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Kañch

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

Vol. 9 | No. 2 | July-September 2021

Contents

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From President's Desk

As part of the International Year of Glass 2022 activities and partner organisation in India, AIGMF in association with CGCRI, ICG and IYOG successfully organised its 1st Photography Contest for the age group between 7-24 years on the theme: *Glass in our Lives,* for which approx., 7,000 entries were received from educational institutes and Youth across India.

Following distinguished Jury Members representing a cross section of glass sectors and regions decided the top three photographs: *Mr. Sanjay Somany, Former President AIGMF and CMD HNG Inds. Ltd.; Mr. Sanjay Ganjoo, Former President AIGMF and COO Asahi India Glass Ltd.; Dr. Suman Kumari Mishra, FNASc, Director CSIR-Central Glass and Ceramic Research Institute and Adjunct Prof. AcSIR and Ex-Dean Eng. Sc. AcSIR; Prof. Manoj Choudhary, Former President Int'l Commission on Glass, Adjunct Prof. Materials Science & Engineering, The Ohio State University and President, MKC Innovations, LLC (USA); Dr. Arun K. Varshneya, Emeritus Professor (Glass Science) Alfred University and President Saxon Glass Technologies, Inc. (USA); and Mr. Dave Fordham, Publisher Glass Worldwide (UK).*

At the virtual Annual General Meeting (AGM) held on Sept 10, Dr. Suman Kumari Mishra, Director, Council of Scientific & Industrial Research - Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata felicitated the winning students. First Prize (Rs. 20,000) was given to S. Christy Laura aged 15 years, 10th class student of Sri Akilandeswari Vidyalaya, Trichy, Tamil Nadu. Second Prize (Rs. 10,000) was given to Medhansh Singhla aged 8 years, 3rd class student of Delhi Public School (Vasant Vihar) New Delhi and Third Prize (Rs. 5,000) was given to Brijesh Jethva aged 22 years from (Junagadh) Gujarat.

Chief Guest Dr. Reinhard Conradt, Vice President and President Elect of the International Commission on Glass unveiled a touring exhibition on 'Glass in our Lives' at the AGM. The roadshow will travel to other cities showcasing the vital role of Glass, being the only 100% recyclable packaging and building material. A digitized version of the exhibits may be viewed at: www.aigmf.com

Also at the AGM, Former Presidents; Mr. Sanjay Somany and Mr. Mukul Somany gave the prestigious annual 'C K Somany Award for Innovation and Technology' to Mr. Udit Kapoor, Director, Kapoor Glass India Pvt Ltd., Mumbai. The 'Balkrishna Gupta Award for Exports' was bestowed to M/s Borosil Renewables Ltd., by the Former President, Mr. Pradeep Gupta. Both awards are supported by Glass Worldwide, preferred international journal of the AIGMF in association with Kanch.

The jury for Industry awards comprised of *Dr. K. Annapurna, Senior Principal Scientist, Glass Division, CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI); Mr. Dave Fordham, Publisher, Glass Worldwide, London (UK); Mr. Sanjay Somany, Former President AIGMF and CMD HNG Industries Ltd.; Mr. P K Kheruka, Former President AIGMF and Chairman Borosil Ltd.; and Mr. Vinit Kapur, Secretary AIGMF.*

As a token of appreciation, lucky 500 photo entries will be given a specially designed empty Glass Bottle made out of recycled glass *(manufactured by Hindustan National Glass & Industries Ltd., under its CSR initiative), carrying logos of International Year of Glass 2022 and Swachh Bharat Abhiyaan (Clean India Campaign)*■

(Bharat Somany)

President AIGMF

and Vice - President, HNG & Inds. Ltd.

GLASS News

BOOSTING TUBING MANUFACTURING – SCHOTT INVESTS IN FURTHER MELTING CAPACITIES FOR PHARMA GLASS IN INDIA

SCHOTT, a global leader in pharmaceutical glass manufacturing, is investing a total of 70 million euros in the expansion of its Indian tubing site in Jambusar, Gujarat, following several million investments in the last years. "*Against the backdrop of the growth trend in the Indian pharmaceutical business and the pandemic, we want to commit to secure the supply of pharma glass*", explains Dr. Patrick Markschläger, Executive Vice President of SCHOTT's Business Unit Tubing.

"*The increase of over 30 percent in the facility's overall Indian production capacity is at the same time a commitment to supporting the government's vision of India becoming a global pharmaceutical hub*", adds Mr. Pawan Shukla, Managing Director SCHOTT Glass India, during the ground-breaking event at the site. The additional tank is scheduled to go into operation at the beginning of 2023, with the second one following a year later.

The expansion in Jambusar will create new jobs for around 225 employees and is part of a more than 1 $ billion strategic investment program of SCHOTT through 2025, leveraging the global pharma tubing and packaging business.

SCHOTT has been a frontrunner in the fight against COVID-19 and provided pharmaceutical glass for primary packaging to fill billions of COVID-19 vaccines worldwide. In India, almost all approved vaccines are packed in FIOLAX® glass made by SCHOTT. With additional melting tanks and production lines, SCHOTT intends to ensure that this Asian manufacturing hub can adequately supply high-quality pharma glass for the Indian pharma industry and neighbouring countries.

LAUNCH OF CALENDAR GLASS BOTTLE 2022 AHEAD OF IYOG2022

In the virtual Executive Committee and Annual General Meetings of the AIGMF held on September 10, the President and Office Bearers released the Calendar Glass Bottle 2022 carrying the logo of International Year of Glass (IYOG2022).

The bottle has specially been designed by AGI glaspac under the capacity of main partner for all IYOG events to be held in India.

As part of the IYOG2022 promotion, the calendar glass bottle is planned to be despatched by Christmas to all stakeholders *i.e., Members of Parliament; GoI Secretaries; office of Chief Secretaries; LGs/Administrators; Chief Ministers; select GoI contacts; Trade Chambers; Education Secretaries; FOSG; AIGMF Members; Regional Associations; Select Universities and Schools; Firozabad; CSIR-CGCRI; BHU; CDGI; General; Overseas Glass Associations and other contacts etc.*

These promotional bottles will also be used during the other events in 2022 and wide distribution at glasspex from Mar 3-5 to every exhibitor and select visitors/contacts, etc.

NEW MANAGING DIRECTOR OF HEYE INTERNATIONAL

Mr. Hans-Peter Müller will join Heye International as Managing Director on 18th October 2021.

In his role, Mr. Müller will be responsible for the development and implementation of the future strategic approach of the company, delivering new business projects through sales negotiations in different countries, worldwide.

Together with the team, he will continue to develop the customer base, maintaining customer relations and supporting the development of a prospect pipeline.

He will be responsible for setting up a long-term sales and innovation strategy, aligned with the Heye vision and transformation into actionable operational plans, including clear goals for performance, cost competitiveness and growth. The role will also involve overseeing company operations and employee productivity, building a highly inclusive culture, ensuring team members thrive and organizational outcomes are met.

Most recently, Mr. Müller worked as Managing Director and Director of Global Filtration / Drying & Powder Handling business for Dietrich Process Systems, where he was responsible for the development and adaptation of the existing organization to the future market challenges. His focus was to develop the company activities on the future path of profit and growth.

Mr. Müller has a proven track record of successfully running a business, change management and launching successful innovation and continuous improvement initiatives. He also holds a university degree in Mechanical Engineering.

IRIS INSPECTION MACHINES EXPANDS ITS INTERNATIONAL SALES TEAM

IRIS Inspection machines announced the appointment of Mr. Altay Capanoglu, as Area Sales Manager. This is part of IRIS Strategy to strengthen a global coverage and IRIS presence in some regions of the world.

Mr. Capanoglu has a strong technical and industrial expertise, having spent 11 years within various functions in industrial leading companies. He speaks fluent Turkish, French and English. Altay brings extensive

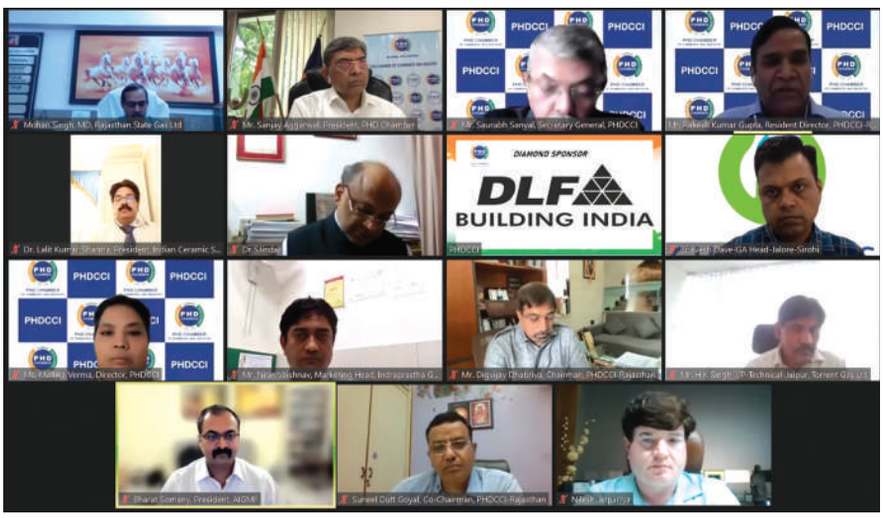
experience he has gained, among others, over 5 years spent in Turkey developing strong relationships with customers in his various missions.

Commenting on his new mission, Mr. Altay Capanoglu said: *"IRIS Inspection machines is a leading company and a pioneer within the intelligent technologies. I'm excited to be part of the team and use my experience to providing proactive service to customers. I've been immersed in the industry for many years and look forward to working with my customers to understand their inspection needs and come up with a solution that best fits those needs".*

At IRIS inspection machines, Mr. Capanoglu will be in-charge of developing and maintaining important relationships with hollow glass customers throughout the world, as well as participating in and managing training and demonstrations.

MBPL GAS PIPELINE NETWORK IN RAJASTHAN - TREMENDOUS INVESTMENT OPPORTUNITIES FOR GAS BASED INDUSTRIES

In the webinar organized on August 20, Mr. Sanjay Aggarwal, President, PHDCCI in his address informed that with the completion of Mehsana-Bhatinda Gas Pipeline Project (MBPL)



Rajasthan will witness tremendous investment opportunities. It will also make existing industries competitive.

Availability of clean and economic sources of energy is a prerequisite for industrial development and Rajasthan was waiting for this opportunity for a long. Rajasthan enjoys a preeminent position in the availability of Ceramic and Glass raw materials, minerals, and many agri-products and these sectors are energy-intensive.

Availability of natural gas will give a tremendous boost to the development of Ceramic, Glass, Food Processing, Mineral, Textile, Pharma sectors in Rajasthan, Mr. Aggarwal observed. *As most of the gas pipeline passes through DFC and DMIC route and Rajasthan's proximity to the major markets, the State would emerge as the most favoured and preferred investment destination in India,* Mr. Aggarwal added. He reiterated the commitment of PHD Chamber in attracting investments in Rajasthan collaborating with RIICO and the state government through its new initiatives and robust policy framework.

Mr. Digvijay Dhabriya, Chairman, PHDCCI-Rajasthan Chapter in his welcome address dwelt light on the features on the MBPL pipeline and informed that the pipeline would prove to be a boon to Rajasthan and give tremendous impetus to the industrialization of Rajasthan. He informed that out of a total of 1381 km long MBPL pipeline, 873 km passes through 11 districts of Rajasthan most of them are close to DMIC and rich in various raw materials and agri-products.

The capacity of the pipeline is 43 MMSCMD which is equivalent to the output of a 10,000 MW power plant which is more than the requirement of the industries in the State around Rs. 3500 crores investments have been made in Rajasthan by GSPL India Gasnet Ltd. (GIGL), an SPV especially created for this prestigious project.

Leading City Gas Distribution Companies (CGDs) have been given authorization for around 19 districts and the process is on for other GAs. PHD Chamber would work with RIICO and State Government through various initiatives in attracting investments based on the gas pipeline network in the State.

The chief guest of the webinar Mr. Ashutosh Pednekar, IAS, MD, RIICO, and Industry Secretary, Government of Rajasthan in his address emphasized the importance of the gas pipeline infrastructure in the State for leveraging tremendous investment opportunities especially in Ceramic and Glass, Food Processing, Mineral, Textile, Pharma etc.

Mr. Pednekar informed that State Government and RIICO are working for developing Rajasthan as an Industrial Power House in the country and the availability of gas will help to achieve this. RIICO is developing new industrial areas for promoting sector-specific clusters i.e. Handicraft and Furniture Park, Medical Devices, Pharma etc. through its investor-friendly policy framework. RIICO is also prompting Horizontal Industrialization and would soon be developing around 100 new industrial areas across the State, some of them close to the gas pipeline, Mr. Pednekar informed.

The strategic projects like DMIC, Marwar Industrial Growth Cluster, PCPIR etc., along with the robust gas pipeline infrastructure being put in place by MBPL and GAIL pipelines would be leveraged to take industrialization to new growth orbit, he added. *Gas companies need to embark upon a joint strategy and programs for educating and motivating the users and evolving very competitive and hassle-free supply policies for the user so that use of natural gas in the industry can be increased,* he advised.

In the webinar, the industry leaders representing prominent beneficiary sectors namely **Mr. Bharat Somany, President, The All India Glass Manufacturers Federation,** Dr. LK Sharma, President, Indian Ceramic Society, Dr. Subodh Jindal, President, All India Food Processors Association, and Mr. Nilesh Jetpariya, President, Morbi Ceramic Associations shared their wish list from the Gas companies and observed that with this pipeline tremendous investment opportunities would be generated in the State for many sectors. All of them requested

gas companies to offer competitive prices and flexible contract conditions to the consumers.

SCHOTT AND SERUM INSTITUTE OF INDIA ANNOUNCE JOINT VENTURE FOR PHARMACEUTICAL PACKAGING

Germany's specialty glass company SCHOTT AG has a new partner: Serum Institute of India, the world's largest vaccine producer and manufacturer of highly-effective biologics, has bought the 50% stake in the Indian joint venture SCHOTT Kaisha from former co-owners Mr. Kairus Dadachanji and Mr. Shapoor Mistry. The joint venture is the leading Indian manufacturer of pharma packaging products such as vials, syringes, ampoules and cartridges used to package life-saving medications.

With this acquisition, Serum is securing its supply of high-quality pharma packaging amid rising global demand.

Mr. Adar Poonawalla, CEO Serum Institute of India says, *"Even the best medication can't reach the patient without the right packaging. Securing this supply chain is of strategic importance. SCHOTT is the perfect partner for us to do this because of their expertise and global network. As a longtime customer, we use their vials, ampoules and syringes to store our vaccines including COVISHIELD™. Working even closer together is in the best interest of global health".*

An employee at SCHOTT Kaisha's production facility in Jambusar inspects two glass vials

SCHOTT is looking forward to the cooperation with the new partner. Dr. Frank Heinricht, CEO SCHOTT says, *"As India has steadily established its position as a global pharmaceutical hub, we are delighted to strengthen our footprint within the Indian pharma supply chain. We are looking forward to strong impulses from this partnership. It is an excellent example of shifting towards new cooperation models, with greater synergies between pharma manufacturing and packaging production".*

The joint venture will definitely continue to supply its customers in India and abroad as a reliable partner, says Mr. Eric L'Heureux, the new Managing Director and former longstanding Head of Operations. *"We have significantly increased our production capacity in India. Over the last three years we have invested roughly INR 600 crores to set up two new plants in Umarsadi, Gujarat and Baddi, Himachal Pradesh, and to secure uninterrupted supply in our existing facilities during the pandemic."* Both SCHOTT and Serum are committed to invest further and will announce concrete plans as this partnership evolves.

Working together in the joint venture opens a new chapter in the successful partnership of Serum and SCHOTT. The companies have had a strong business relationship – and both have been playing a crucial role during the pandemic. From the onset of the COVID-19 outbreak Serum rose to the challenge of developing and/or manufacturing live-saving vaccines, such as COVISHIELD and COVOVAX. To this day, the company has filled and delivered hundreds of millions of doses to India and the world.

On the packaging end, SCHOTT has already exceeded its target to deliver vials for more than two billion vaccine doses through 2021. The company is providing glass vials globally to key vaccine manufacturers. The fact that SCHOTT has an integrated value chain, covering also the glass tubing, the packaging is made of, further helped to secure the supply chain.

GHCL TO SET UP 0.5 MTPA SODA ASH PLANT IN KUTCH

Heavy chemicals major, GHCL Limited will set up a greenfield soda ash plant of 0.5 million tonnes capacity in Kutch, Gujarat to increase its manufacturing capacities from 1.1 million tonnes per annum to 1.6 MTPA. This is seen as a move to help reduce the import dependence of the key ingredient for **Glass, Ceramics** and detergent industries.

The greenfield plant, to be set up with an investment of Rs. 3,000 crores, will require about 800 acres of land, of which about 70 percent has already been acquired.

"We are in the process of taking the necessary government approvals and filing for the Environment clearances for the proposed plant," said Mr. R S Jalan, Managing Director, GHCL Ltd.

The company, with its current 1.1 million tonnes facility at Sutrapada in Gir Somnath district in Gujarat, caters to about 25 percent of domestic Soda Ash demand in the country.

During Vibrant Gujarat Summit in 2017, GHCL had signed a memorandum of understanding (MoU) with the Gujarat Government to set up a Greenfield Chemical Complex in Kutch, Gujarat. GHCL looks to set up 11,00,000 tonnes per annum Light Soda Ash, 5,00,000

TPA Dense Soda Ash, 2,00,000 TPA Sodium Bicarbonate manufacturing plants besides a solid fuel-based 120 MW Captive Co-generation Power plant and other utilities in Mandvi taluka of Kutch district.

"Further expansion wasn't possible at the current location. So, for the future growth, we needed an extra location. At the new plant, we would still have the scope for future expansions," Mr. Jalan said.

The required investments will be met through a mix of internal accruals and debt. *"The plant will take about 3-4 years to be ready. We have an annual cash generation of around Rs. 500 crores. So, we will be able to fund the plant with our internal accruals along with debt. We plan to maintain a 1:1 D/E ratio,"* he said.

In 2019-20, India imported record 9.5 lakh tonnes of soda ash, while domestic production stood at 33.8 lakh tonnes. The annual consumption hovers around 40 lakh tonnes. An increase in the domestic capacities will reduce the dependence on cheap imports to meet the consumption, which is growing at the pace of about 200,000 tonnes per annum.

"Consuming sectors such as glass - construction glass, flat glass etc are recovering from covid impact. The demand growth will continue and there will still be room for fresh capacities. So, this will continue to be a promising space for all the players," said Mr. Jalan.

BIDDING FAREWELL TO GAJENDRA SINGH BHIST

Mr. Gajendra Singh Bhist, support staff at the AIGMF Secretariat was bid farewell on July 2 for having served for almost 45-years in the AIGMF.

Joined in 1976, Mr. Bhist retired in 2014 but continued to work on an extension till 2021 before finally being relieved from his services.

AIGMF remains thankful for his long and dedicated service.

BOROSIL GROUP BAGS INDIA GREEN MANUFACTURING CHALLENGE AWARDS

Borosil Renewables Ltd. won the Gold Medal in the India Green Manufacturing Challenge Award 2020-21 (IGMC Award). IGMC is an awarding platform that is designed to recognize manufacturing firms that have shown consistent progress in improving sustainability factors associated with a manufacturing facility.

Borosil Limited's Jaipur plant won the Silver Medal in India Green Manufacturing Challenge 2020-21.

WORLD FIRST': SHEET GLASS PRODUCED WITH HYDROGEN AT UK PLANT FOR FIRST TIME

In what's being hailed as a worlds first, hydrogen has been used in the manufacture of sheet glass.

Results of a trial project in the Liverpool City region of England have been released after the UK Government unveiled its Hydrogen Strategy.

Glassmaker Pilkington replaced natural gas with hydrogen at its factory in St. Helens to manufacture sheet glass, also known as float glass.

The HyNet Industrial Fuel Switching project was led by Progressive Energy, with hydrogen being provided by BOC, as was designed to provide confidence that low carbon hydrogen can replace natural gas.

Pilkington's UK Managing Director Mr. Matt Buckley said the HyNet project *"will be a massive step to support our decarbonisation activities".*

"This full-scale production trial over several weeks successfully demonstrated that it is possible to use hydrogen to safely and effectively fire a float glass plant. We now look forward to the HyNet concept becoming a reality."

Mr. Steve Rotheram, Metro Mayor of Liverpool City Region, said: *"Just as we led the first industrial revolution, our region is leading the green one too.*

"HyNet has the potential to be a transformative project for our region, cutting carbon emissions across the North West by 25% and helping us take a big step towards our climate targets."

Mr. David Parkin, Director of Progressive Energy and Project Director of HyNet North West, added that *"industry is vital*

for the economy, but is difficult to decarbonise. HyNet is focused on removing carbon from industry through a range of technologies including the capturing and locking up of carbon and the production and use of hydrogen as a low carbon fuel."

He added that he believed this switch to green power could create *"over 6000 new, permanent jobs, setting the region on course to be the world leader in clean energy innovation".*

SUNRISE GLASS INDUSTRIES NAMED THE MOST TRUSTED CONTAINER GLASS COMPANY

Worldwide Achievers organized Indian Icon & Business Leaders Awards 2021 on August 27 at Grand Hyatt, Goa in the fields of Sports, Arts, Culture, Politics, Entertainment, Media, Business, Education and Healthcare.

Mr. Gaurav Thakkar, Managing Director of Sunrise Glass Industries Pvt. Ltd. received the award of India's most trusted Container Glass company.

Sunrise Glass Industries Pvt. Ltd., is a part of Astron Group and is manufacturer of Container Glass situated in Surat, Gujarat since 2011.

UPGMS की वार्षिक आम-सभा

फिरोज़ाबाद: UPGMS (यू.पी. ग्लास मैन्युफैक्चरर्स सिंडीकेट) की वार्षिक आमसभा दि 25/09/21 को होटल पेराडोर में सम्पन्न हुई। जिसमें श्री राजकुमार मित्तल जी की अध्यक्षता में सचिव श्री पराग गुप्ता जी द्वारा विगत वर्ष में संस्था द्वारा किए गए कार्यों से अवगत कराया।

बैठक में मुख्य अतिथि सदर विधायक श्री मनीष असीजा जी, चुनाव अधिकारी प्रमुख उद्योगपति श्री प्रदीप गुप्ता जी थे। वार्षिक सभा में सचिव पराग गुप्ता ने बताया कि यूपी में बनने वाली देसी शराब की 25% मात्रा को कांच की बोतल में पैक करने का आदेश शासन द्वारा जारी हो चुका है, माननीय विधायक असीजा जी ने बताया कि इस प्रस्ताव पर कैबिनेट की मंजूरी मिल चुकी है और शीघ्र ही देसी शराब बनाने वाली कम्पनियों द्वारा कांच की बोतल का प्रयोग आरम्भ हो जाएगा। सचिव जी ने बताया कि पर्यावरण मंत्रालय द्वारा कांच की भंगार के आयात पर पिछले 2 वर्षो से प्रतिबंध लगा रखा है, जिसकी भी शीघ्र अनुमति मिलने की सम्भवना है।

बैठक में नई कार्यकरिणी हेतु चुनाव अधिकारी श्री प्रदीप गुप्ता जी को जिम्मेदारी दी गयी। जिसमें सर्व सम्मति से विगत वर्ष की कार्यकारिणी को ही इस वर्ष पुन: जिम्मेदारी दी गई, जिसमें अध्यक्ष श्री राजकुमार मित्तल, उपाध्यक्ष श्री संजय अग्रवाल, उमाशंकर अग्रवाल, सचिव श्री पराग गुप्ता, कोषाध्यक्ष श्री दीपक गुप्ता, सह सचिव श्री रितेश मित्तल को पुन: जिम्मेदारी दी गई। संस्था में नए सदस्य हेमन्त अग्रवाल, चॉइस ग्लास जुड़े, जिन्हें सर्व समिति से कार्यकारिणी समिति में लिया गया और गैस और लीगल सेल का अध्यक्ष मनोनित किया गया।

बैठक में अन्य सदस्य उद्योगपति मनोज मित्तल, संजय मित्तल, प्रमोद गर्ग, सुरेश बंसल, अनुराग मित्तल, मोहित अग्रवाल, मनीष बंसल, नवेद जी, विश्वदीप सिंह, राष्ट्र दिप सिंह, मोहित जैन आदि उपस्थित थे।

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

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'Youth' help setting tone for the International Year of Glass 2022 activities in India

Awards given to Students and Industry Members

(Sept 10, Virtual Event)

Chief Guest Dr. Reinhard Conradt, Vice President and President Elect of the International Commission on Glass unveiled a touring exhibition on 'Glass in our Lives' at the virtual Annual General Meeting of the All India Glass Manufacturers' Federation (AIGMF). Online entries were invited from the age group between 7-24 years to participate in the I[st] Photography Contest, a kickstart event to mark the International Year of Glass 2022 activities in India.

A distinguished Jury of Members representing a cross section of glass sectors and regions decided the top 3 photographs out of approx., 7,000 entries received from educational institutes and Youth across India:

Mr. Sanjay Somany, Former President AIGMF and CMD HNG Inds. Ltd.; Mr. Sanjay Ganjoo, Former President AIGMF and COO Asahi India Glass Ltd.; Dr. Suman Kumari Mishra, FNASc, Director CSIR-Central Glass and Ceramic Research Institute and Adjunct Prof. AcSIR and Ex-Dean Eng. Sc. AcSIR; Prof. Manoj Choudhary, Former President International Commission on Glass, Adjunct Prof. Materials Science & Engineering, The Ohio State University and President, MKC Innovations, LLC (USA); Dr. Arun K. Varshneya, Emeritus Professor (Glass Science) Alfred University and President Saxon Glass Technologies, Inc. (USA); Mr. Dave Fordham, Publisher Glass Worldwide (UK).

"This is a type of Still life photography. It's a type of photography used for depicting inanimate subject matter. This photograph is well balanced and also has an interesting geometric play. It's visually appealing as it follows the rule of thirds. It has a complementary colour scheme which in turn creates a pleasing sensation for the viewers. Modern life would not be possible without glass.

Glass is an immensely versatile material; it is used every day in numerous applications. We use it to drink beverages, to store food, and as windows in our homes and automobiles.

One of the key reasons we love glass is because it is so safe. It is completely inert and is impermeable to liquids and gases. These inert and impermeable qualities of glass makes it completely safe for various usages.

Glass can be recycled easily and it is very easy to melt glass and remake it into different other products. Talking about the different glass objects that are present in the picture, glass is predominantly used as a safe keeping object because of its higher temperature withstanding tendency.

Glass is used as bowls in the kitchenware as a container for pickles, dry powders, milk, oils, ghee storage, etc. Also glasses are used as bottles to store milk, beverages, soft drinks, hot drinks etc. It might be hard to find a kitchen without a single glass utensil.

Not only is glass a safe place of storing objects, but also is very fashionable and opulent in nature.

Glasses are used for making many posh utensils such as perfume and scent bottles. Glass gives the substance a better appearance and hence attracts the onlookers for buying objects. As briefed earlier, since glasses are inert in nature, it doesn't react with any substance. Glasses are highly resistant to chemical interactions and their transparent property helps to watch the sample during the experiment. Hence, glass is used to make laboratory ware like a test tube. There are other objects used by a man daily.

We use them to illuminate our homes, offices, roads etc. The bulbs have a filament to generate light. But these filaments are covered by a transparent glass. Besides protection, they allow the passage of light through them without obstruction. You cannot replace the glass with metal or plastic as they are

not transparent and heat resistant. The other important usage of glass is that it's used as a magnifier. It has the property of magnifying objects that are far away in distance. Without this glass made magnifying lenses, it won't be possible to use microscopes. Thus, we got to know about glass, that it's an unlimited and innovative material that has various uses. It is an essential component of numerous products that we use in our day to day to life, most often without noticing it. Enhance the usage of glass and at the same time use it with utmost delicacy and care.", said I[st] winner S. Christy Laura from TAMIL NADU

"In the picture, I have captured different things which are made of glass and I use everyday.

I have highlighted the various properties of glass:

1. Transparent - the sipper allows me to see the fruits mom puts in my shake. The windows allow me to see the beautiful trees and birds outside.

2. Strong - the table and the window is strong

3. Used for decoration

4. Safe from virus

5. Permanent",

said 2nd winner Medhansh Singhla from DELHI

"At the first instance, you may have missed to notice the parents of the child in the frame (standing near the car). Grandparents of child are in the car, thus, I tried to capture "One Family Through Glass". Such beautiful moments make Life look more beautiful. If you look around, Glass in our lives is playing a major role i.e. recyclable, transparent, inert, protection from virus, eco-friendly, enables communication, addition in décor and many more features. My request goes to all to please adopt more GLASS in your lives, which would be a great contribution to beautify Mother Earth. Thank you ! ", said 3rd winner Brijesh Jethva from GUJARAT

Dr. Suman Kumari Mishra, Director, Council of Scientific & Industrial Research - Central Glass & Ceramic Research Institute (CSIR-CGCRI), Kolkata felicitated the winning students.

The roadshow will travel to other cities showcasing the vital role of Glass, being the only 100% recyclable packaging and building material.

As a token of appreciation, lucky 500 photo entries

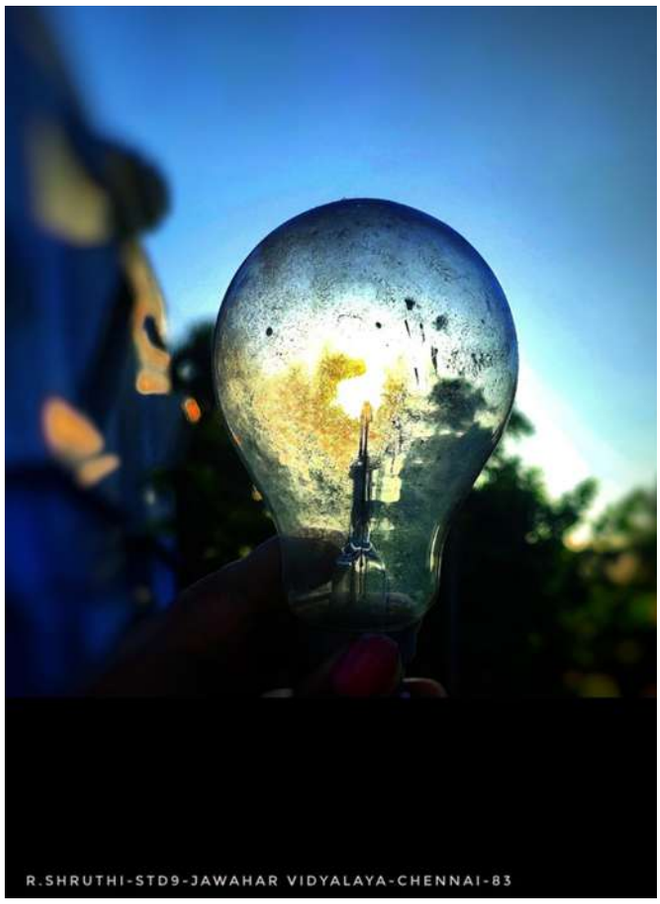
1st Prize (Rs. 20,000) was given to S. Christy Laura aged 15 years
10th class student of Sri Akilandeswari Vidyalaya, (Trichy) Tamil Nadu

2nd Prize (Rs. 10,000) was given to Medhansh Singhla aged 8 years
3rd class student of Delhi Public School (Vasant Vihar) New Delhi

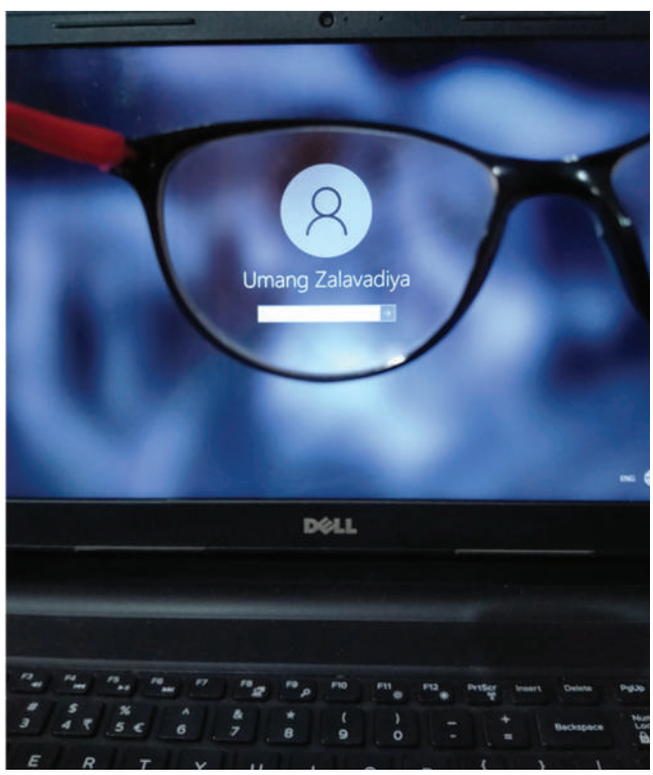
3rd Prize (Rs. 5,000) was given to Brijesh Jethva aged 22 years
from (Junagadh) Gujarat

Winning entries can be viewed at: www.aigmf.com

A digitized version of the exhibits may be viewed at: www.aigmf.com



will be given a specially designed empty Glass Bottle made out of recycled glass *(manufactured by Hindustan National Glass & Industries Ltd., under its CSR initiative)*, carrying logos of International Year of Glass 2022 and Swachh Bharat Abhiyaan *(Clean India Campaign)* ■



Select photos of the event can be downloaded from: http: //www.aigmf.com/pastevents.php

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4th AIGMF Glass Awards

Former Presidents; Mr. Sanjay Somany and Mr. Mukul Somany gave the prestigious annual 'CK Somany Award for Innovation and Technology' to Mr. Udit Kapoor, Director, Kapoor Glass India Pvt. Ltd., Mumbai. The 'Balkrishna Gupta Award for Exports' was bestowed to M/s Borosil Renewables Ltd., by the Former President, Mr. Pradeep Gupta. Both awards are supported by Glass Worldwide, preferred international journal of the AIGMF in association with Kanch.

Mr. Udit Kapoor *represents the 3rd Generation at Kapoor Glass. He completed his Electromechanical Engineering from The University of Southampton in 2004 and has been involved in the family business. His primary focus is to innovate and build equipment and systems to improve product quality and efficiency to meet the growing International requirements and meet customer expectations in terms of quality at affordable costs.*

Kapoor Glass India Pvt Ltd., *is one of India's leading manufacturers and exporters of high-quality glass ampoules, tubular vials, Insulin & Dental cartridges, perfume samplers, and laboratory test tubes. With a manufacturing base in India, they serve 32 countries including highly regulated markets in the Americas, Europe, and Japan.*

Borosil Renewables Ltd., *the first and only solar glass manufacturer in India, part of the Borosil group, are proud manufacturers of "World's First" Antimony-free solar glass and fully tempered 2mm solar glass. The Company is adding another 2.5 GW equivalent and will be a 5.0 GW equivalent solar glass manufacturer by July 2022 and will add a further 2.5 GW equivalent for commissioning in April 2023 to take it to 7.5 GW. It is targeting to raise exports significantly once the additional production is available from July 2022.*

Ashok Jain, Borosil Renewables Ltd.

The jury for Industry awards comprised of Dr. K. Annapurna, *Senior Principal Scientist, Glass Division, CSIR-Central Glass & Ceramic Research Institute (CSIR-CGCRI); Mr. Dave Fordham, Publisher, Glass Worldwide, London (UK); Mr. Sanjay Somany, Former President AIGMF and CMD HNG Industries Ltd.; Mr. P K Kheruka, Former President AIGMF and Chairman Borosil Ltd.; and Mr. Vinit Kapur, Secretary AIGMF.*

Udit Kapoor (left) with his brother Dhruv Kapoor Kapoor Glass India Pvt. Ltd.

"*I heartily congratulate Mr. Udit Kapoor of Kapoor Glass India Pvt. Ltd. to receive the prestigious CK Somany award for Innovation and Technology for developing indigenously hot-end camera system along with operating software to achieve online automation control over key production parameters to end up with quality production of glass vials of international standards. This is certainly towards attaining a country's self-reliance in such a critical technology. Equally, I applaud M/s Borosil Renewables Ltd., to bag yet another esteemed Balkrishna Gupta award for its achievements in quality productions and exports. I feel privileged to be part of the Jury to select such worthy contenders for these 4th AIGMF glass awards*" said Dr. K. Annapurna, Senior Principal Scientist, CSIR-CGCRI.

"The inhouse achievements overseen by Mr. Udit Kapoor during the integration of advanced technology into Kapoor Glass' production line of ampoules and vials cannot be underestimated and have resulted in multiple benefits. It was a pleasure for Glass Worldwide to be part of the judging process and we offer congratulations to Mr. Kapoor and Kapoor Glass as worthy winners of the prestigious C K Somany Award 2021. Congratulations also to Borosil Renewables who are deservedly recognised for tremendous export figures during unprecedented global market conditions. The company is investing significantly into its operations and its progress has deservedly been acknowledged with multiple honours recently, crowned with the AIGMF's 2021 Balkrishna Gupta Award for Exports", said Mr. Dave Fordham, Publisher – Glass Worldwide ■

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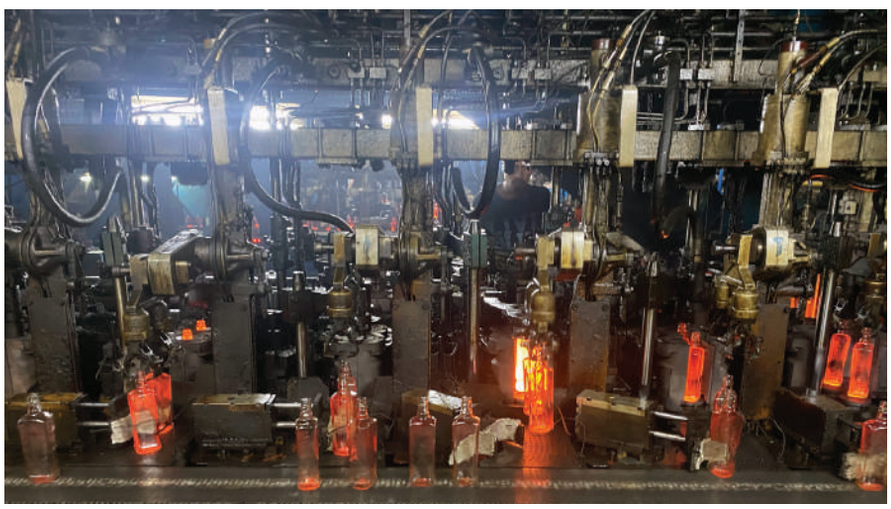
Rising to a new challenge

Anticipating further growth of the glass market in India and worldwide, container glass producer Sunrise Glass is expanding its facilities in Gujarat with a third furnace. In an exclusive interview with *Glass Worldwide,* preferred international journal of the All India Glass Manufacturers' Federation, Executive Director Gaurav Thakkar discusses the company's strategy for success in the post-Covid era.

Gaurav Thakkar is Executive Director of Sunrise Glass.



A manufacturer of flint container glass, Sunrise's priority markets are food and beverages.

One of the key players for manufacturing flint glass in India, Sunrise Glass is the container glass division of the Astron Group of Companies founded in 1982 by the late Hasmukhbhai M. Thakkar. The Group is India's leading manufacturer of ceramic raw material, involved in manufacturing zircon products, zinc oxide, sodium silicate, organic chemicals, ceramic glaze mixture, container glass and other ceramic raw materials.

"Astron Group has extensive manufacturing experience," explains Gaurav Thakkar, Executive Director of Sunrise, who entered the glass industry seven years ago and looks after marketing and day to day operations for the company. "Sunrise Glass has always had the advantage of management, technical and financial expertise from Astron Group," he continues, and is "progressing under the leadership" of Upesh Thakkar – Chairman of both Sunrise and the Astron Group – alongside Managing Director Hargun C. Bhambhani.

The company benefits from being based in Gujarat where the soda ash manufacturers of India are located.

Current capabilities

Sunrise Glass Industries employs 700 people and manufactures flint container glass to produce vessels for food and beverages – including soft drink bottles and liquor bottles, cosmetics and fragrance, and pharmaceutical containers. "Our priority markets are food and beverages, especially the alcobev [alcoholic beverages] industries," says Mr Thakkar.

Current production facilities include two furnaces – each with a fully automated batch house, eight high speed DG 5ins and 41/4ins IS-8 section machines, 1–8 section TG and 1–6 section single gob for making bottles in a wide range of shapes, sizes and weights, and high quality annealing courtesy of six automated 8ft/10ft wide lehrs. Current total capacity is 380 metric tons.

Geographically, the company has one of the most strategic locations for glass manufacturing, believes Mr Thakkar. "We are based in Gujarat where all the soda ash manufacturers of India are located," he explains. "In Gujarat you find the best quality silica sand. Also we are just 20km from the seaport – Hazira Port which helps us to increase our exports."

The business's main customers are high profile producers of alcoholic beverages, Pernod Ricard India and Diageo India. The key to a successful customer relationship is to combine the best service with the best quality product, according to Mr Thakkar. "The success mantra of our founder is 'We have to become the best and simply deliver ▸

Originally published in Glass Worldwide, preferred international journal of AIGMF

glass WORLDWIDE

the best to our customer with respect to quality, service and cost', and Sunrise Glass believes in it," he expounds.

An emphasis on environmental factors is also important to the company: "We are focused on reducing [our] carbon footprint," affirms Mr Thakkar. The company is committed to increasing the rate of recycling glass and using clean fuel. In addition, Sunrise is focused on the development of its employees and is involved in CSR activities for positive impact.

New furnace

In India, glass is growing steadily, reports Mr Thakkar. "Glass is the best packaging solution and we are sure that many producers will switch from PET [polyethylene terephthalate] to glass." Sunrise has increased its capacity three times in the last ten years and to meet future demand the company is in the process of setting up a third furnace in 2021.

"With the upcoming furnace we will have a capacity of 610 tons per day," forecasts Mr Thakkar. "With 610 tons per day, we will be India's sixth largest flint container glass manufacturer."

Key elements of the investment include upgrading technology with advanced AIS and inspection machines for a greater focus on quality. "The furnace will have four lines with three AIS 10 triple gob Emhart Machines. All the lines will have EVM inspection machines, and along with this we have installed an automatic cullet sorting plant that has been imported from Binder+Co in Austria," says Mr Thakkar.

The criteria for selecting suppliers to support this expansion varies according to different areas of the process, notes Mr Thakkar but in the main "reliability of the supplier" is the deciding factor, with long term relationships underpinning Sunrise's most fruitful partnerships.

Despite a Covid-related delay of six months to get the new furnace up and running, customers have reportedly already shown a positive response to the company's investment and the opportunities it presents.

Mr Thakkar's role entails looking after marketing and day to day operations for the company.

AIGMF membership

Sunrise is a member of the All India Glass Manufacturers Federation (AIGMF), the sole representative body of all segments of the Indian glass industry, which Mr Thakkar believes plays an important role in the Indian glass industry. "AIGMF is the platform where the issues and problems related to glass industry are presented to Government. AIGMF plays the most important role for the development of glass industry in India," he states.

At the virtual AIGMF Executive Committee Meeting held on 20 April 2021, members were educated on how AIGMF activities were reported globally via *Glass Worldwide* articles and shown how the existing co-operation provides the Indian sub-continent with an effective forum for the exchange of news and views between glass manufacturers and their suppliers.

Similarly, in October 2019 the 6th edition of glasspex INDIA provided a global platform for India's key industry players of the flat glass, container glass and tableware to come together to discuss industry trends, challenges and market insights including the Indian regulatory framework.

Mr Thakkar cites AIGMF's International Conference and the glasspex INDIA exhibition as events which have "always helped us to get the updates for the global glass industry and new updates on technology."

Sunrise Glass is the fastest growing producer of container glass in India.

Future plans

"We are looking and hopeful for the constant growth of the glass market," states Mr Thakkar. Utilising its third furnace Sunrise is hopeful of boosting the export side of its business but the immediate challenge is "to get the market recovered fully from the Covid impact. [There are] also new capacities coming [from the] west which will be competitive for us," Mr Thakkar observes.

The company's short/medium-term ambitions concern the food market, and establishing "a good presence" in this sector. "Our long terms goals are to build an amber or green colour glass furnace," says Mr Thakkar. ●

Further information:
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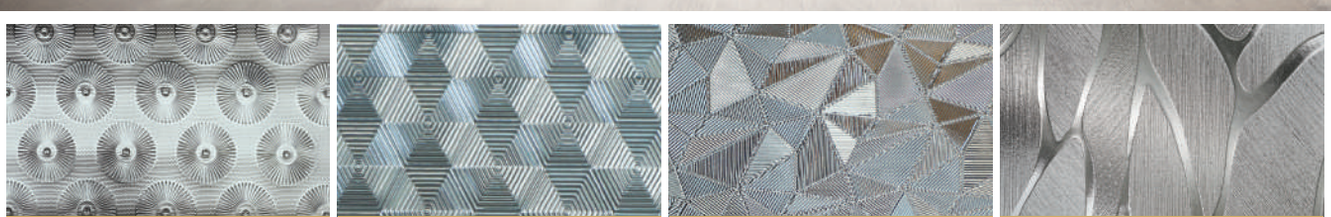
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3D

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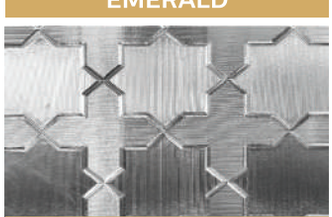
LILY


CRYSTAL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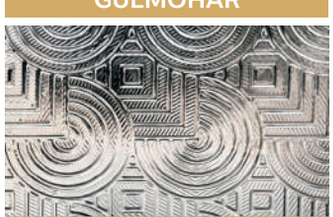
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Peak performance in its DNA

A global provider of glass packaging solutions, PGP Glass (formerly Piramal Glass) is Asia's largest speciality glass manufacturer. Now under new ownership, the rebranded and revitalised company is accelerating digital transformation to optimise the business and assert its dominance across multiple market sectors. Vice Chairman Vijay Shah speaks exclusively to *Glass Worldwide* (preferred international journal of the All India Glass Manufacturers' Federation) to share his vision for the company and its roadmap to greater growth.

Vijay Shah is Vice Chairman of PGP (formerly Piramal Glass Pvt Ltd).

A lot has changed for Vijay Shah since the last time this publication caught up with him at work *(Glass Worldwide November/December 2016).* As Director of Piramal Glass Ltd, Mr Shah led the glass packaging company until the Piramal Group sold the business to American investment management company Blackstone at the end of 2020. Acquired for US$1 billion, the purchase was finalised on 31 March 2021 and Piramal Glass was rebranded as PGP Glass, with Mr Shah appointed Vice Chairman.

The change of ownership affords PGP greater scope to broaden its reach in the premium cosmetics and perfumery (C&P) and specialty spirits markets, particularly in Europe. The company also has plans to expand into new product lines such as food jars and premium water bottles.

Fresh opportunities

Operating from India, Sri Lanka and the USA via four manufacturing facilities and several decoration plants, Piramal makes 1475 tonnes per day of glass globally from 12 furnaces and 65 production lines. The Blackstone takeover has presented multiple new opportunities and will enable the company, as PGP, to generate more business, for example in the C&P sector, where "gaining market share in Europe inorganically will be a priority" says Mr Shah. "We believe, it may be done quickly with support from Blackstone.

"In the long run, the perfume market is expected to grow exponentially in India and PGP will be poised to take advantage of it," adds Mr Shah. "PGP (erstwhile Piramal Glass) entered the C&P sector in 2005 and became the world leader in the nail polish product category. We aim to gain the similar position in perfumery line of products as well. While doing that we want to add a second engine to our growth journey which is the specialty spirit segment. It is a huge market and PGP will create its mark in that segment as well," he maintains.

In addition to rapid growth of the premium spirit market in India, PGP stands to benefit from heightened environmental awareness and climate concern which is increasing demand for glass packaging in the food and beverage sectors.

Piramal becomes PGP

Rebranding Piramal as PGP Glass seems to have been a decision borne of pragmatism and aesthetic considerations. As a B2B business, "It is the quality and service level that matters the most to the customers,"

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explains Mr Shah. “PGP is easier to pronounce and will bear the continuity of the business that we have built of the years. Our visual brand identity and logo will be distinct, elegant, dynamic and embody our ambition going forward.”

In retaining Piramal’s near 4,000 staff during the transition, PGP benefits from a “leadership team [that] is the most experienced among all the company’s competitors,” according to Mr Shah, who does not expect any major changes to the structure of the company under Blackstone ownership. Nor is he likely to abandon his colleagues on the executive management team: “Glass is my passion and I will continue to pursue it,” he vows.

“This business is a game of craftmanship,” he continues. “We compete with European players who have been in this business for more than 100 years. Unlike entrepreneurs, private equity looks for quicker value creation through various means.”

Assisting the Piramal team in a Non-Executive Director capacity is Uwe Roehrhoff, former CEO of Dusseldorf-based packaging company Gerresheimer Glass. “Uwe has excellent knowledge about the European market,” notes Mr Shah. “His association will help us in achieving our goal of growing rapidly in the perfumery segment in Europe.”

Responding to the pandemic

PGP has felt the effects of the pandemic on two fronts: its impact on the health of employees and their families, and the decline of the C&P market worldwide. “International trade imbalance has disturbed global supply chain adversely,” reports Mr Shah. In addition, sea freight rates have gone up and PCR glass “seems to have [experienced a] challenge as well,” he notes.

Responding to the escalating health crisis and reduced C&P business, Piramal/PGP diverted its capacity to other segments. “We grew significantly in pharma, food and beverage segments during the pandemic,” says Mr Shah. The company is committed to ensuring the health and safety of all employees in the current pandemic environment and in the future.

In anticipation of demand for a Covid-19 vaccine supply, PGP started to increase production of its type 1/moulded vials last year and is hopeful of filling a gap in the market. “We [specialise] in moulded glass whereas for vaccination, tubular glass vials are preferred by manufacturers,” explains Mr Shah. “So far it looks that moulded segment has missed the opportunities.” However, he is optimistic that moulded vials will be used for vaccinations “in the near future” due to severe shortages of tubular vials.

Business development

Last summer Piramal commissioned HORN Glass Industries to redesign a melting furnace for the production of premium cosmetics and perfumery bottles at its Kosamba plant in India. The brownfield expansion increased capacity from 395 to 440 tons per day. Investments/modernisation in production doubled decoration capacity at the factory three years back and the option for metallisation has now been added. The Kosamba factory also benefits from an added capability to manufacture heavy-bottom bottles, and a focus on the C&P sector is in the pipeline for new product development. Future plans for the plant include “investing in people” with more staff training, while investment in digital and analytics continues.

Piramal’s container glass plant in Jambusar, India, is currently undergoing a $42 million greenfield expansion upgrade that will generate an extra 250 tons per day.

Glass manufacturing line at the Kosamba plant.

Scheduled for completion “ASAP” according to Mr Shah, the project includes an additional furnace and seven new production lines to capture growth in the domestic specialty spirit sector. The investment will also create approximately 700 additional jobs. Commercial production will begin in August, with a brownfield expansion planned for the next financial year that will see one furnace relined to increase capacity from 115 to 170 tons per day.

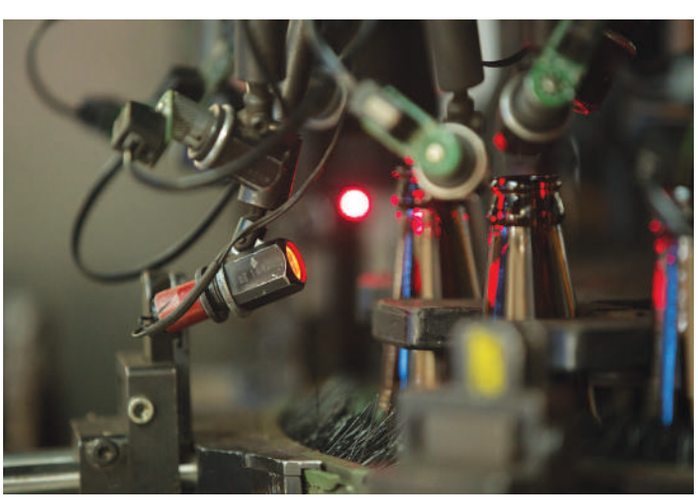
PGP is also committed to investment/modernisation at its factory in Horana, Sri Lanka, where it produces Type III flint and amber glass bottles for the pharmaceutical, C&P and specialty food and beverage industry sectors. Following CEO Sanjay Tiwari’s move to Piramal USA in 2019, former Vice President (Marketing) of Piramal Glass Pvt Ltd India Sanjay Jain was appointed Chief Operating Officer of the Ceylon firm.

Over at the USA facility in Missouri, USA, PGP will continue to grow its offering for the speciality spirit market.

Introducing green energy initiatives is another ongoing investment opportunity for PGP. “Wherever we get the opportunity, we invest in roof top solar [energy],” says Mr Shah. “We have an in-house commodity desk which focuses on alternate sources of energy. We have deployed Advanced Analytics models to optimise energy consumption by minimising absolute consumption [to a suitable level] and also by mixing energy sources [where appropriate].”

Digital journey

Vijay Shah has pioneered the use of digital technology in glass making. His strategic vision champions Smart Manufacturing, Connected Supply Chain, and Smart Customer Experience and Workplace Solutions to create a seamless, transparent and efficient end-to-end business ▸



Laser precision machine for glass bottles at PGP’s Kosamba plant.

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PGP Glass employs technology from globally renowned partners.

Furnace at Jambusar plant.

operation. In October 2020 Sudip Mazumder was appointed Vice President, Global Chief Digital & Information Officer to help catalyse Piramal's digital transformation journey.

To this end, the company has incorporated the Industrial Internet of Things and Big-Data platforms into its operational procedures and manufacturing, and partnered with Microsoft to implement Real-Time Manufacturing Insights – a real-time process tracking system to gain live visibility into operations. PGP can track ocean and land-based inbound and outbound shipments, both at material as well as container level. It has also implemented a Unified Energy Management System to assist its commitment to green and sustainability goals.

In pursuit of its goal to reach peak operational efficiency and the highest level customer experience, Piramal recently collaborated with management consultants McKinsey & Company. "McKinsey helped us in nurturing Digital & Analytics (DnA) culture in the organisation," explains Mr Shah. "We have created an inhouse team of Data Scientists, Data Engineers and Translators who will take forward the DnA initiatives within the organisation. We have developed Citizen Data Scientists – possibly [the] first in the industry segment that we operate in."

This year Piramal/PGP tested blockchain technology [a digital database used to securely record transactions across many computers – a 'block' of records cannot be altered retroactively without the alteration of all subsequent blocks] from fintech firm #dltledgers, based in Singapore as a means of increasing transparency between stakeholders whilst protecting intellectual property and sensitive data. PGP plans to use the technology to reduce manual processes and streamline supply chain processes across its global manufacturing operations.

Supplier relations

Having employed technology from globally renowned partners such as Tiama, Bucher Emhart, HORN, Interglass, Lubitech, Refmon, VP Instruments, Sheppee, Koenig & Bauer Kammann, SORG, Bottero, Vertech, Furnotherm, Shamvik and Dukhiram, Piramal has longstanding experience in selecting suppliers that best support its investments. "The main criterion for selection of vendor is their cost competitiveness over life cycle of the equipment," explains Mr Shah. "For imported equipment, service and support is a major selection criterion [along with] response time." Reliability and adherence to implied specifications is a further consideration, he adds.

The cornerstone of PGP/Piramal's partnership with its extended supply chain partners is formed by a triumvirate of trust, aligned values and growth strategies, and transparency.

"Trust has been the foundation for our overall vendor management," expounds Mr Shah. "For example, a long standing, more than decade-old relationship with our major mineral suppliers has helped us to perform extremely well, even during the strictest of lockdowns.

"We ensure that we select vendors who have the required hunger to grow with us and are willing to try out new innovative ideas for value addition," he continues. Using P2P and SRM tool Ivalua has also helped the glassmaker to build stronger and clearer communications channel with suppliers.

AIGMF involvement and recognition

"PGP Glass has been a very active member of the All India Glass Manufacturers Federation (AIGMF)," states Mr Shah. "We have taken the forefront in many important cases affecting the overall glass industry like the sustainability efforts around cullet usage, natural gas and renewable usage and life cycle analysis studies. Further, important issues like fighting the anti-dumping on soda ash, representing to the ministry the issues around pollution and import licenses pertaining to glass cullet. AIGMF has been on the forefront of identifying necessary technologies in glass manufacturing and brings together experts of the industry and technology fraternity to speak and share ideas.

"AIGMF cooperation with *Glass Worldwide* (preferred international journal of AIGMF in cooperation with KANCH) is very useful because it enriches the content of KANCH," Mr Shah continues. "We subscribe to several copies of *Glass Worldwide* because it's the global industry's most useful magazine. Our senior people go through every issue because it is very educative and informative on all the industry's latest developments. The articles are very good and the industry learns a lot."

At the inaugural AIGMF Awards to celebrate achievement in the Indian glass industry, Piramal won the Balkrishna Gupta Award for Exports in recognition of its contribution to the identification/growth of glass exports during 2017–2018. The award was presented by Pradeep Gupta, Former President of the AIGMF, in honour of his father Balkrishna Gupta who founded of the Advance Group of Glass Industries in Firozabad and served as President of the AIGMF and the Uttar Pradesh Glass Manufacturers' Syndicate. Piramal was "humbled and happy to be recognised" for the prestigious award, reflects Mr Shah. "It has taken many years of hard work to achieve the high standards of quality required to cater to the exports markets and we continue to do so and hope to win this award again," he confides. Having set a target of penetrating the European market for specialty liquor sector in the next five years, along with a pressing ambition to equal its success with nail polish and become the dominant player in perfumery, it seems more than likely that PGP will be honoured again in the near future. ●

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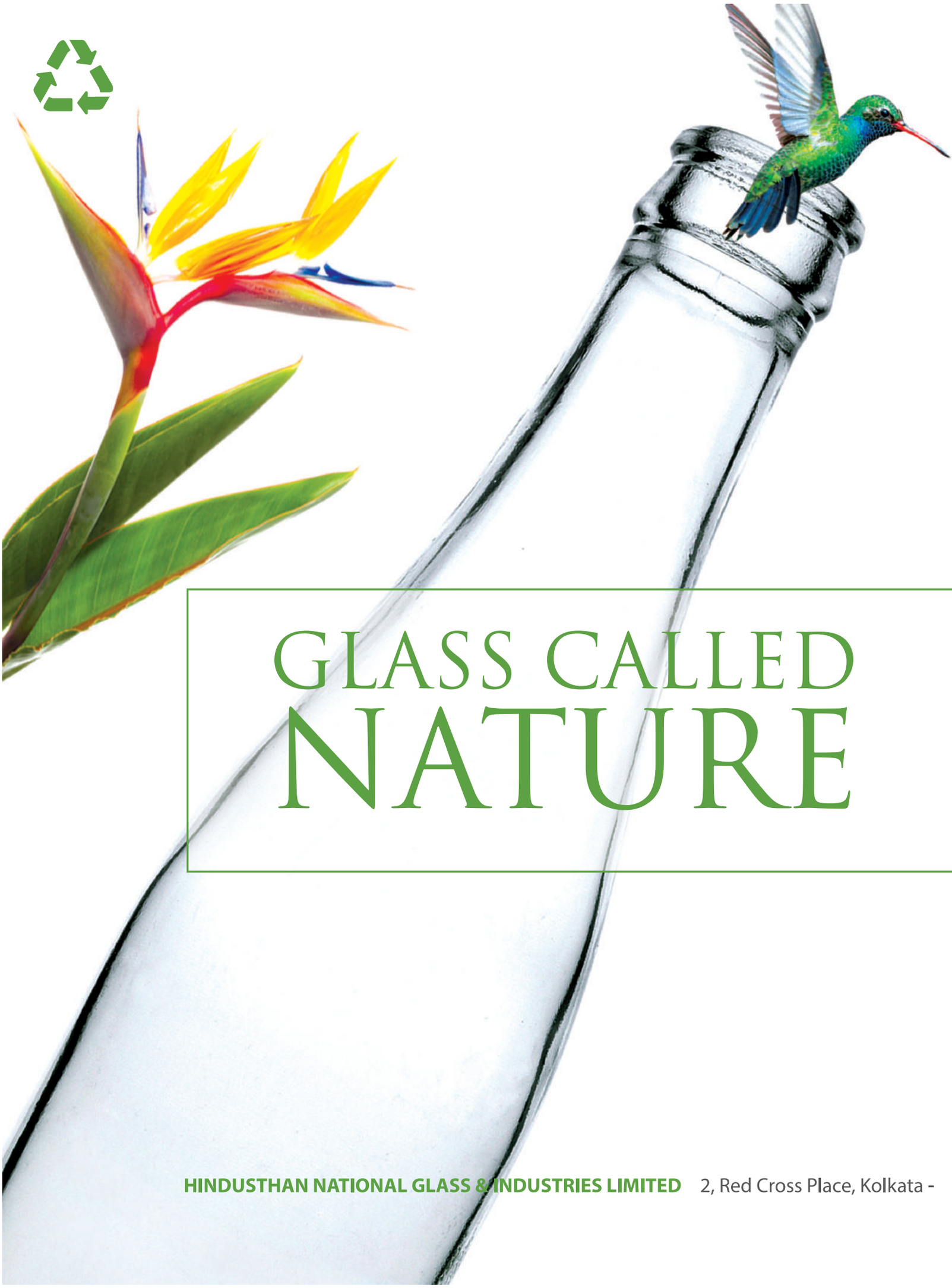

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Specialty Optical Fibers Activities at CGCRI

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Abstract

This article focus on fiber optics related R&D activities in the area of specialty optical fibers at CGCRI and also provide a brief introduction on optical fiber, its important properties, global and Indian market, fabrication technique starting from optical preform to fiber drawing along with characterizations facilities. A sincere effort has been made for development of photonics devices and components using the specialty optical fibers in India.

INTRODUCTION

Specialty optical fibers, an important glass based component has been used for making of photonics devices starting from high speed broadband internet to medical surgery. On the other hand, optical fiber fabrication technology is one of the important topic in the area of fiber optics. Now-a-days we never overlook the utility of fiber optics in our modern human's life where photonic devices play an important role. The matter of specialty optical fibers involved an interdisciplinary field covering chemistry related to material science, fundamental physics and optoelectronics. Dr. Narinder Singh Kapany, an Indian-American Physicist invented fiber optics first in India showing the transmission of images through bundles of tiny drawn glass fibers in 1954 and known as the 'Father of Fiber Optics'. In 1966, Charlse Kao and G. A. Hockham predicted that optical communication is possible if the transmission loss could be reduced to 20 dB/km in a guided medium [1]. In September 1970, they have announced the development of optical fiber with loss below 20 dB/km. In 2009, Dr. Kao was awarded Nobel Prize in Physics for his outstanding achievements in the field of optical communication.

CGCRI is an unique and only Research Institute within India involved in R&D work for making of various kind of specialty optical fibers to meet the demand in our country. In CGCRI, a state-of-the-art facility is available for development of optical fiber preforms and drawing of fibers along with full range of geometrical and optical characterization for high power fiber laser, amplifier, broad-band source as well as Fiber Bragg-grating (FBG) based components and devices. CGCRI also dedicated for development of specialty optical fibers based photonic components and devices under technical support of photonics industries such as Sahajanand Laser Technology Ltd. (SLTL), Gandhinagar; Bharat Electronics Limited (BEL), Bangalore; SFO Technology, Cochin; Vinvish Technologies Pvt. Ltd etc. in India.

STANDARD AND SPECIALTY OPTICAL FIBERS

Standard optical fiber is a very thin silica glass wire of 125μm diameter which consists of central core glass with high refractive index surrounded by cladding glass of low refractive index covered by the outer silica glass coated with protective resin material responsible for transmission of CATV signals, telephone signals and internet communication almost instantaneously around the world. High purity silica glass with doping of some standard high purity (99.999%) elements such as fluorine, germanium, phosphorous into cladding and core glasses as well as perfect waveguide structure enabled to carry the today's world communications. Every researcher in the area of fiber optics should know the most important waveguide parameters such as V-parameter which determine the fraction of the optical power in a certain mode confined to the fiber core; Attenuation which controls the light transmission properties of fiber; Cut-off wavelength is the minimum wavelength above which only one particular mode propagate; Numerical Aperture which control light capture capacity of the fiber and core/clad ratio. Depending on core diameter as well as NA, fibers can support many propagation paths known as multimode fiber or support

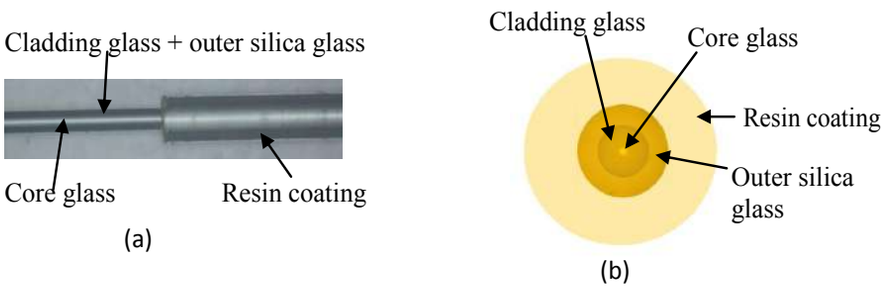

Fig. 1: Axial (a) and Radial view of coated optical fiber (b)

single propagation path known as single mode fibers.

One fiber optic cable can have as few as two strands or as many as several hundred. Each fiber-optic cable can easily transfer more than several million calls where each fiber strand allows 25,000 telephone calls. A team of University College London engineers reached the world's fastest data transmission rate of 178 terabits (trillion bits) per second using single mode fiber which is enough for organization of 100 million Zoom sessions [2]. Light guided into optical fiber through total internal reflection (TIR) phenomenon. Light ray propagates into the core through multiple TIR's at core-cladding boundary. Specialty optical fibers have either special waveguide design or novel material compositions become heart of all-fiber based advanced photonic devices and components. The axial and radial view of optical fiber are shown in Fig. 1(a) and Fig. 1(b), respectively.

GLOBAL AND INDIAN MARKET

The global market of specialty optical fibers was 1377 million USD in 2020 and expected to reach 2313.5 million USD by the end of 2027, growing at a compound annual growth rate (CAGR) of 7.9% during 2021-2027[3]. In India, the recent report focused that optical fiber and accessories market is expected to reach $ 1.66 Billion by 2026 at 17.2% CAGR from $ 4461.6 million in 2018[4]. At present, almost 28 lakh kilometer optical fiber network is spanned throughout India against the target deployment of 50 lakh kilometers of optical fiber within 2024[5]. Presently the country's fiber deployment rate is at 4 lakh kilometers annually [6]. There are some Indian companies/industry working in conventional telecom fibers/cable i.e. Finolex Cables Ltd., Universal Cables Limited, Aksh Opti Fiber Ltd., Polycab India Limited, Sterlite Technologies Limited, Birla Cable Limited, Gupta Power Infrastructure Ltd., and Vindhya Telelinks Ltd. Till now there is a lack in industrial production of rare-earths doped specialty optical fibers for use as high power fiber laser, optical amplifier as well as sensors in India. CGCRI is carrying out basic as well as R & D work to improve the lasing efficiency, amplification performance of Er and Er/Yb doped optical fibers with long term stability of output power to reduce the overall cost of the amplifier/laser module.

FIBER FABRICATION AND CHARACTERIZATION FACILITIES AVAILABLE IN CGCRI

Fabrication technology of optical fibers involves two steps: First making of optical preform; second: drawing of fiber from the preform. In fiber optics, a preform is a glass rod of various dimensions having different refractive index based medium to serve as the core and cladding of the fiber. To improve the performance of fiber based photonic, devices require the judiciously selection of suitable composition of the core glass of optical fibers along with their waveguide parameters (core diameter, cladding diameter, numerical aperture etc.). In order to improve their spectroscopic properties towards their specified application areas, require minimization of spectral attenuation as well as concentration quenching phenomenon through uniform doping of each element into core glass along the diameter of fiber.

Different fabrication process such as Outside Vapor Deposition (OVD) [7], Vapor phase Axial Deposition (VAD) [8], Modified Chemical Vapor Deposition (MCVD) [9], Plasma Chemical Vapor Deposition (PCVD) [10] have been used for making of optical fiber preform. MCVD is considered as one of the most well-accepted and adjustable process for fabrication of different types of optical fiber's preform which is practiced in CGCRI since 1981. Fabrication of optical fibers in CGCRI involved preform making through MCVD process with incorporation of different suitable elements into core and cladding glasses followed by drawing of fiber from the preform using fiber drawing tower applying on-line resin coating. The equipment for MCVD process consists of glass working lathe, gas control module and other accessory/ supporting equipment shown in Fig. 2a. The glass working lathe consists of two concurrent chucks with three head gripping jaws along with a fire carriage holding 2 quartz burners and infra-red pyrometer. The burner movement back and

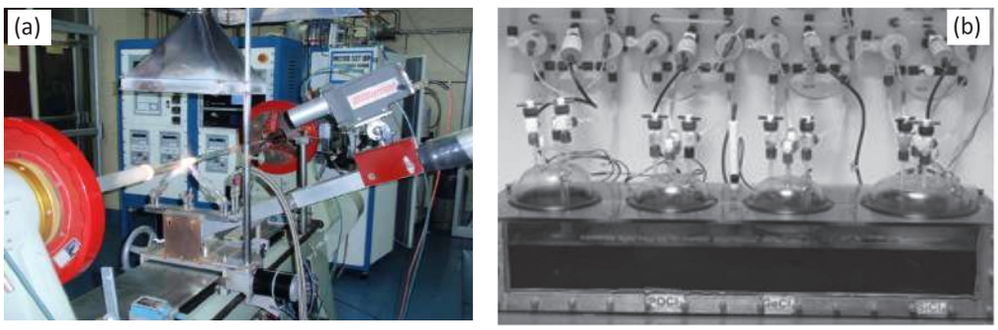

Fig. 2: MCVD set-up (a) and Bubbler chamber (b)

forth is controlled by a burner speed controller. An IR pyrometer (Williamson Corporation) was used to record the heating temperature of outer surface of the silica tube continuously during movement of the burner along forward/backward direction at its hot zone.

The gas control module has a temperature-controlled chamber (± 0.10^{0}C) housing pyrex glass bubblers of 1-5 liter capacities of the desired liquid chemicals ($SiCl_4$, $GeCl_4$, $POCl_3$ etc.) shown in Fig. 2b. The moisture level of high purity (99.9995%) carrier O_2 gases down to less than 0.012 ppb after passing through millipore filter which serve as a purifier to reduce the impurity content. The control of the flow of oxygen gas into different bubblers of source chemicals is done by Mass Flow Controller (MFC). The vaporized chemical gases enter into the reaction waveguide silica tube from the bubbler using oxygen gas at a particular flow through MFC.

PREFORM FABRICATION BY MCVD PROCESS

Different steps such as material selection for cladding and core glasses, tube selection, etching of inner wall of silica tube, deposition of cladding and core glasses followed by sintering and collapsing are involved in the MCVD process. The basic principal of chemical vapor deposition (CVD) process involved to vaporize the high purity chlorides of Si, Ge, P, B etc. through bubbling with high purity oxygen gases into the liquid filled bubblers for filtering mainly the transition metals which caused high absorption loss and degrades the fiber quality. Using gas control module, such high purity halide precursors of different oxides along with oxygen and He gases allowed to enter into a rotating high purity silica tube whose outer surface is heated by moving oxygen-hydrogen burner along the forward/backward direction to produce sub-micron sized soot particles. Such soot particles generated from oxidation reaction of reactant halide vapors with oxygen at high temperature and uniformly lay down along the cooler side of the hot zone by thermophoresis mechanism [11]. Different composition based glass layers deposited through alternation of vapor phase mixture is repeated several times to optimize the waveguide design. Finally, the deposited tube is converted to a solid rod called "preform" (Fig. 3) which is made through collapsing process by 3 to 4 passes at a temperature above 2000^{0}C [12]. The diameter of fabricated preform varies from 10.0 to 25.0 mm depending on the thickness of starting waveguide silica tube. Sometimes over cladding of the initial preform using silica tube of 4.0 mm thickness is completed to reduce the core diameter for adjusting the cutoff wavelength of the fiber required for particular application.

Generally, preforms with incorporation of standard dopants such as Ge, P, F, Ti, B, Al etc. are made by MCVD process using their halide precursors for drawing of GeO_2 and GeO_2-B_2O_3 doped photosensitive fibers for use as FBG as well as radiation sensor [13-14], P_2O_5 doped radiation sensitive fiber [15], TiO_2 doped fiber as radiation sensor [16-17], SiO_2-F doped fiber [18] etc.

MCVD WITH SOLUTION DOPING TECHNIQUE

MCVD with solution doping technique [19] is one of the important processes for manufacture of various rare-earths doped optical fiber preforms which is used for drawing of specialty optical fibers for fiber laser, optical amplifier as well as super-continuum sources. On the other hand, vapour phase chelate delivery (VPCD) technique [20] is used for incorporation of rare-earths along with aluminum directly into silica glass to develop large core area fibers preforms. In solution doping technique, the porous soot layer (Fig. 4a) of various

Fig. 3: Specialty optical fiber preforms

composition deposited into inner surface of silica tube by MCVD process at optimum deposition temperature used for solution soaking purpose through entering of an alcoholic solution of different rare-earths salts along with other co-dopants, mostly Al.

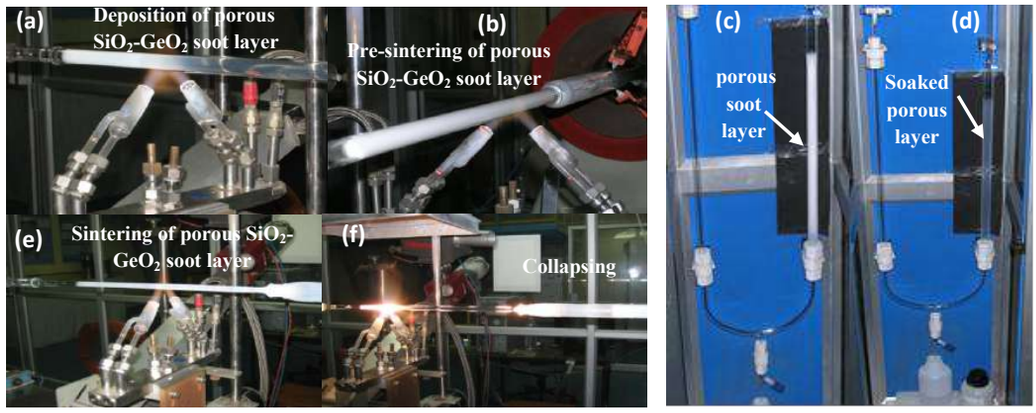

Fig. 4: Solution doping technique: Deposition of porous SiO_2-GeO_2 soot layer (a); Pre-sintering of soot layer (b); Fixing of porous soot layer coated silica tube into solution doping chamber (c); Soaking of soot layer (d); Oxidation with sintering (e) and Final collapsing (f) to make preform

The most important step involved is the formation of soot layer of is various composition (SiO_2 or SiO_2-GeO_2 or SiO_2-P_2O_5 or SiO_2-GeO_2-P_2O_5 etc) having uniform porosity through optimization of deposition temperature within 1200-1500^{0}C into inner wall of 20/17 mm silica tube. The deposition temperature can be observed using an Infra-red pyrometer moving with O_2/H_2 burner along the direction of the flow of soot particles suspended into gas mixture. Variation of the porosity as well as pore size distribution gives rise to non-uniform incorporation of RE along the length of the preform/ fiber [21-23]. Pre-sintering (Fig. 4b) was done at lower temperature below the deposition temperature to prevent detachment of soot layer from the inner silica surface. After that porous soot layer coated silica tube is fixed into solution doping chamber (Fig. 4c). On the other hand, several controlling factors such as solution composition, the ratio of doping levels of aluminum and rare-earth, solvent type, etc. are involved during the solution doping step to get the good optical properties in the fiber. Different rare-earths such as Er, Yb, etc along with Al are incorporated into the porous soot layer through solution doping technique using an alcoholic solution having different content of $ErCl_3$ $6H_2O$, $YbCl_3$ $6H_2O$ and $AlCl_3$ $6H_2O$. After a certain period of soaking time, the solution is drained out (Fig. 4d) followed by air drying of the soaked porous layer. Then the tube is mounted again on the glass working lathe for oxidation and dehydration of the soaked layer with flow of Cl_2 and O_2 gases at optimum ratio at lower temperature around 800-900^{0}C (Fig. 4e). Sintering of the soaked layer is done through increasing the heating temperature from 1500 to 1900^{0}C to make transparent glass layer. After that, tube is collapsed (Fig. 4f) above 2000^{0}C into a solid rod to make a preform.

CGCRI developed different varieties of specialty optical fibers [24-26] for making of photonic devices and components such as erbium doped fiber for optical fiber amplifier (Fig. 5a), Er/Yb codoped cladding pump fiber (Fig. 5b) for high power optical amplifier, Yb doped fiber for fiber laser at 1.0 micron (Fig. 5c), Er doped intrinsically photosensitive fiber (Fig. 5d) having ultra high NA (~ 0.30) with low diameter (~ 3.0 micron) for distributed (DFB) fiber laser, and Photonic crystal fiber (Fig. 5e) for super-continuum source. The microscopic view of different specialty optical fibers is as shown in Fig. 5.

For cladding pump high power optical amplifier and fiber laser we require asymmetric structure of the cladding glass for getting better pump absorption efficiency using high power multimode (MM) pump source. Generally made of octagonal shaped fibers to reduce the splicing losses. Initially we make octagonal shaped preform through proper grinding and polishing process from the circular preform using special kind of preform holder as shown in Fig. 6a. The octagonal shaped preforms are shown in Fig. 6b

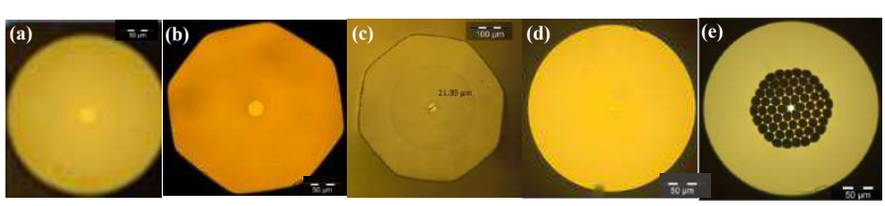

Fig.5: Microscopic view of Er doped fiber (a), Er/Yb codoped fiber (b), Yb doped fiber (c), Er doped intrinsically photosensitive fiber (d), and Photonic crystal fiber (e)

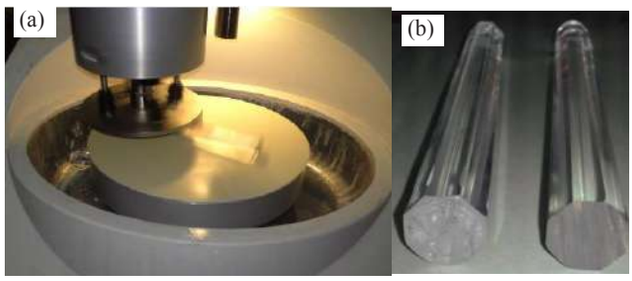

Fig. 6: Grinding and polishing set-up (a) and Octagonal shaped preforms (b)

Fig. 7: MCVD System with high temperature vapor delivery unit for making laser fibers. (Nextrom, Finland)

VAPOUR PHASE CHELATE DELIVERY (VPCD) PROCESS

Central Glass & Ceramic Research Institute has established a state of the art vapour phase chelate delivery (VPCD) system (Fig. 7) and successfully demonstrated process technology to develop large core active fibers. The VPCD technique is similar to MCVD with an additional high temperature cabinet (HTC) housing different RE-doped chelate materials, and anhydrous $AlCl_3$ filled bubblers that provide RE and Al vapours at certain fixed temperature. The initial research work was aimed to optimize several process parameters namely bubbler temperature, carrier gas flow rate, front and back ribbon burner temperature, etc. to achieve a reliable and repeatable fabrication process with good dopant distribution profile [20, 27]. With this initial success, CSIR-CGCRI has achieved a capability to develop step-index large mode area Yb-doped fibers with core-dimension ~10±1μm w.r.t 125μm cladding, numerical aperture within a range of 0.08 to 0.14 having Yb-concentration in the range of 1000 to 6000 ppm with uniform dopant distribution profile along the diameter of fiber core in a repeatable manner. The maximum core diameter of 40μm has been reached through implementing this process [28-29].

Using VPCD system, CGCRI made two waveguide structures based Yb doped fibers, one for continuous wave (CW) laser operation and another pulsed laser operation. Through optimization of Yb-concentration level, laser cavity and cooling arrangement, CGCRI has achieved a CW laser operating at 1.06 μm suitable for marking, engraving, etc. and demonstrated a packaged module with output power of 30 to 100W. The fiber used for this particular work has a core dimension of 10μm with octagonal shaped double cladding structure and NA of 0.09 [28]. CGCRI also developed suitable Yb doped cladding pump octagonal shaped fiber having Core/Clad diameter: 20/400 μm with NA: 0.065 – 0.075 showing 500 W output power. An output energy of 186μJ with the 1.86W-average power, 100ns pulse width and 10 KHz repetition rate is reported suitable for pulsed laser application [29].

FIBER DRAWING

CGCRI installed 10 meter fiber draw tower used for drawing of specialty fibers with on-line dual acrylate coating shown in Fig. 8a. The tower uses high temperature graphite resistance furnace and is equipped with state of the art control and monitoring of the parameters like diameter of the bare as well as the coated fiber, draw tension, coating concentricity etc. Wet on dry coating technique is used for dual layer acrylate coating on the fiber using two coating stations. The maximum preform length that can be accommodated is 100 cm and maximum diameter is 30 mm. Maximum draw speed that can be attained is 300 meters/min.

Before fiber drawing, the back end of preform connected with suitable silica rod using H_2/O_2 burner followed by proper cleaning of the outer surface of preform with acetone. The silica rod portion of the joined preform is then fixed on the down feed chuck with proper centering followed by slowly lowering down into the hot zone of furnace centre maintaining temperature at 1950-2000^{0}C. Initially some melted conical zone of preform known as a neck-down region (Fig. 8b) came out from the outlet of furnace after softening the preform through proper heating using a precision temperature controller where bare glass fiber is continuously drawn. The bare fiber coated with primary as well as secondary coating on-line required for enhancement

of the tensile strength along with protection from diffusion of OH content and dust particles coming from outside. Several important fiber drawing parameters such as fiber diameter and coating thickness along with its concentricity should be controlled properly for optimization along the whole fiber length in order to improve the fiber's quality. The uniformity of primary (Desolite DP-1004) and secondary (Desolite DS-2015) coating along with their thickness can be controlled through adjustment of the flow pressure of the inlet Argon gases into their container during fiber drawing. The fiber is then wrapped around a spool (Fig. 8c). Under steady state condition, $s=S(D^2/d^2)$, where s and S are fiber draw speed and preform speed; d and D are fiber & preform diameter, respectively.

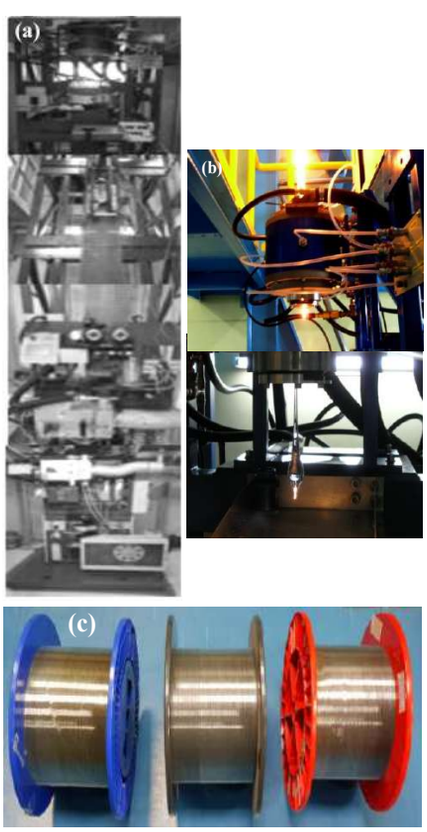

Fig. 8: Fiber drawing tower (a), Preform neck down process (b) and Specialty optical fiber drawn into fiber optic spools (c)

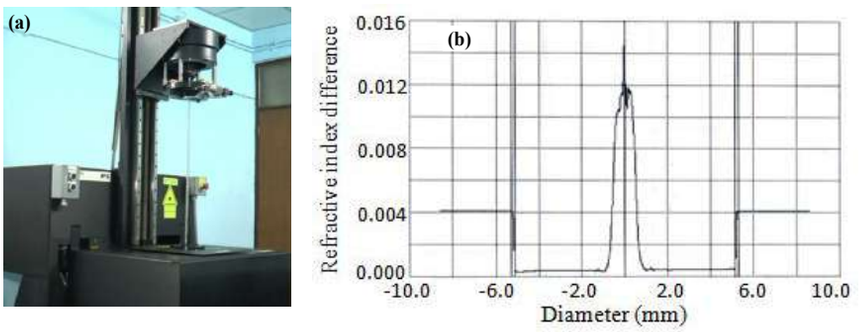

Fig. 9: Optical preform analyzer (a) and Refractive index profile of specialty optical fiber preform (b)

PREFORM AND FIBER CHARACTERIZATION FACILITIES AT CGCRI

A full range of characterization facility is available at fiber optics and photonics division for preform and fibers. Different varieties of preforms and fibers fabricated are characterized for their geometrical and optical properties e.g. core-clad dimensions, concentricity, mode field pattern, RI profile, NA, attenuation spectrum.

Preform analyzer: The vertical type preform analyzer (Model: PK-2600) shown in Fig. 9a which accurately measures RI profile (Fig. 9b) of accuracy ± 0.0002 of index values, MFD, cut-off and chromatic dispersion. It accommodates upto 80 cm long preform and of diameter 50 mm.

Optical fiber analyzer: A versatile optical fiber analyzer (Model NR-9200 from EXFO, Canada) shown in Fig. 10a was used to measure the refractive index profile of fiber (Fig. 10b). The analyzer unit provides extensive characterization of the refractive index profile of accuracy of ± 0.0001, geometry and mode-field profiles of optical fibers

Bentham spectral attenuation set-up: The facility to measure the transmission characteristics of both standard and specialty fibers in the wavelength range of 350 nm to 1600 nm is available in CGCRI. The spectral attenuation test set-up (Fig. 11a) is driven by efficient control software and the application

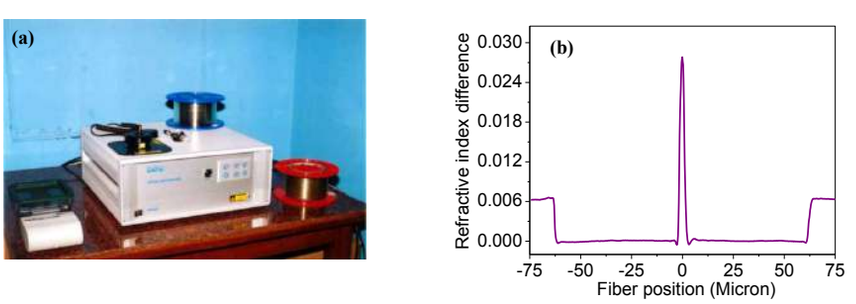

Fig. 10: Optical fiber analyzer (a) and Refractive index profile of specialty optical fiber (b)

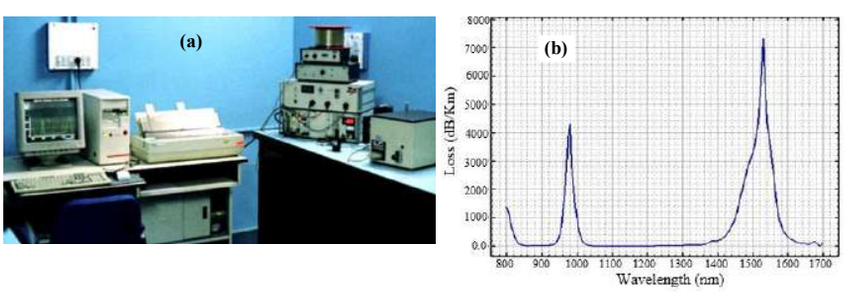

Fig. 11: Bentham spectral attenuation set-up (a) and Optical loss curve of erbium doped fiber (b)

software directly calculates the spectral loss at any wavelength in dB/km from 350nm to 1600nm. The Er ion concentration of erbium doped fiber (EDF) is usually measured from its characteristics absorption peak at 980 nm (Fig. 11b). The system has measurement reproducibility of 0.02 dB, wavelength accuracy of better than ± 0.03 nm with wavelength repeatability of 0.08nm.

Spectrofluorometer (Model-FS920), EDFA and Lasing characterization set-up: The spectrofluorometer FS 920, Edinburgh Instruments, UK (Fig. 12a) is used to measure fluorescence spectra as well as fluorescence decay kinetics from microseconds to seconds. FOPD has excellent combination of instruments for characterization of EDFA in C and L band wavelength regime (Fig. 12b). Single wavelength measurement of parameters like optical gain, noise figure and ASE levels are done using high resolution tunable laser sources. CGCRI has good facility for high power lasing characterization of rare-earths doped specialty optical fibers (Fig. 12c).

DEVELOPMENT OF PHOTONIC DEVICES

Packaged optical amplifier module for CATV application: Erbium doped fiber amplifier (EDFA) for CATV application was developed jointly with M/s. SFO Technology Pvt. Ltd., Cochin using erbium doped specialty optical fiber and was commercialized. The specification of developed EDFA module is given in Table 1. EDFA (Fig. 13) is an assembly of a special kind of optical fiber and a series of electronic inputs with controls which amplify the low intensity optical signals in fiber optic communications system.

Table 1: Specifications of developed EDFA

Parameters	Values
Operating wavelength	1540 - 1560 nm
Input power	0 to +10 dBm
Output power	+ 16 dBm
Noise Factor	5.5 dB
Polarization dependent gain	≤ 5.5 dB
ASE	< -20 dB
Return Loss	> 50dB
Pump leakage power	≤ -30 dB
Operating temperature	0 to +65^{0}C
Storage temperature	-25 to +70^{0}C

Fig. 13: Erbium doped optical fiber am

Packaged Ytterbium pulsed laser for marking and engraving: CGCRI developed pulsed fiber laser (Fig. 14) at 1.064 micron using Yb doped fiber of core /clad dimension of 30/125 μm having NA 0.08 – 0.09 for marking and engraving having average output power of 20 W, pulse energy of 0.5 to 1.0 mJ, Beam quality $M^2 < 1.4$ and pulse width of 80 – 200 ns.

Packaged Ytterbium CW Laser for Additive Manufacturing / 3D Printing: Continuous wave (CW) based fiber laser (Fig. 15) at 1.0 micron was also developed for additive manufacturing and 3D printing using in-house fabricated cladding pump octagonal shaped Yb doped fiber having core/clad dimension of 20/400 micron and NA of 0.065-0.07 with maximum output power of 100W and Beam quality $M^2 \sim 1.2$

Fig. 14: Package Ytterbium pulsed fiber laser

Fig. 15: Package Ytterbium CW fiber laser

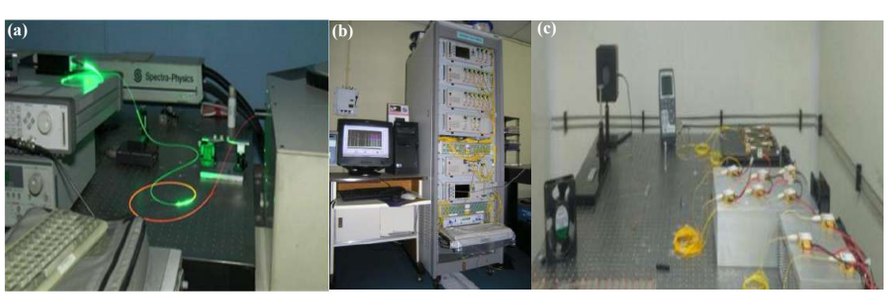

Fig. 12: Spectrofluorometer FS 920, Edinburgh Instruments, UK (a); EDFA characterization set-up (b) and Lasing characterization set-up (c)

CONCLUDING REMARKS

Presently, a state-of-the-art facility is available at CGCRI for making of various kind of specialty optical fibers which have many important

applications as well as market demand for photonic industries, other research Institutes, IIT's and universities in India. CGCRI also appeared as an important R&D Lab on specialty optical fibers activities which is well supported by a complete characterization facility to evaluate different optical properties. Although development of specialty optical fibers becomes the main backbone of all fiber based research, CGCRI expanded fiber optic research activities in other key research areas for making of fiber optic components and devices. At present, CGCRI participate directly for R&D work in the area of fiber optics with different defense research development organizations (DRDO) such as Jagadish Chandra Bose Centre for Advanced Technology (JCBCAT), Jadavpur; Terminal Ballistics Research Laboratory (TBRL), Chandigarh; Centre for High Energy Systems and Sciences (CHESS), Hyderabad; Defence Metallurgical Research Laboratory (DMRL), Hyderabad; Naval Physical and Oceanographic Laboratory (NPOL), Cochin etc. CGCRI also engaged for the active and effective collaborations with various foreign countries such as UK, Mexico, Portugal, Russia, Malaysia, etc in the field of Photonics. With the knowledge base and expertise generated during the last two decades, CGCRI is now ready to take challenges in the emerging areas of fiber optics.

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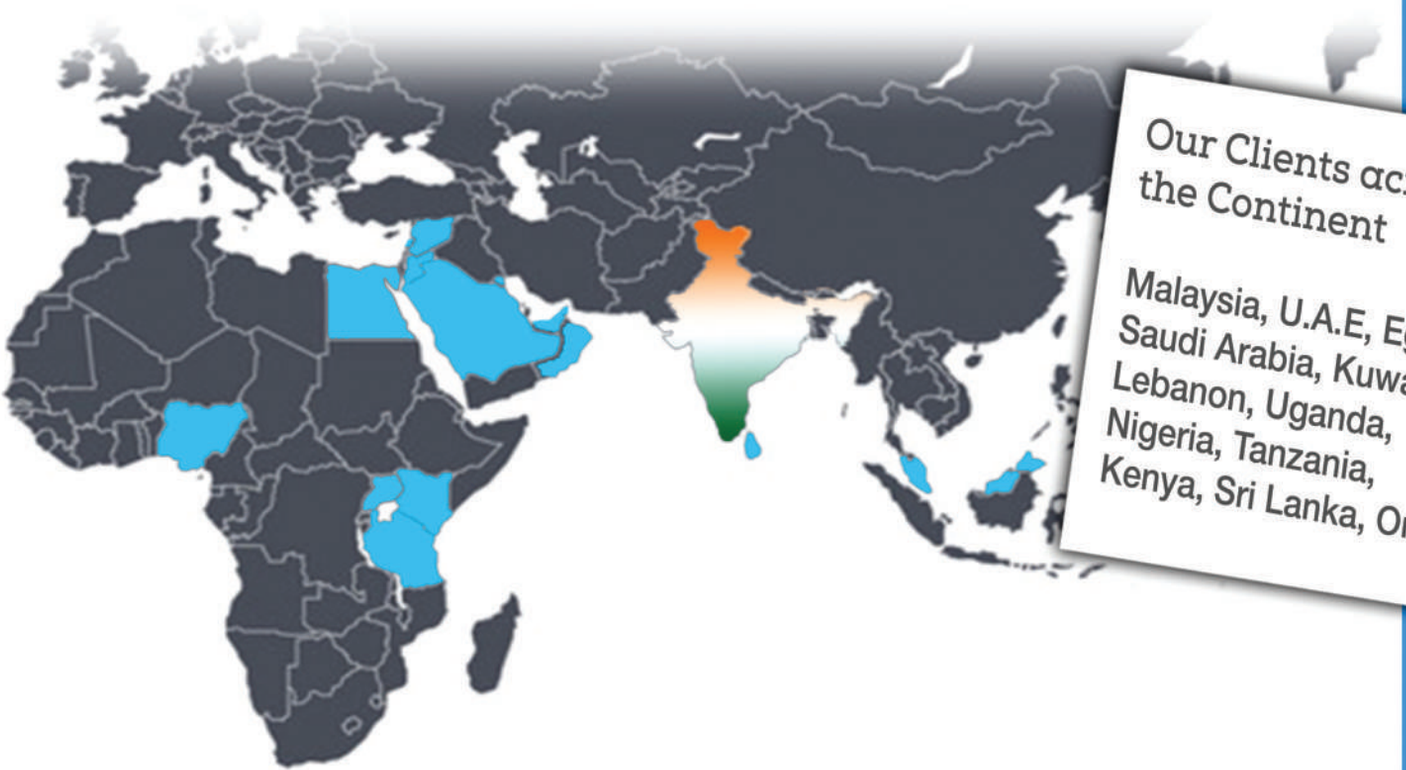

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Abstract

Oxide glass is mainly produced by mixing various ingredients with silica sand as the main component that works as the network former and other components, such as carbonates and/or nitrates of sodium and potassium to add soda or potash as the network modifier, and carbonates of calcium and magnesium to add lime etc. for chemical resistance. Also, alumina is added to give rise to higher mechanical strength. There are numerous other ingredients, combining the very small proportion of refining agents such as arsenic oxide or antimony oxide, to get rid of the bubbles from the glass melt **[1-3]**. This typical content of a glass composition in various permutations and combinations are the basis of a variety of glasses that are useful to different applications in many industries including the building construction industry. Some of these glasses will be discussed here.

INTRODUCTION

There are some glasses that are used in various forms as they are made after melting in a glass tank furnace, shaping in various shapes and sizes in different machines and then finally heated slowly in an annealing lehr to remove the stresses in the hot glass. There are a large number of small-scale industries that "fashion" the glass sizes to suit the actual requirement, particularly in the building construction industries. Incidentally, this is not possible in container glasses. like bottles and jars, where the machines are tuned to the actual requirement. Having this idea of distinction being kept in mind, for sheet or plate glasses, i.e. float glass **[1-3]**, there are techniques to manufacture various types of other glasses, such as toughened glass, sandwiched laminated glass, chemical-resistant glass, E-glass for saving energy, etc.

These glasses are now well-studied materials. Glass can have different properties being combined with other materials. For example, laminated glass is a glass–plastic film (polyvinyl butyral (PVB) or ethylene vinyl acetate (EVA))–glass sandwich. Some special glasses such as laminated and toughened glasses cannot be recycled **[4]**. Low-E glass has a molecular layer of metal on the inside surface of the double (or triple) glazing unit that accounts for its insulating properties. 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 **[5]**. Glass can be recycled though currently most end of building life and glass finishes up in landfill. Some of these aspects involving plastic materials are discussed briefly blow:

EVA Material

In order to discuss those types of special glasses, it is very important to elaborate on some points about EVA type of materials. Polyvinyl butyral (PVB) is considered to be an acetate and is formed from the reaction of an aldehyde and alcohol, but it is generally 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. The relative amounts of these segments are controlled but they are generally randomly distributed through the molecular chain. The properties of the polymers can be optimized by controlling the ratios of the three segments.

These mixtures are manufactured by various companies for supply to the glass companies who make such special glasses, and these are known by various trade names as follows:

1. Brutacite by DuPont™
2. KB by GlasNovations
3. Saflex by Solutia Inc.
4. S-Lec by Sekisui and
5. Trosifol by Kuraray

The above are mostly popular in the concerned glass industries. These are obviously manufactured by controlling the molecular structure and some relevant properties.

Sometimes, there is a need for a post-treatment, mainly heat treatment, that imparts better physical structure in terms of porosity and average pore diameter so that the adhesion in the sandwiched material improves along with improved mechanical strength. Zhang et al. **[6]** carried out a useful attempt to control porous structure and enhance the mechanical performance of PVDF/polyvinyl butyral (PVB) composite W&B membranes by introducing thermal post-treatment. PVB with a low softening point interfused mutually after the thermal treatment for the membranes that resulted in an obvious 3D porous non-woven geometry with bonded networks inside the PVDF/PVB membranes.

With increasing PVB weight ratio, the gradually increased physically bonded network of the membranes reduced its average pore diameter and porosity simultaneously that could hinder liquid water penetration. Meanwhile, the membranes with bonding structure can bear more load, showing good mechanical properties compared with the pure PVDF membranes. Except for the PVB proportion, the physically bonded network was affected by the heating temperature. It turned out that with increasing temperature, the gradually increased bonded structure caused smaller pore size and lower porosity. There are two consequences: i) The WVT rate is reduced; and ii) Air permeability has dropped, but the rate of increase of "hydrostatic pressure" is greatly enhanced.

For the PVDF/PVB membranes with weight ratio of 8:2 heated at 140°C, this results in a comprehensive optimized performance as shown by the important properties as follows:

1) Robust tensile strength (10.5 MPa)
2) Breaking elongation (64.5%)
3) WVT rate (10.6 kg/m^2 day)
4) Air breathability (9.8 mm/s) and
5) Hydrostatic Pressure (58 kPa)

Laminated Glass →

It has been already mentioned that glass can have different properties by being combined with other materials, for example laminated glass by means of sandwich with plastics whose properties are described above, toughened glass by suitable heat-treatment, E-glass by giving metal coating (double or triple), etc. These are all secondary processes that are carried out on the prepared glass to be useful for different purposes of application in a variety of industries, particularly automotive and building construction industries.

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 "composite" glass product. The glass sheet for making laminated glass can be ordinary glass, float glass, tempered glass, colored glass, heat-absorbing glass or heat-reflecting glass etc. The layer quantity is 2, 3, 5, 7, up to 9. 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. The mechanical stress is important in such glasses, and toughened glass seems to be a better choice. There is also a great "safety factor" in such glasses. For example, 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 that effectively prevents fragments from penetrating or falling, thus it ensures human safety. Laminated glass made of different sheet glass has different features such as durability, heat resistance and moisture resistance, etc.

In the USA and Europe, 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 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. Heavy vibration like Aeroplanes landing in a particular gate or large machines working nearby could also create safety hazards, and here laminated glass could be useful, particularly in certain portions of the Airports.

Sound Insulation effect is one of the important factors to evaluate the quality of modern residential buildings. Glass with PVB interlayers 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. For example, ancient libraries with a collection of a lot of old books require such glasses to be used. Moreover, it also reduces the transmission of light and 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, as oily smoke is easy to stick to the surface. However, such trouble will disappear if laminated glass is used instead of frosted glass. Moreover, large surface partitions at homes are always a hidden trouble to the safety of active kids. If laminated glass is applied, parents will feel relieved about the safety of their 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-rise buildings; showcases and partitions in stores; banks and jewellery shops, etc.

In a glass that has to resist the snow-load in the winter, the interlayer stiffness is both temperature and time dependent **[7]**. ASTM E1300 standard practice includes the use of polyvinyl butyral (PVB) interlayer material properties. Forthcoming versions of ASTM E1300 will be providing a method to determine effective thickness of laminated glass for analysis of load resistance and deflection in standard practice. The method is intended for use with standard engineering formulae or finite element (FE) methods for calculating glass stress and deflection of laminated glass subject to uniform load. This needs a lot of mathematical analysis and the use of computer simulation by FE methods. This is mentioned here, as laminated glass also has to bear load in certain applications.

CONCLUSIONS

This is an extensive subject, which is written only in a few pages that does not quite justify its proper importance in the field of applications of special glasses. Previously in Kanch, this subject of laminated glass was described in some detail **[8]**. Moreover, in this category of special glasses toughened glass **[9]** and E-glass were also described in more detail **[1,10]**. Here we are dealing with plastic materials needed for making sandwich between glass and plastic for safety and also for a variety of other reasons. Some issues concerning various applications of laminated glass are also discussed. In the future Volumes of Kanch, some more issues will be discussed.

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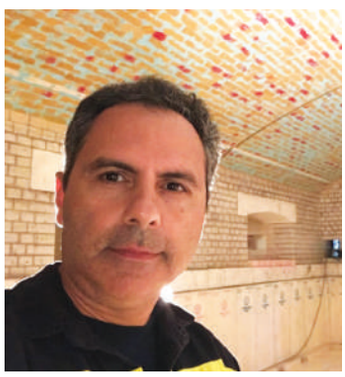
Harnessing the power of electric boosting

In the first of a series of articles in *Glass Worldwide* (preferred international AIGMF journal) on electric boosting of melting in glass furnaces, Fernando Salvino explores the main definitions, settings, tests and commissioning of the technology prior to start-up.



Fernando Salvino has over 20 years' experience in the glass world, mainly in float glass and packing glass.

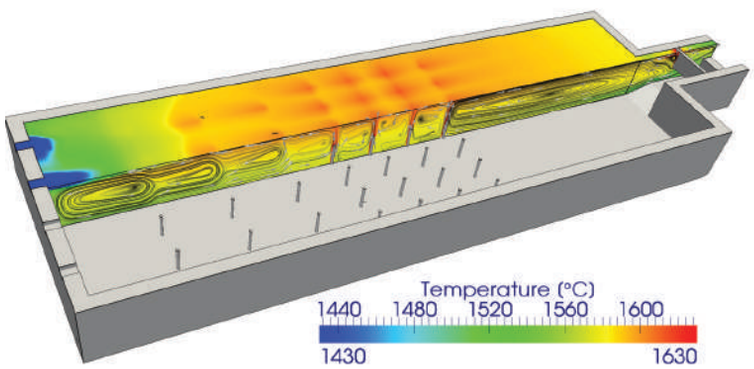


Figure 1: Simulation of electric-boosting – electrodes on the bottom of the furnace. A CFD (Computational Fluid Dynamics) simulation is a useful tool for analysing electric boosting. Image courtesy of Celsian Glass & Solar B.V.

The use of electricity is gaining increasing strength in the production of glass, often for environmental reasons, such as increasingly restrictive environmental laws or a strategic decision to embrace production of electricity by solar or wind energy.

There are 100% electric furnaces which offer a great advantage: that of not emitting fumes (waste gas) – something that is very appealing for solving environmental issues. However, due to the cost of electricity, these are not widely used in glass packaging. In the float glass sector the major obstacle to a 100% electric furnace is obtaining glass with the same optical qualities as that produced in traditional furnaces.

There are also hybrid furnaces which use fossil fuel (gas or fuel oil) as their main source of energy and use electricity as an auxiliary source, employing electric boosting to enhance the quality and versatility of glass production. The majority of these furnaces were converted to hybrid operation during reconstruction periods, but some have been designed with electric boosting in their original conception.

How electric boosting works

Electric boosting involves a set of electrodes (cylindrical bars in molybdenum metal – see Figure 1) installed on the bottom of the furnace (but in some cases can be installed in the side wall – see Figure 2). When an alternating current is passed through the electrodes, due to the Joule effect [the process by which the passage of an electric current through a conductor produces heat], the system is heated and melts the glass. Electrodes are usually made from molybdenum (see Figure 3), in appropriate quantities and dimensions (diameter/length) for the boosting system.

Some glass companies do not use electric boosting due to concerns about leakage from the bottom of the furnace (a leak can empty an entire furnace in a few minutes to a few hours, depending on the size of the furnace and the size of the leak hole). This risk factor exists and should not be forgotten, but with a good knowledge of the system and with the use of controls that we will address here, this risk can be controlled. If the plant adheres to the correct regulations and procedures, this risk of leakage by electrodes is near to zero.

Reasons to use electric boosting

1. Increase the extraction of a furnace beyond its maximum value (when a refractory reaches its superstructure temperature limit).
2. Improve quality for a given production (best quality under the same pull rate).
3. Enable production of strongly absorbent or special colour glasses.
4. Partially replace fossil energy with electricity.
5. Prolong the life of the superstructure of a furnace.

Electric boosting offers the prospect of financial gain by

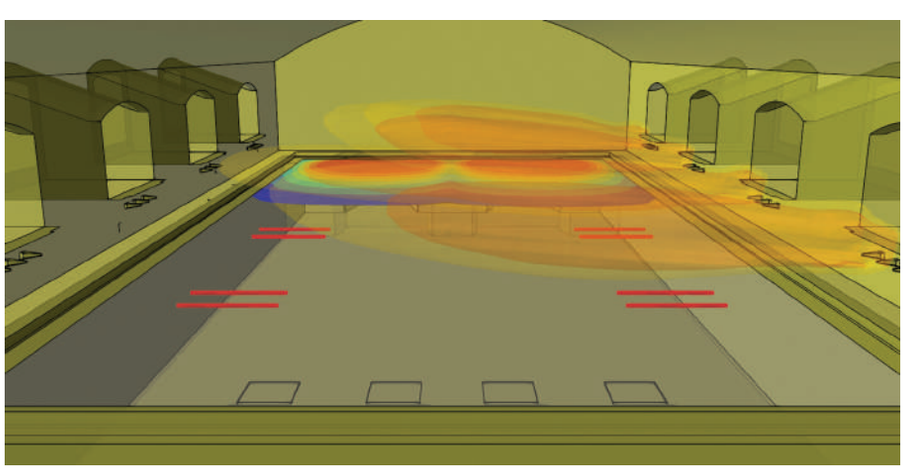


Figure 2: Another way to use the electrodes: by the tank melter (side wall or soldiers blocks). Image courtesy of Celsian Glass & Solar B.V.

Originally published in Glass Worldwide, preferred international journal of AIGMF

producing additional glass at a lower cost, increasing the duration of a furnace's operational life span and by improving glass quality or for greater programming flexibility.

Avoiding sublimation

Sublimation is the physical process of direct transformation from solid to gas phase, without going through the liquid phase. Using electrodes made from molybdenum (a metal that sublimates readily at a temperature of 800°C when in contact with oxygen) means that avoiding sublimation whilst boosting is crucial. To do this, water cooling is used on the assembly (blocks and electrodes), and to avoid contact with oxygen (present in air), nitrogen is used to create a protective atmosphere.

Two types of electrode assembly technologies

Inconel pipe electrode: This system is cooled by water and allows progressive introduction during operation to compensate for the wear of the molybdenum electrode (see Figure 4).

- The electrode passes through the refractory block from the outside of the sole.
- A water box cools the electrode below the molybdenum sublimation temperature between the electrode and the base of the refractory.
- An inconel pipe (refractory metal) centred on the water box penetrates the refractory.
- This tube will be partially filled with glass that has penetrated between the electrode and the refractory.
- A neutral gas (nitrogen – N_2) feed ensures an oxygen-free atmosphere around the electrode and in the water tank.
- The flow of this gas compensates for the exhausts.

The principle in this case is to protect the molybdenum at the sublimation temperature using a neutral gas and to ensure water tightness on top using a cold glass joint (approx. 1000°C).

This glass joint will progressively devitrify [harden; become crystalline] and could thus prevent the electrode from moving. It is therefore necessary to raise the electrode every three months so that it does not get stuck.

Graphite sleeve electrode: This refractory and water-cooled assembly allows the progressive introduction of the electrode during operation but prevent oxygen (present in the air) from reaching the electrode molybdenum in the sublimation temperature zone (800°C), the electrode is wrapped in a graphite sleeve that fits its diameter (see Figure 5).

- The assembly is cooled by a water box in the area under the refractory block.
- The graphite sleeve penetrates the refractory block. Drilling the diameter of the block slightly larger than the electrode should allow the glass to descend to the graphite tube to do the sealing.

Conception study for better boosting

A conception study should establish:

- The number of groups of electrodes and the type of electrical supply. For example: two groups of electrodes (one melter group and one refining group). Melter group in three-phase feeding. Single-phase feeding is normally used on the throat.
- The number of electrodes per group, their positions and diameters; for example: melter group consisting of six electrodes with 76mm diameter according

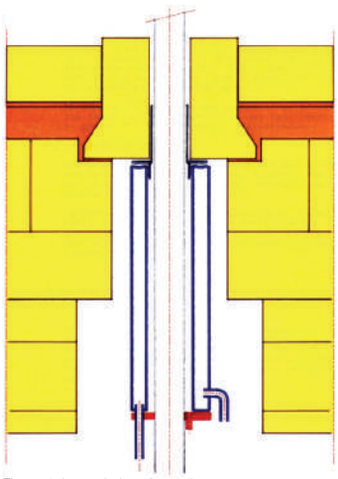


Figure 4: Inconel pipe electrode.

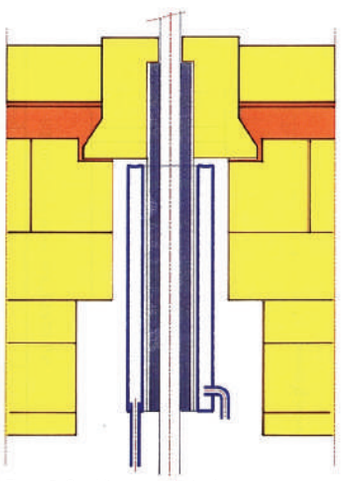


Figure 5: Graphite sleeve electrode.

to the positions of the furnace assembly design.

- The connections (phases) of the electrodes: for example: (melter group, three-phase) electrodes 1 and 6 phase R; electrodes 2 and 5 phase T; electrodes 3 and 4 phase S.
- The characteristics of the power supply system and power control; e.g. transformer to plots of 1350kVA, maximum intensity: 3500A and output voltages: 100 - 120 - 140- 160- 180 - 200V.

In addition, the conception study should contain the initial recommended data:

Initial deepening of electrodes: always lower than the target depth in the study, thus allowing adjustment of wet height. A good depth to be adopted at the beginning may be 100mm lower than the calculated theoretical depth.

Probable impedance range: with the initial depth and the objective impedance. The objective impedance will always be lower than the initial impedance.

Preliminary tests and checks

It is strongly recommended that the following tests be performed before heating up.

Electrodes: Check that the electrical, water and gas connections will not hinder the deepening of the electrodes.

Electricity:

- Check the feeding phases.
- Check the isolations (measurements) of the transformer-electrode connections are not connected, such as the sets after connection.
- The isolations should be checked cold and hot, as well as after heating-up.
- Properly tighten all connections (from the transformer region to the electrodes).
- Check the ability to increase and lower the voltage in different modes (manual, semi-manual, remote-controlled, supervision system, etc.).

Cooling water:

- Short circuit the inlet and outlet pipes and clean the circuits, then clean the filters.
- Put the feeding of the electrode water boxes into service after connection.
- Check that the electrode flow is sufficient and adjustable.
- Check that the nominal flow is achieved in all electrodes in parallel.
- Keep the power on for 8–12 hours and check that there is no leakage.
- Check the filters and test alarms, and check their signalling.

Gas protection:

- Definitive checks can only be made when there is a good water tightness of the electrode head, otherwise the gas escapes into the furnace. For this it will be necessary to wait for the filling-up.

General:

- Before the beginning of heating up, check that the pipes are watertight (sealed) at a pressure of 150–200mbar.
- All emergency feeds (water, electricity, nitrogen) must be installed and ready to operate.

Start-up of electric boosting

Initial depth: Once filling-up is complete (to fill the furnace with cullet and batch and thus obtain the total filling-up of the furnace with molten glass), the electrodes will be submerged/lowered to the initial recommended depth provided by conception study.

Figure 3: Molybdenum electrode.

After this, perform the measurements of the different electrical characteristics (voltages, currents, power, impedance) and make sure they are taken at not less than 25% of the rated power.

Once this is done, continue to increase depth of submersion until the objective impedance range is reached, and then take all electrical measurements again. Try to leave each group of electrodes (melter/refining/ throat) as balanced as possible with regard to impedance and power.

This state will constitute 'the reference': all temperature data of the electrode blocks, bottom temperatures, impedance, voltage, current, etc. This initial data will be taken as reference data and will be used in graphics and controls throughout the furnace's campaign lifetime.

In the next article we will deal with the controls (surveillance) and maintenance necessary for a perfect electric boosting operation, which can be so valuable and versatile for a good glass furnace. ●

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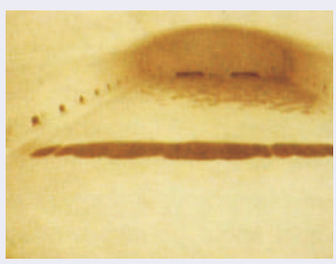


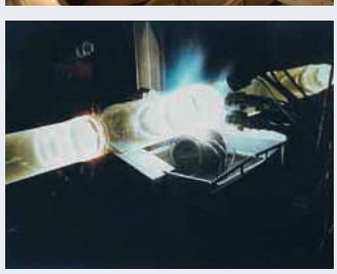




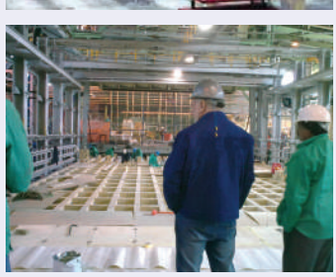

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The glass plant of the future

smart plant

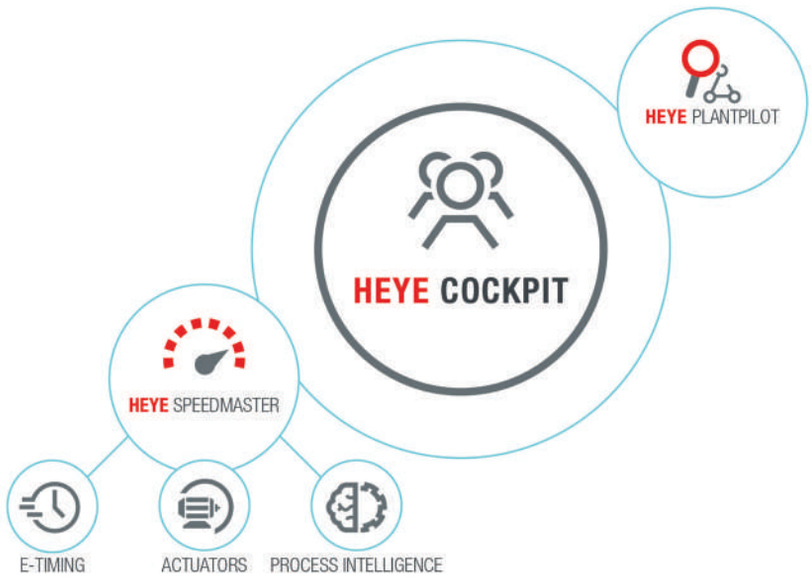
Adopting the latest Industry 4.0 technologies is now crucial for the international glass container industry, says Mr. Hans Renders, Head of Product Management at Heye International. Heye offers customers a partnership on their individual path towards a smart plant, resulting in the creation of a highly 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 the 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. Hans Renders.

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.

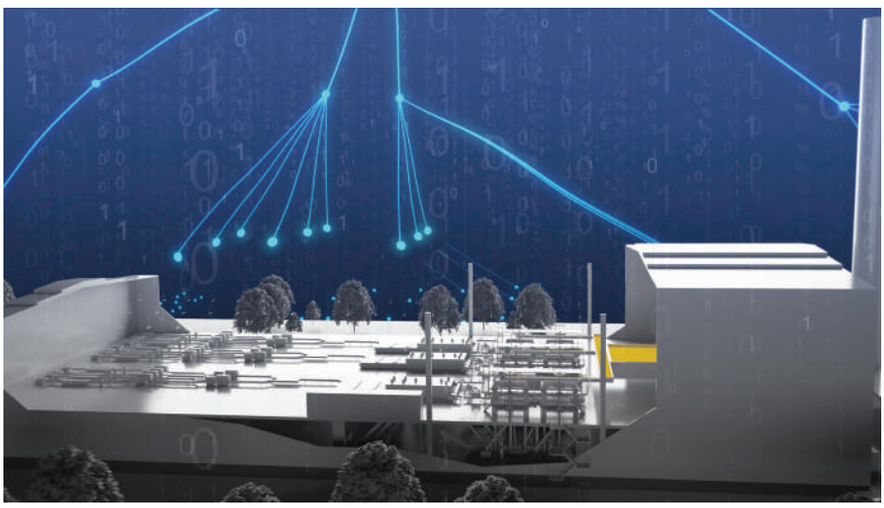
Following the glass flow, on the blank mould side, closed loops for cooling and press duration/glass distribution

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.

About the author:

Mr. Hans Renders is Head of Product Management at Heye International ■

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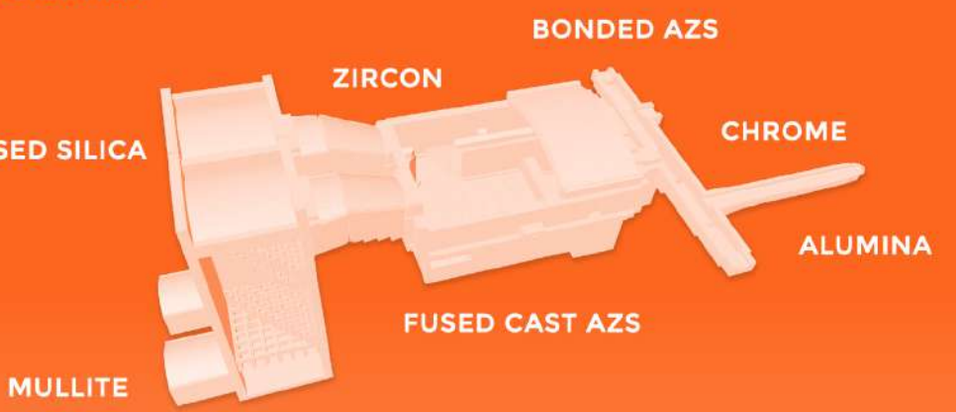

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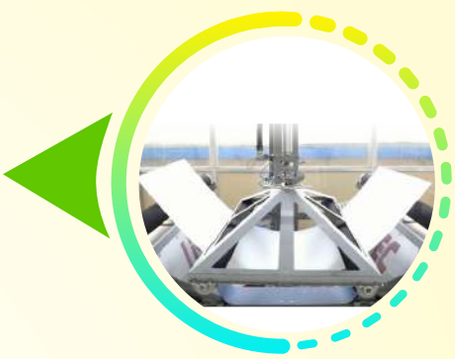

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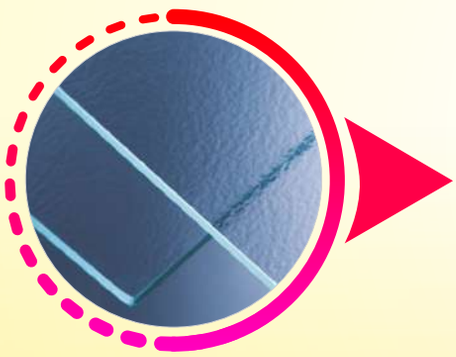

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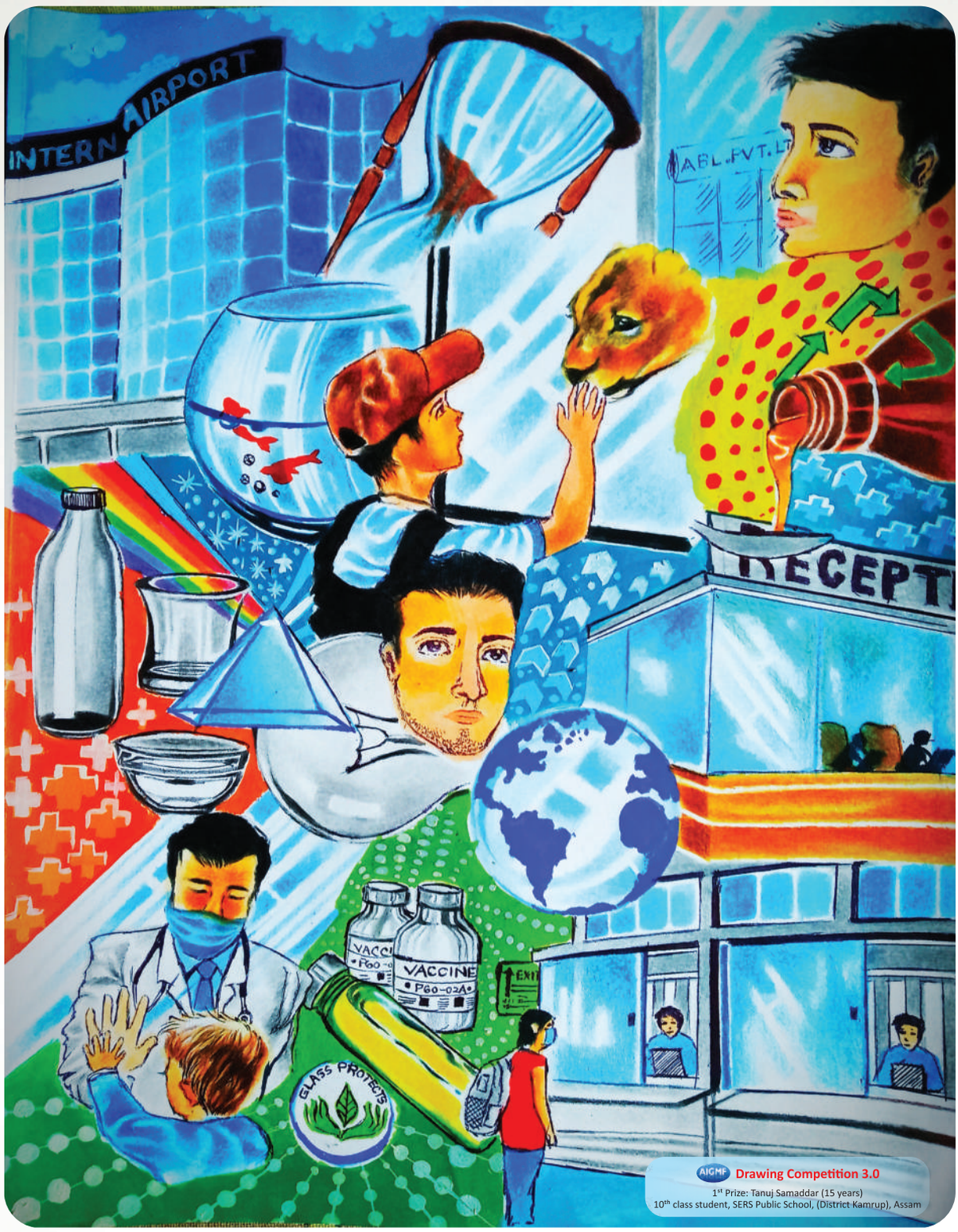
... says School Children ...



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