries as Belgium, Greece, Hungary, the Czech Republic and Portugal.

In 1970 there were only two megacities in the world, Tokyo and New York. 2011 already saw 23 megacities and in 2030 numbers are estimated to reach 43. As a rule, megacities grow at an enormous pace although there are, of course, regional differences. Tokyo today occupies the top rank with over 38 million inhabitants but will shrink due to demographic change. By 2050 the Japanese capital is estimated to be down to "only" just under 32.6 million people.

The Indian state capital of New Delhi is currently home to some 28.5 million people. By 2030 another 10 million will live there.

When cities grow they not only expand in terms of area because land and space are limited – houses also skyrocket. In times of globalisation buildings often have to comply with international standards, regardless of whether they are erected in Frankfurt or Singapore; a case in point being sustainability requirements – with the buzzword Green Building.

Despite high standards, construction costs must not get out of hand however. Here glass panes used over large expanses or glass façades provide enormous possibilities because glass combined with steel allows sometimes very filigree shapes to be realised for building skins. In general, glass is considered a dominant construction material in modern architecture these days as it makes a visual statement while offering multiple technical functionalities at the same time. Be it for thermal and solar protection or sound insulation, as a design feature, as tempered safety glass or as part of solar energy systems – the industry offers matching glass types with individually configurable technical values for just about every application. Especially against the backdrop of climate protection energy-saving construction takes very high priority in architecture today. Here, too, glass can score points as a filler element or a structural or enveloping component.

The unbeatable argument in favour of glass, time and again, is its transparency because natural daylight decisively contributes to people's well-being. Glass is also getting smarter because by incorporating glass in building networks' interactive façades can be realised that produce both indoor and outdoor effects. Or by connecting it to control technology systems glass becomes the "media and control centre" that can regulate a variety of functions in the building.

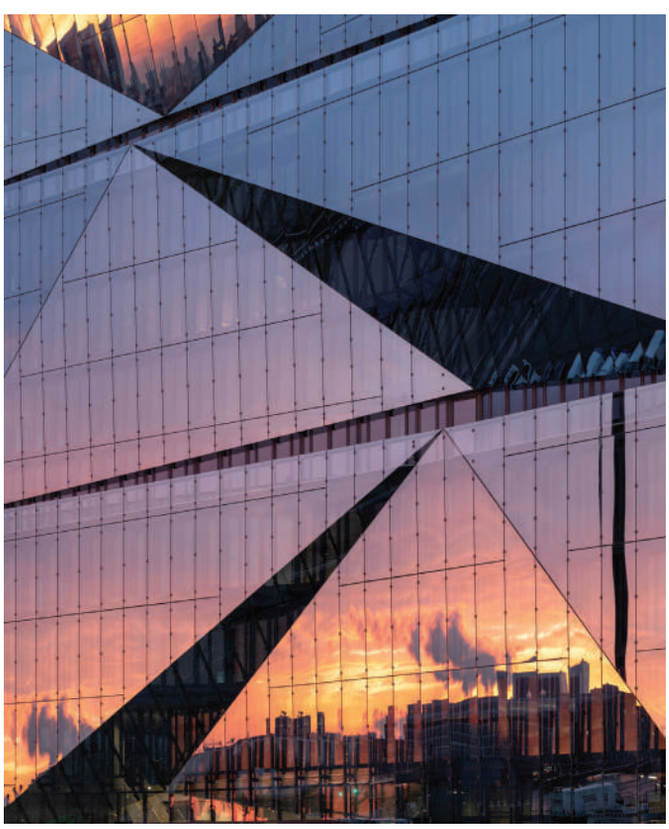
Alongside the actual primary benefit of windows, architects and building owners increasingly call for differentiated add-on functions. In most cases these include applications-related and construction physics solutions. As a consequence, people increasingly speak of functional windows or façades.

EXAMPLES FOR INNOVATIVE GLASS DEVELOPMENT

Energy efficiency is an essential theme for glass in architecture. The "cube berlin" project, for example, shows how innovative architecture and energy efficiency can be perfectly coupled with each other. Energy consumption in this building is lower than in conventional office blocks thanks to a ventilated twin-skin façade. The twin-skin façade not only permits natural daylight to enter but also provides effective protection against (solar) heat gains and natural ventilation for those living in and using the building. To avoid excessive heat build-up in the void between the

two façade skins the outer skin was fitted with solar protection coatings and a solar-absorbing PVB film. The structural requirements made on the glass here proved another challenge. They called for an additional structurally active film interlayer that had to be compatible with the solar-absorbing PVB film. This solution is a new development. By adding the extra film layer the edge stability was increased while reducing the risk of delamination as well as the yellowness index.

But glass in modern architecture can deliver so much more. When low weights are called for, vacuum insulated units will in future come into play more often. Modern vacuum insulation glass consists of two at least three-millimetre panes with a high-insulation coating each and separated by a vacuum layer of 0.1 millimetre. Boasting Ug-values of 0.4 to 0.7 W/(m²K), the double- glazed unit insulates as well as a triple-glazed insulation unit but weighs a third less in terms of the glass component alone. This permits significantly slimmer profiles.



Especially for high-rise buildings windows and façade cleaning plays a pivotal role. Self-cleaning glass helps save costs here in the long run because a pyrolytic special coating makes the glazing extremely durable and uses UV radiation decompose organic dirt in five to seven days. The next rainfall then simply rinses the residues.

In terms of solar protection on large-surface façades highly selective glazing is in particular demand since it allows as much daylight into the building as possible while minimising the climate burden through effective solar shading. Multiple silver-coated glass sheets transmit plenty of visible daylight into the room despite strong solar shading. Boasting a Ug-value of 1.0 W/(m2K) for double glazing or 0.5 W/(m2K) for triple glazing, this glass protects the rooms from cooling down at low temperatures.

Load-bearing capacity and shatter proofing are the aspects of primary importance for laminated safety glass which is up to 100 times more resilient due to a special PVB film compared with conventional PVB films. At the same time, the intrinsic colour of the laminated glass is not even changed by thicker laminates. Under load this product features comparatively lower bending, which increases its load-bearing capacity overall. Under specific circumstances even the tempering process can be dispensed with– this ensures shorter delivery periods.

Another topic is the translucence or opaqueness of glass. With this type of glass users can choose between transparent or non- transparent – regardless of whether the glass is installed indoors or out. This effect can be repeated any number of times because it is caused by liquid crystals embedded in a conductive layer. As soon as electric power is applied the glass changes from being opaque to transparent. After switching off the power supply, the crystals re-arrange and the glass sheet turns opaque again ■

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Some Aspects of Laminated Glass

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Abstract

Laminated glass is a type of 'safety' glass that does not break into small pieces when impacted by external forces. There is a layer of polymer-type material between, say, two layers of glass sheet that holds the glass pieces together, when broken. These glasses also require high mechanical strength to withstand the severity of the impact forces that can be imparted by tempering or heat-treatment. The quality of glass in terms of higher mechanical strength as well as the quality of polymeric material between two glass pieces are important for the overall quality of the safety glass. Some of these features are discussed here.

INTRODUCTION

In order to talk about versatility of sheet or float glass, a lot of discussion has been made in a book on glass published by AIGMF with various papers already published in Kanch **[1]**, along with the most important quality of float glass as transparency **[2.3]**. In order to define laminated glass, it is generally said that it is a type of 'safety glass' that holds together when shattered, i.e. a type of glass with additional safety features that make it less likely to break, or less likely to pose a threat when broken. It helps human beings get hurt from the broken glass pieces. Common designs include Toughened glass, i.e. also known as Tempered glass **[4]**, Laminated glass, and Wire-mesh glass, i.e. also known as Wired glass.

Wire-mesh glass was invented by Frank Shuman. Laminated glass was invented in 1903 by the French chemist Édouard Bénédictus (1878–1930). The above four approaches can easily be combined, allowing for the creation of glass that is at the same time toughened, laminated, and contains a wire-mesh. However, combination of a wire-mesh with other techniques is unusual, as it typically betrays their individual qualities.

By external forces, when it is broken, the glass piece is held in place by an interlayer, typically of polyvinyl butyral (PVB), Ethylene-Vinyl Acetate (EVA), or Thermoplastic Polyurethane (TPU), between its two or more layers of glass. The interlayer keeps the layers of glass bonded even when broken, and its high strength prevents the glass from breaking up into large 'sharp' pieces, i.e. less dangerous to humans. This produces a characteristic "spider web" cracking pattern when the impact is not enough to completely pierce the glass. In the case of the EVA, i.e. the thermoset EVA, offers a 'complete bonding' (cross-linking) with the material whether it is glass, polycarbonate, PET, or other types of products. TPU is the best choice for Bullet-Resistant Glass (BRG) and for so-called E-Glass (Smart Glass).

Laminated glass is normally used when there is a possibility of human impact or where the glass could fall if shattered and also for architectural applications. Skylight glazing and automobile windshield typically use laminated glass. In some geographical areas requiring hurricane-resistant construction, laminated glass is often used in exterior storefronts, curtain walls and windows.

Laminated glass is also used to increase the sound insulation rating of a window, where it significantly improves sound attenuation compared to monolithic glass panes of the same thickness. For this purpose a special "acoustic PVB" compound is used for the interlayer. In the case of the EVA material, no additional acoustic material is required, since the EVA already provides sound insulation. TPU is an elastic material, so sound absorption is intrinsec to its nature within its elastic bound. An additional property of laminated glass for windows is that an adequate TPU, PVB or EVA interlayer can block essentially most ultraviolet radiation. A thermoset EVA could block up to 99.9% of all UV rays. This is a very good limit that could be achieved when such application is desired. Let us now discuss the chemical aspect of the bonding material.

Polyvinyl Butyral -->

This is a wonder material and very important to glass technologists involved in making interlayer glasses with special properties. Glass makers need some knowledge about this material in order to make a good quality of laminated and other safety glasses. Polyvinyl butyral (PVB) is

considered to be an acetate, and it is formed from the reaction of an aldehyde and alcohol. The structure of PVB is shown in Fig. 1, but generally, it is not made in exactly this form.

It is made in a way such that the 'polymer' is a mixture of PVB, polyvinyl alcohol (PVOH), and polyvinyl acetate segments as shown in the figure. The relative amounts of these segments are controlled but they are generally randomly distributed through the molecular chain. Such a molecular distribution in the chain is a complicated process and is studied by a variety of physical techniques that reveal a wealth of information. The properties of the polymers can be optimized by controlling the proper ratios of the three segments.

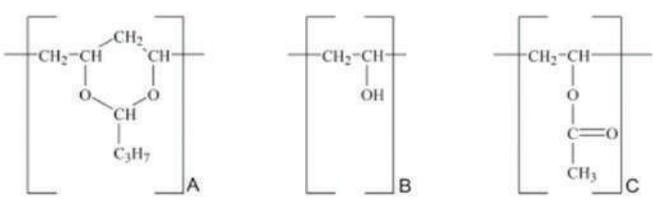

Figure 1: Chemical Bonding Pattern in Polymeric Material

Permeation of gases at 25°C for oxygen is 0.771, for argon 0.463 and for nitrogen - it is 0.133. In normalized coefficient, in the units of cm3.mm/mm2.day.atm, it is 50.6 for oxygen, 30.4 for argon and for nitrogen - it is very low at 7.4. These data are also important while choosing the right type of material as an inter-layer compound.

For safety glasses and various architectural glasses, manufacturers with different trade names exist: GlassNovations KB@, DuPont Butacite@, Solutia Inc. Saflex@, Sekisui S-Lec, Kuraray TROSIFOL@

SOME ASPECTS OF LAMINATED GLASS

Whenever we talk about laminated glass - it reminds us of the composite material - although it is not explicitly described as such. Glass can be given different properties by being combined with other materials. A typical example is laminated glass that is a glass–plastic film, i.e. polyvinyl butyral (PVB) or ethylene vinyl acetate (EVA) – glass sandwich. Some special glasses such as laminated and toughened cannot be recycled. Low-e glass has a molecular layer of metal on the inside surface of the double (or triple) glazing unit, which accounts for its insulating properties in 'smart' buildings. This can be recycled but like the majority of glass not as window glass but as glass fiber insulation or powdered for use as filler in paints. Glass can be recycled, though currently most end of building life glass finishes up in landfill as in Europe reported since 2013. A typical structure is shown in Figure 2.

Laminated glass is made by pasting PVB (polyvinyl butyral) resin glue film between two or more pieces of glass sheet, then heating, pressing and bonding them together to create flat or curved compound glass products. The glass sheet for making laminated glass can be:

a. Ordinary glass,
b. Float glass,
c. Tempered glass,
d. Coloured glass,
e. Heat-absorbing glass, or
f. Heat-reflecting glass, etc.

The layer quantity is 2, 3, 5, 6, up to 9. The thickness of glass sheets varies with increasing number of layers. For double-layer laminated glass, the common thickness of glass sheet is (mm) 2 + 3, 3 + 3 and 3 + 5 etc. Laminated glass has good transparency, and its impact resistance is several times higher than that of ordinary sheet glass. Bullet-proof glass is made by compounding multiple layers of ordinary glass or tempered glass that are properly heat-treated at appropriate temperatures to impart higher mechanical resistance.

Due to the adhesion of PVB glue film, even when the glass breaks, its fragments keep binding on the thin film and will not hurt people, and the surface of the fragmented glass remains clean and smooth, which effectively prevents fragments from penetrating or falling, thus ensuring human safety. Laminated glass made of different sheet glass has different features such as durability, heat resistance and also moisture resistance, etc. **[1,5]**.

In Europe and America, laminated glass is applied to most buildings to avoid dangerous accidents because of its strong anti-shocking and anti-break-in abilities. The glue film in the middle is

Figure 2: A typical Glass-clad Structure with Laminated Glass

able to resist the consecutive striking by lethal weapons such as hammers and wood-cutting blades, and to resist the penetration of bullets for a certain period of time, so it is of high security level that was the intended 'goal' of laminated safety glass for construction industry.

It is known that the 'Sound Insulation' effect is one of the important factors to evaluate the quality of modern residential buildings. Glass with PVB interlayer films is able to block sound waves, and retain calm and comfortable office ambience. Its special UV filtering function not only protects human skin, but also prevents important and precious furniture and exhibiting artworks from fading. It also reduces the transmission of light **[2]**. It also saves refrigerating energy.

Due to so many advantages, laminated glass creates unimaginable unique effects in household decoration. For instance, now frosted glass is applied to home doors, including kitchen doors, and oily smoke is easy to stick to the surface. However, if laminated glass is taken instead of frosted glass, such difficulty will disappear. Moreover, large surface partitions at home are always a hidden trouble to the safety of active kids. If such laminated glass is applied, parents will feel relieved about the safety of the children.

Laminated glass is safe to people even if it is broken. Hit by a heavy ball, it is likely to break into fragments, but the whole block of glass remains consistent, and its debris and small sharp fragments keep binding with the glue film in the middle. Laminated glass is safer, so it is generally applied to doors, windows and skylights of high buildings, and showcases and partitions in stores, banks and jewellery shops, etc. There are a variety of possibilities in its applications.

We should write a line or two on the manufacture of laminated glass. Laminated glass is produced by combining two or more sheets of float/tempered glass with one or more interlayer and is processed by autoclaving at 1400°C and pressure up to 14 bar, as evident from the works of Haldimann et al. in 2008. Polyvinyl butyral (PVB) is the most common interlayer used in Laminated glass. "Alternative transparent" interlayers may be used in laminated glass to obtain special properties, such as solar control, thermal insulation, fire protection, etc.

Laminated glass also provides satisfactory structural behaviours under extreme loading conditions such as explosions. One of the main reasons for the use of Laminated glass in building envelopes is its safe failure mode compared to that of float glass and tempered glass. Recent developments include high-tech 'ionoplastic' interlayers. According to the manufacturers, Laminated glass with ionplastic is lighter and stronger than conventional Laminated glass. Further, it can withstand storms, impacts and powerful blasts as evidenced by Dupont in 2015. It is also worth noting that toughened glass with polycarbonate interlayers is used in bulletproof glass. This is a vast area of research.

It should be relevant to mention that the glazing materials in a vehicle are laminated glass that is used for:

(a) Windshield, and
(b) the Tempered glass used for:
(1) the Side windows,
(2) the Rear window, and
(3) the Sunroof.

Laminated glass is constructed of two 1.8–2.3 mm thick sheets of glass with a very thin layer - typically 0.76 mm thick of polyvinyl butyral (PVB) in between. So, the total thickness of the composite is 4.36 - 5.36 mm.

The PVB layer makes the windshield shatter-proof that is essential for the safety of the driver and the front passengers. Tempered glass is a single sheet of glass - typically 2.4 to 2.6 mm thick - and is strengthened by heating it above the annealing point of 720°C followed by rapid cooling **[6]**. Tempered glass is much easier to penetrate than Laminated glass and fractures in a brittle manner when impacted, but it is 3 to 4 times cheaper than laminated glass. Therefore, these considerations are also important when designing the correct material for a given application.

CONCLUSIONS

Some basic features of laminated glass are given here along with the chemical behaviour of PVB layer that is included within two pieces of glass in order to make such a composite material, i.e. glass-plastic composite, for various applications. While designing such a material, cost considerations are also important. The possibility of using Tempered glass in certain applications is also explored when higher mechanical or impact strength is desired. In future, various aspects of such glasses - coming under a broad category of 'safety' glasses - will be discussed to explore various other features.

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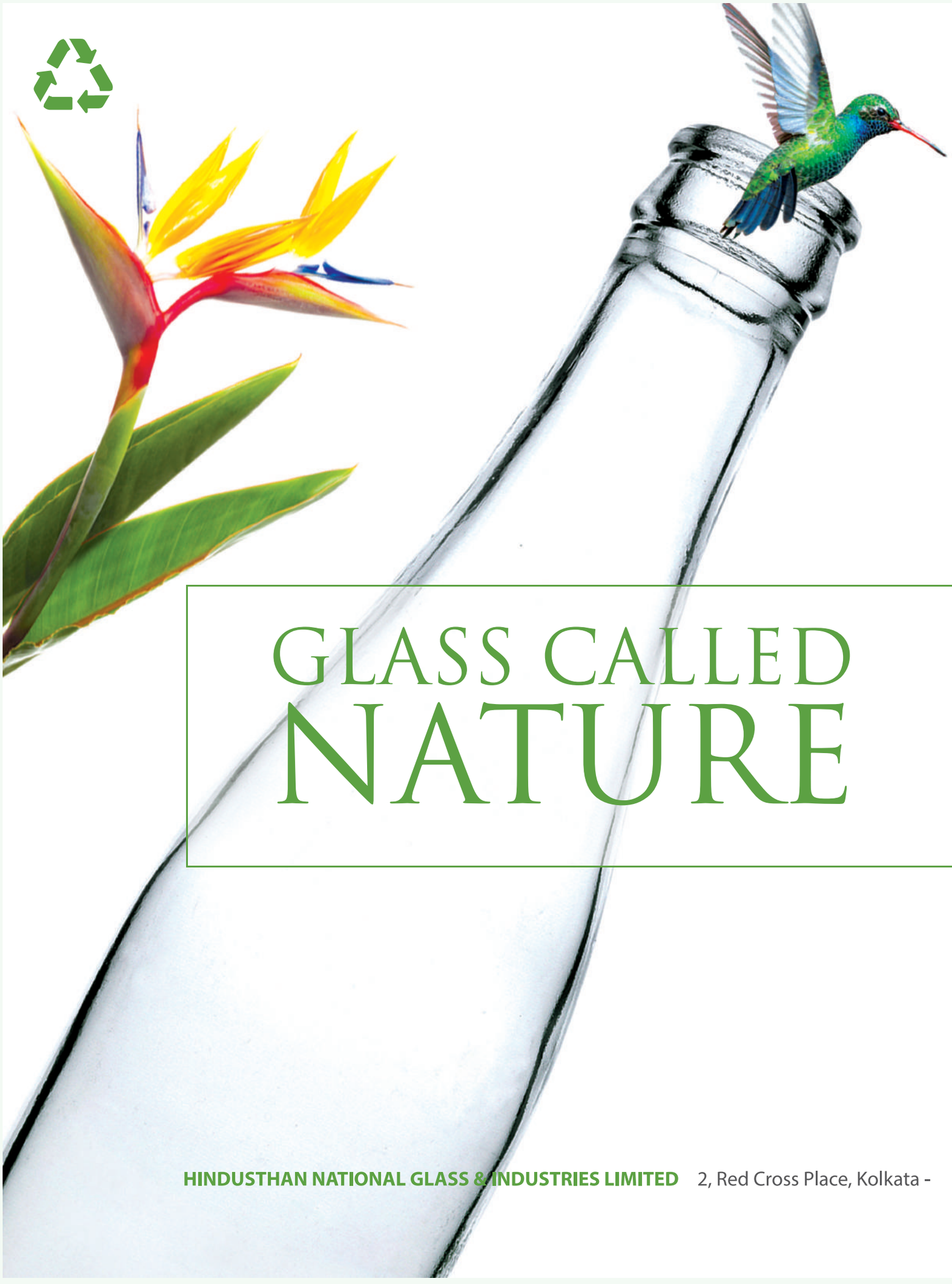

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Enamel-based digital printing on hollow glass

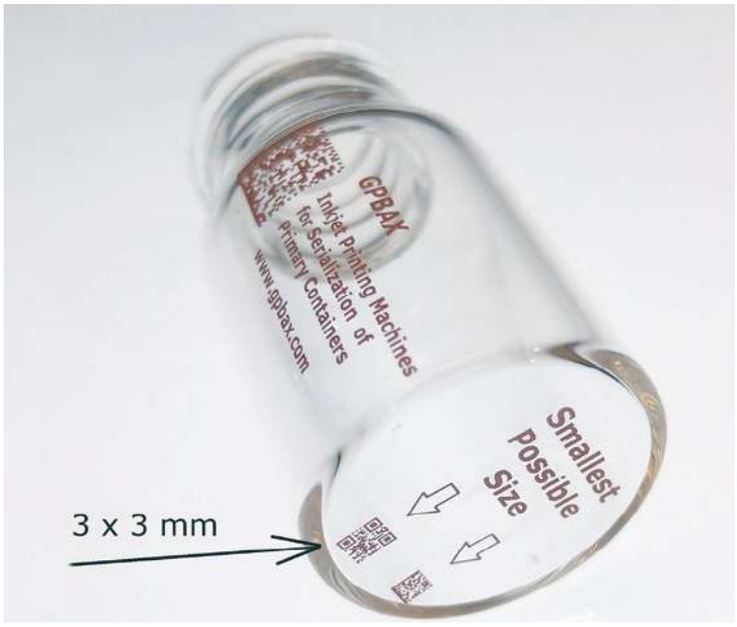
Originally published in *Glass Worldwide* (preferred AIGMF international journal), Manuel Bernroiter Manuel Bernroitner discusses the route to abolish screen printing and introduce serialisation/track and trace solutions on primary glass packaging.

The origins of screen printing go back to the 19th Century or the first decades of the 20th Century. While this technology has evolved over time, there were hardly any revolutionary approaches to new developments in the marking and the decoration of glass, except for a few outliers based on different analogous principles. Now there may have been good arguments for this technology in the past but the present decade of the 21st Century at the latest should slowly and steadily herald the end of screen printing.

Towards organic and inorganic digital printing

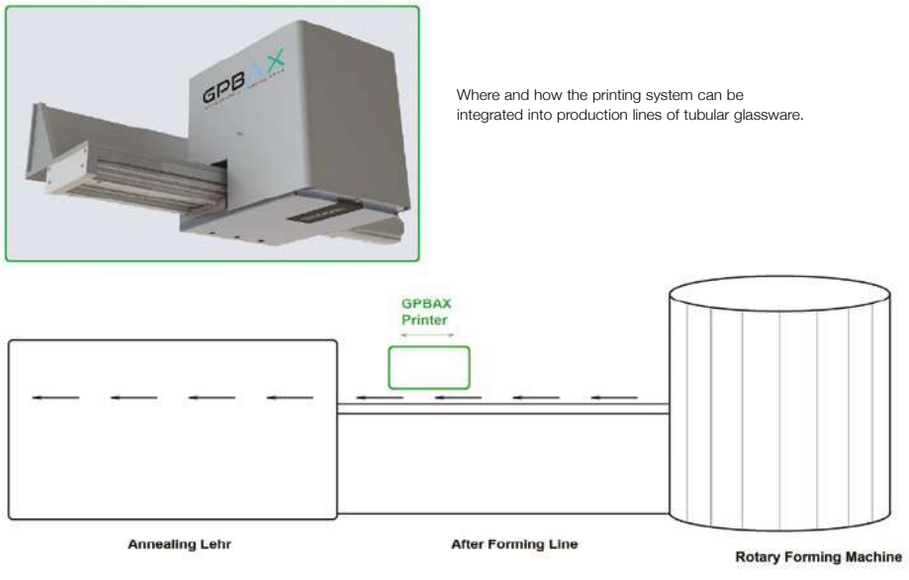
In recent years, some manufacturers have already started to offer inkjet-based digital printing systems. The focus here, as is the overall standard in digital printing, is on the application of organic, mostly UV or air curing inks that are particularly suitable for applications with low to medium resistance requirements. The big gap concerned enamel-based printing for highest resistance requirements.

While resistance is often neither required nor desired for some, mostly decorative applications, this 'organic' technology often fails in demanding functional applications. Just think of autoclaving, lyophilisation and often enormous stress during disinfection and cleaning in the laboratory and medical sector. GPBAX - as a bi-national joint venture in the digital printing and glass processing sector, is proud to be probably the first company worldwide to offer a solution for such an ink, as well as for the digital printing technology required for its application. Its ink is applied by ink jet and then fired above the softening temperature of the glass, creating a virtually unbreakable bond.



Markings applied on a small borosilicate vial (10ml), showing minimum size of traceability codes.

This solution should be correspondingly interesting for manufacturers of pharmaceutical and laboratory glassware, where it is still common practice to apply functional and decorative markings by screen printing with ceramic glass inks fired at similar temperatures above 500°C. With this technology, the process is now being put on a 'digital' basis, with significant, positive possibilities arising.



Where and how the printing system can be integrated into production lines of tubular glassware.

Volumetric glassware can be marked with codes linking to a product's individual certificates.

Originally published in Glass Worldwide, preferred international journal of AIGMF

glass WORLDWIDE

What advantages may there be? In contrast to the 'analogue' technology, the fully digital inkjet technology offers the following benefits:

- Possibility to print track and trace - codes/serialisation: As there is no need to use masks, stamps, screens or other auxiliary products, every single print can be modified and a complete, permanent serialisation of the produced products can be achieved and traceability from hot production to the end user (patient) can be achieved.
- Template modification by mouse click: The time-consuming set-up and adjustment of screen printing masks is 100% eliminated. All templates are created digitally, transferred to the GPBAX printing system and the data to be printed is generated via connection to the existing data management system. All this is only a matter of a couple of mouse clicks.
- Heavy metal issues: Since the ink used was developed almost from scratch, care was taken from the outset to prevent the use of dangerous heavy metals (lead, cadmium etc).
- Coating thickness control: Every marking is made from individual drops, each with a known drop size. By controlling the amount of drops per unit area, the amount of ink or the layer thickness of the marking can be controlled with maximum reproducibility. Problems with chipping of the marking due to inconsistent layer thickness settings can thus be actively avoided.
- Closed system with minimised ink consumption: The entire ink reservoir forms a closed system, from which only the ink quantity actually required (a few millilitres per fully printed square metre) is taken. This makes it possible, for example, to serialise several million pharmaceutical bottles with only one litre of ink.

How it all began

GPBAX came across the topic of digital printing on borosilicate glass in the laboratory glass sector. Here, especially in the production of volumetric glassware, there are still many manual work steps to be carried out to calibrate the vessels and manually mark them by screen printing. Since autumn 2017, the company has been working on a solution to automate and digitalise all these steps, always with a view to the strict requirements for marking resistance resulting from ISO 4794.

After a 30 month development period, GPBAX now offers both liquid-free measuring technology and enamel-based digital printing technology for the production of these vessels. At the beginning of the development process, the pharmaceutical glass sector was not in mind at all. All the more reason to be pleased that this technology now creates possibilities for serialisation, traceability and digitalisation, very likely providing benefits all the way to the end user.

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The Future of Skilled Trades is Digital

Digitalisation is not only something for start-ups or major enterprises. It applies just as naturally to many skilled trade businesses. The German Association of Glazier Trades (Bundesinnungsverband des Glaserhandwerks – BIV) will pick up on this topic as part of the glasstec trade fair in Düsseldorf from 15 to 18 June 2021.

Many still believe that skilled craftspeople often have difficulties with digitalisation. However, this is not quite true, as shown by a current and representative study commissioned by Bitcom, the German Association for Information Technology, Telecommunications and ZDH, the Confederation of German Skilled Crafts. For this study, 502 businesses in the skilled trades were polled across Germany.

Some background: according to the figures, one in two businesses (53%) already use digital technologies or applications in Germany. This is an 8% increase on the 2017 survey which found only just under 45% of German skilled trade businesses employed digital technologies and applications. So-called cloud computing – currently used by already 27% of the firms – enjoys the highest penetration. Approximately one in eight of such businesses (13%) capitalises on smart software that allocates working hours automatically to project statuses. 12% make use of tracking systems that allow tracing machinery and resources. Predictive maintenance where sensors and the analysis of the data they generate make it possible to predict imminent asset failure early on, is already being used by one in ten outfits (10%). In contrast to this, 3D technologies (7%), drones (5%) and robots (5%) only rank relatively low, according to further insights.

Most firms have now also consistently digitalised when it comes to communicating with customers and suppliers. Nearly all skilled trade businesses have their own website (97%) and some 84% are represented in online directories such as Google Maps or "Wer liefert was". Three out of ten outfits (30%) are even active on social media such as Pinterest, Facebook, Instagram or YouTube although this predominantly

holds true for larger companies.

Twenty five per cent of firms employing up to nine people are active on social media; at 49% the number of skilled trade businesses employing ten or more people is almost twice as high. Furthermore, one in four firms (23%) are listed with rating platforms and one in six (14%) are active on online platforms such as 'MyHammer' or 'Treatwell'.

PROGRAMS FOR INTERNAL WORKFLOW

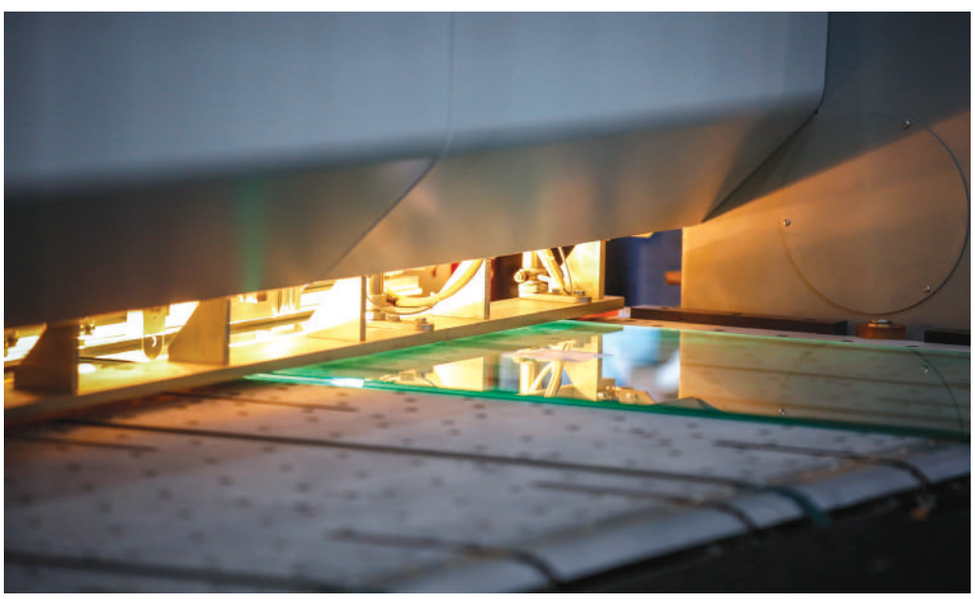
As part of their organisation and administration work, almost two thirds of skilled trade businesses (64%) use digital applications. This corresponds to a slight, 7% increase against the same period in 2017 (57%). Fifty two per cent of these companies already capture and file their orders using Customer Relationship Management (CRM) software. In 2017 this figure still stood at 46%. Just under one in three skilled trade businesses (31%) uses Enterprise Content Management (ECM) software for digital document organisation. In 2017 this figure was as low as 22%. And even personnel planning is done with an HR application by every fifth company (20%) compared to 15% in 2017.

"These figures show impressively that digitalisation in the skilled trade favours new forms of value added as well as new value-adding networks with suppliers, customers and partners. Last but not least, *digital networking also brings about a new form of communication,"* explains Mr. Stefan Kieckhöfel, Executive Director of the German Association of Glazier Trades.

In cooperation with the "Kompetenzzentrum Digitales Handwerk*" the German Association is currently busy to point out possible ways for digitalisation of glazier firms to its member companies. By glasstec in June a printed compendium and an online platform will be available on the association's website. These sector-specific tools are designed to not only assist associated members in the digitalisation of their own operations but also to familiarise them with various software programmes; programmes that can cover various working areas such as production planning, acquisition or order and financial management as well as quality assurance and logistics.

OPTIMISATION OF ORDER PROCESSING

Glazier or fenestration firms that already use modern industry software can often access the firm's data



*The "Kompetenzzentrum Digitales Handwerk" (Centre of Expertise Digital Skilled Crafts) forms part of the funding initiative "Mittelstand 4.0 – Digitale Produktions- und Arbeitsprozesse" (SME 4.0 – Digital Production and Working Processes), supported by the Federal Ministry of Economics as part of the funding priority "Mittelstand-Digital – Strategien zur digitalen Transformation der Unternehmensprozesse" (SME Digital – Strategies for the Digital Transformation of Corporate Processes).

pool via smartphones or tablets. In concrete terms this means that field service staff only need to bring their mobile devices as well as a Bluetooth-enabled measuring device to construction sites. They no longer need paper to generate orders or enter dimensions, thereby removing the need to subsequently enter this data into the system in a cumbersome manual process.

Via the App they have access to all relevant data required for a job. Next to the mandatory customer address these include all order and/or document data or the measurements required for each item, for instance. Furthermore, they can check on site just in time, so to speak, whether the profiles, glass types, fittings, etc. desired for the planned doors or windows are available or still need ordering. Likewise, important added information on the project in the form of text, voice, image and video or also drawings and free-hand sketches can be processed via the App. Subject to web access at the construction site the entered data are immediately available for further processing in the back office. However, an App like this also works offline.

"Such examples show that smart digitalisation in the skilled trades can save time and optimise costs. And the skilled trade operation signals to suppliers and customers that it is keeping up with the times," concludes Mr. Stefan Kieckhöfel ■

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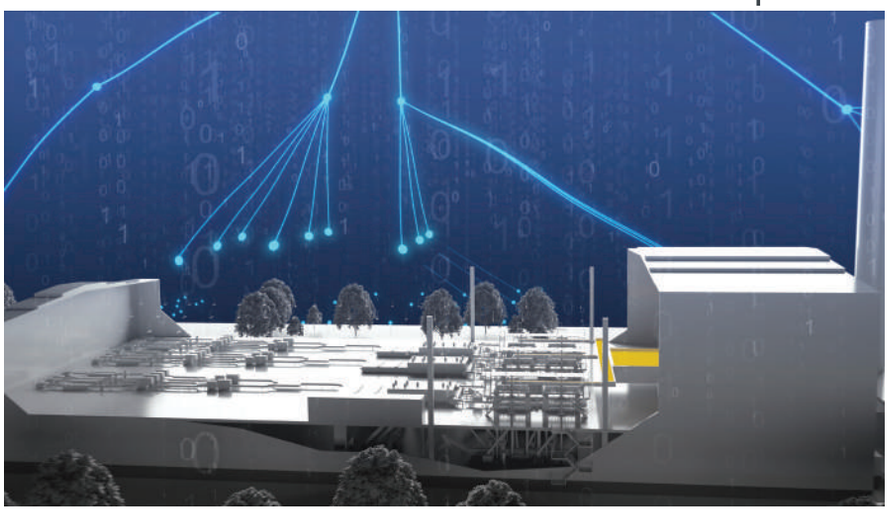
The glass plant of the future

smart plant

Adopting the latest Industry 4.0 technologies is now crucial for the international glass container industry, says Mr. Dirk Pörtner, CEO at Heye International. Heye offers customers a partnership on their individual path towards a smart plant, resulting in the creation of a highly automated and cost-effective glassworks.



Selection is key to defining the perfect path but it's a challenging job to keep track of the Industry 4.0 jungle. The Glass People at Heye combine long-term process expertise and a passion for the material with advanced skills in the latest technology. Every possible solution is evaluated by the company's process experts based on the decision criteria of financial ROI, workplace safety and influence on product quality. Heye International is your partner to select the correct technology from Industry 4.0.

SMART USER INTERFACES

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

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

The Communication Tower has already integrated a multi-functional remote maintenance router, which enables access via a VPN tunnel, if required.

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

PROCESS CONTROL AND CLOSED LOOP SOLUTION SET

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

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

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

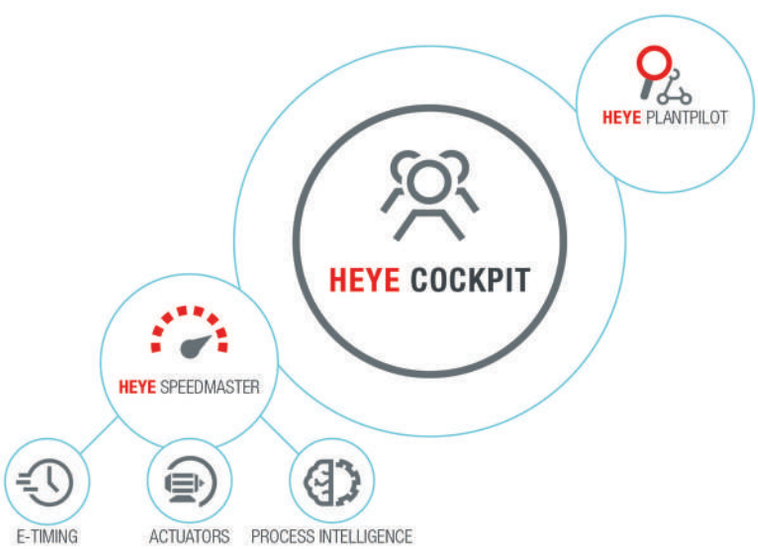
CONNECTING HOT END AND COLD END

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

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

HEYE REMOTE SERVICES

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



SUMMARY

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

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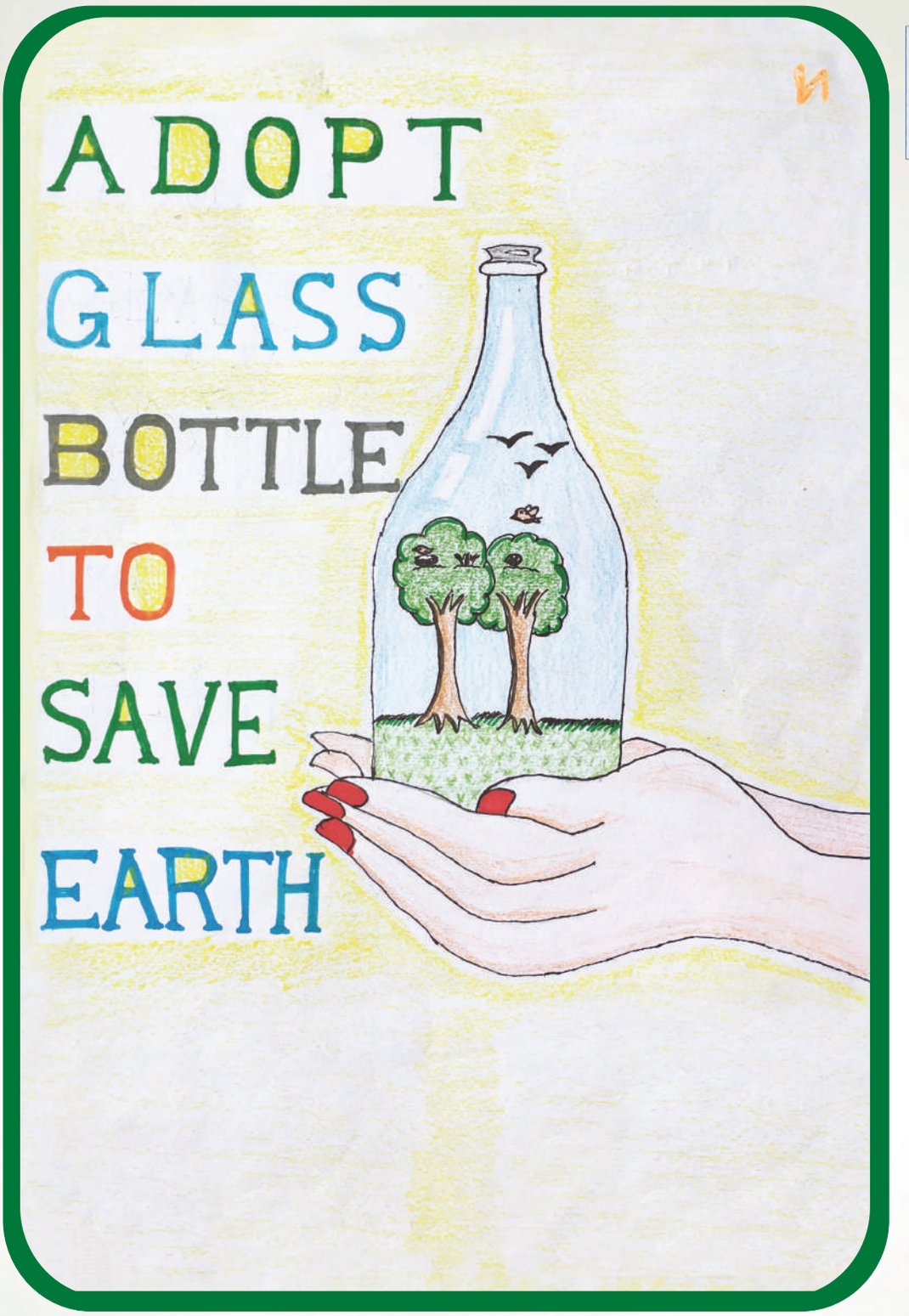

A 25% improvement is possible!

Twenty years ago, Netherlands-based XPAR Vision made its first steps into the global glass container industry, the first to introduce infrared sensor technology for hot end inspection and process monitoring. Subsequently, the company has become a specialist and market leader for hot end sensor and robot technology, with the overall ambition of assisting the global glass container industry to make its bottles and jars lighter and stronger, produced with zero defects and at higher speed. Paul Schreuders reported in *Glass Worldwide* (preferred AIGMF international journal).

Paul Schreuders, Chief Executive Officer at XPAR Vision.

During the last few years, XPAR Vision's ambition has become increasingly relevant for glass container producers, as they are confronted with the following challenges:

- Competition against other packaging materials and requests from major fillers to reduce the carbon footprint, thus driving productivity improvement and weight reduction.
- Legal requirements from (national) governments regarding health and safety.
- Attractiveness for younger generations, knowing existing working conditions and ambitions from the millennials, in other words how to maintain a good workforce.
- Changing customer requirements that put pressure on becoming more flexible, while dealing with more complexity.

Figure 1: Glass wall thickness variation.

The answer to all these questions is to change traditional ways of operating IS machines: From mainly manual interpretation and control by humans to mainly machine interpretation and control by sensors, robots, data, artificial intelligence and automation. By doing so, a step-wise change in the level of forming process control will become feasible, while giving an answer to all challenges mentioned above.

The level of forming process control

Looking at a forming process today, many disturbances are affecting the glassmaking process. Think about cullet quality, viscosity, temperature, glass homogeneity, ambient temperature, deterioration and wear of material and even swabbing, job change, stop/start sections or bottle design.

In the world of glass container forming with mainly manual interpretation and control, these disturbances lead to relatively high variations in the glass forming process. These high variations in the glass forming process result in bottles with variations in glass distribution or glass wall thickness, both vertically and laterally, of more than 50%. In the meantime, efficiency levels (pack-to-melt) are in the range of 85%-90%, which basically means that 10-15 of 100 gobs cut do not result in a good bottle or jar (defects produced are 10%-15%). In the knowledge that the majority of defects produced originate in the variation of the glass forming process, variations in glass distribution or glass wall thickness also produced defects (figure 1). They are a main indicator for variations in the glass forming process and thus, for the level of forming process control.

A step-wise change but not overnight

With mainly machine interpretation and control by sensors, robots, data, artificial intelligence and automation, a step-wise change in the level of forming process control will become feasible.

Simply think of differences between the two worlds of glass container forming; the old world with mainly manual interpretation and control by humans or the new world with mainly machine interpretation and control by sensors, robots, data, artificial intelligence and automation. This means, for example:

- Humans have different eyes and experiences, thus see things differently and certainly not consistently.
- Humans due to other tasks to execute can only review and check about 100 bottles in one hour, whereas production speeds nowadays are up to 40,000 bottles in one hour. Sensors can see every single bottle.
- Humans cannot be as accurate and consistent as sensors or robots. They cannot discriminate mm length differences of falling gobs (7m /second), while these differences have an effect on the quality of bottles and swabbing by humans in comparison to swabbing by robots is much less consistent and leads to much more forming process disturbances and thus variations, thus defects.
- Issues on any IS machine can be many and cavity-related, machine-related, section-related or related to only front or only back gobs. How can any human continuously and accurately review 48 (12 x 4 or 16 x 3) cavities?

Knowing these differences, it is not difficult to understand that in the new world, one is able to create a step-wise change in the level of forming process control. Of course, this step-wise change will not happen overnight.

Step-by-step, one moves from a more experienced base to a more science-based solution and from more manual control to more automatic control. And yes, this new environment is more attractive for millennials and due to a higher level of automation, health and safety is becoming less of a burden, while flexibility and complexity are better taken care of. But most importantly, this 'new' forming process

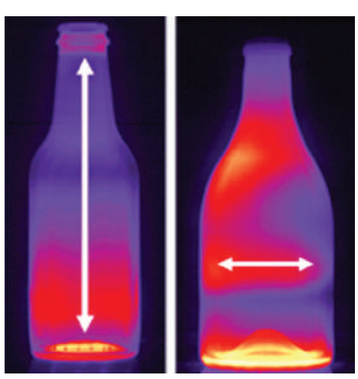

Figure 2: Infrared images measuring both vertical as well as lateral glass distribution.

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creates bottles and jars with much less glass wall thickness variations and much higher efficiency levels. Lighter and stronger containers, produced with much less defects at higher speed and less human dependency is the result.

A 25% improvement is possible

Knowing the values of the indicators for the variations in the glass forming process, namely variations in glass wall thickness of more than 50% and defects produced of between 10% and 15%, there is a lot of room for improvement. Based on 20+ years of experience in the field of forming process and based on an unlimited number of good examples, the author dares to state that in the new world of glass container forming, with the correct tools, focus and ambition, the glass container industry is able to do 25% better than today!

This 25% comes mainly from efficiency increases, weight reduction and speed increases and equalises a value of between Euro 3.5 million and 7 million per production line per year. And due to the origin (energy, materials, capacities), everybody benefits: Glass container manufacturers, users and last but not least, the planet.

A recipe for change

Within this chapter, a recipe for change will be provided.

Hot end forming: Quality focus: For a long time, hot end forming was steered towards putting as many bottles into the lehr as possible, without too much attention paid to their quality. Quality was a concern for the cold end. Hot end and cold end, naturally divided by the lehr and the lehr time, were like two different worlds. Consequently and in the case of quality issues, there was hardly any communication or feedback from cold end to hot end. And if there was any communication or feedback, the time delay due to lehr time made it ineffective. Due to this fact and in order to ensure good quality output to be sent to fillers, in any cold end area or warehouse, one finds a lot of pallets to be resorted.

In order to create the new world of glass forming, it is necessary to admit that quality is made at the hot end and organise accordingly. Tools are available to support a proper quality focus at the hot end.

Use of IR sensors: The glass forming process is determined mainly by temperatures and exchange of heat. The result is a bottle or jar with a certain glass distribution. As infrared (IR) measures the thermal properties and the glass distribution of the newly formed container, IR is the best sensor for hot end bottle inspection.

By applying IR sensors, critical defects can be eliminated at the hot end (figure 2). Logically, implementing these devices is of help in improving the quality delivered to customers. Nevertheless, hot end sensors for bottle monitoring should not be used for inspection only. The reasons are obvious. First, these sensors are able to inspect many but not all types of defects. Moreover, like any inspection machine (at the hot end or cold end), no sensor will be able to be 100% effective for inspection. And last but not least, as every rejected bottle or jar is a direct loss of production time and energy, the focus should be on preventing defects to be produced.

Reviewing all bottles produced allows for collecting signals. Besides defects, one can see shifts in glass distribution, both vertically and laterally, changes in verticality and shape of bottles etc. As these signals can be related to the cavity of origin, analyses can be converted in indications for cavity, section, front or back gob or machine performance. These indications allow for effective root cause analyses (learning, preventing) and fast remedial action in case of problems. Fast remedial action at the hot end on the basis of real-time information leads directly to an improvement of efficiency and is the starting point for improving the level of forming process control. An example is given in figure 3.

Controlling glass distribution is the key to lighter and stronger bottles and jars, produced with (almost) zero defects at higher speed. Logically, controlling glass distribution requires continuous monitoring of bottles and jars produced and evaluating every action on the IS machine against changes in glass distribution. In order to effectively manage the forming process, glass distribution is the reference.

Lowering disturbances: Apply robots for swabbing: Disturbances, as mentioned previously, are root causes for forming process variations (glass wall thickness variations and defects). It speaks for itself that lowering the level and frequency of disturbances will be of great help in realising the ambition of lighter and stronger bottles, produced with zero defects and higher speed.

For example, currently there is a lot of emphasis on swabbing. It is true that swabbing is one of the main disturbances in the glassmaking process. An example is given in figure 4. As such, swabbing is more an enemy than a remedy. Robot swabbing will reduce forming process variations and is of great help to an operator. The BlankRobot from XPAR Vision swabs moulds and neck rings in a very consistent way. Therefore, the variation in glass distribution (glass wall thickness) will be lower and critical defects due to swabbing will be zero. And thanks to automatic swabbing, the operator has more time to concentrate on the quality of the bottle or jar.

Use of other sensors: Besides IR for bottle inspection and monitoring, other sensors are also available today to be applied in the forming process. There are sensors that monitor the status of gob condition (weight, temperature, shape) at the area of gob cut, the status of gob loading (speed, length, time of arrival, position) just before the gob enters the mould and the temperatures of parison, moulds, plunger and neck ring. All data collected somehow relates to the quality of the bottle or jar produced. The more one knows about these relationships, the higher the level of forming process control.

How to effectively lower glass wall thickness variations?: With the sensors mentioned above, the glass forming process is completely observed. One has enough information (data) relating to the forming process to be in control and to reduce glass wall thickness variation. On most IS machines, the operator is responsible for the quality of glass. All data given by all sensors must be processed by the operator and he must make the interpretation and conclusion. Is the forming process still ok or is any remedial action needed? This is not an easy job. Moreover, this is because the operator is already fully occupied with swabbing machine parts (50% of his time), conducting regular quality checks and changing worn parts. Even for skilled personnel, interpretation of all sensor data is difficult.

For example, the operator looks at the IR charts and sees that the IR intensities for a certain cavity have been changed. In case he is well trained and experienced, the operator might conclude that the vertical glass distribution has been changed; the lower parts of the bottle are thicker and the neck/shoulder areas are thinner. This conclusion is correct but which remedial action should he take? Change the blank mould cooling? Change the contact time? Luckily, he has a sensor that measures parison temperature. From here, he sees the parison temperature is increasing. But if he looks at the other cavities in the section, he sees normal parison temperatures. As a result, he knows that mould cooling and contact time changes will not be an effective remedial action. So maybe gob loading? From the sensor measuring loading parameters, he looks at the length of the gobs and sees a decreasing length of the gob in time. At the hit point of the deflector, the coating is worn and the friction is too high, which reduces the length of the gob. His conclusion now is to replace the deflector as the effective remedial action. And indeed, after changing the deflector, the IR charts show that glass distribution is restored and the variation in the glass wall thickness reduced. But only for one cavity. Now, the operator must look at and deal with the other 35/47 cavities…. due to his many other tasks, he will not have enough time for this.

This example illustrates two important bottlenecks for reducing glass variation:

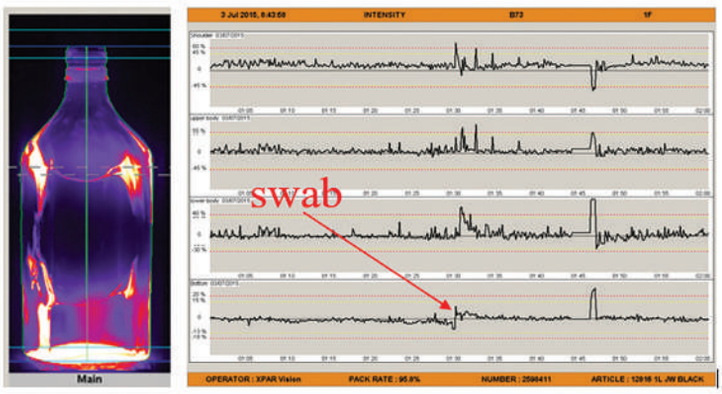

Figure 3: Birdswing detected and rejected. Root cause in swabbing. Improving swabbing leads to preventing this defect from being produced.

- Operator skills and experience.
- Operator time spending limit.

To give the operator more time to spend on the quality of the bottle and to reduce the variation, a swabbing robot is a great help for the operator (quite apart from his health and safety!).

The other bottleneck is associated with the skills and experience of the operators. It takes a lot of training time and practice to utilise the potential benefit of the sensors. Also, nowadays experienced operators are retiring and valuable knowhow is leaving the shop floor with them. In order to effectively reduce glass variation, glassmakers should adapt to process artificial intelligence.

Process artificial intelligence (AI): In the last decade, artificial intelligence has grown into a mature technology. The breakthrough of AI is caused by new algorithms (methods) and increased computer power. The process AI uses all available sensor information and by means of the methods of AI, the interpretation of all this sensor information is performed automatically. The process AI informs the operator that the glass forming process needs attention and provides the operator directly with the correct remedial action. If the operator performs this remedial action, the glass variation will be quickly restored. Returning to the example of the worn-out deflector with process AI, instead of performing the described interpretation steps, the operator directly receives the following message: 'Please, change the deflector of cavity 11 M'.

In this way, glass forming will be stable (more output) and the glass distribution variations will be much lower (more quality). Because the process AI continuously monitors all sensor information, the detection of an anomaly in the glass forming process is much faster than with an operator. As such, process AI is a necessity for making a step-wise change in the level of forming process control.

Automation: Another contribution is coming from automated control loops that compensate the drifting parameters of the glass forming process. A control loop uses the sensor data to see if the process variables are still at the setpoint values. The sensor observes, analyses and through feedback to the IS timing, the necessary adjustments are made. As the feedback is computer feedback, adjustments can be made within milliseconds. Even the very best operator/specialist will never be able to do this.

Within the past few years, (hot end) automated control loops have become available for controlling gob weight, ware spacing, mould temperature, plunger process and vertical glass distribution. It is to be expected that in the near future, more control loops will become available.

Experience shows that all different control loops once applied basically have the same positive effect; the process variation is reduced and the bottles show less shift in glass distribution and have less defects. These control loops help the operator. But do not forget that these automated control loops are not effective if the parts wear out. In this case, the operator must notice in time and replace the worn out parts.

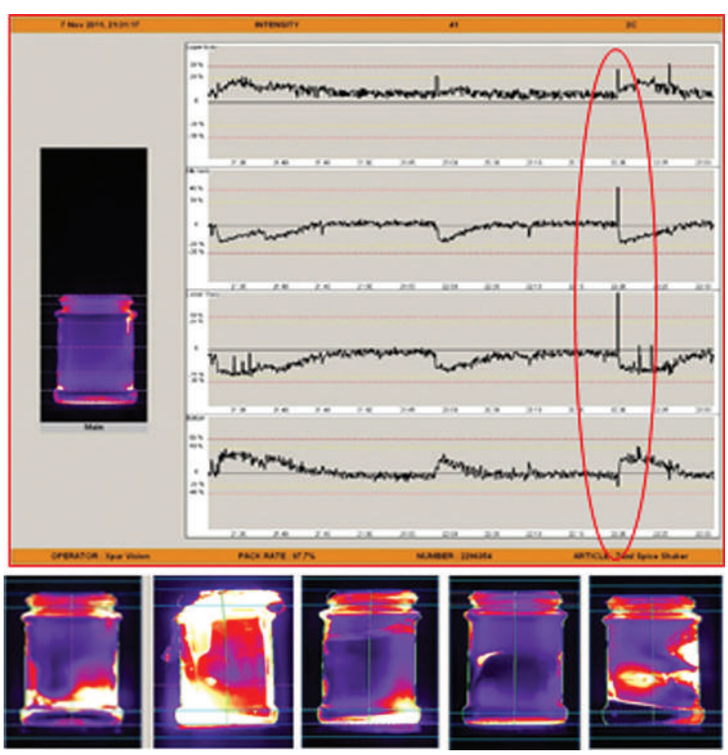

Figure 4: Swabbing is a main disturbance in the glassmaking process and creates defects.

Conclusion

A recipe for change has been provided, in order to create a new world of glass container forming. In this new world with mainly machine interpretation and control by sensors, robots, data, artificial intelligence and automation, a step-wise change in the level of forming process control will become feasible.

This step-wise change in the level of forming process control pays off: With the correct tools, focus and ambition, the glass container industry is able to do 25% better than today! Of course, this step-wise change will not happen overnight. Step-by-step, one moves from more experienced-based to more science-based and from more manual control to more automatic control.

And yes, this new environment is more attractive for millennials and due to a higher level of automation, health and safety is becoming less of a burden, while flexibility and complexity are better taken care of. But most importantly, this 'new' forming process creates bottles and jars with much less glass wall thickness variations and much higher efficiency levels. Lighter and stronger containers, produced with much less defects at higher speed and less human dependency are the result. ●

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- Designer Glass Bottles
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Innovating greener glass manufacturing technologies

Glass manufacturers have historically been concerned mainly about product quality, plant reliability, cost and energy efficiency. Today, they add to this the pressure to reduce emissions and increase sustainability. Fives, an international engineering group, has always been committed to an environmentally-friendly process. From fully electric furnaces to advanced forehearth design, pioneering glass melting and conditioning technologies have been developed for maximum thermal efficiency with minimum energy consumption. Alexandre Brusset and Andrew Reynolds reported in *Glass Worldwide* (preferred international journal of AIGMF).

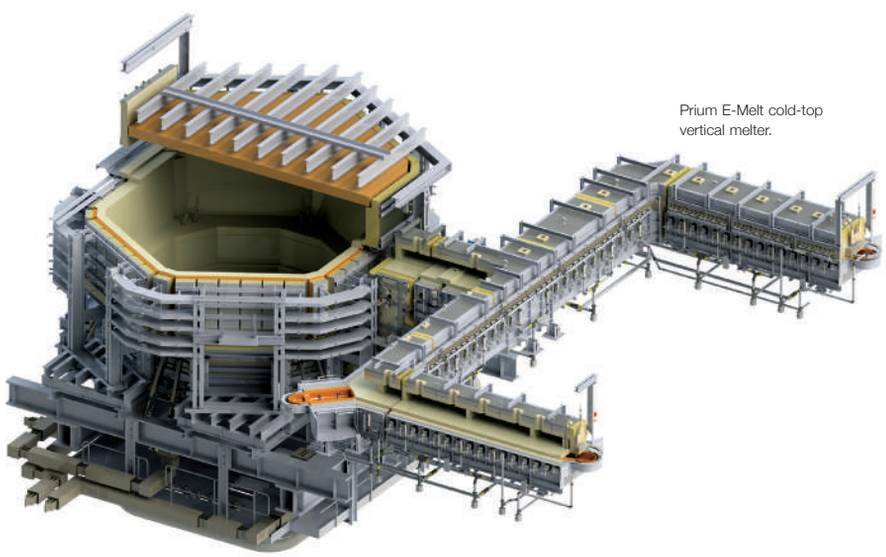
Electric furnaces are a green alternative to traditional technologies based on combustion of fossil fuels and offer better thermal efficiency, lower emissions and the potential for advanced automation. The life of the furnace may be less than for gas furnaces but this offers the possibility of greater innovation. CAPEX can be lower once the costs of emission control are accounted for. With a reliable supply of renewable energy, electric furnaces have the potential to lower operating cost, while reducing emissions.

Cold-top all-electric furnaces are especially suited to manufacturing lines melting one glass type under a relatively stable load. Capacities as little as five tons/day and as much as 150 tons/day are currently in operation and there is no technical reason why this rate could not be increased to 300 tons/day or more. Example applications include:

- Pharmaceutical (ampoules and tubing).
- Container (bottles and container ware).
- Tableware.
- Perfumery and cosmetics.
- Borosilicate glasses.
- Opal glass.
- Fibre and insulation products.
- HV insulators.
- Flat glass products.

A straightforward layout for simple operation

In all-electric melting, the raw materials are distributed evenly over the surface to form an insulating batch layer in a cold or semi-hot top vertical process. The materials are melted and refined as they are drawn down through a deep melting tank to exit at the throat.



Prium E-Melt cold-top vertical melter.

This process ensures minimal heat loss. In fact, electric furnaces can reach very high thermal efficiencies. This high thermal efficiency and the system's energy efficiency and low emissions are the main reasons why glass manufacturers choose electric furnaces.

Furnace control is achieved through only a single main input parameter, power and leads to a process that can be readily automated.

Cost-effective option

Fives offers cold-top and mixed melt electric furnaces, as well as electric boosting, in its Prium E-Melt range:

- Prium E-Melt cold-top vertical melter (CTVM) offers a cost-effective option for the production of a wide range of glass types. The deep-CTVM format will produce exceptional quality glass with low fault concentration and high homogeneity.
- Prium E-Melt mixed-melt (or warm-top) furnaces offer an alternative for situations in which cold-top operation is not possible due to high gassing of melting reactions (eg carbon-sulphur amber) or when greater output flexibility is required. They use a low power combustion system to heat the crown. Warm-top formats extend the applications of an electric furnace to situations in which electric melting would not previously have been feasible.

Prium Oxy-Melt.

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glass WORLDWIDE

Create the ideal furnace with electric boosting

Increasing efficiency and reducing the furnace's environmental impact are two of the key concerns for glass manufacturers. Electric boosters can improve melting efficiency and reduce fuel consumption, enabling glassmakers to design the optimum melting process for specific applications and increase output without adding to the furnace footprint.

Electric boosting is especially valuable when melting difficult glasses including ECR glass fibre and coloured glass but is applicable to all glass types. Fives uses numerical modelling to design the best electrode layout to optimise and control convection currents within the tank.

Ultimate control, optimum results

The strategic placement of electrodes, tailored to the design of the furnace, enables the group to achieve the best power distribution for individual applications. Fives uses advanced modelling techniques to plan not only the electrode array but also the burner configuration, the batch distribution/cover and the geometry of the melting tank. All this insight is combined to deliver:

- Increased output, without increasing the footprint.
- Improved flexibility of furnace operations.
- Reduced emissions and less gas usage/waste.
- Improvement in overall energy efficiency.
- Reduction in crown temperature and therefore, increased furnace life.

High power capacity boosting

Most are familiar with the application of electric 'boosting' as a means of increasing output without necessarily enlarging furnace footprint. However, it is becoming more common that fuel-fired furnaces are conceived at the outset with high capacity electrical heating systems ('super-boosting') as an integral part of the design. These boosters, often with a large array of electrodes and multiple control zones, not only increase melt rate and improve glass quality but offer the possibility to steer furnace conditions in order to maximise fuel efficiency over a broad range of conditions.

E-boosting takes advantage of what is known about the behaviour of melting glass and the heating effect. With most heat released near electrodes, a hot spot can be created that drives useful currents and opposes unwanted ones. Both the power profile and the furnace's melting characteristics can be tailored to the application and can even overcome the limitations of the furnace geometry.

Although this technology is applicable to any type of furnace, to date Fives has focused its development efforts on fibre and float sectors. In E-glass fibre the results are particularly significant, since these furnaces typically use oxy-fuel in the melting process. The integration of oxy-fuel combustion and electric boosting is a particularly good combination for minimising gas consumption and reducing emissions.

Oxy-fuel combustion

Oxy-fuel combustion increases furnace efficiency, reduces emissions and improves glass quality by creating a more stable process. The addition of oxygen to the fuel almost eliminates nitrogen from the oxidiser, which greatly reduces the mass flow rate of flue gas leaving the furnace. Oxy-fuel technology is also a good option to limit the furnace footprint due to the absence of regenerators.

Fives has more than 25 years' experience in applying oxy-fuel combustion technologies to glass melting furnaces of all kinds, on greenfield projects as well as major rebuilds.

Combustion design and heat recovery

The design of oxy-fuel combustion space is different and more flexible than conventional air-fuel furnaces. A vast range of oxygen and fuel injector solutions are integrated to suit each application and furnace size. The combustion space is designed to prevent hot spots, minimise the evaporation of volatile compounds, limit batch carryover and maximise heat transfer efficiency.

The Heat Recovery Area (HRA) is a patented energy saving solution that optimises the use of combustion heat for maximum thermal efficiency. The HRA's clever layout forces flue gases to sweep above the batch blanket, transferring most of their usable heat and lowering their exit temperature. The design also limits the energy-consuming ingress of cold gases into the high temperature combustion space.

The Heat Recovery Area superstructure includes a lowered crown, which can be suspended or arched and flue exhausts that are specially designed to prevent batch carryover. The design is adaptable to all oxy-fuel furnace sizes and glass types.

Combustion reactant preheating

Fives is the first independent engineering company to integrate combustion reactant preheating in glass furnaces, in partnership with Air Liquide, to improve combustion efficiency. Oxygen and natural gas preheating is achieved by recuperating the residual heat contained in fumes using metallic heat exchangers.

Oxy-fuel combustion for glass conditioning

In collaboration with Linde and Corning Inc, Fives developed the oxy-gas firing system to provide highly controllable heating of the side glass in a forehearth. The result is a more responsive forehearth, enabling users to achieve:

- Increased glass throughput.
- Improved thermal homogeneity.
- Improved glass quality.
- Longer refractory life with volatile glasses.

Flexible hybrid furnace

Fossil-fuel driven furnaces are emissions-intensive. Electric boosting can help reduce the furnace's carbon footprint but the balance of energy efficiency has typically been lost at around 30-50% electrical input – until now. Fives has designed a type of hybrid furnace - Prium Eco-Flex, incorporating its Heat Recovery Area (HRA) technology - to achieve up to 80% electric boosting, which could reduce emissions by up to 60%.

Prium Eco-Flex addresses the disadvantages of gas combustion, while mitigating the limitations of all-electric furnaces. By replacing up to 80% of the natural gas with green electricity, furnace emissions are dramatically reduced but the additional benefit of this system is the ability to use high rates of recycled glass (up to 80%). For every 10% of cullet added to the mix, CO_2 emissions are reduced by 5% and energy consumption falls by 3%. These savings are not possible with electric furnaces, which cannot use large quantities of cullet.

Design for all types of glass container production

Previously, hybrid furnaces were limited by three things:

- High electrical energy ratios require a lower temperature above the batch layer.
- Separation of melting and refining and effective degassing of the melt, require higher temperature above the fining section (with free glass surface).
- High boosting input increases need for a strong thermal barrier (division between melting and refining).

This implies the need for a temperature gradient within the combustion chamber, which is difficult to achieve in a single combustion zone, especially with the burner/combustion configuration in an air-gas end-fired port furnace. Low temperature regions of the crown are prone to volatile attack and it can be difficult to control temperatures in an optimal way.

The hybrid furnace is designed to operate with the same quality level, from 15% to 80% electric boosting. It is not simply a case of fixing on a number and continuously operating at, say, 50% electric boosting – users can change the boosting ratio on the fly, without a production stop, down to a minimum of 15%.

The Prium Eco-Flex uses the proprietary HRA principle to overcome these limitations. HRA technology lowers the crown height over the pre-heat zone to maximise the heat transfer between waste

Prium E-Boost.

gas and the batch surface. In a conventional oxy-fuel furnace, this creates an energy saving of 8%-10% and reduces waste gas temperatures, benefitting secondary heat recovery and simplifying exhaust handling.

The HRA zone length can be adapted to suit individual needs and the whole system can be scaled to suit any capacity and container glass type/cullet ratios. Combustion can be adapted to either oxy-fuel or air-gas. ●

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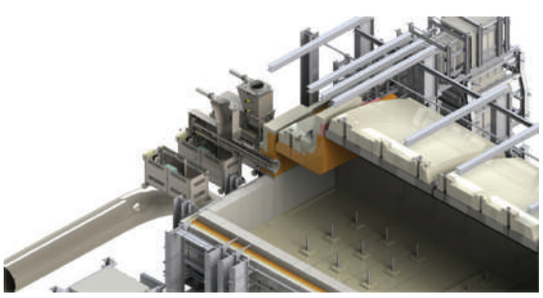

Prium Eco-Flex with HRA technology.

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glass WORLDWIDE

Multiple furnace projects completed during Covid-19 crisis

Indian furnace contractor Furnotherm has successfully completed a series of construction projects for local glass plants in recent months, illustrating its ability to execute several projects simultaneously at different locations. According to Managing Director, Jogendra Singh in an article originally published in *Glass Worldwide* (preferred AIGMF international journal), much of this work was undertaken during the challenging social and business conditions created by the Covid-19 pandemic.

Two projects were successfully completed on behalf of Piramal Glass in Kosamba at the beginning of the year, for example. This included the rebuilding of a 40 tons/day glass container furnace at the beginning of January. The project was finished in record time, six days ahead of schedule.

Subsequently, an existing 100 tons/day furnace at the Kosamba site has been enlarged to 145 tons/day. This job involved the fabrication and erection of 300 tons of steel and the installation of approximately 2800 tons of refractories, along with the erection of furnace cooling ducts and associated equipment. Work started in mid-February and was completed by mid-June.

A greenfield furnace construction project has also been completed on behalf of SCHOTT Glass in Jambusar, India. Furnotherm was responsible for the fabrication and erection of steelwork for the T66 project, along with refractory installation. Steel fabrication started before India's Covid-19 lockdown but refractory installation began during lockdown, in the third week of April.

Separately, Furnotherm has extended the existing batch house at Jambusar. This involved the fabrication and erection of different silos and steel structures, plus the installation of batch house equipment.

Two important projects are also being executed this year for Sunrise Glass in Surat, India. This includes the supply and erection of steelwork for a greenfield 225 tons/day furnace project, while also rebuilding an existing 180 tons/day furnace. Started at the end of May, the second project has involved dismantling and rebuilding the furnace. Construction was completed in record time, with production initiated at the beginning of July. ●

Furnotherm offers a comprehensive range of furnace construction services, including draining, demolition, rebuilds, heat-up, steelwork, refractory installation, utilities, electrical and instrumentation work.

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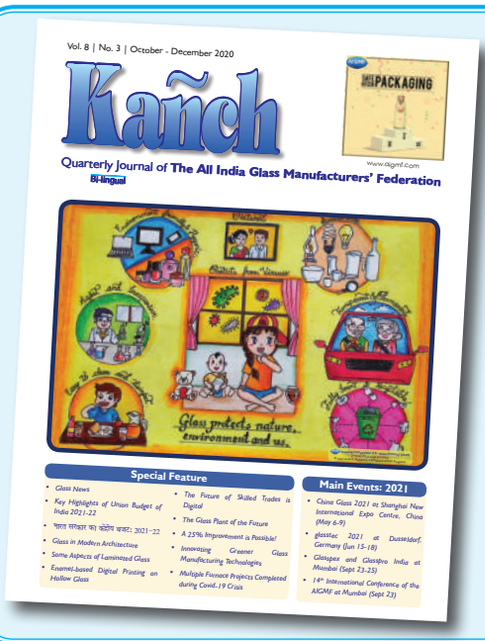

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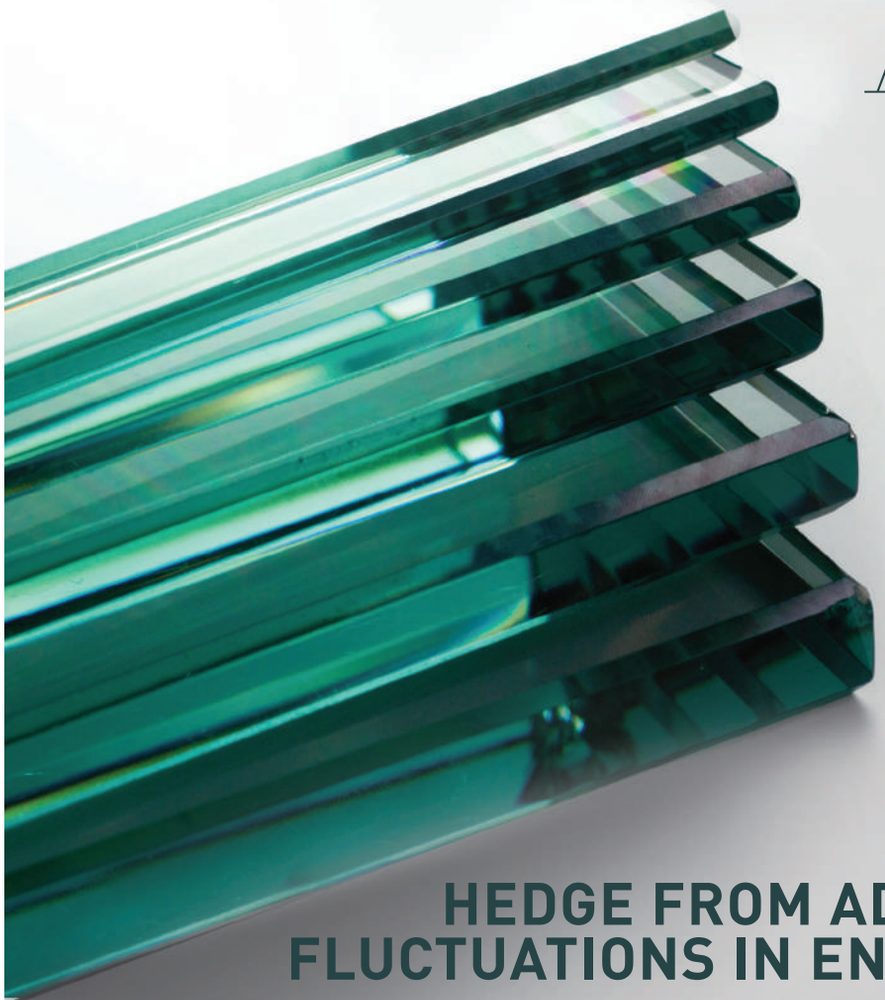

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