Vol. 7 | No. 4 | January - March 2020

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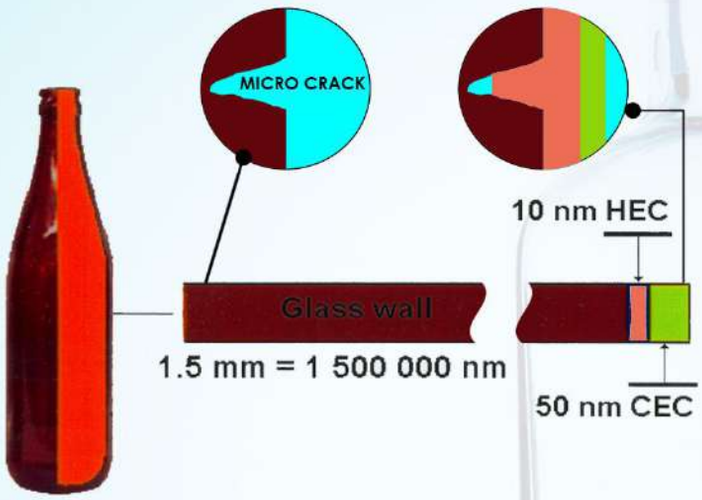

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Quarterly Journal of **THE ALL INDIA GLASS MANUFACTURERS' FEDERATION**

Vol. 7 | No. 4 | January-March 2020

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From President's Desk

Due to the current developments regarding COVID-19, AIGMF Executive Committee Meeting slated for March 21 at The Taj, Jaipur was postponed to April 20. The meeting would now be held over the video-conference facility as the Ministry of Corporate Affairs (MCA) has allowed companies to use video meets, other audio-visual means. I request all members to join the Executive Committee for which meeting link would be sent in due course by the Secretariat.

Inputs were invited from the Member companies on the anticipated disruption (owing to COVID-19 outbreak) in Products, Production, Sales, Essential Raw Materials/Intermediate Goods required to be imported for Production, Exports or Any other Issues like GST/Direct or Indirect Taxes etc.

A detailed industry representation was submitted to various Ministries of GoI and Trade Chambers covering present industry position due to Coronavirus (COVID-19); problems being faced by the Industry; problems anticipated in the future and support sought from the Government. Virtual meetings were held with CII, DPIIT and we aim to work more closely to seek concessions for the Industry in these trying times.

The nation-wide lockdown, announced on March 24, to contain the COVID-19 pandemic has disrupted glass production significantly and only essential packaging related glass production are currently being carried out by glass manufacturers i.e., producing vials/glass bottles of different sizes required by Pharma, Food and Beverage Industries.

Most of the units are either closed; operational in the reduced capacity or in a recycling mode as Glass manufacturing facilities utilize high-temperature furnaces that must run continuously, 24 hours a day. They cannot be turned off or easily idled and when shut down, and can take months to restart, highlighting the need for its supply chain to be fully functioning and operational.

To safeguard employees, contract staff and others, manufacturing units have driven various awareness programmes through banners, leaflets, workshops, etc., to bring in safety as the utmost priority for the workers.

I am happy to report that AIGMF Secretariat is working remotely round-the-clock in the present lockdown situation; coordinating with various stakeholders on daily basis over tele/video conferences; preparing representations wrt urgent nationwide operational permission for glass industry to operate as required by the user industries under essential category; ensuring Requisite Logistics Clearances for Availability of Raw Materials and Fuel to Industry and for downstream supply of essential products to customers; obtaining clear orders to enable key personnel to be able to come to work.

I am hopeful that this situation will be over in the next few months and wish good health to all members and their families ■

(Raj Kumar Mittal)

President AIGMF

President U.P. Glass Manufacturers' Syndicate (UPGMS) **and**

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GLASS News

PHILIPPE BASTIEN IS THE NEW CHAIRMAN OF GLASS FOR EUROPE

After joining AGC Glass Europe, formerly Glaverbel, in 1992, Mr. Philippe Bastien has covered several managerial positions from financial control to general management, through to marketing, business development and R&D. AGC Glass Europe produces, processes and distributes flat glass for the building, automotive and numerous other sectors such as transport, solar power and high-tech applications. It has over 100 sites throughout Europe, from Spain to Russia, and employs around 16,500 employees.

"I am honoured to take on this Chairmanship role and I realise responsibilities that now fall upon me in these difficult times. With the spread of COVID-19, the flat glass industry is reacting quickly to ensure the health of all its workers, while we must safeguard the integrity of our industrial operations." said Mr. Bastien.

For the weeks and months to come, Glass for Europe will engage with European authorities on creating the conditions for a rebound in activity in the glass and glazing sector once the health crisis is over. It will require a massive macro-economic stimulus, which should be in line with Europe's climate ambitions and the need to launch a 'building renovation wave.

In January 2020, Glass for Europe released its 2050 vision on Flat glass in Climate-Neutral Europe. This comprehensive work, which offers a pathway for the sector to maximize contributions to climate neutrality, is more than ever topical. *"An efficient post-crisis stimulus package will be required to support the flat glass sector and it must be climate-compatible: a massive renovation of ageing buildings with high-efficiency glazing, support for clean mobility transition and increase in the share of solar energy"* said Mr. Bastien.

GPI PRESIDENT SCOTT DEFIFE TO LEAD GRF's EXECUTIVE BOARD

Mr. Scott DeFife, President of the Glass Packaging Institute (GPI), the trade association representing the North American glass container industry, was named President of the Glass Recycling Foundation's (GRF) Executive Board. The Glass Recycling Foundation, a non-profit organization, provides and raises funds for localized and targeted assistance, demonstration, and pilot projects that address gaps in the glass recycling supply chain across the United States.

GRF's vision is to increase recycling through sustainability education and best practices to ensure the maximum benefit for communities and the environment.

"I am honoured to serve as President of GRF's Executive Board," said Mr. DeFife. *"I am grateful for the time and talent that Ms. Lynn Bragg contributed to the Board and thank her for her years of leadership. I look forward to continuing her work and driving forward GRF's mission to promote and preserve glass recycling across America. GPI and GRF already work closely together to address gaps in the glass recycling supply chain and increase glass recycling access through education and industry collaboration. I am eager to continue building upon this important work."*

Mr. DeFife takes the helm as Board President just as GRF has received the foundation's first $50,000 to its endowment. Owens-Illinois (O-I) Charities Foundation and Diageo North America each donated $25,000 to support the GRF through pilot projects leveraging best practices to improve glass recycling.

CONTAINER GLASS TO REDUCE CO_2 BY 50%

The 'Furnace of the Future' is

a fundamental milestone in the industry's decarbonisation journey towards climate-neutral glass packaging. It will be the first large-scale hybrid oxy-fuel furnace to run on 80% renewable electricity in the world. It will replace current fossil-fuel energy sources and cut CO_2 emissions by 50%.

For the very first time, the industry has adopted a collaborative approach where 20 glass container producers have mobilised resources to work on and fund a pilot project to prove the concept.

"We are extremely proud to announce this joint-industry project", comments Mr. Michel Giannuzzi, President of FEVE. *"The hybrid technology is a step-change in the way we produce and will enable us to significantly reduce the carbon footprint of glass packaging production. The move marks an important milestone for the glass sector in implementing our decarbonisation strategy".*

The industry already works with electric furnaces in several of its 150 glass manufacturing plants across Europe, but they are small scale and exclusively used to produce flint (colourless) glass with virgin raw materials, therefore using very little or no recycled glass content. With this new technology, the industry will be able to produce more than 300 tonnes per day of any glass colour, using high levels of recycled glass.

Ardagh Group – the second largest glass packaging manufacturer in the world – has volunteered to build the furnace in Germany. It will be built in 2022, with an assessment of first results planned for 2023.

"With this new technology we are embarking on the journey to climate-neutral glass packaging, and ensuring the long-term sustainability of manufacturing", states Mr. Martin Petersson, CEO of Ardagh Group, Glass Europe. *"We aim to demonstrate the viability of electric melting on a commercial scale, which would revolutionise the consumer glass packaging market".*

Bringing the 'Furnace of the Future' to life is an extremely ambitious project requiring significant financial and human resources and a wide range of expertise. For this reason, the industry has committed to work together. By adopting a sectoral approach, it also intends to gain the support of the European Commission through the ETS Finance for Innovation Fund Programme. Despite its key importance, this project is not the only one the industry is working on. Other pathways towards clean production technologies and climate-neutral glass packaging are already implemented and others are also being explored.

SCHOTT INCREASES SALES IN INDIA AND PLANS RECORD INVESTMENTS

SCHOTT AG has continued on its growth course in fiscal year 2018/19 (Oct 1, 2018 to Sep 30, 2019). Its key financial figures developed positively or remained at a solid level from previous year.

"We are pleased with the past fiscal year. We were able to meet our forecasts from last year and continued the positive business development of previous years despite the difficult global economic situation," emphasised Dr. Frank Heinricht, Chairman of the Board of Management, at the Annual Results Press Conference.

The international technology group managed to increase its sales by 5.1% to around EUR 2.2 billion. The operating result (EBIT), which now stands at EUR 275 million, also improved at a consistent rate, resulting in a consolidated net profit of EUR 206 million. Business with special glass tubing for pharmaceutical packaging and the ampoules, vials, syringes and cartridges produced from it, contributed substantially to the successful year.

Investments in property, plant and equipment amounted to EUR 257 million in the fiscal year, an increase of 38% over the previous year. Internationally, the largest investments in the fiscal year went to sites in India and China. More than EUR 21 million (INR 165 crores) was invested into a new tank facility at the Gujarat manufacturing plant, which supplies the supreme quality FIOLAX® glass tubing for pharmaceutical packaging.

At the presentation of the annual results, CFO Dr. Jens Schulte pointed out that the equity ratio had remained at a solid level of 32%. "*The company is thus in a strong financial position and has sufficient scope to achieve organic growth as well as make acquisitions*," he noted. The global number of employees rose to 16,200.

Record investments in India are also a result of exceedingly positive sales in the Asian market. India alone saw sales of approximately INR 388.6 crores (EUR 49.5 million) – an increase of 18%. Key growth drivers for India were SCHOTT's Tubing, Pharma-Packaging and Flat Glass for Cooking.

Sharing his views on growth of the tubing and pharma packaging segment, Mr. Georg Sparschuh, President SCHOTT Glass India, shared, *"With our Indian growth activities, we aim to further strengthen the local industry and the government's goal of making India a global pharmaceutical hub. We have committed to invest about EUR 51 million (INR 400 crores) in our Gujarat manufacturing plant from 2018 till this year, in order to further cater*

to the expanding domestic and Asian markets."

In addition, SCHOTT also entered the Indian smartphone market last year. Its premium cover glass Xensation® Up., was introduced in the country as part of the new range of vivo premium smartphones.

After getting off to a good start in the first three months of its new fiscal year, SCHOTT expects sales to increase by between 3% and 6% for the year as a whole. The technology group expects impetus to come, among other areas, from demand for specialty glass for pharmaceutical packaging and ultra-thin glass for the foldable mobile devices of the future.

In fiscal year 2019/2020, SCHOTT plans to invest EUR 320 million, the highest amount in the company's history. Main international focus will remain on capacity expansions in the pharmaceutical packaging business in India and China.

To achieve this, the expansion of production capacity in the existing India plant aims to further strengthen its output by mid-2020. SCHOTT has committed additional investments of EUR 28 million for another tank facility which will be operational this year. With the new production facility, the plant's capacity will be doubled, allowing the group to produce its highly specialised FIOLAX tubing material for both domestic and export demands.

At the same time, SCHOTT intends to intensify its efforts to protect the environment and the climate. "With a view towards responsible and sustainable further development, we have set ourselves a clear goal: We want to make SCHOTT a climate-neutral company. During this fiscal year, we will set the course for this and consistently take the appropriate measures," said Dr. Heinricht, Chairman of the Board of Management.

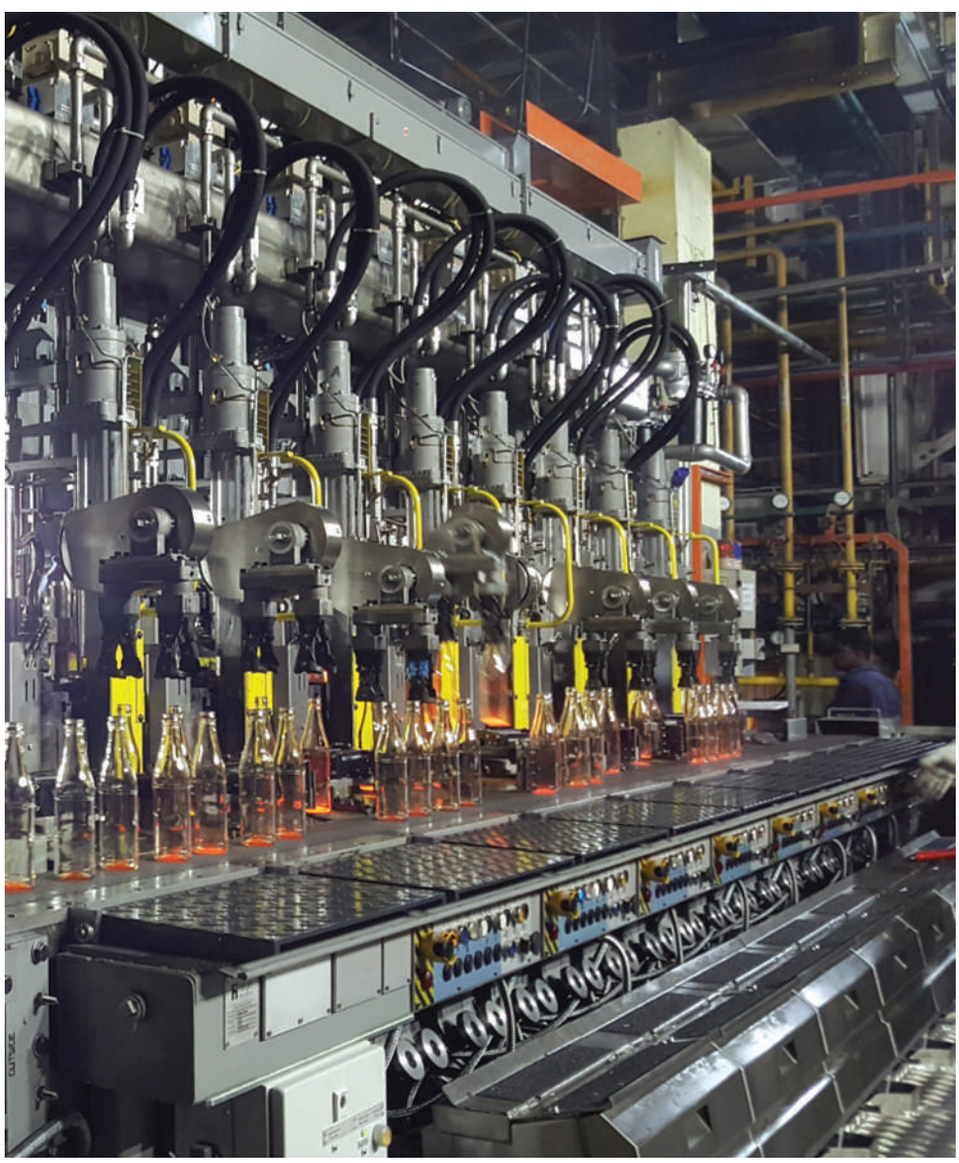
MALAYSIAN GLASSMAKER BENEFITS FROM HEYE PRODUCTION EXPERTISE

Advanced hot and cold end technologies from Germany's Heye International are helping Jg Containers (Malaysia) Sdn Bhd to maximise glass container production yields at the customer's Klang glassworks in Selangor. Located close to Kuala Lumpur, Jg Containers has been making clear glass bottles and jars for soft drinks, liquors, foods and pharmaceuticals since 1972.

With single furnace, 180 tonnes/day, Jg Containers enjoys 50% share of the local flint glass market, as well as exporting 35% of output to neighbouring ASEAN countries, Australia, Hong Kong, Mauritius, and Middle East. To serve domestic and international customers, the manufacturing facility is conveniently situated close to Malaysia's major trunk roads network, as well as Port Klang.

Quality management systems have been implemented in accordance with the requirements of ISO 9001:2015 standards and the factory's products are certified under this scheme.

Over the years, Jg Containers



has regularly modernised its manufacturing operations, adopting proven industry developments in furnace, forming, inspection and packaging technologies, while employing advanced digital methods to improve its products and customer service.

The glassmaker's latest investment calls on the established production expertise of Germany's Heye International. This includes the installation of an 8-section, double gob 5in IS machine that has been specially adapted to accommodate the customer's existing variables. The Heye IS machine is fully prepared for NNPB process and is equipped with latest Heye technology such as rotor mechanism for constant glass homogeneity, dual motor shears and high-speed delivery system. At the cold end, Heye has delivered its Wenspect quality control inspection solution - a combination of Heye SmartLine check detection system, Heye multipoint wall thickness measurement and Iris Evolution sidewall inspection. Since completing this installation, the customer has recorded 93% glass pack efficiencies. Heye team thanks Jg Top Management Mr. Sanjeev Chadha and Mr. Anwardeen for this opportunity and trust in Heye as a reliable partner.

CREATING THE NEXT ERA FOR SMART INSPECTION

In response to the international glass container industry's growing acceptance and adoption of 'smart' manufacturing practices, IRIS Inspection machines has expanded its NEO range of smart inspection solutions.

Created in close consultation with key customers, the latest NEO technology goes beyond the conventional boundaries associated with specialist inspection machines, delivering a more comprehensive offering to face the challenges presented by the smart factory. The NEO Series heralds the arrival of a new era, where glass inspection is not only sustained by machines but also by accurate data and the ability to comprehend, compute and connect it.

NEO Intelligence is an innovative defect approach that relates to intelligent defect recognition and sits at the core of Evolution non-contact glass container inspection equipment.

The latest generation Evolution NEO series marks an important break with other glass inspection machines, bringing the concept of the smart factory even closer. NEO eXperience is the NEO dashboard, designed to assist glassmakers to understand the causes of defects, to simplify the adjustment of settings and to reduce false rejection rates.

The inspection data created is available not only on the machine itself but remotely as well, for plant managers to monitor performance and initiate changes where necessary. In addition, defect images are available to hot end personnel, providing the ability to share critical defect characteristics and defect images in real-time, alerting IS machine operators to instances of critical defect detection.

The NEO series is the result of many years of dedicated research and development. This equipment has received widespread glass industry acceptance, generating multiple orders, in particular from European and Latin American glass packaging producers. Already, 510 machines are running NEO software throughout the world, with excellent customer feedback generated for the innovative defect approach adopted.

EUROPEAN SOFT DRINKS INDUSTRY JOINS THE "CLOSE THE GLASS LOOP" TO OPTIMIZE GLASS PACKAGING CIRCULAR ECONOMY

UNESDA Soft Drinks Europe – representing the European soft drinks industry – joins "Close the Glass Loop" – the major industry stewardship programme for glass packaging initiated by FEVE – EU Federation of the container glass. The platform has the objective to achieve a post-consumer glass container collection target of 90%, and to ensure that this is recycled into the container glass production loop to come back as a new packaging.

"We are proud to join the Close the Glass Loop platform. It is a strong initiative and a step in the right direction towards making Europe's Economy Circular. Its objectives are in line with our theme of 'Circularity works, let's all give it a chance', and we are glad to be involved in building its foundations," says Mr. Nicholas Hodac, UNESDA Director General. *"By contributing to an increased collection and endless recycling of glass packaging we help to drive sustainability throughout our value chain. Recycled glass is essential for the container glass industry. It means a more resource-efficient production process and more sustainable glass packaging solutions for our member companies".*

The "Close the Glass Loop" initiative aims to unite the container glass value chain under a multi-stakeholder European programme but also crucially to support national level action plans. UNESDA's company and national association members will cooperate with national glass value chains across Europe to improve the collection and recycling of glass packaging. The Close the Glass Loop national action plans will drive

sustainability throughout the whole value chain.

"We are delighted to have UNESDA's support and collaboration to reach the full potential of our Circular Economy model predicated on the endless recycling possibilities of glass. Soft Drinks are a key customer for our industry and are frontline in persuading consumers to recycle more and better together" – stated Ms. Adeline Farrelly, FEVE Secretary General. *"The collaboration with UNESDA members is a key milestone in our pathway to 90% collection target and towards a climate-neutral glass packaging industry".*

All consumer goods industries are being called upon by the European Commission to collect, recycle and reuse packaging. Each country will need to achieve the 2030 recycling targets fixed by the recently reviewed Packaging and Packaging Waste Directive. For glass, it is 75% by 2030.

EUROPEAN AND US GLASS INDUSTRIES SALUTE ALL STAFF WHO ARE WORKING RELENTLESSLY TO KEEP ESSENTIAL INDUSTRIES GOING AND TO CONTRIBUTE TO FOOD SECURITY ACROSS THE GLOBE

European and US glass industries salute all staff who are working relentlessly to keep essential industries going and to contribute to food security across the globe.

The US Glass Packaging Institute (GPI), the European Container Glass Federation (FEVE), and the European Federation of Glass Recyclers (FERVER) released the following statement to thank all employees for their determination and commitment to keep glass manufacturing supplying essential industries during the COVID-19 pandemic: *"The glass container industry, their staff and supply chain partners play essential roles on behalf of food, beverage, and pharmaceutical companies. To guarantee the effective supply of for-sale, in-store packaged food and beverages, the glass manufacturing industry must remain operational as 'essential' throughout the duration of the pandemic. A disruption to the food and beverage packaging industry would greatly impair the public's ability to purchase food and beverages at their grocery store at a time when demand is up considerably, and those outlets remain vital to food security around the globe."*

In addition to the various measures that have always been implemented by the members of GPI, FEVE and FERVER to protect their employees and guarantee their safety, additional actions are being taken to ensure their health and well-being as the situation evolves. *"Glass manufacturers both in the United States and the European Union work diligently to protect the safety and health of their employees while continuing to ensure the supply of new glass bottles and containers for the food, beverage, and pharma sectors. GPI, FEVE, and FERVER are closely following the guidelines and recommendations published by the World Health Organization (WHO) and other relevant authorities and are monitoring the situation carefully. Employee safety is our first priority and paramount, especially during this uncertain time."*

In this context, the waste collectors and the recycling sector are also crucial to ensuring the continued supply of essential glass packaging for the food and beverage industries. Hence the importance of continuing to recycle glass packaging in the appropriate bins. The sourcing of local materials from recycling activities to produce new glass containers will continue to enable the industry to work locally and to maintain its production at a sustained level.

"The role of recycling in the supply chain of glass packaging is crucial. In North America, recycled glass content averages one-third of every new container, and in the EU, that content is 52% on average. Using recycled glass by leveraging local waste does not only reduce dependency on virgin raw materials but also contributes to both a more sustainable environment and economy. Glass recyclers and manufacturers need high-quality material in order to produce high-quality jars, bottles, and containers. We therefore encourage governments to continue their recycling programs especially during this critical time, so that glass manufacturers can remake new, safe products that support the global health system and our food, beverage and pharmaceutical industries."

"GPI, FEVE, and FERVER remain fully committed to glass manufacturing and recycling. Our organizations stand closely together to continue bringing glass bottles and containers from the factory to the table in this challenging time."

COPING WITH COVID-19: AGI GLASPAC

"Dealing with hampered production and lack of input raw materials, AGI glaspac has put in measures to cushion the blow. For starters, a hold on non-critical capital expenditure and a slew of cost reduction initiatives. While 60 per cent staff in key areas like plant engineering, production, and warehouse are on rotational shifts, the rest are working from home" said Mr. Rajesh Khosla, President and CEO, AGI glaspac.

The nation-wide lockdown, announced on March 24, to contain the COVID-19 pandemic has disrupted pharma supply chains. One

week later, members of the ancillary segments, who would like to partner the pharma sector as it fights the COVID-19 crisis, are stepping up to the challenge and hope that things will get better in the days ahead.

Mr. Khosla admits that logistically, it has been difficult to supply to the pharma companies. AGI glaspac's pharma segment, which currently contributes 30-32 per cent of glass packaging in the Indian pharma packaging industry, is facing hampered production, affected supplies and increased stock. So far, the company is working partially with limited raw materials like sand and soda ash, the key input raw materials for glass packaging.

Mr. Khosla is however hopeful that this will change as some of the state governments have now included the packaging industry in the list of industries exempted from the lockdown.

Mr. Khosla also points out that the recent exemption of non-essential goods will help most of the factories with supply materials. His stance is that the glass-manufacturing sector should be proactive at this stage as the pharma companies are putting in considerable efforts to fight this crisis.

Emphasising the key role of glass packaging for pharma companies he says, *"Glass is the only packaging material with the GRAS status from the US FDA. The manufacturers also use a cleanroom environment for pharma glass manufacturing to prevent contamination in glass bottles. Hence, it avoids all kinds of contamination during the storage and supply of products for the pharma company."*

Like many of its peers, AGI glaspac has taken precautions to safeguard the health of employees, respond to clients' requests as well as adhere to the government regulations to contain with COVID-19. Mr. Khosla highlights changes in three areas: input material; workforce; and outward transportation.

Anticipating increased demand as well as possible supply chain glitches, the company has had to ensure that input raw materials used for glass production are stocked up for the next few months. The company is also looking at alternative vendors in certain cases.

According to Mr. Khosla, Soda Ash, a primary raw material, has been stocked for up to two months to cater to the demand. AGI has its own sand manufacturing plant, but due to the lockdown, there are chances that certain operations will run partially.

The situation is a bit better on the fuel front as according to Mr. Khosla, oil, gas and other fuels won't be hit as the industry has informed the company that there won't be any shortage. As machinery parts and cartons used for packaging have been stopped or delayed, the company is reportedly looking at alternative options from local vendors.

To safeguard employees, contract staff and others, Mr. Khosla said that the company has driven various awareness programmes through

63rd Birthday (2nd March) of Mr. Raj Kumar Mittal, President AIGMF was celebrated on March 3rd at the Glass promotion meeting in AIGMF office

banners, leaflets, workshops, etc. to bring in safety as the utmost priority for the workers.

"Almost 60 per cent of our employees are now working from home in the Hyderabad and Bhongir plants with the rotational shifts (alternate days) in our important departments like Plant Engineering, Production, Warehouse, Quality and a 100 per cent work-from-home situation across all our other sales offices. Our production and engineering teams continue to work," says Mr. Khosla.

The company has also initiated temperature checks and sanitisation at entry and punching areas. Hot water dispensaries have been implemented in various areas. The employees are only following virtual interactions for customer and internal meetings. All the outgoing and incoming transportation is being carefully monitored to avoid any spread of the virus.

"We have given truck drivers proper awareness and information on the outbreak of the virus. Truck drivers are not allowed to enter without washing their hands. Hand sanitisers have been made available for the truck drivers and cleaners," reveals Mr. Khosla.

There is no doubt that the COVID-19 situation will impact the company's revenues. As Mr. Khosla reveals, *"All non-critical capital expenditure is on hold. Cost reduction initiatives have been identified wherever possible."*

Mr. Vijay Shah, Vice Chairman, Piramal Glass at the groundbreaking ceremony

PIRAMAL GLASS IN $42 MILLION EXPANSION AT ITS JAMBUSAR, INDIA PLANT

Piramal Glass is to invest US$42 million to expand its Jambusar, India container glass manufacturing plant.

The expansion plan includes one new furnace with seven manufacturing lines across its 300,000 sq. feet plant. It will cater to the high-end speciality spirit, food & beverage and pharmaceutical markets for exports to countries in Asia, Europe and the US.

The Indian glass packager said the facility will be one-of-its-kind in Asia as there is a growing need for high-end water bottles, spirits bottles and food packaging.

The Jambusar plant already has three furnaces with 23 manufacturing lines and produces 540 tonnes per day of glass. It employs 2130 people and with this expansion it will create additional direct employment to 700 people.

Mr. Vijay Shah, Vice Chairman, Piramal Glass said: *"This world-class plant equipped with cutting-edge technology rooted in the principles of digital manufacturing, will also create job opportunities in the region."*

Piramal Glass has global sales of US$357 million and operates from India, Sri Lanka and the US through its four manufacturing facilities and several decoration plants.

Globally, it manufactures 1435 tonnes per day of glass from 12 furnaces and 63 production lines. 40% of its sales are in high-end cosmetics & perfumery market, 37% in speciality spirits market and 23% in pharmaceutical market.

ग्लास एक्सपोर्टरों के गोदामों में भरा पड़ा करोड़ों का माल

कोरोना लॉकडाउन से उद्योग-धंधे बुरी तरह प्रभावित हो गए हैं। जिसमें कांच नगरी के ग्लास एक्सपोर्टरों सहित प्रदेश के कई जिलों के निर्यातकों का करोड़ों रुपये के आर्डर का माल उनके गोदामों में पड़ा हुआ है। लेकिन विदेशी खरीददार उसका उठान नहीं कर पा रहे हैं। जिससे एक्सपोर्टरों की धड़कनें बढ़ी हुई हैं।

अब एक्सपोर्टरों की समस्या पर शासन ने भी ध्यान देना शुरू कर दिया है। प्रदेश के प्रमुख सचिव उद्योग नवनीत सहगल ने वीडियो कांफ्रेसिंग के जरिए डायरेक्टर एक्सपोर्ट प्रमोशन काउंसिल ऑफ हैंडीक्रॉफ्ट (ईपीसीएच) के माधयम से एक्सपोर्टरों की समस्याओं को गंभीरता से सुना। साथ ही यथा संभव शासन से निर्यातकों को राहत दिलाए जाने का आश्वासन दिया।

Do you have news to share?

Send your news and press releases to info@aigmf.com

प्रमुख सचिव सहगल ने वीडियो क्रॉफेसिंग के दौरान ईपीसीएच के चीफ डायरेक्टर राकेश कुमार, निदेशक आरके वर्मा व राजेश रावत के अलावा फिरोजाबाद ग्लास मैन्यूफैक्चरर्स एसोसिएशन अधयक्ष मुकेश बंसल टोनी, मुरादाबाद से शरद बंसल, कमल सोनी, आरके मल्होत्रा, आगरा से रजत अस्थाना से सीधा संवाद किया। इस दौरान शहर के प्रमुख ग्लास एक्सपोर्टर मुकेश बंसल ने प्रमुख सचिव को अवगत कराया कि कोरोना महामारी की वजह से कांच नगरी का ग्लास एक्सपोर्ट तबाह होने के कगार पर पहुंच गया है। फिरोजाबाद के निर्यातकों के 100 करोड़ से अधिक के आर्डर का माल भेजने के लिए गोदामों में तैयार रखा है। लेकिन अमेरिका व यूरोप के अनेक खरीददारों ने आर्डर कैंसिल कर दिए हैं।

उन्होंने कहा कि 90 प्रतिशत से अधिक कांच नगरी के ग्लास हैंडीक्रॉफ्ट आयटम का माल अमेरिका, इटली, जर्मनी, इंग्लैंड, स्पेन व अन्य यूरोपीय देशों में जाता है। जहां पर सबसे ज्यादा महामारी फैल रही है। मुकेश जी ने कहा कि सबसे बड़ी दिक्कत तो यह है कि कोई भी विदेशी कारोबारी बकाया राशि भी नहीं दे रहा है। जो कि करोड़ों में हैं। ऐसे में निर्यात कारोबार को सरकारी राहत की दरकार है। इसी तरह आगरा, मुरादाबाद के निर्यातकों ने अपनी समस्या बताई। साथ ही राहत पैकेज दिए जाने की मांग उठाई। जिस पर प्रमुख सचिव सहगल ने शासन स्तर से यथासंभव राहत दिलवाए जाने का आश्वासन निर्यातकों को दिया। ■

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

कोरोना लॉकडाउन में शहर के चूड़ी व कांच उद्योग को करोड़ों का नुकसान हो चुका है। कारखाने भी बंद चल रहे है। ऐसी स्थिति में हम लोग हजारों श्रमिकों को अप्रैल माह में बिना काम कें मेहनताने का भुगतान नहीं कर सकेंगे।

– राजकुमार मित्तल
चेयरमैन यूपीजीएमएस उद्यमी संगठन

विदेशी कारोबारियों ने हमारे आर्डर रद्द कर दिए है। तैयार माल गोदामों में भरा हुआ है। कांच उद्योगों में लॉक डाउन चल रहा है। उद्योगों पर करोड़ों रूपये का बैंक लोन है। किश्त भी नहीं चुका पा रहे है। श्रमिकों को बिना काम के पगार नहीं दे सकते। इसके लिए सरकार को राहत पैकेज देना चाहिए।

– मुकेश बंसल टोनी
चेयरमैन, फिरोजाबाद, ग्लास मैन्यूफैक्चरर्स एक्सपोर्ट एसोसिएशन

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Membership of the Federation

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

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

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

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

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

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- Annual subscription: Single Unit: ₹ 27,500 + GST as applicable
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Absorption, Reflection and Birefringence in Glasses

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Abstract

Optical property is the single most important property in glasses. The study of this property is important, as there is a direct relation with transparency. For many container glasses and all float glasses, transparency is the most required or the most desired quality aspect without which the product looses its relevance in the market. So the glass manufacturers are very careful about transparency for these products. To understand optical properties, a basic knowledge about it is essential. In this short article, a glimpse on absorption, reflection, refraction is given along with birefringence that is an elasto-optical effect.

INTRODUCTION

The word "transparency" comes to our mind whenever we talk about glass. There are a variety of applications that are based on transparency, and for some reason we cannot forget about this unique optical property of glass, e. g. among container glasses, we tend to give importance to those glasses that are typically used for drinking water, fruit juices and for some people, beers and other drinks, and they are also contained in different types of container bottles with or without aesthetic appeal with further usage as jars, pans, bowls, trays, plates, etc. If the drinking glass is transparent, i.e. a ray of light passes through it in a clear manner we could identify any suspended particles in the water – that occurs due to the scattering of light. Secondly, transparent glasses are also used as 'float glasses' as windows for getting more light inside the building, room separators in offices, staircase sideways in commercial buildings and Malls, etc. This has been discussed in the past in many articles in Kanch**[1-4]**.

The "float" or sheet glasses with no surface aberrations give rise to a good transparency, but they have a very high emissivity or low reflectance so that undesirable light rays with wavelength in the infrared region of the solar spectrum are not filtered through the windows. A lower emissivity can be imparted in double or triple layers of window glasses with special coatings that considerably reduce the heat losses keeping the buildings cooler in the summer months, but warmer in the winter months. While this has a strong implication in the saving of energy, it also indicates much lower carbon dioxide emission, as desired by the environmental authorities. These glasses, called E-glass, are also important in the overall optical property of glass. When light falls on a piece of glass, some part is reflected, a small part is absorbed, but a major part is transmitted that makes glass stand apart. This is shown in Fig. 1.

The optical property of glass is based on the "interaction" of the medium (i.e. glass) and the energy of the electro-magnetic waves. The spectroscopic method has already been mentioned while discussing the structure of glass covering a very wide range of frequencies. Here, we are discussing glass as 'optical

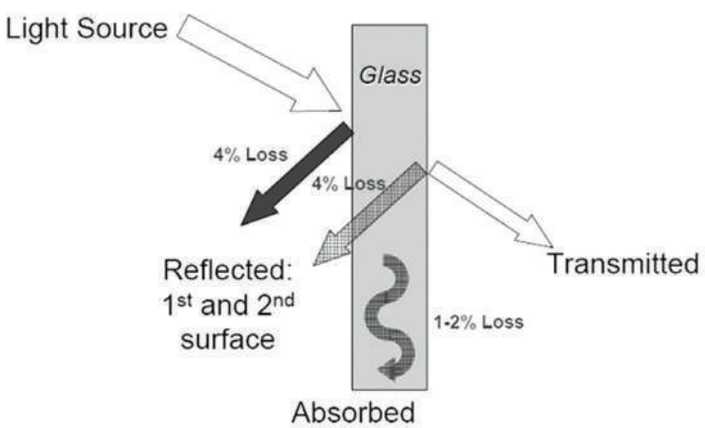

Fig. 1: Transmission through a piece of glass

material' by mentioning some of the important aspects of optical quantity that signifies glass.

The interest in optical glass is related to certain characteristics which are typical property of glass: (a) Isotropy, (b) Degree of high homogeneity, (c) Possibility of continuous variation in property with composition (i.e. absence of stoichiometry), (d) Possibility of obtaining a glass piece upto any limit on dimension. In majority of cases, the structural order in short distance (say, 20-30 Armstrong) control the optical phenomena. It is possible to find optical quality of the crystals without their various limitations.

The optical glass is used for making high-value added items, such as Prism, Lenses, Filters, Mirror supports, etc. The most recent applications consist of Laser glasses as well as conductor of light like optical fibres for long distance communication industry. Let us discuss the theory of optical properties.

The Theory →

The propagation of an electro-magnetic wave inside a material produces a displacement of electric charge. For a sinusoidal wave, the change of speed and intensity is contained within the complex index of refraction, n*, that is related to the complex relative permittivity as:

$X^* = X' + iX''$

$n^{*2} = X^2$

by writing $n^* = n - ik$, we have index of refraction, n, and the index of absorption, k, we have the following relation:

$n - k = X'$ and $2nk = X''$

where X' – 1 is called electric susceptibility. These are some of the basic equations that involve a lot of mathematical functions with mathematical transforms that are used like Hilbert Transform. These are the basic knowledge on which the entire optical property of materials was built.

Absorption Coefficient →

From the index of absorption that is a function of wavelength (λ), we could define the "absorption coefficient": $\alpha = 4\pi k/\lambda$. For a real homogenous material (like glass), the fraction of light intensity (I) depends on the coefficient, α, and the distance of light travel, i.e. thickness of glass sample (dx):

$dI/I = -\alpha dx$

On integrating this equation, we get the attenuation of light traveling within a material of thickness, x. This is thus expressed as:

$I = I_0 \exp(-\alpha x)$

Where, I is the intensity of transmitted light, I_0 is the intensity of incident light and here α is the "linear coefficient of absorption". Instead of light transmission $(I/I_0)x100$, generally we consider the "optical density" (O.D.) that is defined by the following formula:

$O.D. = \log_{10}(I_0/I)$

From the intensity formula, we could find the transmission quality of a glass piece, e.g. float glass slab. If (I/I_0) is 0.98, i.e. the entire visible light does not transmit through the glass piece, and multiplying by 100, we get 98% transmission that indicates 2% absorption due to the problem of glass defect or due to the presence of transition metal ion impurity that absorbs in this region of wavelength. However, 99% transmission signifies a better optical product for commercial use, while 99.99% transmission (or more) is considered "acceptable" for better optical clarity that is needed in optical lenses and other important applications.

From the above formula, a 1% transmission means that the optical density O.D. = 2. The technology of optical fiber has popularized the use of decibels (dB) by relating it to:

$1\ dB = (1/I_0)\ O.D.$

It has to be noted that there is a loss of internal reflection inside the optical fiber when carrying information through it that is expressed as dB/Km, by expressing the formula in terms of the distance traveled by light, e.g. 100s of kilometers in length. The loss has continuously been reduced by R & D activity of various laboratories around the world. The formula for loss is expressed as:

$\alpha = \ln(I_0/I)/x = 2.303\ (O.D.)/x = 23.03\ dB/x$

The above absorption coefficient can also be due to the presence of a particular metal ion (i.e. chromophore). In this case, the absorption is directly proportional to the concentration (c) in mol/litre of a given metal ion, and in this case the formula is expressed as:

$\alpha = \varepsilon c$

Where ε is the (molar) "extinction coefficient. Thus, we get:

$I = I_0 \exp(\varepsilon c x)$

This is the famous Beer-Lambert equation and is useful for any laboratory calculation dealing with glass colour. The higher the concentration of metal ion, the higher is the absorption coefficient, and the coefficient is also higher for longer distance traveled by light, or sample thickness. This is the reason when a "10 cm square" glass piece of 0.5 cm thickness looks clear when viewed from the top of the plate – as the distance travelled by light is only 0.5 cm. However, when viewed from

the side, it looks deeply coloured – as the distance traveled by light is 10 cm (i.e. 20 times higher path length), and naturally higher absorption for a given metal ion present in fixed concentration, e.g. for an ordinary soda-lime-silica commercial glass with some iron content that gives rise to greening tinge. Another way of stating this fact is that either we change the concentration of a metal ion or change the thickness of the sample, i.e. path length to get more or less colours apparent to our eyes **[5]**.

The molar extinction coefficient is constant for a given transition metal ion present in a glass (e.g. iron ions), which is again dependent on the ligand field strength or the alkali concentration that supplies the extra oxygen anions (ligand) around the metal ion. So, the only way to reduce colouration in a glass is to reduce total concentration that reduces the absorption coefficient of a particular metal ion. If the product is made thinner, then also for a given concentration of metal ions, the effect of colour is reduced, e.g. glass lamp shade or similar items.

The Reflection →

The fraction of light reflected (R) under a normal incidence is given by the formula as:

$$R = ((n - 1)^2 + k^2)/ ((n + 1)^2 + k^2)$$

In the optical region of the spectra, k is almost equal to zero. So, this equation is reduced to:

$$R = (n - 1)^2/(n + 1)^2$$

This is a much simpler equation, and if one determines the refractive index, the value of R could be calculated, With respect to the total light incident on a piece of glass, one could then find out % Reflectance.

Here, some units describing optical property need to be given. Light is a wave of photons. Photons have energy that is dependent on the wavelength of light. The refractive index and absorption coefficient are always given as a function of wavelength, or energy of the incident photons. The wavelength in general is indicated in micron (μ), millimicron (mμ), Angstorm (Å), or nanometers (nm) and they are related as follows:

$$1 \text{ nm} = 1 m\mu = 10 \text{ Å} = 10^{-3} \mu$$

There is a relation between energy (E) and wavelength (λ) as:

$$E \text{ (eV)} = 1239.8/\lambda \text{ (nm)}$$

And the frequency v(cm-1) = 1/λ(cm).

The Birefringence →

Glass is an isotropic material, i.e. any property measured in any direction is almost constant. However, in certain conditions, glass can be anisotropic. The most important reason being the application of mechanical force that induces some thing called birefringence. The speed of propagation, i.e. refractive index, depends on the orientation of the plane of polarization. The ray of light perpendicular to the axial stress (σz) is called 'ordinary ray' and that parallel to the axial stress is called 'extraordinary ray'. The glass piece will have to indices of refraction corresponding to these two directions of ray of light (no and nex) and the birefringence is given by:

$$n >= \Delta n = n_o - n_{ex}$$

The lag (δ) for a thickness (x) of glass is given by:

$$\delta = x(n_o - n_{ex})$$

Usually, it is evaluated by the ratio (δ/x) in nm/cm and the relative lag is given as:

$$S = (n_o - n_{ex})/n$$

Where n is the refractive index of the glass not subjected to any mechanical stress (σ). It is a quantity that defines a sort of 'deformation'. The relation between S and σ is given as:

$$S = \Delta n/n = B\sigma$$

Where B is defined as the "elasto-optical" constant. If Δn/n (non-dimensional quantity) is measured in mμ/cm and σ in dynes/cm2, B is measured in Brewster. In this case,

$$\Delta n/n = 10^{-6} B\sigma$$

For a normal glass, the birefringence is 2.6 Brewster.

CONCLUSION

To get a glimpse of the most important property of glass, i.e. optical property, a theoretical description is given here on absorption and reflection with the familiarity of various units used in different monographs and research reports of glass laboratories. A brief description is also given on the birefringence or 'elasto-optical' property of a glass. In a future article, some data of different types of glasses will be given.

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About

The All India Glass Manufacturers' Federation

The All India Glass Manufacturers' Federation was founded in 1944. The Federation is made up of five Regional Associations viz.

Eastern India Glass Manufacturers' Association **(EIGMA)**-Kolkata

Northern India Glass Manufacturers' Association **(NIGMA)**-Haryana

South India Glass Manufacturers' Association **(SIGMA)**-Hyderabad

Uttar Pradesh Glass Manufacturers' Syndicate **(UPGMS)**-Firozabad and

Western India Glass Manufacturers' Association **(WIGMA)**-Mumbai

The Federation was incorporated under the Companies Act, 1956 (No. 1 of 1956) as a Limited Company on 15-6-1970.

The main aims & objectives of the Federation are:-

- To encourage, promote and develop the manufacture of glass articles of all kinds and to safeguard and protect the interests of glass industry and glassware business in India.
- To form a common link amongst Glass Manufacturers' in India and thus develop a spirit of mutual help and cooperation with one another.
- To promote the study and research in Glass Technology.
- To consider all matters relating to the manufacture and marketing of glass articles in India and the question of export and import thereof.
- To devise ways and means for securing necessary supply of raw materials required for the manufacture of glass articles at comparatively lower prices and thus to decrease the cost of production and increase the national wealth.
- To collect necessary information and data and propagate it for the benefit of Glass Industry and trade in India.
- To make representations whenever necessary to the Union Government or any unit of the Union of India for the removal of difficulties that might hamper the trade of glass articles or for grant of special facilities for the Glass Industry.
- To draw Government or public attention to the difficulties in the way of Glass Industry and to solve other problems confronting it and to solicit their help and support through concerted action.
- To organise a united front on behalf of all glass manufacturers and thus strive to gain all those advantages which may not be possible through individual effort.

All those engaged in the manufacture of glass and glass articles are enrolled as **Ordinary Members** of the AIGMF and those associated with the Glass Industry are enrolled as **Affiliate Members** of the Federation.

Almost all glass manufacturers including many in the small scale sector are 'Ordinary' Members of the Federation.

Articles of Association of the AIGMF were amended in September 1992 to enroll foreign companies as Affiliate Members of the Federation ■

Reputation built on performance

Furnotherm Glass Projects India is a leading glass melting furnace construction company, based in Maharashtra, India. As Jogendra Singh explains, the company provides complete turnkey construction services from draining/demolition to commissioning, including construction.

Jogendra Singh

Furnotherm maintains an extensive base of professional manpower and equipment to construct many furnaces simultaneously worldwide. Recently, for example, projects have been executed for Schott Glass T65, Piramal Glass Ceylon, Piramal Glass India, Vitrum Glass India and Sirdaryo Glass, Uzbekistan. Current projects include Schott Glass T66, Piramal Glass 145 tonnes/day, Frigo Glass, Nigeria and Sunrise Glass India, all of which have been conducted simultaneously.

Furnotherm is constantly working on the development of innovative and modern techniques for installation work and has also developed in-house workshop facilities for the fabrication of steel and glass plant equipment.

Industry recognition

The company was created by Jogendra Singh, who has been associated within the glass industry for the last 20 years and has constructed many glass melting furnaces in India and abroad. Recognised for executing projects with utmost customer satisfaction, Mr Singh is highly experienced in the field of glass melting furnace construction on a semi-turnkey basis.

Furnotherm is the only furnace builder in India to cover the maximum range of furnace construction activities, extending from draining to heat-up and involving demolition, rebuild, steel work, refractory installation, utility, electrical and instrumentation.

Activities

Furnotherm's knowhow is in the areas related to furnace construction, which means the company can offer a comprehensive service in all fields according to client specifications.

The expertise of its specialist departments guarantees the best possible solution in the following areas:

- Demolition and waste management.
- Steel structure fabrication and installation.
- Controlled furnace cool down.
- Hot drilling and electrode insertion.
- Refractory and steel materials logistic management.
- Total refractory installation.
- Industrial chimney construction and refractory lining.
- Cold and hot repairs.
- Hot sealing and insulation.
- Furnace heat-up/cullet filling.
- Pre-manufacturing and installation of ductwork for metal-line cooling ducting for combustion air and the installation of electrical blowers.
- Electrical and instrumentation cable laying and installation of electrical equipment.

Furnotherm's goal is to provide overall service and good value for money to glass industry customers, from project conception to completion and commissioning. Utilising experience that has been gained from two decades of global activity, the company's personnel understand that attention to detail and quality as well as dedicated services are critical to the company's success.

With complete confidence in the skills of employees and their knowledge, the company's search for the latest and best installation techniques has enabled Furnotherm to become a leading furnace construction company, with the implementation of safe working practices and ensuring good industrial relations. Adopting high performance specifications monitoring ensures excellence and quality assurance.

These attributes enable Furnotherm to create a competitive advantage by providing high efficiency to execute solutions with superior quality, low cost and outstanding customer satisfaction. ●

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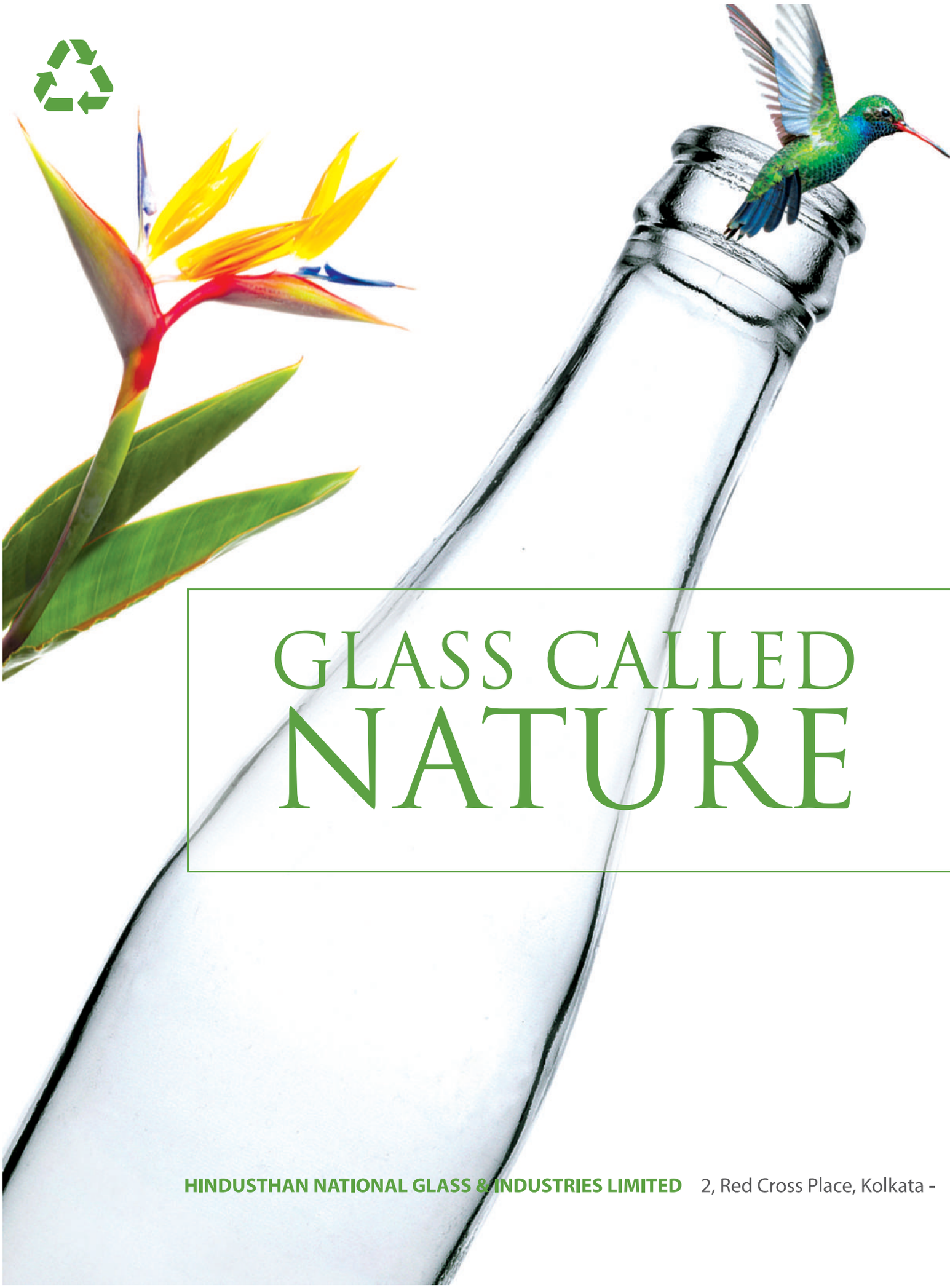
Mr. M.D. Farooq, the founder of Umda Enginering, brings to the table more than 35 years of expertise in the manufacturing industry. Starting from humble beginnings, today more than 350 of Mr. Farooq's Lehr machines are successfully installed around the world.

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

Belts

Office & Works
Plot No. A – 581, TTC Industrial Area, MIDC Mahape, Navi Mumbai – 400 710. MS. India. Tel. 022-2778 20 41/42, Fax : 022-2778 13 38



GLASS CALLED NATURE

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Leaders in Glass Containers

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Customer focus drives positive results for Indian glassmaker

A hot topic of conversation at last October's glasspex INDIA 2019 exhibition in Mumbai involved the positive performance of Borosil Glassworks and the diversified company's latest pro-active investments. Shreevar Kheruka, Managing Director, exclusively explained his influential role in the family-owned glassmaking organisation's return to success to *Glass Worldwide,* preferred international AIGMF journal.

Shreevar Kheruka took over as Managing Director of Borosil in 2011.

Today, Pradeep Kheruka concentrates on the Borosil Renewables solar business.

Borosil Ltd is the market leader in India for laboratory glassware and microwavable kitchenware. The parent company, Borosil Glass Works Ltd was established in 1962 in collaboration with Corning Glass Works. This business became a wholly-owned Indian enterprise in 1988, managed and directed by members of the Kheruka family from headquarters in Mumbai. Sister company Borosil Renewables Ltd specialises in the manufacture of high performance solar glass. Other production specialties include lighting, extra clear patterned glass and pharmaceutical glassware. In 2016, Borosil completed its acquisition of Hopewell Tableware (manufacturer of tempered opal glass tableware) and Klasspack, a producer of glass ampoules and tubular glass vials. Both businesses have now been successfully integrated within the Borosil Group.

In the 2000s, however, the business has encountered severe financial difficulties, before ultimately returning to its current position of stability and profitability. Labour problems, challenging bank lending rates and escalating fuel costs all combined to impact the company's performance, at a time when cheap imports started to flood the local market. In addition, it became necessary to source some products from outside India to satisfy customer requirements. "It was a very difficult situation" Shreevar Kheruka confirms "but I was blessed to be placed in a position to be able to address such huge challenges."

Over the years, the company has operated four different manufacturing sites in India but its two main production sites are at Bharuch in Gujarat and at Jaipur in Rajasthan.

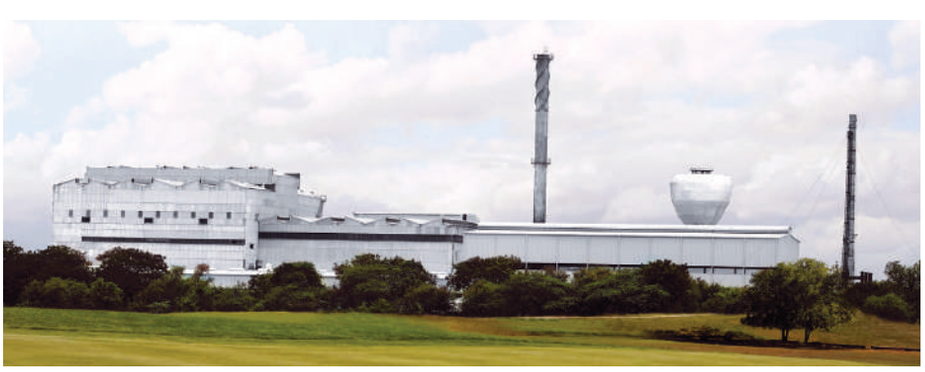
Family glassmaking dynasty

Shreevar Kheruka was six years old when his grandfather, Mr B L Kheruka, who already owned a glass manufacturing business in Kolkata, took the decision to acquire Borosil from Corning in 1988. "Where I grew up in the Marwari or Gujarati community of north west India, the area is famous for its entrepreneurial families, where it is normal to hear business discussions at the dinner table. Even though I might not have been aware of it on a career level, subconsciously the knowledge and experience keeps going in and as children, we would visit the glass plant in Kolkata every weekend. So when our family took over Borosil and relocated to Mumbai, I was fully aware of the company."

Following the completion of his studies in India, Shreevar Kheruka completed a dual finance and international relations degree at The Wharton School of the University of Pennsylvania in the USA. He then worked for two years at Monitor Consultants (now Monitor Deloitte) in Boston, before returning to Mumbai in 2006 to join the management team at Borosil.

It was always envisaged that Shreevar Kheruka would follow in the footsteps of his father and grandfather and work in the family glassmaking business. During four years at university in the USA, he was exposed to different types

Mr B L Kheruka is still Executive Chairman at Borosil.



The Borosil Renewables factory at Bharuch, Gujarat.

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glass WORLDWIDE

Shreevar Kheruka addresses staff at the Borosil glassworks.

of communication and education, in a very international environment, before experiencing how corporate America works during his time in Boston. "Studying at a prestigious university and having worked for a successful company gave me a lot of credibility when I came back to India to work at Borosil, rather than being viewed as someone who was entitled and the son of the owner!"

He joined as Assistant Vice President, at a time when the business was in the midst of a substantial crisis, suddenly going from being profitable to making losses. As explained above, the Mumbai operation was bleeding money heavily and represented a tough initiation for the latest member of the Kheruka dynasty. "The challenges that affected the business so significantly all arose within a short space of time, so we were caught unawares." It was necessary to address product costings and Shreevar Kheruka visited numerous glass factories around the world, learning many best practices that helped in the formulation of a new business model. "There were lots of moving parts but by 2010, I think we had managed to deal with the bigger problems and ever since, the company has been on a very good wicket."

Close-knit family benefits

While the company's patriarch, Mr B L Kheruka (Executive Chairman) concentrated on developing valuable architectural business opportunities and his son Pradeep (Vice Chairman) was heavily involved in intensive labour and legal issues, grandson Shreevar was tasked with the day-to-day running of the Borosil Glass Works consumer and scientific division. This involved sourcing, operations, setting up a new plant in Gujarat and connecting with customers.

The reallocation of responsibilities worked well, to the point where Shreevar Kheruka was made Managing Director in 2011. Today, he has full responsibility for the consumer and scientific division, while his father Pradeep is responsible for the solar business. "I would never say that my grandfather has retired because he has a very high level work ethic and I don't know what he'd do with himself! But as Chairman of the Board, he is now in a more advisory role rather than operations" Shreevar explains. "Obviously, we are a very close-knit family and any key decisions are taken with 100% consensus between the three of us. Overall, the co-operation between us could not be better and the communication and level of understanding is very strong."

In recognition of his six decades' long career in the glass industry and his valuable contribution in the areas of technology, manufacturing, innovation, services and education, last year Mr B L Kheruka was announced as a worthy winner of the AIGMF's C K Somany Award for Innovation and Technology. This award was supported by *Glass Worldwide*. "Always thinking beyond himself, he has continually been trying to improve the prospects of not just Borosil but the glass industry in general" his grandson commented. "He was delighted to receive this award because it means so much to receive recognition from his peers."

All three generations of the Kheruka family share the same work ethic and approach to the delivery of appropriate value systems, respecting customers and suppliers alike, offering high quality products and observing the simple yet important tenet of promising only what can be delivered and delivering what is promised. "There is no culture of making a quick buck and there is a high degree of alignment."

Importantly, Shreevar Kheruka has pioneered the introduction of a different approach to employee involvement in the creation of a shared company vision and the adoption of a more 'bottom up' rather than 'top down' decision-making process. "The way the company operates has changed dramatically in the last 10 years" he confirms. "The world is changing… we have to be more flexible and move with the times to meet expectations and recruit and keep the best people. It is our responsibility to continue to evolve with the times."

Staff training and development is an important aspect of the management style adopted by Borosil and a strong performance management process has been devised, where the company's vision and deliverables are created and regularly assessed. Shreevar Kheruka is strongly committed to this approach, personally devoting in excess of 30% of his time to HR and organisational development related to

Solar glass production at the Borosil Renewables factory.

Borosil's Classic Delite ware.

people. “It’s time well spent” he contends. “It’s simply not always possible for us to make the best decisions from top down; the market is evolving rapidly and new product ideas need to come from our people on the ground, who are talking to customers every day. What we need to do in terms of investing in the plant should come from the people at the plant, rather than head office as it often was in the past. Our employees need to feel part of the organisation for the company to continue to move in the right direction.”

Sales and product development practices are consistent across the company, observing a customer-centric focus. This embraces the concept of teams setting goals together in a room and people buying into those goals for the medium and short term. “The openness of discussion that we have across our teams, the transparency of data sharing is absolute across the company” Shreevar Kheruka confirms.

Including contract workers, the group currently employs 2500 people, 1500 of whom work for the consumer and scientific division and 1000 for the solar division. These numbers reflect the lower labour costs in India compared to many other parts of the world, where automated production practices are increasingly more cost-competitive.

Investing in the future

Like every forward-looking glassmaker around the world, Borosil is investing strongly in digital technology to optimise production efficiencies. While all equipment is already linked to the internet and data is gathered from every operation, however, the company recognises that opportunities exist to use this data in a more meaningful way. For example, Shreevar Kheruka believes that the level of autonomous or predictive maintenance algorithms adopted can be increased to reduce downtimes. A pilot project has been budgeted for 2020 to illustrate the benefits that could be realised.

Separately, a pilot on-line production monitoring project was initiated last year to show the yields of operating machines. Although further analysis of the data generated has still to be undertaken, this project is considered a step in the right direction.

Leading suppliers of production and processing technologies are playing an equally important role in the company’s recent resurgence. “Working with the correct supplier for machinery and technology can make all the difference between being a low performance company and a high performance company” says the Borosil Managing Director. “We are not in the business of saving money in terms of using

Mr B L Kheruka was announced winner of the AIGMF’s C K Somany Award for Innovation and Technology in 2019.

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the cheapest equipment. We invest in the best equipment to make the best quality glass, with the highest efficiency, so we always prefer to buy the best machinery and technology available for a specific purpose and that is the case for all Borosil business units."

Last October's glasspex INDIA 2019 exhibition in Mumbai was recognised as a valuable opportunity to meet international suppliers in one place and is prioritised for attendance, along with glasstec in Germany. "A lot of discussion is undertaken in a short period of time and many things can be resolved in terms of cross checks and functionality, because we select suppliers on a project by project basis" says Shreevar Kheruka. "The 13th International Conference of the All India Glass Manufacturers' Federation that was staged alongside glasspex INDIA with the support of *Glass Worldwide* was also a great opportunity to see and hear from international suppliers. We don't have tie-ups with individual suppliers but if their previous work with us has been successful and we are well connected with them, we will strongly consider them again, of course."

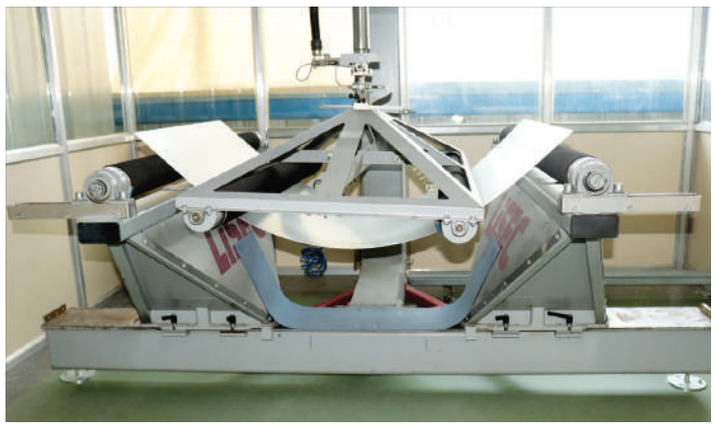
Strongly performing acquisitions

Since their acquisition in 2016, Hopewell Tableware (manufacturer of tempered opal glass tableware) and Klasspack (manufacturer of glass ampoules and tubular glass vials) have been successfully integrated within the group. And according to Shreevar Kheruka, both companies have grown substantially in the intervening period.

By 2019, Hopewell's revenue had tripled and continues to increase. European melting and forming technology has been introduced, while the product portfolio has been upgraded via investments in new shapes and moulds. In addition, sales and marketing functions have been integrated within Borosil, as the brand continues to successfully benchmark its opal products against leading European manufacturers.

Since Borosil acquired an approximately 80% interest in the pharmaceutical packaging producer Klasspack in 2016, sales have increased from approximately $4 million to some $8.5 million in 2019. Investments have been made in the latest forming lines, camera inspection systems and clean room technologies to satisfy the demanding requirements of the pharmaceutical sector.

Borosil's Vision glasses range.



Performing a bending test on 2mm solar glass.

Having now stabilised the business as a whole and witnessed the benefits of its latest acquisitions, Borosil is constantly on the lookout for further possible acquisitions that are considered 'a good fit' with the existing portfolio. "Acquisitions can be a risk from a cultural and disruption perspective, so the reward has to be commensurate" says Shreevar Kheruka. "We have a fantastic franchise here in India in terms our brand name, distribution strengths and the teams that have been built up and go out to see customers… and we should be looking to push as many quality products as possible through that pipeline. We have a good vehicle for acquisitions and if we find something interesting then we will review it; our progress in the last decade and the position of the company now means we are able to do that."

Solar glass investments

In 2019, approximately $37 million was invested to double solar glass production at the Bharuch manufacturing site in Gujarat. The original 180 tonnes/day line has been repaired and its capacity has been increased to 210 tonnes/day, while a second line of the same size has been added.

Examples of calibrated laboratory glassware.

This significant production capacity expansion was undertaken in an effort to keep up with fast expanding local demand for solar glasses but another doubling of capacity could soon be on the cards. Sufficient space at the site exists to increase manufacturing capacity to some 840 tonnes/day and another fast track investment is currently the subject of evaluation.

"Our solar company is extremely innovative in terms of cost cutting and achieving higher efficiencies" Mr Kheruka explains. "The team is strong and the very high levels of efficiency achieved allow us to be competitive with Chinese suppliers. The quality of glass and our energy consumption per tonne is world beating, as are other areas of the business."

Focus on customer value

While acknowledging that the glass industry has been boosted by the prevailing anti-plastic sentiment throughout the world, Shreevar Kheruka warns that greater innovation is necessary if the industry is to solve the challenges of reducing weight and increasing strength at a viable cost. "There is a huge growth opportunity in the field of glass but increased innovation and technology are key" he stresses. "At Borosil, we are constantly trying to find new ways to deliver this value to the customer." ●

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Emerging Trends in Container Glass Packaging for the Food and Beverage Industry

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The global packaging industry has witnessed a significant transformation over the last few decades. Today's packaging plays a far more complex role than just making containers for products during the processes of logistics, sales and end-use. It is now also an essential element in terms of product design, branding, marketing and user experience. As the global demand for packaging continues to grow and diversify, the packaging industry is likely to be more heavily influenced by consumer preferences, industry dynamics, environmental concerns and developments in technology and manufacturing equipment.

People, nowadays, are opting for a healthy and sustainable lifestyle, given the current situation. COVID-19 has created a growing necessity for industries in the F&B sector to focus more on hygiene and sanitisation. As most of the products in the F&B sector are included in essential services, it becomes crucial for the packaging sector to follow conservative practices. While we have let plastic invade our lives, because of the convenience it brings us, there is a whole laundry list of toxic chemicals that leach into our environment due to the manufacture and the careless disposal of plastics. Even if recycling can help alleviate some of the environmental problems, the best way to protect the earth from plastics is to replace them with more eco-friendly alternatives like glass. It's time to make that change. Glass can be recycled multiple times, so it doesn't have to end up in landfills. It is cost-effective, considering its durability and recyclability. Manufacturers in the glass industry are more focused on environmental containers that will drive the demand for more recyclable products.

Glass manufacturers are leveraging technology to provide an environment-friendly ecosystem to create innovative products that will help meet the already existing demand more efficiently.

Some of them include:

- Strengthening glass containers through a new tempering method
- Creating light weight containers in different geometric shapes
- Using newer technologies like single-stage forming to produce thinner but stronger glass containers
- Developing a coating on the surface of the glass to avoid strength loss
- Creating heat-resistant pyrex glass

The glass industry faces a major share of its challenges in attaining its goals; however, the technological advancements in this sector are helping manufacturers stay ahead of the game. Pre-emptive R&D will lead to the development of new opportunities and energy-efficient production strategies. Some examples include:

- Smart glass bottles and containers whose colour changes depending on the liquid temperature (medicines, wines, perishable products, etc.)
- An interactive drinking glass, which refills automatically or stops refilling when not required
- Photovoltaic sunroofs replace regular car sunroofs by including solar PV cells to recharge the vehicle's battery in electric cars
- Glass mirrors that will help assess the health condition of the person standing in front of it

BEVERAGE INDUSTRY TO HOLD THE HIGHEST MARKET SHARE

The market for glass packaging in the alcoholic beverage industry is facing intense competition from the metal packaging segment, in the form of cans.

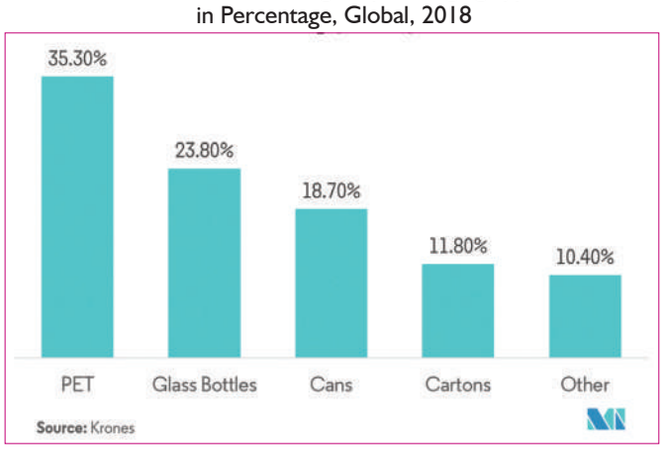
However, it is expected to maintain its share due to its use in premium products. The growth is expected to be witnessed across different beverage products, like juices, coffee, tea, soups, non-dairy beverages and others. Among alcoholic beverages, beer witnessed tremendous growth in the past few years. The majority of beer volume is sold in glass bottles and is driving the need for increased production rates in the glass packaging industry. The increasing demand for premium variants in alcoholic drinks is driving the growth of glass bottles. Developing nations, like India, are also showing a preference for premium beer. Returnable glass bottles are a cost-effective option for companies to deliver their products. This form of packaging is largely used in the non-alcoholic beverage industry. Currently, about 70 per cent of the bottles used for natural mineral water is made of plastic. The choice for bottled-water packaging material is increasingly taking into account environmental considerations.

ADVANCES IN GLASS TECHNOLOGY

AGI glaspac has adopted the following measures:

1. Production of light weight glass containers

Pack of Mix Beverages by Packaging Type in Percentage, Global, 2018



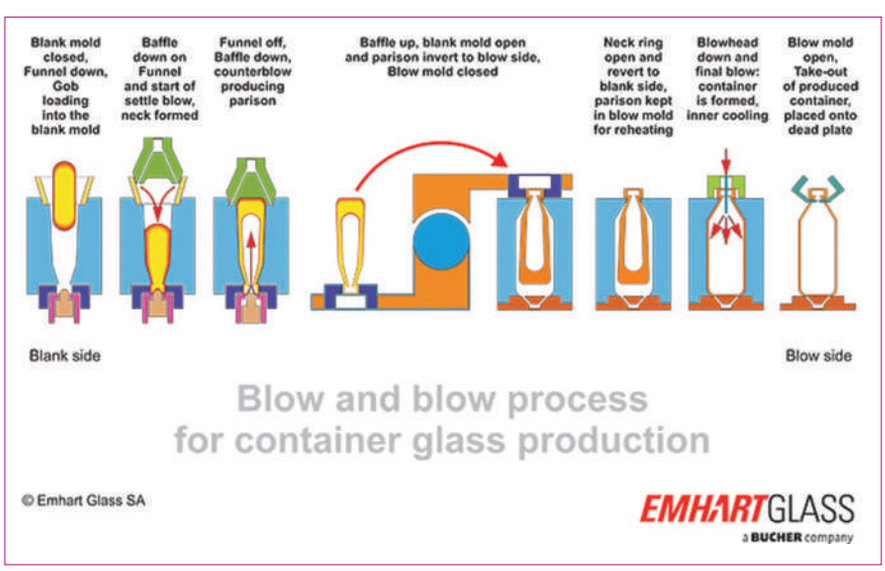
2. NNPB process for light weight glass containers
3. Glass containers with unique codes for counterfeit proofing
4. Innovations in colouring forehearth technology
5. Hollow decorated glass containers
6. Cullet processing system

PRODUCTION OF LIGHTWEIGHT GLASS CONTAINERS

Light weighting of glass containers requires fundamentally low parison forming time, i.e. the time between glass loading into the blank mould and starting of parison formation. It requires faster neck finish formation by way of faster settling of glass into the neck. Also, corkage reheat time is less. It minimizes the temperature difference in the parison due to different glass contact times of the settled glass to the counter-blown glass.

With the help of the advanced blow-blow technique, vacuum is applied through a plunger to pull the glass into the neck ring while the gob is being loaded. It results in faster neck finish formation and quick settling of glass in the blank mould. AGI glaspac is successfully using a vacuum on the blank side and also valve baffle to minimize the time gap between gob loading and settle blow. All the above processes help to minimize the settle wave effect in the blow- blow process-formed container.

A specially designed parison with a higher run and anti-settle wave shape, with longer reheat, means that the glass has enough time to heal the micro-checks produced in the glass during parison formation. It, in turn, helps to produce stronger containers. It requires a higher gob temperature and homogeneous glass.



NNPB PROCESS FOR LIGHTWEIGHT GLASS CONTAINERS

The introduction of the NNPB process has enabled AGI glaspac to increase overall productivity and reduce weight and variations in

the thickness distribution of glass containers.

The light weight container need not be a weak container. Glass, in its pure state, is extremely strong. Its strength is reduced considerably due to microscopic surface defects and variations in thickness. The NNPB process, together with hot-end and cold-end coatings on glass is developed to address this issue. Containers with a large weight-to-capacity ratio can be lightly weighted without affecting the impact or bursting pressure strength.

Lightweight containers made by NNPB are lighter by around 30 per cent and have fewer variations in thickness besides being stronger than the containers made by the blow-and-blow process.

The NNPB process requires sophistication in control of the variation in the weight of glass. The Plunger Process Control System (PPC) monitors individual plunger motions during the parison-forming process. The system uses full stroke sensors and controls the glass weight within 1g.

Master: Is the center of the system for control and visualization

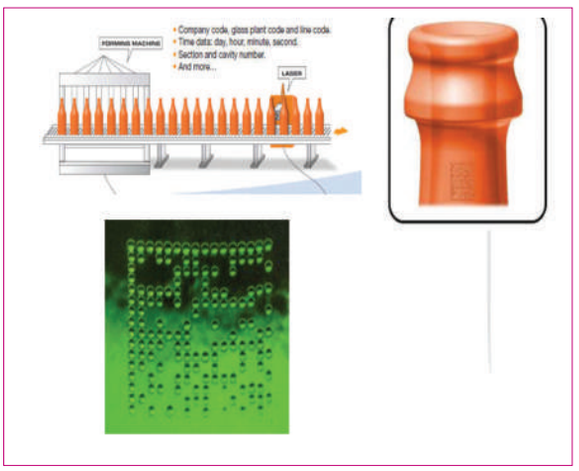
Control Box: Supplies Master with energy enables control loops and transmits weighing information from an electronics caleto Master

Full Stroke Sensor: The signal source is mounted in the Emhart Quick Change Plunger mechanism

Adapter Plate: Mounted on plunger mechanism base plate for wireless sensor signal transmission

Motor Controller: Needle height and tube height motor control for machine without FlexIS control. On machines with FlexIS the tube height control is connected direct to the Master

Universal Adjustment Drive: For optional needle height adjustment and on non FlexIS installations used for tube height adjustment

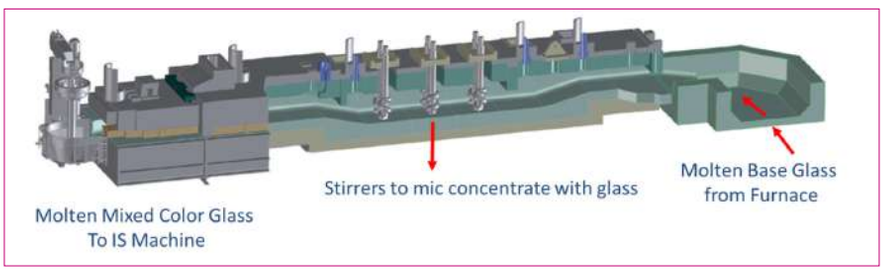


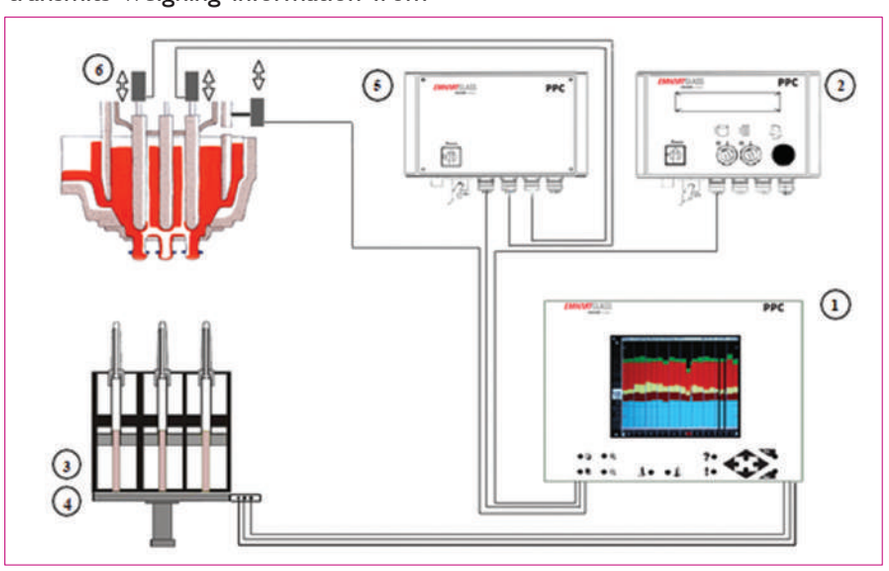
GLASS CONTAINERS WITH UNIQUE CODES FOR COUNTERFEIT-PROOFING

Printing unique codes on glass bottles facilitate the collection of information at the filling point and outlet. Thus, the number of times each bottle is filled and sold can be tracked to identify a counterfeit product.

INNOVATIONS IN COLOURING FOREHEARTH TECHNOLOGY

Colouring forehearth technology is used by the glass container manufacturing industry to produce special coloured glass containers. AGI glaspac has recently innovated new concentrates to feed into this forehearth to produce negative ion emission containers and anti-bacterial





containers to cater to the growing needs of the consumer market.

HOLLOW DECORATED GLASS CONTAINERS

AGI glaspac has recently developed a new method of producing bottles with decoration/embossing on the hollow areas of glass containers. Earlier, only external decorated bottles were being produced.

CULLET PROCESSING SYSTEM

Cullet is recycled broken or waste glass used in glass-making. Waste cullet contains impurities and needs to be freed for reuse. AGI incorporates green and dry European technology for cullet processing in removing impurities like stones, ceramics, porcelain, iron, aluminium and organics, such as paper, plastics, wood, etc. from raw cullet.

This technology consists of the following major equipment for impurity separation:

i. Magnetic separator: For Iron

ii. Eddy current separator: For aluminium

iii. Air-knife breezer: For organics

iv. De-labelling: For label

v. Suction unit: For dust and light papers

vi. Three-way optical sorter: Sensor and imaging-based pneumatic ejection technology for ceramic, stones, porcelain and coloured glass

vii. Vibratory screens: Fines

Technology Benefit: As a result of all these innovations, energy savings, longer furnace life, higher production rate, decreased CO_2 emissions and enhanced safety with no use of water have been realised.

ABOUT AGI GLASPAC

HSIL Ltd., Packaging Products Division, AGI glaspac, was established in the year 1972. It is engaged in the manufacture of high-quality glass containers for packaging food, pharmaceuticals, soft drinks, liquor, beer and wine. The company caters to a large and demanding customer base with a product range covering flint, amber, blue and green containers. With four furnaces today, AGI can commit to the availability of flint, amber and green glass throughout the year. The product range varies from a small 5 ml pharma bottle to a 4000 ml chemical/food jar ■

For more information, visit www.agi-glaspac.com

Colour Centres or Solarization and Colour due to Suspended Particles in Glasses

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Abstract

A variety of glasses exist that are useful for the human necessity. A majority of such glasses are in the bulk form thereby drawing the utmost importance both in terms of volume and values in the market, e.g. float glass, container glass of various forms and sizes. However, there are also a host of special glasses that are used for specific needs and these glasses also serve a great purpose for the humanity. Apart from ordinary coloured glasses containing transition metal ions due to redox reaction during the melting process, there are also a range of other coloured glasses containing colour centres or that is induced by prolonged exposure to sunlight, or solarisation. This will be discussed in this part of the article along with that kind of colour arising out of the suspended particles within the glass matrix.

INTRODUCTION

In the modern era, we have a variety of glasses for a diverse field of applications for the human necessity **[1]**. There are bulk glasses, such as float glasses, container glasses, fibre glasses, etc., for building and construction industry, as well as special glasses for specific applications. Some important applications that touch human lives will be briefly noted below to highlight the importance. This was also done in several conferences on glasses by AIGMF.

Glass is a versatile material with diverse applications in human life. It is a vital material for the construction of buildings that satisfies the age-old desire of human beings for housing. There are also several facets of application in this particular field. It is assuming more significance in the present age of energy conservation, or rather environmentally conscious design concepts of energy-efficient buildings both for residential and commercial purposes, i.e. smart buildings for a smart city. The scope is already of immense dimensions.

The normal use of glass products, mainly oxide glasses, is related to their good transmission property in the optical part of the spectrum: Ultraviolet – U.V. (below 400 nm) + Visible Spectrum – VIBGYOR (400 – 700 nm) + Infrared – I.R. (above 700 nm). The latter is sub-divided into near-I.R. and far-I.R., and various equipment involving different glassy and crystalline materials exists for a huge study.

The two sides of the above "optical window" correspond to a sensible spectral part of the human 'eye' is due to the electronic transition from the lower valence band (which is mostly filled with electrons) to the upper conduction band (which is mostly empty) with a cut-off in the U.V. and due to atomic vibrations between the constituent cations with oxygen anions (e.g. Si-O, B-O, P-O, etc. bonds in the oxide glasses) in the I.R. region.

The absorption in the visible part of the spectrum results in the superposition of the tails of these transitions: electronic and vibration. To the transitions, one has to also add the effect of the impurities, i.e. the transition metal ions, like iron ions that are most notable to the glass manufacturers and of colour centres. For the most important applications of glass is fibre-optics in modern telecommunication system. The presence of water (OH- or hydroxyl ions) in such glasses mostly based on purest form of silica-glass can be set as an example of 'toxic impurity'.

Light or optics is somehow intimately related to glass science and technology due mainly to the transparency of glass **[2]**. This is due to transmission of light through a given piece of glass. If the light is partly transmitted and partly absorbed, then depending on the wavelength of the light absorbed

by the glass that again depends on the impurities, there is a sensation in our eyes and we see the glass coloured. If the sensation lies within a particular wavelength of light in the VIBGYOR scale, say, e.g., in the green wavelength range, then we see the glass coloured as 'green'; likewise for other colour wavelength ranges. However, there is also a possibility of scattering of light by the small particles suspended intentionally within the glass matrix that give rise to the opaqueness in the glass that gives rise to opal glasses. Here, we are mainly concerned with optical absorption, i.e. opposite to the transmission.

When the rays of light or light waves pass through a piece of glass, two things could happen as shown below:

1) Some part of light are transmitted through the glass piece, and

(2) Some part (maybe a smaller part) may be absorbed by the glass depending on the presence of impurities (intentional or unintentional?) in the glass, i.e. transition metal ions, such as Fe, Mn, Cr, etc.

Colour Centres →

Prolonged exposure of a piece of glass to the U.V. portion of solar radiation produces coloration due to a change in valence state of certain ions or a mixture of ions. This is the phenomenon of "solarisation". If the glass contains Fe and Mn ions as impurities, one could have the following ionic reaction:

$Mn^{2+} + hv \rightarrow Mn^{3+} + e^-$

Where, h is the Planck's constant and v is the frequency of the concerned "band". The energy (hv) is a photon of U.V. and an ejected electron that will be trapped or blocked somewhere inside the glass structure. For example, for a relative site of Fe^{3+} we get:

$Fe^{3+} + e \rightarrow Fe^{2+}$

The solarised colour centre is thus stabilized and the glass tends to have a violet type colour due to the presence of Mn^{3+} ions that is observed in case of ancient glasses which was observed due to a prolonged exposure to Sunlight.

Silicate Glasses strongly reduced and containing Eu^{2+} and Ti^{4+} ions develop colour centres under the action of the photons, which progressively disappears as the source of light is removed. These glasses are denominated under the name "photo-chromic glasses". In this case, the following reaction is given as:

$Eu^{2+} + Ti^{4+} \rightarrow Eu^{3+} + Ti^{3+}$

The colour centre responsible for coloration is due to the ion Ti^{3+}. There are other examples of "photochromism" due to the fine crystalline particles that are uniformly dispersed in the entire glass matrix. This is the reason, why we talk about uniformity of colour and homogenization. If the glass contains such particles homogeneously distributed throughout the entire piece of glass, then the colour due to such effect will be uniform and the glasses would not be rejected for customer appeal.

This colour could result from the absorption of light (i.e. photons) by interaction with the electrons that are not associated with any specific metal ion, but are trapped inside the glass matrix as defects or faults due to some broken bonds in the glass structure network, etc. The variety of sites for trapping inside the glass matrix gives rise to the transition that is generally distributed in an uniform manner over the entire spectrum which produces a 'colour hue' more or less uniform as 'grey tinge; rather than a very well-defined colour.

There is another way of creating such defects or colour centres. This is done by bombardment of the glass piece by 'energetic' particles – or, by the irradiation by X-rays or Gamma-rays (more energetic). This produces a modification of transmission that could be suppressed by a heat-treatment or annealing of glass, i.e. known as "thermal whitening". Thus, the atomic mobility becomes sufficient for the restoration of a structure that is not disturbed.

This progressive modification of transmission under irradiation can be detrimental for some applications, such as nuclear materials, spatial technological, etc. and it is always advisable to avoid such consequences. The other cases by contrast is that of a situation, whereby one intentionally looks for 'variable transmission' for special types of lenses, and glasses for radiation dosimeters.

Colour due to Suspended Particles →

The glass consists of a "special" medium for a 'precipitation reaction' that are highly variable under the influence of 'heat-treatment' or from the reaction of light, i.e. known as photo-sensitivity. There are examples of commercial utilization of this phenomenon in the glass industry, where value-addition is an important consideration.

The ions of some expensive metals, such as Cu, Au, Ag, Pt dissolved in the glass could be reduced to a metallic state. Normally, as it is well-known that mostly 'oxides' of different metals are added in the glass for dissolution during melting, and these metals then remain within glass structure network

linked to oxygen bonds like silicon atoms as Si – O bonds, boron as B-O bonds, etc.

This is normally done by incorporating certain 'reducing' additives to the glass composition, such oxides of tin (SnO2) giving rise to divalent tin ions (Sn^{2+}) or antimony (Sb2O3) coming from trivalent antimony ions (Sb^{3+}). For example, the most celebrated coloured glass is "ruby glass" containing gold particles. This type of glass is fabricated by adding a small fraction of gold – 0.01 to 0.02% by weight. The glass thus made is heated at a higher temperature, i.e. higher than the annealing point, and the gold ions are then reduced as:

$Au^{3+} + 3e^- \rightarrow Au^0$

So, for a trivalent gold ion, one needs 3 extra electrons as shown above. These extra electrons are then supplied by the reaction:

$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$

Or,

$Sb^{3+} \rightarrow Sb^{5+} + 2e^-$

This is produced during the course of heat-treatment above annealing point of the glass, where some ions can change its position even without disturbing its normal site within the structure - but relaxing the "stress" related to the change of size of the ions.

Fig. 1: Typical Drinking Glasses made of Ruby Glass

Fig. 2: A typical Ruby Glass Christmas Flower Vase

During the course of heat-treatment, it produces a kind of agglomeration of gold atoms. First of all, colloidal gold is produced and then small crystals of gold atoms are dispersed in the system. Initially, the glass is colourless and it then takes the form of bright "ruby" colour during the heat-treatment – that is called "striking".

This kind of lively "ruby" colour results from the 'interaction' of light (i.e. photon) with the metallic colour thus produced within the system due to the presence of finer particles of gold. It is not due to a phenomenon of scattering, but through the absorption of light by the "gold sol". This formation of "ruby" colour is theoretically guided by the famous "theory of Mie" **[5]** by using the well-known Maxwell equation. Doremus has suggested that this phenomenon is due to the "resonance effect" of plasma, whereby the electrons collectively oscillate at a characteristic frequency of the particles – whose dimension is around 200 Armstrong **[6]**.

It should be pointed out that similar absorption is produced in the glass due to the presence of silver in 'solid solution'. The Ag+ ions initially dissolved in the glass produce no colour that could be reduced by the electrons supplied by other ions to metallic (Ag0) – the atoms in this case being 'fluorescent'. The agglomeration of silver atoms at the colloidal state makes 'fluorescence' disappear, but in its place provokes a yellowish colour that is explained by the theory of Mie. The corresponding absorption around 396 nm has been utilized in the study of scattering of hydrogen in the glass doped with silver that serves as a 'tracer'.

The reduction of Cu^+, Au^{2+}, and Ag^0 ions could be effected by the 'photo-sensitivity' reaction by incorporating small quantity of 0.05% of 'photo-reducing' elements to the glass, e.g. cerium ions in the form of CeO_2. Under the action of irradiation by U.V. at room temperature, there is an emission of an electron from the cerium ions as:

$Ce^{3+} + hv \rightarrow Ce^{4+} + e^-$

This will serve the purpose of reducing a mono-valent Cu+ ion added in the glass as:

$Cu^+ + e^- \rightarrow Cu^0$

The Cu atoms serve as a centre of nucleation for the formation of small crystals of metallic copper and a simple heat-treatment could produce a colouration in the irradiated parts of the glass. From such a range of 'photo-sensitive' glasses containing Cu^+, Au^{2+}, and Ag^0 ions, it is possible to make a real photography by using the exposure or sensitization to the U.V. light – followed by heat-treatment at a temperature of 500-600 °C. The application of this process has a deep-rooted implication in the glass industry for nucleation of small crystals for making various items of 'glass-ceramics'.

In the glass, it is possible to precipitate small crystals of silver halide (e.g. AgI, AgCl, AgBr, etc.) and thus obtain transparent glass with the property of 'photochromism'. Typical glasses are alkaline boro-alumino-silicate containing these silver halides in the form of small crystals of dimension of 80 to 150 Armstrong. The space between these dispersed particles

is around 1000 Armstrong. The chemical composition of glass, the homogeneity, the size of such particles, and the heat-treatment influence the 'sensitivity' of the kinetic process of 'darkening' and their return to normal state. It should be noted that the addition of copper ions increases the 'sensitivity' of such glasses to the light.

This kind of system works like a reversible 'plate of photography': Absorption of one photon provokes dissociation to Ag and halogen ions. The metallic silver (Ag0) absorbs the light and gives rise to a grey colour to the glass. By contrast to the usual 'photosensitive' layer in photography, these pair of ions could recombine when light is suppressed that provokes the 'whitening.

The systems are perfectly reversible and do not show the sign of 'fatigue' upto 300,000 cycles: darkening-whitening. This is in contrast to organic photo-chromic materials that show progressive degradation (i.e. aging). These glasses find their application in lenses.

CONCLUSION

Colours in special types of photo-chromic glasses have been described with mechanism for their interaction with light. This type of glass has a vast utility in solarisation. The mechanism of another type of colour for suspended particles within glass matrix has also been described along with various applications. The latter shows some path for a very important fabrication of glass-ceramics due to nucleation of small particles embedded inside the glass.

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On the Spot... Rajesh K Khosla

Announcing plans to enhance production capacity by 100% during the next phases of an ambitious investment programme, Rajesh Khosla, President and CEO of AGI glaspac, spoke exclusively to *Glass Worldwide* about the company's growth, current market trends and the performance of glass versus competitive packaging in India.

GW: What are the prevailing market conditions for the hollow sector in India and what are your forecasts for the next 12 months?
There is a temporary slowdown in the general market, owing to the local political conditions and muted consumer sentiments. The hollow sector, too, is not insulated and is going through a brief period of calmness. The Indian government is taking the necessary steps to drive up the investment, boost liquidity, restore consumer confidence and bring back the bullishness in the economy. We foresee good growth in the alcoholic beverage and pharmaceutical segments in the coming year and estimate 9% to 10% growth in the container glass market in India.

Both AGI glasspac plants have started using natural gas in their furnaces.

GW: Are any markets performing better than others and if so, what is the driving force?
Yes. The alcoholic beverages segment is performing better than other segments such as food and soft drinks. The liquor and wine segment benefitted from an extended winter this year and contributed positively to glass bottle sales. On the other hand, the crop yield this year has been low, as most of it was damaged due to heavy rainfalls in some parts of the country, while also affecting demand for jars in the food segment.

GW: How is legislation from the Indian government influencing the performance of glass versus competitive packaging such as plastic?
The initiative by the government to phase out single use plastics has been commended, in general, by the public. But the impact of the same on glass sales is yet to be realised. For alcoholic beverages, which is our major user segment, glass is already a preferred packaging material and is being used extensively. In the food and soft drinks segment, which is a high potential market for packaging materials, the switch from plastic to alternate packaging materials is happening at a slow pace. Similarly, pharmaceutical companies are yet to make up their mind on glass replacing plastics. In the long-term, I expect that most segments will follow the consumer preference of sustainable packaging, thus benefitting the hollow sector.

Future plant investments will see manufacturing capacity increased by 100%.

GW: How have other political climates such as the China-USA trade war affected prospects for the Indian glass sector?
In the age of globalisation, no country or market is insulated from the global political climate and India is no exception to that. The US adventure in Iran affects global crude supplies and has an impact on the profitability of glass in India. The China-USA trade war is also expected to affect the Indian industry but its impact on glass would be a fraction of that, as the glass business is very cost-sensitive and freight becomes a major cost element when transporting over long distances.

GW: How would you summarise the performance of AGI since our interview last year?
The past year has been a very positive and promising one. We have launched new designs, resolved bottlenecks that were limiting our capacity and improved operational indicators. Looking forward, we have plans to invest in greenfield and brownfield expansion and double our capacity.

Originally published in Glass Worldwide, preferred international journal of AIGMF

glass WORLDWIDE

GW: What are the significant movements in Indian consumer trends and how well positioned is AGI to adapt accordingly moving forward?

Indian consumer taste is evolving. The demography is shifting towards the young. They are educated, have higher disposable income and are striving for a lifestyle that is on par with international standards. They are sensitive to the environment and prefer a sustainable product. AGI, with its in-house design team and R&D capability, is well equipped and abreast of evolving trends and preferences; and would be first among equals in meeting customer expectations.

GW: Have you been particularly pleased with any recent product innovations launched by AGI?

Yes, we had a good year. The new design launches were well received and appreciated by our customers. The drive towards reducing bottle weight has been a mutually beneficial initiative and is bringing good returns to us and to customers. This year, we have launched two special types of bottles:

- Hollow decoration bottle, where the design is clearly visible but cannot be felt when the container is emptied.
- Anti-depression (negative ion) bottle: The most important benefit of AGI's negative ions is that they clear the air of airborne allergens such as pollen, mould spores, bacteria and viruses. Negative ions perform this function by attaching themselves to positively charged particles in large numbers and negatively charging those particles.

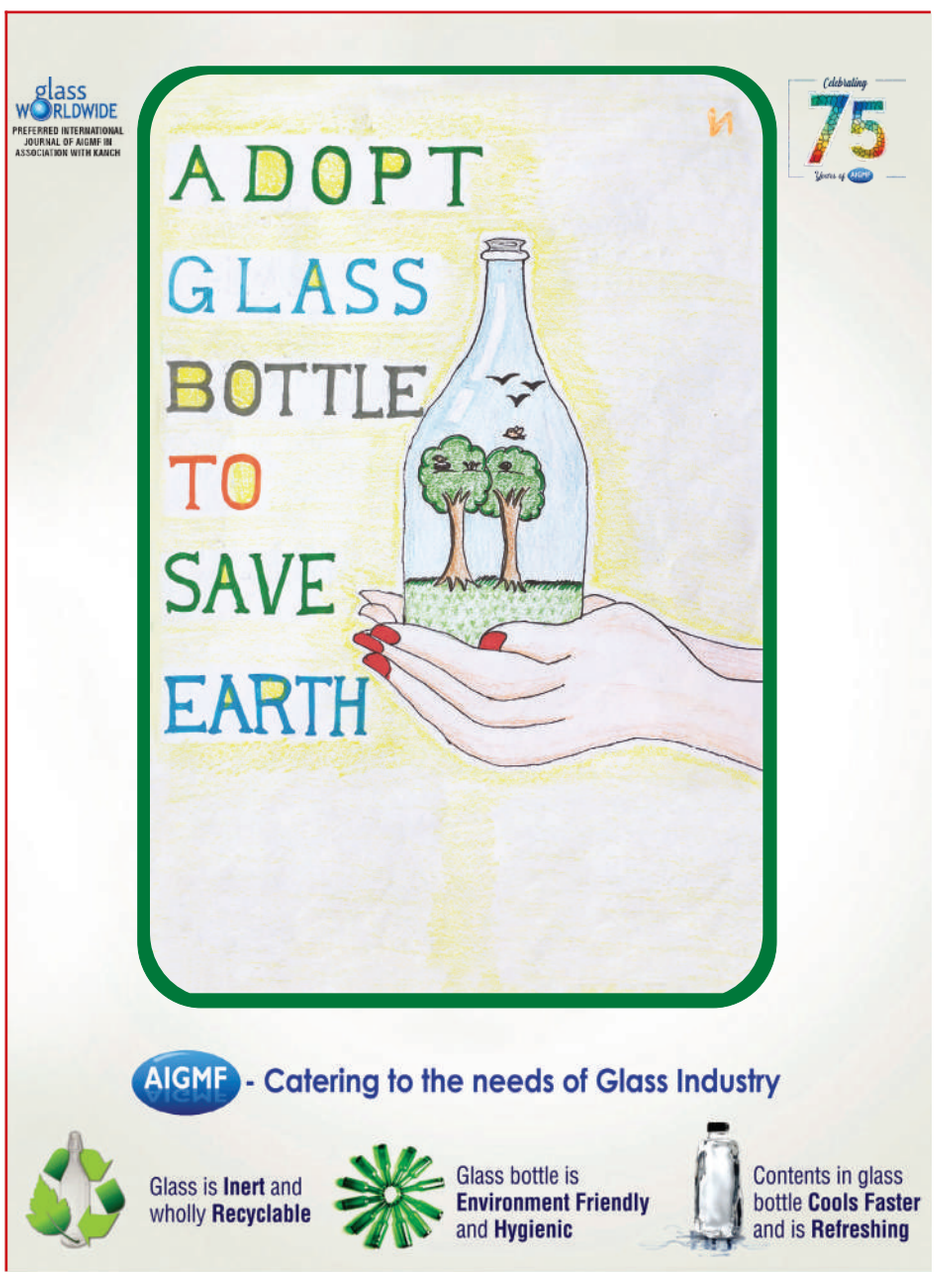
GW: Are any further product launches already planned for this year?

Yes, we have a few product launches planned this year and some of them are already in the pipeline. Our thrust is towards strengthening the in-house design and R&D capability, so you will be seeing more innovations from us in the future.

GW: Is the company taking any specific measures to control energy, raw materials and other production costs?

The company is very particular about its cost of production and believes that each cost should be accounted for and nothing should go to waste. We are entering into long-term contracts ▸

A series of greenfield and brownfield investment projects are planned.



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AIGMF/*Glass Worldwide* co-operation

Glass Worldwide is the preferred international journal of the All India Glass Manufacturers' Federation (AIGMF), in association with *Kanch*, providing the Indian sub-continent with the best possible forum for the exchange of news and views between glass manufacturers and their suppliers. *Glass Worldwide* shares the AIGMF's goals of promoting the Indian glass sector to a domestic and global audience, as well as informing Indian glass professionals of all developments from other regions. Rajesh Khosla, a member of the AIGMF executive committee, lists the main benefits of this exclusive co-operation:

- To encourage, promote and develop the manufacture of glass articles of all kinds and to safeguard and protect the interests of the glass industry and glassware business in India.
- To form a common link among glass manufacturers in India and thus develop a spirit of mutual help and co-operation with one another.
- To promote study and research in glass technology.
- To consider all matters relating to the manufacture and marketing of glass articles in India and the question of exports and imports.
- To devise ways and means for securing necessary supply of raw materials required for the manufacture of glass articles at comparatively lower prices and thus to reduce the cost of production and increase the national wealth.
- To collect necessary information and data and propagate it for the benefit of the glass industry and trade in India.
- To make representations whenever necessary to the Union Government or any unit of the Union of India for the removal of difficulties that might hamper the trade of glass articles or for the granting of special facilities for the glass industry.
- To organise a united front on behalf of all glass manufacturers and thus strive to gain all those advantages that may not be possible through individual efforts.

The Anti-depression (negative ion) bottle development

AGI glasspac's Hollow decoration bottle innovation.

with our suppliers so that they have visibility and we get the best price and guaranteed sustained supply. An energy audit of the plants is being carried out to identify and plug the energy leakages. Now, both of our plants have started using natural gas in the furnaces and are substituting for a part of the alternate less green fuel in our energy mix. To harness the advances in technology, the company has plans to invest 130 Crs in the technology upgrade.

GW: How successful have investments in production facilities proved to be in recent times?
We have generated favourable returns on investments. As mentioned earlier, we have plans for further technology upgrades and investment in building new capacities.

GW: What is your strategy for further investments in AGI's manufacturing plants?
As stated earlier, we are enhancing our production capacity by 100%. The investment is planned in two phases and will be spread over a number of years.

GW: Will there be any further increases in capacity and are any specific investment projects already underway or planned for the coming months?
The additional capacity will be added through both greenfield projects and brownfield expansions. The major addition will be from new facilities planned in two phases. Phase one will add 400 tonnes/day and phase two will add 350 tonnes/day capacity.

GW: Are you investing in digital platforms to assist the production capabilities?
Yes, we are working on automation, IoT, Industry 4.0, smart manufacturing and digitalisation fronts. It will standardise processes, minimise errors on account of human inefficiency and equip us with a lot of process data that can be analysed for further improvements. Our intention is to extend digitisation to our customers and suppliers as well.

GW: How important are your suppliers of production technology and machinery in reaching the company's goals?
We believe in maintaining a sustainable business relationship with our suppliers. They are very important and are an integral part of our business strategy.

GW: How useful was glasspex INDIA 2019 in Mumbai last September for meeting your international suppliers and what was achieved?
Glasspex INDIA 2019 was fantastic for AGI glaspac. Our stand attracted many visitors and suppliers from more than 10 countries and from companies involved in glass production, processing and finishing technology, measurement and control engineering, tools, replacement, auxiliary, equipment fittings, contracting, consulting, engineering, research and teaching, trade literature, trade associations and many more. We have built many strong relationships with our suppliers and discussed their contributions to AGI glaspac.

GW: And what did the parallel 13th International Conference of the AIGMF add to proceedings?
This was a high profile content-driven conference that highlighted key issues and developments by industry experts. I compliment the complete AIGMF team and Dave Fordham of *Glass Worldwide* for his exceptional moderation. ●

Further information:
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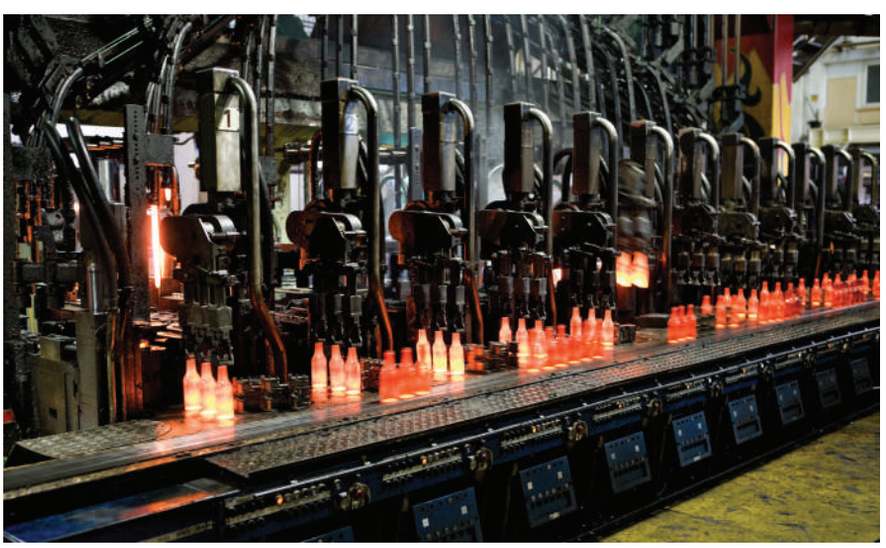
Glass Production and Sustainability

The production of glass or molten glass, to be precise, is doubtlessly very energy-intensive. The approx. 6,800 tons of glass produced in Germany in 2015 consumed almost 18.50 terawatt hours of energy. By comparison: in 2019 the entire power generation in Germany amounted to some 607 terawatt hours. Almost 273 million tons of CO_2 were emitted just from power generation in this country.

At 44% container glass accounted for slightly less than half the energy consumed in glass production. Approx., 29% of energy was used for manufacturing flat glass and another 11% for processing it. The remaining consumption was accounted for by fibreglass and special glass production. The lion's share of energy required at just under 80% takes the shape of process heat, which is predominantly obtained from natural gas. Additionally, electricity is needed for electrically propelling machines and electric boosting for melting.

In glass production temperatures must be kept constant. This is the only way to ensure the sustained high quality of the finished products according to the Federal Association of the Glass Industry (BundesverbandGlasindustriee.V. (BV Glas)). Against this backdrop a constant energy supply of sustained quality is imperative because glass production is a non-intermittent process 24/7, 365 days a year.

In the wake of the on-going energy transition and desired decarbonisation, various alternatives to natural gas are currently being considered and studied. In Germany, for example, one container glass producer will build the first hybrid oxy-fuel melting tank, which can be operated with 80% renewable energies. The aim is to save 50% CO_2 emissions in melting. The project was initiated by the European container glass industry and is funded by the EU. BV Glas has launched a project on the national level that looks at whether hydrogen is suitable (Power to X) for being added to, or even replacing natural gas. Even the use of biogenic fuels based on biogas, for example, could be considered but is challenging due to the high demands made and need for consistent quality.



Looking at these red-hot glass bottles it is evident that glass production is highly energy-intensive. *Photo: Federal Association of the Glass Industry*

HIGH DUST POLLUTION ASSOCIATED WITH PRODUCTION

On top of this, glass melting also produces fine dust as a result of waste gas scrubbing and fine grains when reclaiming cullet. In Germany the percentage of waste glass reused ranges from roughly 60% for white glass to almost 95% for green glass. As a matter of principle, glass is a material that can be recycled 100% time and again without any loss of quality.

The resulting dust, however, could not be molten and used for production so far because this would have caused plenty of dust in the combustion and regenerator chambers and, hence, led to process disruptions and damage to the plants. As part of an environment innovation programme, a solution was found for this and a plant was funded at a Bavarian glass manufacturer for the beverage and food industry. In this plant the fine dust is compacted into briquettes and then introduced fully automatically into the melting tank with cullet and primary raw materials. This reduces waste by some 25,000 tons annually and saves about the same amount of primary raw materials.

Just as important as climate protection and sustainability including compliance with the Paris Climate Accord is, of course, maintaining competitiveness and/or the further economic growth of this industry. To reconcile both of these objectives there are various strategies and concepts such as the "IN4climate.NRW" initiative launched by the North Rhine-Westphalian government or the energy efficiency network "GlasNET 2.0", a network of companies in the glass industry under the umbrella of the Energy Efficiency Network of the Federal Government.

SHORT-TERM FINETUNING OF RECYCLING PROCESSES

A crucial component for improving environmental protection and sustainability is a continued expansion of the recycling industry. Here, the aspect of resource savings also comes into play. Despite fully operational material cycles glass recycling still has some fields that require exploring from scratch. A case in point is the following example of a large-scale plant erected to break down cathode ray tubes from TV sets.

The introduction of modern displays using LCD, LED, plasma and 3D technology entailed a rapid replacement of old CRT TV sets and monitors over the past years – and, hence, over 160,000 tons of used sets per year. Today, there are only small quantities of CRT sets being discarded but in this day and age we are confronted with the question of how to find a meaningful exploitation of the coated glass tubes that are usually treated as hazardous waste.

In the mid-1990s ZME Elektronik Recycling GmbH already commissioned a plant that could sort up to 500,000 tubes and allocate the materials to the respective glass types for further reclamation. The plant was something special because systems for treating and cleaning cathode ray tubes, so-called decoating lines, were not available as standard solutions in machinery and plant engineering. The experience gained back then served as a blueprint for engineering a bigger and more modern plant commissioned in 2007.

The aim of television tube recycling was to retain the raw materials included in the glass matrix such as lead, barium, strontium etc. Today, these raw materials are increasingly extracted and the tubes are practically de-coated. Reusable picture tube glass only requires a very low energy input for re-melting and therefore saves between 10% and 15% of the heating energy required. What's more, meaningful recycling helped to remove television tube glass from other "recycling paths" such as road building or construction and also rendered landfill superfluous.

The input materials for glass production: 60% cullet, 29% sand, 5% soda, 4.5% lime, 1.5% dolomite and feldspar. *Illustration: Federal Association of the Glass Industry*

This example shows that practically every technical development requires its own recycling concept ■

Heye Ranger 2 – Camera Check Detection at its Best

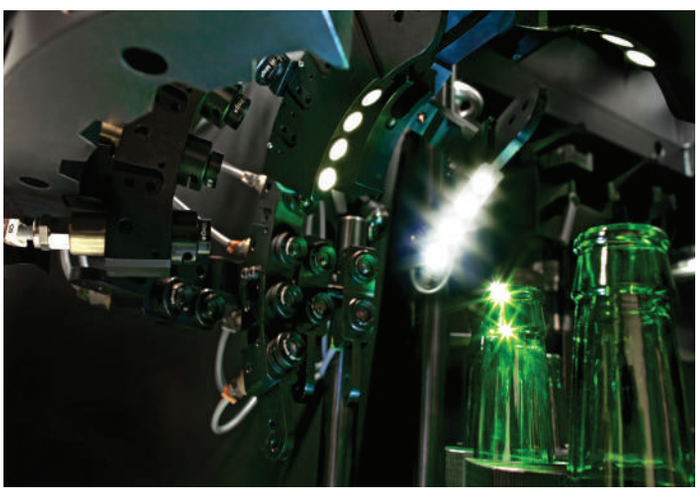
Check detection is one of the most important quality inspections in container glass production. The HiSHIELD Ranger 2 has been developed to fulfill the customer's quality expectations and it is fully available in every country.

FULLY MODULAR AND SCALABLE SYSTEM

A Ranger 2 system consists of one camera, collecting five images simultaneously via five lenses and fiber optic image guides, the illumination unit and the control unit with the software for image processing, including the decision "container okay or not okay". Based on the budget and needs of the glass plant, you can start with one system and add any number of parallel systems whenever you want. A typical and recommended configuration would be four parallel systems, each dedicated to and optimized for one of the following types of checks:

- horizontal
- shoulder
- vertical
- bottom

Each system runs independently and does not need to be synchronised with the others. So there is no influence or need to compromise between the systems. This allows an individual optimisation of all settings (illumination etc.) for the respective type of check. If one system is not



available or not adjusted optimally, the others are still fully operational.

INTELLIGENT CLOUD MASKING – SELF LEARNING SYSTEMS

Every container produced must be regarded as a unique object and any check detection concept has to respect this. For this reason each Ranger 2 system is using Heye's Intelligent Cloud Masking (ICM). Bearing in mind that each article is distinctive, the Ranger 2 system is designed to investigate each one independently. Accordingly, it is not necessary to teach the detection system, but each container serves as a time saving reference for itself. Moreover, the inspection zones are dynamic in nature. The Ranger 2 system is therefore able to detect different variations of checks, as well as to recognize new variations of them during production.

Apart from advanced camera and non-contact solutions, smart data is the key. The HeyePlantPilot collects and aggregates production data in the plant. The borders between Hot End and Cold End will disappear, information is shared on the spot. Tracking and tracing as well as the possibility of creating user-specific analysis are additional components, allowing continuous improvement processes to increase productivity. Self-learning systems are one of the cornerstones of Industry 4.0. The Ranger 2 camera check detection proves to be the best solution in the market. Heye's clear and innovative product strategy, integrating latest camera solutions, remains unchanged ■

Further information:

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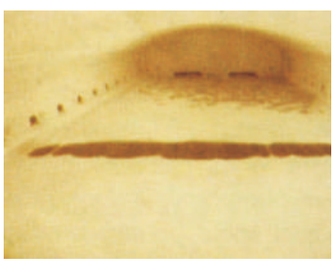







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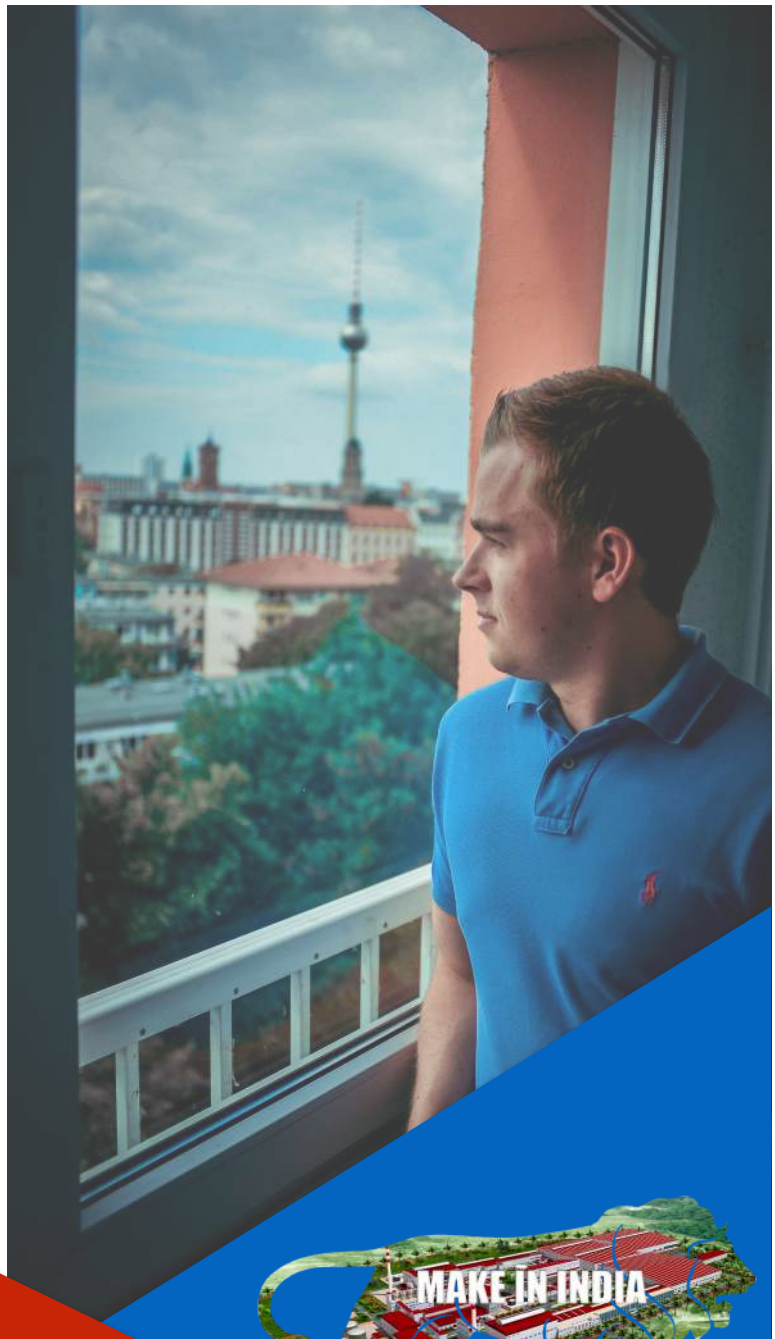

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