Vol. 4 | No. 1 | April - June 2016

Kañch

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

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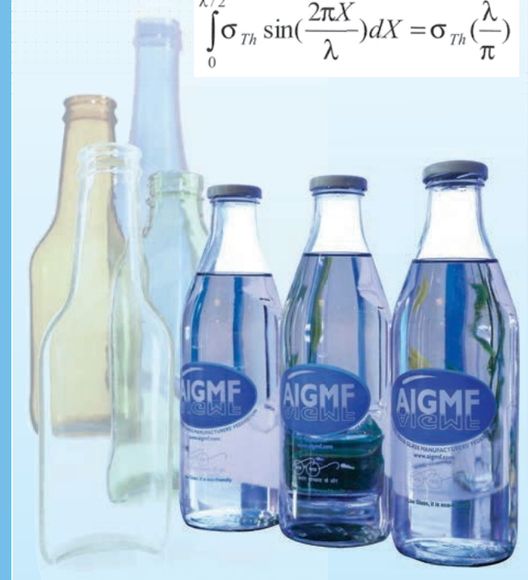

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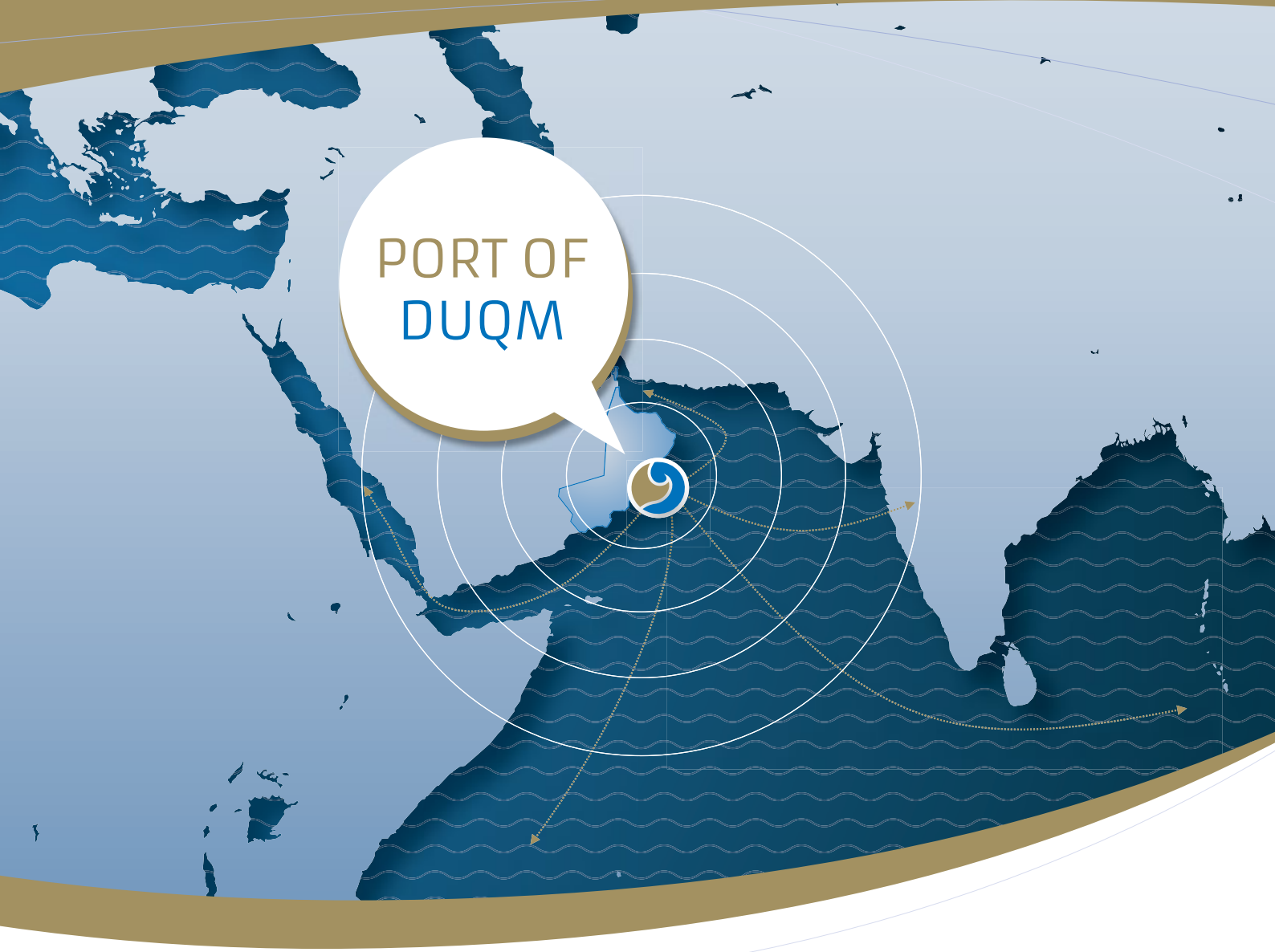

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Vol. 4 | No. 1 | April-June 2016

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From President's Desk

The Federation continued to work for the development of glass articles of all kinds and to safeguard and protect the interests of glass industry and glassware business in India. Several meetings were organised with stakeholders of flat and container glass segments including Govt. Departments i.e. Ministry of Commerce, MSME, etc.

The Executive Committee of the AIGMF met on June 25, 2016 at Central Glass and Ceramic Research Institute (CSIR-CGCRI), Kolkata.

A parallel session on Glass Packaging Supporting Swachh Bharat Abhiyan was organized with CSIR-CGCRI, which provided an opportunity to debate on use of glass packaging as responsible and safe packaging, which supports Swachh Bharat Abhiyaan (clean India campaign).

As CSR initiative, AIGMF gifted 400 glass water bottles specially manufactured by Hindustan National Glass and Industries to CSIR-CGCRI and 100 glass bottles to Dr. Chintamoni Ghosh, Director, Drug Control, Health & Family Welfare Department, Govt. of West Bengal. The bottles carried a logo of Swachh Bharat Abhiyaan enabling people demand responsible and safe packaging.

About 80 participants from CSIR-CGCRI, Glass Industry, Media, Govt., Scientists, etc., attended the event.

A presentation on 'Need of Glass Packaging for Health and Environmental Reasons' was made by Sr. Vice President AIGMF, Mr. Arun Kumar Dukkipati, which highlighted that Glass is a very important material for daily life in the entire world. It is a natural material for packaging, particularly items like food and medicines consumed in abundance by humans.

Dr. K Muraleedharan, Director CSIR-CGCRI applauded advanced production techniques used by the Industry to manufacture light weight glass bottles and jars with no loss of safety or quality. This benefits not only consumers but also the environment.

Presentations and select photographs of the event are available at http://www.aigmf.com/past-events.php ■

Sanjay Ganjoo
President, AIGMF
and COO, Asahi India Glass Ltd., Taloja (Maharashtra)

Glass Packaging Supporting Swachh Bharat Abhiyaan

(Kolkata, June 25, 2016)

स्वच्छ भारत
एक कदम स्वच्छता की ओर

(Clean India Campaign)

After the successful sessions on Swachh Bharat Abhiyan at Delhi, Firozabad, Jaipur and Mumbai, the Executive Committee of The All India Glass Manufacturers' Federation (AIGMF) decided to hold its next meeting at Central Glass and Ceramic Research Institute (CSIR-CGCRI), Kolkata.

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Environmental Reasons' was made by Sr. Vice President AIGMF, Mr. Arun Kumar Dukkipati, which highlighted that Glass is a very important material for daily life in the entire world. It is a natural material for packaging, particularly items like food and medicines consumed in abundance by humans.

The presentation covered that Glass containers made from cullet or weight reduction technology saves energy. Every ton of glass recycled saves 322KwH of energy, 246 kg of CO_2 and 1.2 tonnes of virgin raw material. Mr. Dukkipati shared some of the main characteristics of glass:

- Glass is 100% recyclable - It does not lead to generation of any solid waste, thus saving land fill space. This is a major advantage from environmental point of view in the present times, when municipalities are finding it difficult to find space to dump urban waste
- Glass is resistant to chemicals and solvent - It is used for packaging of chemicals and solvents as it does not react with them
- Glass ensures hermetic seal - It provides air tight packaging for products thus providing longer shelf life. It is the most preferable product for vacuum and carbonation
- Glass is transparent - The customer is afforded the facility of visually examining the content from outside the pack
- Glass has best recycling performance - It is a cradle-to-cradle packaging - meaning it can be recycled infinitely to be re-made into new bottles

or jars as good as those manufactured by using fresh raw materials

A presentation on Recent Initiatives by Glass Industry on Swachh Bharat Abhiyaan was given by the AIGMF Secretariat.

Dr. Ranjan Sen, Chief Scientist and Head, Glass Division, Fiber Optics & Photonics Division, CGCRI gave an overview on the CGCRI and its activities.

His presentation covered services offered by CGCRI towards testing of Glass/Glass Products.

Dr. Basudeb Karmakar, Sr. Principal Scientist and Head, Glass Science & Technology Section, CGCRI in his brief presentation covered some useful suggestions on how Glass Packaging can further bolster clean India campaign.

As CSR initiative, AIGMF gifted 400 glass water bottles specially manufactured by Hindustan National Glass and Industries to CSIR-CGCRI and 100 glass bottles to Dr. Chintamoni Ghosh, Director, Drug Control, Health & Family Welfare Department, Govt. of West Bengal.

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The bottles carried a logo of Swachh Bharat Abhiyaan enabling people demand responsible and safe packaging.

Dr. K Muraleedharan, Director CSIR-CGCRI applauded advanced production techniques used by the Industry to manufacture light weight glass bottles and jars with no loss of safety or quality. This benefits not only consumers but also the environment.

It was mentioned that use of glass bottles supplements Prime Ministers' vision of Swachh Bharat Mission (Clean India Campaign) as waste from other packaging material are usually found in streets, drains, rivers, etc., with people having the tendency to litter anywhere and everywhere. On the other hand, Glass being 100 % recyclable mostly reaches junk seller for recycling and adds to clean environment.

Mr. Sanjay Ganjoo, President, AIGMF said that apart from flat glass, container glasses are also used in modern 'Smart Cities' for

delivered a thank you note to all stakeholders for their valuable contribution in making this program a success.

About 80 participants from CSIR-CGCRI, Glass Industry, media, scientists, etc. attended the event.

Presentations and select photographs of the event are available at http://www.aigmf.com/past-events.php ■

tumblers, bottles, cooking wares, etc., at home and eateries.

Mr. Ganjoo congratulated CSIR-CGCRI for adopting use of glass bottles in its premises, which is a step forward towards clean environment.

Mr. Sushil Kumar Jhunjhunwala, CMD, LA Opala RG Ltd., and President, Eastern India Glass Manufacturers' Association (EIGMA)

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GLASS News

Phoenix Award- Glass Person of the Year 2016

In recognition of his outstanding contribution to the international automotive glass industry, Cho Tak Wong, Chairman of Fuyao Glass Industry Group, has been selected as the 46th recipient of the Phoenix Award 'Glass Person of the Year 2016'.

Born and raised in rural China, the life of Chairman Cho is a true rags-to riches story. Having peddled cut tobacco and sold fruit on the streets of his hometown at the age of 16, he worked as a farmer and a chef, before joining Fuqing Gao Shan Special Glass Factory in 1976. Mr. Cho was invited by the local authorities to take over the ailing flat glass processing business in 1983, a decision that soon led to the creation of a hugely successful Sino-foreign joint venture, manufacturing automotive safety and industrial technology glass throughout the world. In 1993, Fuyao Group became the first company in its sector in China to be listed on the Shanghai Stock Exchange.

Today, the Fuyao Group is China's largest exporter of automotive glass, with 11 advanced production centres strategically located throughout the country, as well as international subsidiaries and business organisations in the USA, Japan, South Korea, Australia, Russia, Germany and Hong Kong. Customers include such global automotive producers as Audi, Bentley, BMW, Chrysler, Daimler, Fiat, Ford, General Motors, Honda, Hyundai, Jaguar Land Rover, Nissan, Volkswagen and Volvo.

In 2009, Mr. Cho became the first Chinese citizen to be named Ernst & Young World Entrepreneur of the Year.

Alongside his extensive business commitments, Mr. Cho is one of China's foremost philanthropists, his Heren Charity Foundation seeking to offer poverty relief, disease prevention and infrastructure projects. "I have always believed that an entrepreneur carries three responsibilities" he comments, "mightiness of the nation, advancement of the society and abundance of the people. By achieving these three items, an entrepreneur can fully deserve his title."

The Phoenix Award Committee congratulates and acknowledges Mr. Cho Tak Wong's many achievements and looks forward to presenting him with the 46th Annual Phoenix Award at a specially arranged banquet in Dayton, Ohio, USA this October.

Heye International announces new Sales Director

With effect from April 1, 2016, Heye announces the appointment of Jens Langer as Director Sales & Marketing.

Since many years, Jens Langer has gained extensive experience as international Sales & Marketing Director as well as Head of Project Management in the mechanical engineering industry. Now he will share his knowledge with Heye International to keep and develop the company's growth strategy.

Falling Solar Cost Attracts Foreign Investment of India

Solar energy tariff in India has become extremely competitive, falling to a record-low of Rs. 4.34 a unit in January as overseas and local renewable energy firms bid aggressively to win projects under the government provided solar parks. These solar parks provide ready infrastructure and land for developers to build projects, reducing the risks and helping bring the cost of energy down.

India needs as much as $200 billion to meet its target to install 100 GW of solar power and 60,000 MW of wind power by 2022. This has seen global investors, including the renewable energy companies, make a beeline for the country.

CLP India Pvt. Ltd., one of the largest investors in India's power sector, is planning to invest about $1 billion for setting up over 1 GW of solar plant over the next 3-5 years through JNNSM. CLP India operates more than 3,000 MW of power capacity across its wind, coal fired and gas-based power projects. A number of renewable energy producers too are looking for investors and partners to finish their pipeline of committed projects.

"Solar has now become manageable in the country as far as the tariffs are concerned. With tariffs coming down we thought it was a good time to start solar. In last couple of years, we've been making a lot of effort to put up a bid together", CLP India said.

2nd ICG Winter School held in Wuhan, China

34 Students and 12 teachers gathered this springtime for the second China Winter School. The seasonal mismatch in the title was even more apparent as warm weather arrived in Wuhan at the same time as the delegates. Nevertheless the heavy rain and thunder which quickly followed did nothing to dampen the enthusiasm of those present.

The date (March 31 - April 4, 2016) though had been chosen so that the school immediately proceeded the ICG Congress in Shanghai with the intention of attracting more overseas delegates. In the event most were still from China, but with India, Japan and Sudan also represented.

The day began early for teachers and students alike with an 8 am start in a well-equipped lecture theatre just a quarter of a mile from the hotel. Apart from the first day, five 45 minute lectures were completed each day before the lunch break at noon. The subject matter ranged over glass fundamentals through structural analysis to advanced applications, and from glass strength to optical properties such as coatings and quantum dot structures. The ICG team gave about half the lectures and the remainder were presented by academics from Wuhan itself or other Chinese Universities working on glass.

At the end of each lecture the students were encouraged to ask questions

and this was one of the successful aspects of the course. Indeed based on student perceptions of the event, the next course will shift the emphasis slightly from formal teaching to both unstructured and structured discussion sessions, the latter having a more tutorial emphasis.

On the first afternoon, students gave short presentations of their research. This was planned to help them find their voices but also to inform those present of the wide range of glass activities in China. Presentations spanned subjects as diverse as foamed products for buildings to nanocrystalline fibre laser amplifiers. Almost immediately afterwards project subjects and groupings were announced, based on individual interests. The target date for presenting their conclusions was the last afternoon of the school.

Immediately after lunch on the second day the group activities began and the class room atmosphere was almost as electric as the gathering storm clouds outside. Separating the students from their groups for dinner at 6 pm proved a significant task. The third afternoon was equally intense and a planned social session after dinner in a local coffee house proved a time for discussion with tutors and final honing of presentations.

On the final afternoon, eight groups had 10 minutes to present their conclusions and were then faced by a further 10 minute grilling by speakers and students alike. Subjects ranged widely from the analysis of archaeological samples through the carbon footprint of double glazed windows, and from the motion of oxygen's linked to sodium ion diffusion to 3D printing. Finally the winning group who examined the value of double glazing in Wuhan was the one adjudged to have produced the best structured and most persuasive argument. The members of this group were: Zhou Wang, Kai Chen, Jun Zhang, Wenke Li and Jinwei Li.

Following were the main speakers: Prof. Yiwang Bao (China Building Materials Academy), Prof. Reinhard Conradt (Aachen University), Prof. Bernard Hehlen (Montpellier University), Prof. Lili Hu (SIOM, CAS, China), Prof. John Parker (Sheffield University), Prof. Jianrong Qui (South China University of Technology), Prof. Jinjun Ren (SIOM, CAS, China), Prof. Jian Ruan (Wuhan University of Technology, Dr. Akira Takada (Asahi Glass Company), Prof. Rene Vacher (Montpellier University), Prof. Yuansheng Wang (FJIRSM, CAS, China), Prof. Song Ye (Tongji University), Prof. Xiujian Zhao (Wuhan University of Technology).

ICG acknowledged particular thanks to the Dean of Faculty at Wuhan, Prof. Xiujian Zhao and the local event organiser, Prof. Chao Liu. The quality of the organisation for the event was praised by several students in their final questionnaire with comments such as "Wonderful" and "Don't change anything!"

The next ICG Winter School is currently planned for 13-17th November 2017. Do put the date in your diary and watch the ICG web site (www.icglass.org) for updates.

Safe & Circular: Boosting Recycling Rates and Ensuring Food Safety

A tighter convergence of objectives and a stronger legal coherence between the safety of Food Contact Materials and the principles of the Circular Economy were debated at European Parliament and co-hosted by MEPs Birgit Collin-Langen (EPP, DE) and Christel Schaldemose (S&D, DK). The increase of waste recycling in the future EU Circular Economy must also ensure increased safety of food contact materials.

Food contact materials and articles are today covered by the EU Framework Regulation (EC) No 1935/2004 which establishes general safety requirements and identifies 17 groups of materials and articles that may be subject to harmonised measures. In the absence of the specific rules for non-harmonised groups of materials and articles the possibility remains for Member States to adopt national provisions. Thus, diverse national interpretation results in additional market obstacles, loss of competitiveness, and difficult access to the market for business operators.

The draft report on the implementation of the Food Contact Materials Regulation (1) has been recently published by its Rapporteur MEP Schaldemose in the ENVI Committee. It calls for further harmonisation at EU level for non-harmonised materials through specific measures based on scientific evidence, better risk assessment, and traceability and monitoring of compliance with legislation.

"The EU Framework Regulation constitutes a solid legal basis, and its objectives remain relevant, commented MEP Schaldemose, but this is no longer enough to guarantee the safety of recycled materials which can potentially contain substances dangerous for consumers' health. It is really great we can work on this topic together".

A more harmonised Food Contact Material legislation which takes account of the Circular Economy challenges will also give better market access to those materials which do not contain chemicals, are safely recycled in clean and simple streams and can guarantee consumer safety

because of their inherent properties.

"We are now working at these challenges in the ENVI Committee. Safety and recyclability of food packaging needs to be addressed simultaneously and urgently", warned MEP Collin-Langen, Shadow Rapporteur on the Report, "only then will we be able to guarantee a high level of health protection for EU citizens and minimize the impacts on the environment".

In his intervention to the debate, Michael Warhurst from CHEM Trust made the case for more harmonised regulation of chemicals in contact with food and called for a direct link between REACH and food contact legislation (2). "We need a stronger connection between the promotion of recycling and ensuring the safety of recycled materials used in food contact applications. In addition, a true circular economy requires the removal of problem chemicals at the design stage, making non-toxic material cycles a reality".

The Secretary-General of the European Container Glass Federation (FEVE), which collaborated in the organisation of the MEP debate (3) remarked that "it is important we have harmonised EU legislation for all food packaging materials to get rid of any internal market barriers to the circulation of safe recycled packaging. The use of permanent materials like glass should be encouraged: they do not lose their safety properties no matter how many times they are recycled".

When it Comes to Recycling, Age Matters

Although Europeans are becoming increasingly aware of the importance of recycling food and drink packaging, older generations are more informed and committed than younger ones. According to a Europe-wide independent survey involving 8,000 European consumers in 11 countries and commissioned by the Friends of Glass community, over 94% of European consumers recycle their household packaging material and most see glass as the most recyclable option.

When categorized into age groups, older generations are generally more aware of the importance of environmental benefits of recycling food and drink packaging. Here the awareness gap is quite important in all countries. In Spain, there is an awareness difference between young/ old of 27%. In Slovakia, this number is down to 20%. The 60+ age group also recycles practically all of their packaging (including glass bottles and jars) and generally outperforms the 18-29 age group. In some countries such as Croatia (23%) and the UK (22%) the gap is much higher than in other countries such as Czech Republic (13%) or Italy (7%).

Speaking on behalf of Friends of Glass, President of FEVE, Vitaliano Torno said, "Nowadays, younger people lead busier lives. We know that their recycling efforts can have a positive impact on the planet their children will inherit. Millennials can make a proactive start now by adopting a more sustainable lifestyle, but also by choosing to use, and recycle, more glass. As the industry body for European Glass Packaging, we are more than aware that a lot needs to be done to better inform and engage a younger generation, hence our continued investment in Friends of Glass".

Most countries surveyed say that glass is their preferred packaging choice for its environmental credentials. In 9 out of the 11 countries surveyed, people on average recycle 6-20 glass items in a month. Some countries like Slovakia or Czech Republic are slightly less engaged. In Switzerland, almost all people claim to recycle glass (93%), followed by Italy (91%) and Germany (89%). France (74%) and Spain (77%) are the countries with the highest rate of people who know that glass can be 'infinitely' recycled into new bottles and jars.

The survey also took gender differences into consideration. Women are less aware of the sustainable properties of glass than men. This was especially prevalent in the survey findings for participants in the United Kingdom, Germany and the Czech Republic. Also, in general, men make use of more packaging than women. In Slovakia and Croatia, there is a lower awareness about the recycling benefits of glass among both genders. In Switzerland, both men and woman recycle at a rate of above 90%.

Vitaliano Torno added: "We are encouraged that, as a sustainable topic, recycling is considered so important for European consumers. Even more encouraging is that they also view glass as the gold standard for sustainable living - given its unique recycling properties. We can be very satisfied with what we have achieved to date but we must not become complacent and we must continue to work hard to inform people that glass bottles have endless lives. Also, they are the most precious resource when it comes to making new bottles as recycled glass replaces virgin raw materials, saves energy and benefits the environment. European consumers can actively contribute to achieve a 100% recycling rate by bringing their used glass bottles to the nearest bottle bank" ■

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

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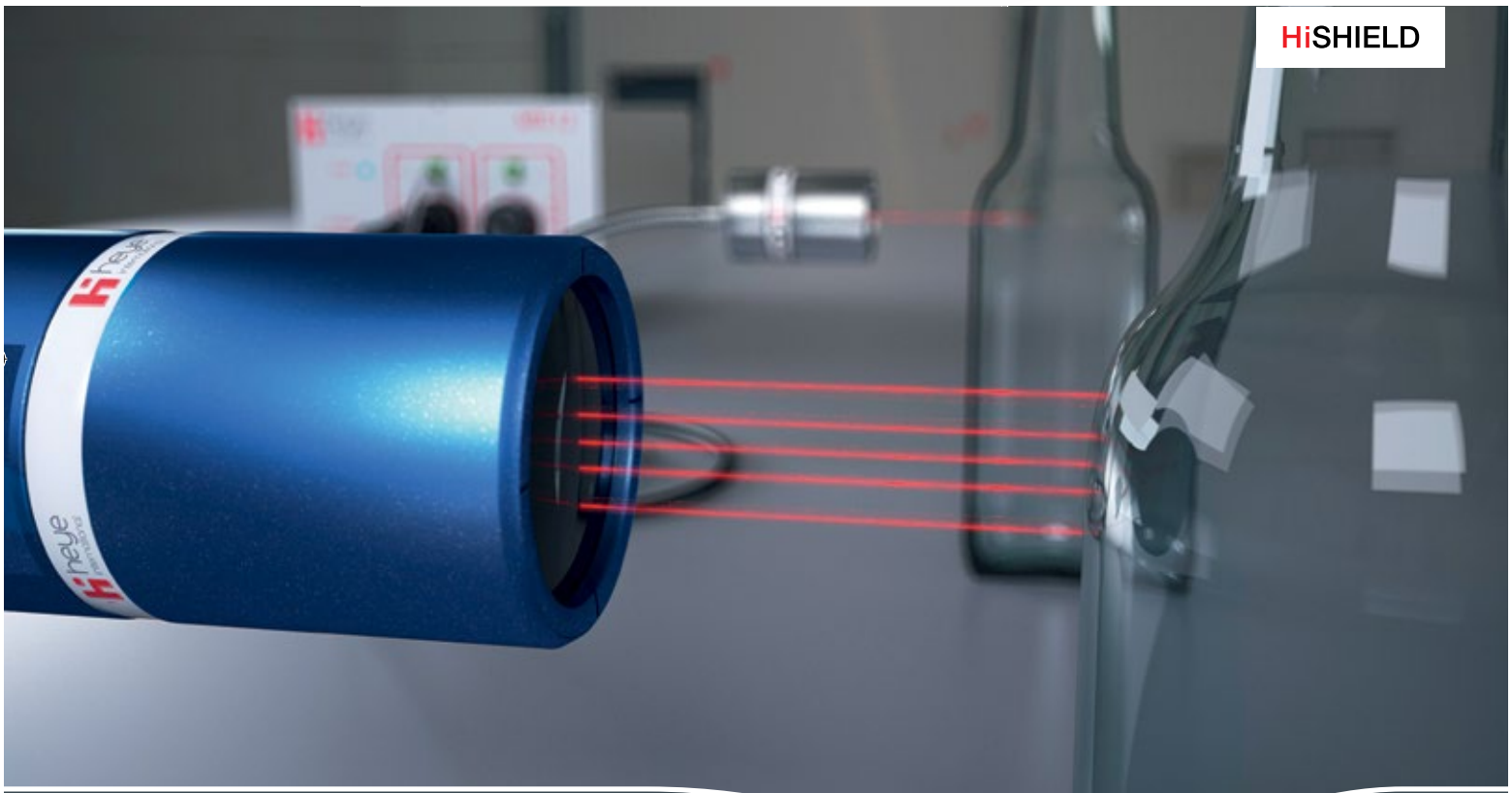

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Sustainability in glass

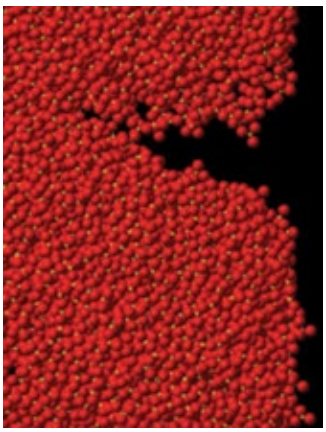
According to Robert Weisenburger Lipetz, the Usable Glass Strength Coalition represents an opportunity to share the costs and benefits of fundamental research into glass strength.

UGSC
Usable Glass Strength Coalition

Glass Worldwide
is the official journal of
UGSC

Robert Weisenburger Lipetz is Secretary, of the Usable Glass Strength Coalition and Executive Director at the Glass Manufacturing Industry Council.

Sustainability is a key strategic objective for industrial organisations. A fundamentally stronger usable glass would revolutionise the efficiencies of glass production, significantly reducing energy use, production and transportation costs, material usage and environmental emissions. A stronger glass would also revolutionise the uses and efficiencies of glass applications, rendering enormous efficiencies in all related industries, such as food and beverage, transportation, wind and solar and electronics.



A crack propagates into the glass from a surface flaw.

Unfortunately, the pace of innovation in the glass manufacturing industry lags behind that of other industries, in part because of the competitiveness of companies, creating uncollaborative silos of research. Such competitiveness tends to force focus more on short-term ROI, which favours applied research over basic research. While useful, applied research is not likely to produce the game-changing innovation in glass strength that would yield a quantum leap in sustainability achievements.

GAME-CHANGER

Although a ubiquitous and extremely versatile material, it is well known that glass is subjected to fundamental flaws, it fractures and to make it strong enough to use, it is heavy. If it could be understood why glass factures and thus create new manufacturing processes that lightweight glass products and create a glass that is tens or hundreds of times stronger in use, it would revolutionise the use of glass as a material and have a huge impact on sustainability objectives.

The industry-led consortium, the Usable Glass Strength Coalition (UGSC), is an opportunity for companies that participate in the glass industry to share costs and the potential benefits of fundamental research into usable glass strength, without breaking their research budgets.

Table 1 compares the theoretical strength of glass and the material's usable strength. Currently, the brittle nature of glass is highly susceptible to the generation of fatal surface flaws during manufacture and handling. As a result, the usable strength of glass has only reached a fraction of its potential and typical glass applications realise only 0.5% of the intrinsic strength. Improved processing techniques and secondary treatments like thermal and chemical tempering have pushed the strength envelope even further to around 4% of intrinsic strength[1].

Even modest gains in glass strength translate to sustainability efficiencies. Less raw material is needed to make the same products. Less energy is required, creating substantial savings and reducing emissions. Furnace campaigns are extended. Forming production requires less time. Stronger glass means lighter products. Transportation costs are reduced and storage is more efficient, yet what holds the most potential to revolutionise glass usage is the fact that stronger, lighter glass vastly multiplies the uses available for products and makes them more efficient. A breakthrough in the understanding and thus the production of strong glass would be a game-changer.

A number of techniques exist to increase the usable strength of glass, such as lamination, chemical and thermal tempering. The UGSC is based on the idea that the real payoff comes from understanding the nucleation of flaws in glass, creating a stronger base of glass and then applying these techniques for a giant leap in glass strength.

FUNDAMENTAL LABORATORY TECHNIQUES

The UGSC is at a point where advancing fundamental laboratory techniques can be exploited. Over the last decade, the development of cutting edge research tools has been observed, including:

- The two-point bend test for glass fibres.
- Improved computer modeling of flaws and fracture surfaces, utilising super computers in national laboratories and universities.
- The Abrio stress birefringence technique, capable of studying the effect of impacts on the near surface region.
- Advances in the use of atomic force microscopy to study flaw sites and the relaxation of indentation on the surface of glass to study cracks.
- Probing of molecular species orientation with vibrational sum frequency generation spectroscopy.
- And an increased understanding of surface phenomena, including corrosion and the interaction of glass with coatings and the environment.

Unfortunately, the funding to rigorously put the techniques and capabilities to use in understanding glass strength is not readily available and research is sporadic. The means to address this has been discussed at international conferences, such as the PACRIM and GOMD meetings from 2009 through to 2011. It was there that the concept of developing a coalition

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glass WORLDWIDE

Condition of Glass	Strength (lb/in²)
Theoretical/Lab Demonstrated	2,000,000
Pressed Articles	3,000-8,000
Blown Ware • Inner Surface	4,000-9,000 15,000-40,000
Drawn Tubing or Rod	6,000-15,000
Glass Fibers • Freshly Drawn • Annealed • Telecommunication	 30,000-40,000 10,000-40,000 >100,000
Window Glass • LCD (0.65 mm) • Chemically Treated Cover Glass	8,000-20,00 45,000 100,000-200,000

Table 1: Theoretical versus usable glass strength.

was born to unite glass users, glass manufacturers, academics and government representatives, as an effort to begin crafting a research roadmap, identifying public and private funding and negotiating a method of sharing information. The shared vision is that most glass companies cannot independently support a fundamental research agenda to understand and significantly improve the usable strength of glass. However, by working together with pooled funding and shared risk, the opportunity to significantly improve the usable strength of glass is achievable.

KEY OBJECTIVES

The UGSC's mission is as an industry-driven and supported pre-competitive research programme to identify critical parameters for improving the usable strength of glass. With this emphasis on pre-competitive research, the UGSC places research results in the public domain and does not seek patent protection. However, coalition participants have the substantial benefit of having first access to research results, prior to these results being made public.

Key objectives of the coalition are:

- A fundamental understanding of the initiation of flaws in both simple and multi-component oxide glasses, including new tools and analysis techniques.
- Ensuring glass science research continues at the university level and to provide industry guidance on the direction of research.
- Fostering collaborative relationships among industry members and between industry and universities.
- The development of the next generation of glass technical experts and researchers.

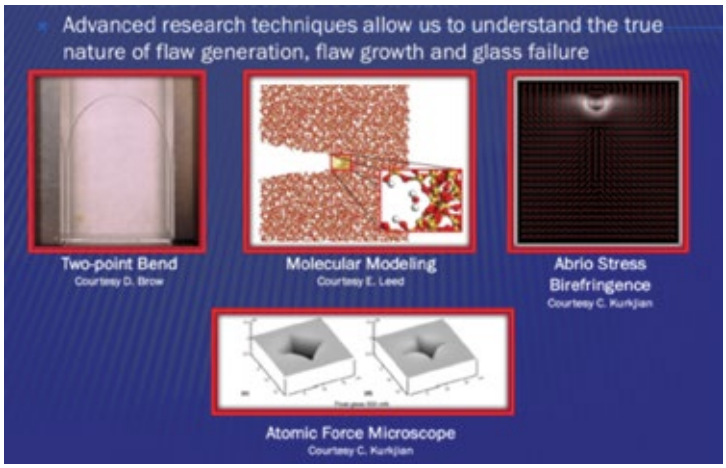
RESEARCH STRATEGY

The coalition's research agenda comprises a series of individual, pre-competitive multi-year university research projects. A number of industry and university experts have contributed to the creation of a research strategy.

The research strategy and research RFPs are governed and refined through research council and board processes. The overall focus of the research strategy can be described in terms of improving the understanding of:

- Glass surface structure and chemistry, particularly as it relates to the susceptibility to chemical, thermal and physical damage.>

Usable Glass Strength Coalition, web: www.gmic.org



Why glass strength now?

- Mechanisms of chemical and physical damage (flaw generation) as they relate to usable strength reduction.

To simplify the roadmap, the UGSC has developed a two-step graphic. The first and current step starts with understanding surface structure and chemistry. A component of this is understanding the effect of chemistry on surface structure and how surface structure is impacted by chemical and physical damage. Therefore, the first goal is to have the researchers explain why glass shows a reduction in strength. The roadmap's second step moves in a direction that is more application-specific. This is not currently within the coalition's research horizon but may be part of its function as the years go on.

To provide administration, the Usable Glass Strength Coalition is aligned with the Glass Manufacturing Industry Council. GMIC is a key strategic partner to leverage its extensive experience and credibility with industry, university and government agencies. The coalition has been incorporated as a Limited Liability Corporation (LLC), wholly-owned by GMIC. Coalition participation and governance is completely independent of the GMIC and does not require GMIC membership.

Coalition participation includes the right to:

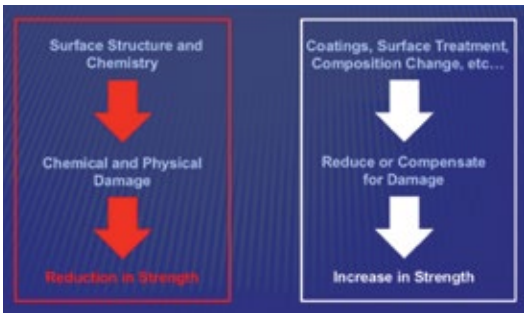
- Obtain early access to the research body of work.
- Collectively set the coalition research agenda.
- Collectively select research projects for funding.

Participation is open to all companies, industry consortia and universities, regardless of country of origin. Each participating organisation appoints a representative to serve on the board of directors and a representative to serve on the research council. The annual participation fee and voting power is determined on a 'sliding scale', based on metrics associated with global annual sales or purchases of the participating company. Current participation consists of six organisations: Diageo, Johns Manville, PepsiCo, Sun Chemicals, GMIC and US Borax. Commitments from additional coalition participants are anticipated in the near future.

Seed Funding of UGSC:
1) To fund the development of a formal membership agreement
2) To fund the development of a formal research roadmap

Organization	Classification	Glass Sector
Corning Inc.	Manufacturer	Specialty
Johns Manville	Manufacturer	Fiber
Owens-Illinois	Manufacturer	Container
Owens-Corning	Manufacturer	Fiber
Saint-Gobain Containers Verallia	Manufacturer	Container
AB/InBev	Manufacturer & User	Container
International Partners in Glass Research (IPGR)	R&D Association	Container
The Coca-Cola Company	User	Container
Diageo	User	Container
Emhart	Supplier	Container
Rio Tinto Minerals	Supplier	All

UGSC seed funding members.



Research RFPs.

In October 2013, the UGSC announced an award of $110,000 for a grant to Pennsylvania State University (PSU), University Park, Pennsylvania, to carry out research to improve the understanding of manufactured glass products' strength properties. The research, which has been renewed for its fourth year, 'Controlling and understanding reactive surface sites on multicomponent glasses', is led by principle investigator, Seong H Kim, Professor of Chemical Engineering and Associate Professor of Materials Science and Engineering at PSU. The aim of the study is to characterise the distribution and chemical nature of reactive surface sites on glass that nucleate strength-controlling defects. As stated in the PSU research abstract: "It is reasonable to expect that the existence and concentration of strength-controlling atomic and nano-scale defect precursors depend on the surface cooling rate and the local atmosphere. These processing variables could provide an effective means to controlling and enhancing the strength of glass through irreversible chemical (or physical) passivation of these defect precursors at time of their creation."

The coalition's second Request for Research Proposals was sent in December 2015 for a 2016 research grant to run concurrently with current research. Ten proposals were received from univerisities around the world. At the time of this publication, UGSC is in negotiations for the additional research grant.

It is the goal of the coalition to understand the fundamental behaviour of glass to the level that a new generation of usably strong glass can be manufactured, with the potential of revolutionising glass as a material and significantly improving the sustainability of allied industries. ■

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A Note on Closed Glass Companies in the USA for Artistic Appreciation

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Abstract

As in many countries in the world, there are 10 or even 20 large glass companies in the USA that we always discuss in terms of types of glass products, quality, larger production volumes and sometimes in the context of stock market performance for investment purpose. However, there are a number of glass companies, perhaps to the tune of several hundred, which are either having a smaller base of production, scattered around the east coast of USA, or they are simply producing some of the exotic art glasses for various decorative purposes, and some elegant shapes for some other useful applications. Many of these glass companies have been defunct in the past 100 years or so due to a variety of reasons, but their stories are not forgotten or rather their historical significance are still a matter of intense deliberations among the concerned people. In this article, some of their stories will be briefly elaborated.

INTRODUCTION

In the early sixties (about fifty years ago), before becoming a glass technologist, I used to watch a medium sized container (bottle) manufacturing activity in the southern part of (now) Kolkata, called Krishna Glass Works, which had later set up another plant in nearby Baruipur. Standing on the main street in front of a large and wide factory gate, one could partially watch the glass tank furnace and the hot gobs taken out from a small pool of molten glass to be formed into glass bottles by a blowing technique for food and beverage industry. Outside the main door, a part of the street used to be strewn with broken glasses that we know today as cullets. This was a significant experience for a glass technologist yet to be born, and now that experience is lingering in the mind as I am travelling in some of the eastern parts of USA, particularly in the states of New Jersey, Pennsylvania and Ohio -- mostly the latter where several glass plants literally took birth in the USA. Many of the glass plants in these areas have been defunct for more than a century.

In the USA as well as in many countries, such type of abandoned or closed glass plants (or any other plants) gave rise to some other type of business activities, particularly the real estate activities in terms of residential blocks and commercial complexes, such as branded shops, supermarkets and dazzling malls that again require a lot of flat glass, as described in several articles of Kanch. **[1, 2]** This is a kind of industrial/business evolution that many people cherish and many creative people do very hard work to make it happen (mostly through a

large investment) -- as if to replicate the past level of activity that created those older plants -- to be able to pay respect to their past creators or their deeds. Although this has a more or less acceptable business logic of transforming older assets (like land) into profitable newer assets, the 'importance of conserving' some of the traditional artistic items in museums and preserving some of the extraordinary moulds & patterns for making such elegant glasses in archives cannot be underestimated. In most of the plant locations described below, one could see both types of activities, i.e. business transformation and archiving of older items of value.

In the transformation of business assets in glasses from one passive plant with land and other assets, such as electricity, water, obsolete equipment or plantation to another business, say a new plant with new set of machinery and equipment, or even a real estate development for the betterment of economic activity in the local region, there is a tremendous amount of creative activity in terms of the requirements of modern management, such as financial engineering, human resource utilization, technical scrutiny and upgradation, etc. for better utilization of assets. As the famous dictum goes: if there is an idle asset -- why not utilize it!!

On the other hand, we must respect our history and conserve our artistic tradition to eventually appreciate the tremendous efforts of entrepreneurial creativity to start something fresh in the midst of nowhere and in the utter financial hardship of those men in the yesteryears. This not only gives rise to some sort of good feeling, but also it gives insights for a start up. This is abundantly clear in almost all regions of the USA. Even in India, although there is a lack of urge "to make museums or even create archives" to be able to perpetuate certain past glorious activities, the entrepreneurial creativity on such matters is quite commendable -- particularly in the context of recent Indian 'start-up' activity that has taken a huge leap forward.

After giving a list of some defunct glass companies in the USA as well as in UK, some of these companies will be chosen for some more descriptions to be really brief in the midst of ocean of data available in this field.

LIST OF DEFUNCT COMPANIES

This list is nevertheless comprehensive and many defunct companies have been possibly left out. In certain states in the USA, e.g. in Massachusetts, New Jersey, Pennsylvania, Ohio, and some mid-western states, the activity in the field of container glass of various hues and colours was quite extensive. The reason was a need to serve the food and beverage industry that started developing in the early 19th century. Even if some of these glass plants closed down after a few years, the entrepreneurial energy remained intact that gave rise to some newer glass companies or even to plastic and metal container companies to be able to serve the same end users. However, many of those companies dealing with artistic/decorative items perished due to the problems of finance and some other reasons, such as competitive pressure, marketing edge, human resources, or labour problems. Nevertheless, all such companies need a little mention on their past glory.

The list of such old and defunct companies in the USA is mentioned in alphabetical order as follows:

1) Bakewell Glass

Englishman Benjamin Bakewell started production of 'glassware' at his Pittsburgh factory in Pennsylvania. Founded in 1808, the factory was renowned for its cut and engraved glass. Bakewell is also known as the "father of the flint glass industry" in the USA. One of his family members (John P. Bakewell) invented and patented the first known process for "pressed glass" in 1825, making possible mass production of glass for the first time.

2) Belmont Glass Company

It was Ohio's early glassmaking companies and was also known as the Belmont Glass Works named after its location in Belmont County, Ohio. The company began operations in 1866 in a riverfront village along the east side of the county (known as Bellaire), Here, the community had resource advantages: a) Transportation infrastructure, b) Fuel from Ohio Coal Belt, c) glassmaking expertise (HR) 8 Km away in Wheeling area in West Virginia. This company made chimneys, lamps, and bar goods -- either blown or pressed that ceased operations in 1890, although Bellaire became the 'glass city' and encouraged a lot of entrepreneurs to start making glass in the Ohio and Indiana regions.

1882 drawing of the Belmont Glass Works

3) Brookfield Glass Company

James Madison Brookfield started making both insulators and bottles as food storage jars (pickle and relish jars) in 1864, when the plant was known as Bushwick Glass Works, in Brooklyn, New York. In the 1870s

and 1880s, the need for insulators increased that was spurred by more telegraph lines. This ultimately gave rise to a 2nd plant in Old Bridge, New Jersey -- where production stopped in 1920, while the Brooklyn plant closed after 1912.

4) Boston and Sandwich Glass Company

A glass factory was built by Deming Jarves in 1825 in Sandwich, Massachusetts, that was taken over by The Boston and Sandwich Glass Co. in 1826, and it was one of the earliest to produce 'pressed glass'. Incidentally, this plant was closed in 1888 amid disputes with a newly formed glassmakers' labor union. **[3]**

5) Cambridge Glass

This manufacturer of glassware was founded in 1873 in Cambridge, Ohio, that produced a range of coloured glassware in the 1920s, initially with opaque shades, but moving on to transparent shades by the end of the decade. Unable to compete with mass-produced glassware, the company closed briefly in 1954, but was reopened in 1955. However, financial difficulties persisted, and, after several ownership changes, the factory finally closed down in 1958. **[4]**


Apple Blossom


Caprice


Chantilly


Chrysanth


Cleo

6) Carr Lowrey Glass Company

The company was founded in Baltimore, Maryland, in 1889 by Samuel Carr and William Lowrey to make glass bottles for the pharmaceutical and perfume industries, which was one of the first plants to use "IS Machine" with individual sections with a timer to automatically blow and move the bottles to a conveyor system. In 1944, the company was acquired by the Anchor-Hocking Glass Company, and they experienced a major expansion. Carr-Lowrey was one of the producers of the famous Avon bottles that were shaped like cars, planes, animals, and also white glass shampoo bottles for Head & Shoulders, as well as facial cream bottles for Procter & Gamble. Carr Lowrey had formidable competition in New Jersey with Wheaton Glass and from foreign companies such as St. Gobain in France and Rocco Bormioli in Italy. St. Gobain eventually opened a plant in Georgia, which spelled doom for Carr-Lowrey. Even if the Baltimore community helped them with money, Carr-Lowrey was never able to remain profitable and eventually closed its doors in 2003.

7) Cheshire Crown Glass Company

The company was established in 1812 in Cheshire, Massachusetts, to take advantage of the high-quality sand in the area, by Captain Daniel Brown's two sons (Darius and John) who had stores and distillery. It produced 'crown glass' for windows by using sand from a nearby Lanesborough. However, the company was not successful and closed down in 1816. This factory was built on a high-quality sand bed that was later discovered in 1845 to give rise to a new plant on plate glass. **[5]**

8) Dugan Glass Company

In 1904, Thomas Dugan bought the closed Northwood glass factory and renamed it after his name in Indiana County, Pennsylvania. The Dugan Glass Co. continued production after the Dugans left the company and was renamed as Diamond Glass Co. in 1913. The company continued production until a fire destroyed the plant in 1931.


Dugan peach opalescent bowl with marigold carnival

9) Dunbar Glass

This was a glassmaking company founded in 1913 in Dunbar, West Virginia, near to the resource area for glass sand and fuel (coal) for furnace. Although this company closed down in 1953, some of its 'craftsmen' formed Kanawha Glass Co. to continue production.

10) Duncan & Miller Glass Company

It was a well-known glass manufacturing company founded in 1865 by George Duncan & family in the neighborhood of Pittsburgh, Pennsylvania, and the glass items were known as "Duncan Glass" or "Duncan Miller Glass". By 1890, the company joined other glass companies to form the US Glass Co., a powerful "glass trust". In 1892, the factory was destroyed in a fire, and the company was relieved of its trust relationship with the USGC. After the fire, the second generation of the Duncan family moved operations to Washington area in Pennsylvania. In 1900, John Ernest Miller, the company's long-time designer, became a full shareholder along

with members of the Duncan family. By 1955, economic pressures from machine-produced glass forced the company to sell off its assets to the USGC, who continued to produce Duncan-style glass until 1980.

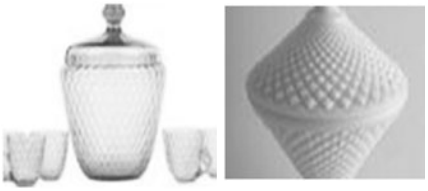
D & M Glass Co. near Pittsburgh, Pennsylvania

A ruby-red pitcher in Duncan's Georgian pattern

11) Federal Glass

The Company started operations in Columbus, Ohio, in 1900, making pressed glass. This manufacturing technique utilized metal forms and hot liquid glass to create a line of glassware that beat out much of the competition due to the low prices and distinctive lines that featured raised designs resembling popular needlepoint patterns. During the early years, the glass moulds for tumblers, breakfast-ware and lunch-ware were filled by hand. Federal expanded its factory and purchased automated glass making equipment in the 1920s. The company also enlarged its sales force and began marketing the glass to homemakers for use as dinnerware and bar beverage sets. The early designs continued to be made using state-of-the-art mould injected machinery and new colored glassware patterns in amber, pink, purple and blue were introduced.

New style of marketing expanded sales into restaurants, hospitals and the military during World War II. Federal remained one of the largest glass manufacturers until the 1960s, when American dinnerware tastes turned to plastics such as Melmac. Federal was incorporated as Federal Paper Board Company in 1958. Federal Glass Co. held its own in the design and sale of tumblers to the home and commercial markets, but new food service offerings, including Texasware, made inroads, cutting the company's commercial sales. During the late 1960s and early 1970s, the company attempted to spin the glass designs that earlier made Federal a household name. The Madrid line (later called Recollection) was introduced in 1976. Finally, Federal's new designs and sales approach was not successful. The doors of the plant were closed in 1979.



Milk Glass & Identifiable item

12) Fostoria Glass Company

It manufactured pressed, blown and hand-moulded glassware and tableware for almost 100 years. It began operations in Fostoria, Ohio, in 1887, at South Vine Street, near Railroad on free land donated by the towns' people. When natural resources declined in Fostoria, the company moved to Moundsville, West Virginia, in 1891. Foreign competition increased during the 1970s. In 1983, Fostoria sold its factory to Lancaster Colony Corporation of Columbus, Ohio. By 1986, Lancaster Colony closed the factory and sold the remaining stock directly to the consumers.

Fostoria Plate with design

13) General Glass Industries

It was a US based wholly owned subsidiary of General Glass International (GGI). This company manufactured sheet glass from 1988 until 1993 using the Foucault process. GGI also produced cut sheet and window glass from flat glass produced by other manufacturers. The site of GGI was located in Jeannette, Pennsylvania, which is located east of Pittsburgh, PA. GGI was one of the largest single employers in Jeannette and was one of the last of the "major" glass plants to operate in the "Glass City". According to local rumors the "Window House", as it was known, was once the largest producer of window glass in the world. Production ceased in 1993 after the expected life of a glass furnace, and after its liquidation, GGI wanted to pursue initiatives in the other regions.

14) Hartford City Glass Company

It was among the top three window glass producers in the USA between 1890 and 1899, and also the country's largest manufacturer of chipped glass, with capacity double that of its nearest competitor. The company's works was the first of eight glass

plants that existed in Hartford City in Indiana during its 'gas boom'. Many of its skilled workers were from Belgium, at the time the world's leading manufacturer of window glass. In 1899, it was acquired by the American Window Glass Co., which controlled 85% capacity of window glass. During the 1920s, competitors developed new production processes that eclipsed their technology, and the company lost its advantage. By the time the Great Depression struck in 1929, the plant had closed.

2 large stained-glass windows installed by Hartford City Glass Co.

15) Hazel-Atlas Glass Company

It was a large producer of machine-moulded glass containers founded in 1902 in the Wheeling area, West Virginia, as a result of merger of four companies: Hazel Glass and Metals Company (started in 1887), Atlas Glass Company (started in 1896), Wheeling Metal Plant, Republic Glass Company. By 1930, they had 15 plants with high volume of production of the white milkglass "inserts" and many types of milkglass cold cream jars and salve containers. They were an important producer of a very large variety of bottles and jars for the commercial packaging industry being the third largest manufacturer of glass containers in the USA (10% market share), making the brand name "Atlas" the most popular line of fruit jars for home canning. In 1964, most of its plants were sold to Brockway Glass Co. that was almost the end of operation of Hazel-Atlas.

16) Heisey Glass Company

It was formed in Newark, Ohio, in 1895 by A. H. Heisey providing fine quality glass tableware and decorative glass figurines. Both pressed and blown glassware were made in a wide variety of patterns and colors, as well as glass-automobile headlights and Holophane Glassware lighting fixtures that were readily identifiable by its high clarity and brilliance, which were highly finished through the process of "fire-polishing" with polished bottoms. The company was operated by Heisey and his sons until 1957, when the factory closed. **[6]**

Heisey "Ivorina Verde" souvenir cup (a decade prior to WW-I)

17) Hemingray Glass Company

It was an US glass making company founded in 1848 by Robert Hemingray and Ralph Gray, in Covington (Kentucky) and Cincinnati (Ohio) with main production in Muncie (Indiana), producing bottles, fruit jars, pressed glass-dishes, tumblers, battery jars, fishbowls, lantern globes and oil lamps. In 1933, the company was sold to the Owens-Illinois Glass Co., but production remained in Muncie under the Hemingray name. The main plant in Muncie shut down in 1966.

18) The Imperial Glass Company

The Imperial Glass Co. was founded in 1901 by Edward Muhleman, with production beginning in 1904 in Bellaire, Ohio, for the handmade glassware sold worldwide with mainly pressed glass patterns. The factory was labeled as one of the largest glass factories under one roof, and its most famous product was their "Candlewick" series, which even has a street named for it in Bellaire. The company hit rough times in the early 1970s and was close to bankruptcy. Imperial Glass Co. was saved by Lenox and turned to a general manufacture, but low demand eventually led to its closure in 1984. The factory was razed in 1995 to make room for commercial development and the office building was transformed into a museum known as the "National Imperial Glass Museum".

19) J. H. Hobbs, Brockunier and Company

The company was first organized as Barnes and Hobbs in 1845 by James B. Barnes and John L. Hobbs, who held supervisory positions at the New England Glass Co. in Massachusetts before starting their business venture. Then, they came to Wheeling, Virginia, to begin their new glass company for mostly pressed and blown tableware. In 1891, the Hobbs glass works joined the US Glass Company trust that controlled over a dozen glass plants. In 1893, the glass works was closed. It remained closed until 1902 when the property was sold to Harry Northwood (a former employee of the company).

20) Jersey Glass Company

It was a maker of pressed glass in Paulus Hook, New Jersey, founded in 1824 by George Dummer, who had experience as a glass-cutter (in Albany, New York) that encouraged him to add a glass production unit to his glass-importing and trading outfit. He

increased to forty-four the number of steam-driven cutting wheels and experimented with materials to produce engraved and gilded glass. After sometime the company specialized in hand-blown, blown-molded, pressed and cut glasses.

Pressed Glass, transparent green Rectangular, embossed with a basket of fruit on each side and a 5-petal flower on each end. 2 x 2 3/4in.

21) Knox Glass Bottle Company

It was a glass manufacturer based in Knox (Clarion County) in Pennsylvania, with several plants throughout the USA for mostly glass bottles, many of which were milk bottles, beer bottles, and a large number of medicine bottles in a variety of standard sizes. The company's founder was Roy Underwood. There was a lawusuit between the company and a former executive that defined in detail the fiduciary duties of a corporate director and officer. The company was acquired in 1968 by the Glass Container Corp., which finally filed a Chapter-11 bankruptcy petition in Delaware.

22) Macbeth-Evans Glass Company

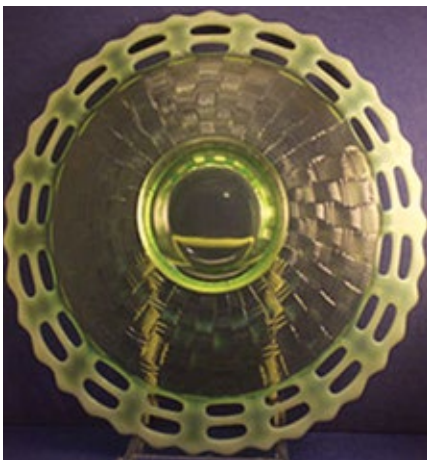
It was an American glass company that created very fine glassware with beautiful designs but is famous for making depression glass. It was located in Charleroi, Pennsylvania, and started in 1899. Before 1929, Macbeth-Evans made hand blown glass before the use of machines became popular. This method was adopted by the company in 1930. The most popular color used in tableware was pink, and the glass made was thinner than other companies of the time, thus more fragile. The company later merged with Corning Glass Works in Charleroi by 1936. **[7]**

23) Millersburg Glass Company

This company was started in 1908 in Millersburg, Ohio, by John W Fenton after he left Fenton Art Glass Co. The factory was state-of-the-art for its day and opened in 1909. The company was well known for its 'carnival color' that was Radium, which was also known for its bright and shiny finish. Other colors being made by Millersburg were green, amethyst, and marigold, as well as vaseline, blue, lavender, and aqua. John was not the best businessman, he was more of a promoter.

The factory was in an obscure location and the company folded in 1911. The company was sold to Samuel Fair and was reopened as the Radium Glass Company. This

Persian Medallion in marigold



Green opalescent Basket Weave plate

company only lasted one year and finally closed in 1912.

24) New England Glass Company

This company started in 1818 by Deming Jarves et al in Cambridge, Massachusetts, producing both blown and pressed glass objects in a variety of colors which had engraved, cut, etched, and gilded decorations. It was one of the first glass companies to use a steam engine to operate its cutting machines, and it built the only oven in the country that could manufacture 'red lead', a key ingredient in the making of 'flint glass'. By the 1850s, this company was considered one of the leading glass-houses in the USA (about 40 existing at that time), best known for its cut and engraved glass. In 1878, the company was sold to end the operation.

A new England Glass Company-ware

25) New England Glassworks

It was a short-lived glass-making factory located in Temple, New Hampshire, founded in 1780, and one of the first glassworks in the USA by Robert Hewes, a Boston-based businessman. The main glasshouse was determined to be about 65 feet (20 m) square, containing a glass furnace of German design. Despite having finance from the state, the quality of its products (window glass, bottles, and similar household items)

was not particularly good, since the sand used in the glass was apparently sourced locally and of poor quality. But it failed due to the financing and logistical difficulties in 1783. Its abandoned site was excavated in the 1970s, and is now listed on the National Register of Historic Places in 1975.

26) New Geneva Glass Works

Due to the efforts of many partners and some glassblowers under Albert Gallatin, the production started in 1798 near Georges Creek in Western Pennsylvania. The glassblowers mainly produced window glass, although whiskey bottles, bowls, and other hollow ware were also made. Production soon grew to an annual average of 4,000 boxes of window glass. At the same time, the company was troubled by supply and production issues, including properly curing the wood they used for fuel, cleaning the sand used to make the glass, preparing batches of glass, and obtaining clay used to make furnace pots. The factory was sold to the partners who looked for coal as fuel and moved the plant to Greensboro that operated from 1807 into the late 1840s, but closed in 1847, because it could no longer compete with newer, nearby, glasshouses. **[8]**

27) New Martinsville Glass Company

It was a plant of decorative glass products, founded in New Martinsville, West Virginia, in 1901 in an old glass factory. At first, it relied upon pressed glass patterns for the majority of its income. By 1905 the company began embellishing their work by adding gold paint and ruby stain. The company was renowned for the use of color in their glassware. They initially made tableware but quickly expanded into vanities, bare ware, lamps, etc. They promoted liquor sets even through prohibition.

Repeal

Janice

Moondrops

Radiance

The company was renamed Viking Glass in 1944.

28) Northwood Glass Company

The original Northwood glass company was founded by Harry Northwood in 1887 in Martins ferry, Ohio, and was moved to Ellwood City, Pennsylvania. But the company did not prosper in that location. In 1895, Haeey opened up the New Northwood glass company in a factory previously owned by the Indiana Glass Co. in Indiana County in Pennsylvania. This factory joined National Glass Conglomerate in 1899. Harry developed his formula for 'carnival glass' in another company in Wheeling area in 1902. The company continued producing glass, but was closed in 1925.

Green Wishbone bowl

29) Novelty Glass Company

It was one of over 70 glass-making companies that operated in northwest Ohio during the region's brief Gas Boom in the late 19th Century. The company made drinking glasses, bar goods, and novelties. Organization of the firm began late in 1890, with banker Rawson Crocker as president and veteran glass man Henry Crimmel as plant manager. The plant was built on the site of the former Buttler Art Glass Company, which had been destroyed by fire in 1889. Production started in February 1891. Like many companies during Ohio's brief 'Gas Boom', the Novelty was short-lived and the plant was shut down in January 1892.

A Novelty Glass Co. Advertisement in 1893

30) Old Dominion Glass Company

This plant started operations in 1901 in Alexandria, Virginia. The company specialized in beer, medicine, and soda bottles, as well as novelty items. In 1911, Lewes Hine photographed some of the child workers in the factory for his exposé of child labour. The factory was later destroyed by fire in 1925. The property can be found at North Fairfax and Montgomery streets.

31) The Root Glass Company

It originated as 'Root Glass Works' in Vigo County, Indiana, by businessman and Pennsylvania native Chapman J. Root in 1901 and a year after, he moved to the city of Terre Haute, Indiana. By 1904 the company was manufacturing beverage bottles for Coca-Cola as well as several other beverage companies in the area. Between 1905 and 1912 the Root Glass Co. workforce increased from 600 to 825 employees. **[9]**

Root sold his Company to the 'Owens-Illinois Glass Co.' in 1932. The iconic Coca-Cola bottle design (made at Root Glass Co.'s Terre Haute factory) was officially trademarked by the U.S. Patent and Trademark Office in 1977, after the New Jersey-based American-Wheaton Glass Corp. purchased the plant to be used as a warehouse in 1960. The building was razed, and a new plant was constructed that was sold to the American Can Corp. in 1962, and the buildings were purchased by the Midland Glass Co. in 1968. In 1982 the Root family sold its Associated Coca-Cola stock, which was worth $417.5 million. The Midland Glass plant closed in 1984, and by the 1990s the buildings had been razed. There is now a state marker at this location.

32) Seneca Glass Company

It was once the largest manufacturer of tumblers (drinking glasses) in the USA, founded in 1892, and its first plant was located in Fostoria, Ohio. The company was also known for its high-quality lead stemware, which was hand-made for nearly a century. In 1896, the company moved to Morgantown, West Virginia, and continued to produce high-quality decorated glassware. A second plant was built in 1911 to produce tumblers and less-elaborate ware. During the 1950s, Seneca introduced its Driftwood Casual table setting pattern in an attempt to capture a less formal segment of the glassware market. This pattern was produced for nearly 30 years, and became especially important to the company as formal glassware became less popular. In 1982, the company was sold to a group of investors that renamed the company as Seneca Crystal Inc., but it filed for bankruptcy in 1983.

Glassware made by the Seneca Glass Company

33) Sneath Glass Company

After a brief 1890s startup in Tiffin, Ohio, the Company moved to Hartford City, Indiana, to take advantage of the 'Gas Boom' for natural gas as an energy source for glass furnace. It was one of many glass-makers that moved to the region, and became Hartford City's second largest employer. Its main products were initially lantern globes and founts, and railroads were its major customers. As demand for lanterns declined in the early 1900s, Sneath evolved to be the maker of glassware for portable kitchen cabinets. While lanterns, kitchenware, and refrigerator products were the major items during its existence, it also made a wide variety of additional products, e.g. aquariums, lenses, mailboxe, etc. and it was also an early producer of heat-proof glass. Management did not adapt to competition from the plastics industry and faced a shrinking market for its products, and could not raise prices due to "post-2nd World War" government price controls. Thus, the factory closed in 1952, after a work stoppage led by the local labor unions.

34) Steuben Glass Works

It was an art-glass maker, founded in 1903 by Frederick Carder and Thomas Hawkes in Corning (Steuben County), New York. Hawkes was the owner of the largest cut glass company then operating in Corning area, and Carder was an Englishman, who had many years' experience in designing glass. Hawkes purchased the 'glass blanks' for his cutting shop from many sources and eventually wanted to start a factory to make the blanks himself. After being acquired by Corning Glass in 1908, it became the Steuben Division -- but in 2008, it was sold to Schottenstein Stores - a holding Co. for retailers that finally ended its 108-year history in 2011.

35) Union Glass Company

It was a glass manufacturer located in Somerville, Massachusetts, founded in 1854 by a wealthy businessman, Amory Houghton, after liquidating Bay State Glass Co. The new factory's design was fairly typical of the time, with several buildings for mixing, melting, blowing, grinding, and storage, on a wide street with immediate railway access. It housed two nine-pot 'coal-fired' furnaces, with each clay pot holding over 1350 Kg of molten glass. It manufactured a full line of flint glass products including lamps, lamp trimmings, bottles, windows, lenses, and tableware during its existence, and art glass (mostly iridescent) from 1892 onwards. After a series of acquisition and name changes, the Union Glass plant operated until its closing in 1924.

36) Westmoreland Glass Company

It was a company that produced glass in Grapeville, Pennsylvania, founded in 1889 after a group of men purchased a Specialty Glass Co. in East Liverpool, Pennsylvania, and moved the plant to Grapeville. There was a large resource of natural gas. Its main production was pressed glass tableware lines, mustard jars, and candy containers, as the owner had its own mustard factory and tin shop in the plant area. The

company began to make high-quality hand-decorated glass from 1920 to 1930, some of which was exhibited at the Carnegie Museum in Pittsburgh. In the 1940s, the new owners phased out the high-quality hand-decorated glass and began to produce primarily milk glass. It went out of business in 1984 and was sold for $75,000, and the location was converted into a storage facility. **[10]**

37) White Glass Company

It was one of Ohio's early members of the glass industry. It existed from 1815 until approximately 1851. It started in Zanesville, Ohio, by I. V. Horne, and they made glass bottles with the 'Eagle' and 'Masonic' symbols. The owners also had fairly deep pockets and were members of the State and Local governments, and as such they went into the enterprise mostly in the way of the modern businessman, as entrepreneurs, rather than as executives. This company was later known as The Ohio Valley Glass Company.

38) Wistarburgh Glass Works

This (also known as the United Glass Company) was the first successful glass factory in the USA, and it was also the first "joint venture" enterprise in the US. It operated from 1739 until 1782. The owner was Casper Wistar, who set up the glass plant near Salem, New Jersey on a 2000 acre plot, and who also created a lot of amenities in those days for its workers as well as for European craftsmen.

The list of some of the closed companies in Europe dealing with artistic and other relevant glass articles are given below:

1. Chance Brothers
2. Chandos Glass Cone
3. Clayton and Bell
4. W. F. Clokey of Belfast
5. Crystal City, Missouri
6. Earley and Company
7. Alexander Gibbs
8. Grönvik Glasbruk
9. Helio Glass
10. Lavers, Barraud and Westlake
11. Manufact. royale de glaces de miroirs
12. Morris & Company
13. Nailsea Glassworks
14. Pittsburgh Plate Glass Enamel Plant
15. James Powell and Sons
16. Ravenhead Glass
17. Rocco Bormioli
18. Stevens & Williams
19. Ward & Company of London
20. Ward & Partners of Belfast
21. Whitefriars Glass
22. Worshipful Co. of Glaziers & Painters of Glass
23. Rocco Bormioli

CONCLUSIONS

Descriptions on some odd 38 glass companies that are closed for many years have been presented in terms of starting date, owners' name, location in the respective states, products and their varieties, diversification activity, merger & acquisition efforts, financing efforts, etc. Moreover, for many of these companies making artistic glasses, such as cut & engraved items with exotic patterns and elegant style, some typical samples that makes them extremely appealing to our eyes are also shown with references in some places. This paper is also presented with the idea of invoking "entrepreneurial spirit" among the newcomers in the start-up ventures in India on glasses and other relevant products to be able to show the hard work gone into the making of a vibrant glass/packaging industry in the USA. It also should encourage the "art collectors" in India to promote an idea of a "Glass Museum" under the aegis of AIGMF to be able to appreciate the 'artistic' aspirations of many people in India.

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Programme Announcement
(Sept 2, 2016)

The All India Glass Manufacturers' Federation

Enhancing Profitability by Empowering Workforce
Business Opportunities for Indian Glass Companies at Port of Duqm, Sultanate of Oman
and
AIGMF Executive Committee Meeting / AGM

VENUE: Casuarina Hall, India Habitat Centre, Lodhi Road, New Delhi- 110 003

1030 hrs	**Registration-** Tea/Coffee
1100 hrs	**Opening Remarks** By Mr. Sanjay Ganjoo, President AIGMF
1115 hrs	**Cost Effective Ways to Increase Morale & Motivation of Employees** • Mr. Ashok Thussu, Executive Director, **LMI (*Leadership Manage*ment International*) • PPT by Mr. Rohit Nayyar, LMI Licensee
1215 hrs	**Interactive Session on Business Opportunities for Indian Glass Companies at Port of Duqm, Sultanate of Oman** • PPT by Mr. Erwin Mortelmans, Commercial Director, ***Port of Duqm Company SAOC* • Short Video on Investment Opportunities • Question / Answer Session
1330 hrs	**Lunch**
1400 hrs	**Executive Committee Meeting** *(for AIGMF Members only)*
1450 hrs	**Annual General Meeting** *(for AIGMF Members only)*

PARTICIPATION: Free of charge
- Non-members need to pre-register at info@aigmf.com

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Nipro Injects Innovation into Pre-filled Syringes and Targets US Expansion

Yoshihiko Sano
President, Nipro Corporation

Medical devices, pharmaceuticals and glass pharmaceutical packaging products are the forte of the Nipro Corporation, and as such is well positioned to benefit from the rising global prefilled syringes market, which accounted for $3.9 billion in 2014 and is expected to grow with a CAGR of 12.9% during 2015-2020.

Yoshihiko Sano, President of Nipro Corporation, explains how it is on track to hit its ambitious growth targets for 2020, its corporate culture of innovation, and its commitment to improve the working lives of medical staff and the healthy life expectations of people worldwide.

Since Nipro's founding more than 60 years ago the corporation has established a well earned and deserved reputation across the industry for its ingenious, high quality product range and constant pursuit of innovative ideas and technologies. It now has more than 20,000 employees and a market cap of approx. 170bn yen. What in your opinion have been the key ingredients in making such a now globally recognized and successful entity?

The end-users of products manufactured by Nipro are patients ultimately; however they rarely ever demand just pharmaceutical products, but rather expect to receive a systemized, streamlined delivery of a group of healthcare products. Nipro has the capability of offering a wide variety of pharmaceutical products that fulfill this demand and we can offer these products as a system specifically through offering medical equipment, disposable medical devices, diagnostic equipment, pharmaceutical products, pharmaceutical product packaging materials, and other medical products.

My predecessor once said that he would make Nipro become a pleasant working environment for those who are "motivated" and "willing" to take on new challenges. This is our credo today. Nipro has always been actively investing and supporting efforts initiated by our employees until we reach success. This is fundamental in our pursuit of innovative solutions and new ideas. I am currently striving to nurture a culture of autonomy throughout Nipro by establishing a system where each department is given a high level of autonomy – they are given the flexibility to adjust their bonuses based on the achievements for their projects thereby allowing flexibility to take on new initiatives.

As a corporation, Nipro has known the impact of globalization that Japan will confront in the future from an early stage. This lead to the development of the trinity product lines – medical devices, pharmaceuticals and glass products as pharmaceutical product packaging – that we operate today. This strategic move was indeed a large investment for Nipro, but also a much needed one in order to build the capability to offer a pharmaceutical solution.

Besides innovation and globalization, our corporate philosophy places a high level of importance on improving quality of life of our customers, and

thereby creating accomplishing results for the company. We also strive to ensure that our employees' efforts and results, on an individual and department level, are properly recognized and rewarded.

In the pharmaceutical industry, tests can be done on animals in a laboratory setting at a maximum, and therefore, regarding clinical data in human, gathering information through clinical data from hospitals and feedback from doctors becomes particularly important. I believe that it is essential for healthcare companies like us to focus their research efforts on the observations and feedbacks that we receive. As a result, the majority of our products are directly derived from the needs of our end-users.

The company's financial performance has also been impressive, the share price now sits approximately 80% higher than in the year 2012, currently at approximately 1,100 yen per share. What do you believe have been the key drivers behind such excellent growth?

I think that the most powerful growth engine is Nipro's efforts targeted towards increasing product competitiveness and modifying and developing such products that are more attractive to the users than other companies.

The company's vision is "to become a truly global comprehensive health care company." How are you hoping to expand the trinity business model on a global level?

We plan on continuing our efforts towards improving our product competitiveness within the domestic market, but also developing products based on the unique needs of each individual market taking advantage of our sales bases which have been expanded across the world. For instance, I believe our pre-filled syringe product is very representative of the integrated properties of the trinity businesses. In this product, which is comprised of glass, rubber parts and pharmaceutical product, the glass syringe containing two pharmaceutical products is made into its final product through mixing within, immediately before use. Also, we offer some products that are manufactured as generic only by Nipro. Thus, we take pride in the fact that Nipro is the pharmaceutical company with the ability to commercialize products as a system based on the trinity policy.

A product manufactured as a system is demanded worldwide and therefore we would like to operate based on the trinity policy on a global scale.

The global prefilled syringes market accounted for $3.9 billion in value in 2014, and it is expected to grow with a CAGR of 12.9% during 2015-2020. How well positioned is Nipro to benefit from this forecast growth?

I believe that we should be seeing an increased number of pre-filled syringe products across the market supplied by us in the near future. We have acquired a medical glass manufacturer in Europe in 2012, aiming to capture a substantial share of the global market. The widespread usage of pre-filled syringes will contribute to taking infection control measures and reducing the number of medical accidents, as it grossly reduces the number of processes that occurs prior to being injected into the patient. I mention this specifically because there have been medical accidents surrounding syringe usages and the injection of pharmaceutical products contained in vial containers into the syringes at clinics until about 10 years ago in Japan. Furthermore, this product will reduce the number of tasks for people who work in the medical field and thus, I think it is important to deliver this product further into the market in order to alleviate the enormous workload of that nurses experience in hospitals today.

In fiscal 2015, net income totaled ¥12.5 billion, an increase of 335.8% over the previous fiscal year. The medical related industry however has faced a challenging business environment with a downturn in demand due to the consumption tax hike. What in your view needs further attention in terms of deregulation and or competition laws?

As most people know, Japan experienced the Great East Japan Earthquake in March 2011. The local medical treatment facilities in the tsunami-devastated regions had suffered a huge damage. We at Nipro thought that we, as a healthcare company, needed to provide emergency medical aid supplies as soon as possible through collaboration with local medical experts and cooperation with transport operators in order to fulfill our responsibility to supply medical equipment and pharmaceutical products. However, at that time, many permitting processes for means of transportation and delivery of supplies to the devastated area and others were legally required the same way as they are at ordinary times, which sometimes posed obstacles to our actions.

As a result, from the experience our company had during March 2011, I believe it is necessary to have special legislation that is to be applied only to times of natural disaster from the viewpoint that human life should be respected under the emergency

situations caused by natural disasters.

Can you take us through the ways in which you try to foster a culture of innovation at Nipro?

Whenever we receive orders for custom-made products from our users – ranging from doctors, nurses, and technicians – we strive to make efforts to respond to all of them, especially those with fresh needs that we have never encountered, even though they are costly challenges. Initially, these newly developed products do not generate good sales figures due to their high associated costs, but I believe it is possible to innovate the product from the users' perspectives and transform it into a form that will meet unsatisfied demands of end-users and make our products attractive to a large number of users.

The US is the largest healthcare market in the world by some margin and of course represents a market with enormous growth potential for Nipro; you recently entered into an agreement with Infraredx in the US to ideally expand your vascular portfolio there. What importance does this deal have on your ambitions in the US?

I believe the US, especially areas like Silicon Valley, is very competent in developing new product technology in a short period of time, and thus I intend to seek and expand upon collaborative relationships with venture capital organizations in the US. I see a lot of potential in the US market. I already have plans for expanding Nipro's existing sales network across the US where we already have our production and sales bases as well as introducing the Nipro training centers model that we already operate in Japan in both the US and Europe.

How are you looking to further utilize M&A as an appropriate model for boosting your growth prospects over the medium term?

The M&A model that I envision as of now is all for the purpose of complementing or supplementing the operations that we have at Nipro. I am always enthusiastic in going forward with an M&A so as long as it produces synergy between Nipro and the acquired company. For instance, the acquisition of Infaredx was not only for the purpose of simply expanding our revenues, but also was undertaken because we understood that the technology that Infraredx can offer combined with Nipro's technology, with the ability to produce new value-added products, would most certainly provide us with great synergy.

How do you aim to communicate your company's brand and capabilities globally?

The healthcare and pharmaceuticals industry has a multitude of facets, especially those based on the various professions within the field. Nipro tries to target all audiences and customers by actively displaying our products through exhibitions across the US, Europe and emerging countries, as well as releasing publications, attending symposiums – basically all events that allow us to communicate ourselves.

As we run up to your fourth year as president at Nipro, what is your long-term vision for where you wish to guide the company?

The healthcare industry is said to grow at 7-8% per annum; our goal is to grow while consistently beating this number. If we can grow at this pace, our goal of reaching 500 billion yen in sales revenue by 2020 and one trillion yen by 2030 must be met. Our sales is increasing steadily – at this pace, we are almost guaranteed to meet our 2020 target. As for our 2030 target, I believe our fields of operations as well as activities in global markets still require further expansion.

Would you like to leave a final message?

Currently, it is said that there is approximately a 10-year discrepancy between the healthy life years and life expectancy for Japanese people. Nipro is constantly striving towards extending the healthy life years of people around the world as we believe that it is essential to ensure that we offer not only means of treatment to live longer, but go a step further by offering the means to live a happier and ever-healthier lives. I hope that the readers would positively support our will to achieve this goal and keep a close eye on our much further efforts in the future ■

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World Soda Ash Conference & Workshop

(September 20-22, 2016)
Lisbon, Portugal

IHS is to host a Soda Ash Conference in Lisbon over the dates September 20-22nd. The theme of the Conference is ***"Profiting from Change: New Industry Dynamics"****.*

Soda Ash (sodium carbonate, Na_2CO_3) is a basic raw material used in many important applications including glass and also in the production of detergents and a number of inorganic chemicals. Glass though dominates as the most important application, accounting for half of world demand. However, in India the demand profile is different to many other regions and the primary application is soaps and detergents which represent about 37% of demand. Glass accounts for only about 29% of total demand in India. The long term demand potential for Soda Ash in India is significant. The Indian market currently accounts for only 6% of world Soda Ash demand. Today the per capita demand level in India is just 2.7 kilograms per person. This compares to a per capita demand level in a mature market such as West Europe of 14.6 kilograms per person. Meanwhile, there is not enough Soda Ash capacity in India to meet the domestic needs. Net imports of Soda Ash (exports minus imports) to India last year totalled 665,000 mt. There are a number of projects under review to build new Soda Ash capacity in India. However, many of these projects have been under consideration for years but to date have yet to materialize.

The global Soda Ash market started off 2016 as being relatively balanced. This quickly changed though at the end of January when Shandong Haihua (Shandong Ocean Chemicals) abruptly halted production following facility issues. The incident at Shandong Haihua had a notable effect on the domestic Soda Ash market as the plant represents about 10% of total Soda Ash capacity in China. As well as being an important local producer, this plant is also a key exporter of Soda Ash. Prices for both light and dense Soda Ash increased very sharply. The incident also impacted on export availability and prices. Spot export prices in February/March increased sharply to $230-250 per mt FOB for dense Soda Ash and $215-230 per mt FOB for light Soda Ash. These prices were considerably higher than levels seen at the end of 2015/early 2016 when spot numbers averaged between $190-200 per mt FOB. While prices for Soda Ash soared, actual volumes fell. As such Chinese exports which grew by 23% in 2015 have to date this year seen a decline. In the first five months of 2016 exports totalled 782,000 mt; 14% lower than a year earlier. The lowest monthly total this year was in February. However, even though exports are still lagging behind the corresponding volumes in 2015 supply has been restored in China. Shandong Haihua has partially resumed production. In addition, some idled capacity has been brought back on line and also some new capacity has been added. As such both domestic and export prices have seen a reciprocal decline.

China has in the past and perhaps will always be a volatile and in many respects an elusive component of the global Soda Ash picture. As the second largest Soda Ash exporter in the world, availability in China has a ripple effects across the rest of the

world. The event though that is set to bring the biggest impact on the global Soda Ash landscape in the not so distant future is the scheduled addition of 3 million mt of Soda Ash capacity in Turkey in 2017-18. This new capacity will be based on low cost natural trona based production. The proximity of this new low cost capacity, in Northern Turkey, to Europe, is an obvious threat for synthetic producers in the region. Some European plants which are very modern and efficient, with access to low cost energy and/or raw materials will likely weather the storm. Some plants in Europe will though be at risk. Since 2008, a total of almost 3 million mt of synthetic capacity has been closed outside of China: 1.9 million mt in Europe. Even recently Solvay idled a small synthetic plant in Egypt. The Soda Ash landscape as we know is perhaps set to change forever.

Please join IHS in Lisbon over September 20-22nd. The event will offer deep analysis from industry and IHS experts on Soda Ash developments and developments in key allied sectors. It is expected to draw close to 200 attendees worldwide for discussion and non-stop networking opportunities on September 21-22th. The conference will be preceded by a full-day Soda Ash Training Workshop on September 20th ■

TOPICS TO BE COVERED AT THE CONFERENCE INCLUDE:

- **Global Soda Ash Overview**
  Marguerite Morrin, Senior Director, Chlor-Alkali/Soda Ash, IHS Chemical
- **Status of Soda Ash Expansions in Turkey**
  Sinan Solaklar, Sales & Marketing Director, ETI Soda
- **Soda Ash Outlook for China**
  Chaoran Ding, President, China Soda Industry Association
- **Outlook for Urea and Ammonium Chloride in China and Impact on Soda Ash**
  Ryan Monis, Consultant, IHS Chemical
- **Global Outlook for Coal and Natural Gas**
  Chris Holmes, MD, Global Gas and LNG Consulting, IHS Energy
- **Outlook for Dry Bulk and Container Shipping**
  Mario Moreno, Lead Economist, IHS Maritime and Trade
- **Novacap, Expansion in Sodium Bicarbonate in Asia**
  Raymond Sinnah, Vice President, Novacap Group
- **India Soda Ash Market**
  Shohab Rais, Head, Sales and Marketing, Tata Chemicals
- **Soda Ash Market Balance in Russia and CIS Region**
  Andrey Alabin, General Manager, Bashkhim Trade House
- **Synthetic Soda Ash Market Overview**
  Senior Official, Ciech
- **China — Plant Technology and Design**
  Mingqiu Ren, GM, Dalian Dahua Engineering Design Co., Ltd.
- **The Outlook for Container Glass**
  Fabrice Rivet, Technical Director, FEVE
- **Growth Prospects for Flat Glass**
  Speaker, TBC
- **Coke or Anthracite? Quality, Commercial and Logistical Challenges**
  Jacek Roek, Sales and Marketing Director, PHU Weglohut SJ
- **EU ETS (Emissions Trading System) and Consequences on Soda Ash Market**
  Speaker, TBC

Information on other speakers will be made public shortly.

For further information, please visit the Soda Ash Business Outlook website at **www.ihs.com/WSA2016**

If you would like further information or have any questions about this conference, please contact:

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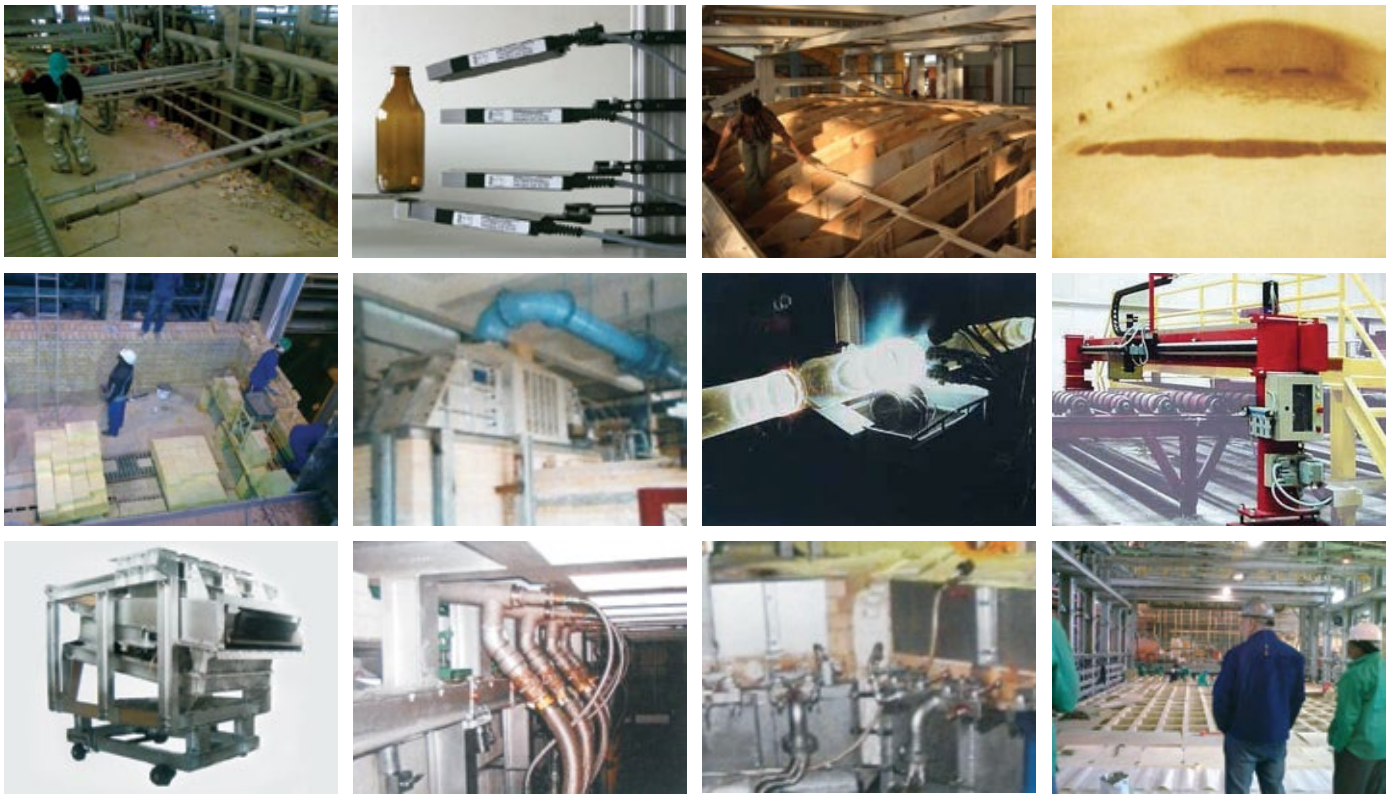

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Mr. M.D. Farooq, the founder of Umda Enginering, brings to the table more than 35 years of expertise in the manufacturing industry. Starting from humble beginnings, today more than 350 of Mr. Farooq's Lehr machines are successfully installed around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

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Efficient Workflow: Automation and Digitisation Reduce Production and Handling Costs

Cost cutting, it is often said, is difficult in glass production and processing as this sector is characterised by manual processes. At the forthcoming glasstec 2016, however, the industry will prove the opposite: further savings are to be expected through innovative approaches for automation, smart networking of production machines and value-creation stages as well as through new handling devices. This means that the glass industry should be well geared up for international competition.

High speed: B'SPEED by Bystronic glass is a quick line for manufacturing insulating glass units, capable of producing triple and quadruple-glazing units in shortest cycle times.

Photo: Bystronic glass

The glass industry is under massive pressure. On the one hand, globalisation enables producers, processors and suppliers of manufacturing technology to gain a global foothold and serve international markets. On the other hand, in the wake of globalisation price-aggressive Chinese companies are heading to Europe with inexpensive products to conquer local markets. In photovoltaics, as an important customer of flat glass, the Chinese have already taken the lead in this cut-throat competition – only very few German producers of solar modules have survived the price war with Asian competitors. The technology leadership of the German solar industry is no longer a given.

Things are also likely to become difficult for the glass industry – especially for enterprises that do not have a foothold abroad and are dependent on the German market. This is the case with many insulating glass producers whose business is largely regional in the vicinity of their manufacturing sites. They not only have to give China and low-price competitors from Eastern Europe as good as they get in technical terms and pricewise, they also face dwindling demand on the domestic market. After all, the impact of this price battle is also seen at the end of the value chain where window makers are forced out of business ever more often because they can no longer cover their costs.

Nevertheless, experts are convinced that the German glass industry will be able to sustain its technology leadership long-term. "The glass industry can ward off cheap imports by undertaking continued quality efforts," says Johann Overath, General Manager of the Federal Association of the German Glass Industry (Bundesverband Glasindustrie e.V.). Quality made in Germany, he adds, continues to be in demand especially for highly specialised applications. At the same time, duties on imports from non-EU states could also be suitable instruments for individual products in order to counter cheap imports. The big questions is: how can technology leadership and quality stand their ground in the face of rising cost pressure?

STILL ROOM FOR INNOVATIONS

The good news is: the innovation

Time saving: the thermoplastic spacer TPS is automatically applied to the glass right from a drum as part of glazing unit production. The spacer width can be altered during operation without any downtimes. Separate manufacturing processes for sawing, bending, connection, filling and butyl coating of spacer frames are eliminated.

Photo: Bystronic glass

and cost-cutting potential in glass production and handling is far from being fully exploited. Many steps in production and processing such as sorting sheets after insulating glass production are still manual today. This slows down material flows and costs time. Appropriate automation as well as integration and smart networking of processes could achieve a more balanced production flow at a higher speed – thereby saving costs.

In this context Industry 4.0, i.e. the digital networking of the individual value chain stages starting with production, could provide an important approach. The opportunity: by making machines and work pieces communicate directly with each other via special interfaces, products could be manufactured more individually, faster and at a lower price, says Linus Schleupner, Professor of Economics at the Rhenish University of Applied Sciences in Cologne. "Digitisation enables quantum leaps in production efficiency." And not only there: thanks to smart networking with customer insights and market intelligence companies can capture shoppers' behaviour precisely and optimise their product ranges accordingly. The result, he explains, are portfolios that are perfectly geared to customer needs. Furthermore, the close networking with customers as well as with upstream and downstream stages of production could help handling jobs faster. "Time optimisation is a huge asset and means a crucial competitive edge," adds Schleupner.

He admits that Industry 4.0 has caused some confusion in medium-sized businesses because there is uncertainty as to the costs associated with implementation. But the economic expert reassures that the investment for Industry 4.0 is manageable. "It primarily takes interfaces and software for linking and data evaluation rather than new machinery. The true challenge for companies is to reflect on what they want to achieve with Industry 4.0 beforehand, and how they have to adjust their processes accordingly. How are the individual value creation stages and production partners to be linked with each other?" asks Schleupner.

INTELLIGENCE RATHER THAN NEW MACHINES

With their cooperation French machinery producer Tecauma and German software supplier A+W have already suggested that intelligence can also benefit the end of the value creation chain – window making. So far, automatic glazing has required a so-called glass buffer into which the individual sheets were introduced manually for each job after being picked from the insulating glass line. Now the two companies have jointly developed a concept that does without glass buffers and permits glazing via robots right from the transport rack. This was made possible by the special A+W Rack Optimizer software. With the help of this software the insulating glass producer's output is controlled by the window maker's specifications: the glazing units can be packaged at the end of the line in exactly the order specified by the window maker – which means manual sorting into the interim buffer is rendered superfluous.

The packaging robot at the end of the line also receives the data from the A+W Rack Optimizer via an interface. It places the panes on the transport rack in the reverse picking order of the window maker. The glazing robot of the glazing unit producer is also linked with the insulating line and the packaging robot of the insulating manufacturer.

It permanently exchanges production data with the other machines via the interface. In the event of unforeseen changes in the job order, caused by glass breakage or short-term job changes, for example, the machines adapt to the new requirements in a coordinated manner. This means automatic production continues without interruptions and that efficiency increases. This example shows: the real drivers of Industry 4.0 are intelligent interfaces between manufacturer and client rather than novel machines.

Other leading glass industry players such as Lisec from Austria, a solutions provider for flat glass processing and finishing, also want to focus more on digitisation. "Industry 4.0 makes for transparent and efficient production processes in the glass processing and finishing industries," says Hannes Pils, Business Unit Manager at Software Lisec. The consistent networking from quote generation to delivery optimises production processes and enables gapless product tracking plus consistent quality reporting, which can double as quality check for specific jobs.

Lisec sees another positive effect of 4.0: learning and self-optimising production machines and lines could in future decide autonomously about the tools and machine settings to be used thereby increasing efficiency. And last but not least, permanent and consistent plant monitoring by means of built-in sensors and assistance systems enables predictive and preventive maintenance and repair. These in turn help to prevent unplanned stoppages thereby increasing plant availability. "Even service jobs and the required spare parts can be planned and organised in an automated way," rejoices Pils. At glasstec 2016 to be held in Düsseldorf from September 20–23, 2016 the expert audience can form a concrete picture of what Lisec has in store for 4.0. "We will exhibit integrated complete solutions for optimising production and will present our take on Industry 4.0 for flat glass processors."

Everything under control: Lisec's glass finishing lines are among the most efficient in the industry. All process steps can easily be tracked and controlled on a special touch screen – key to precision and efficiency.

Photo: Lisec

The experts at Bystronic glass, suppliers of manufacturing equipment and complete insulating glass lines, see similar advantages in digitisation. "As a machine builder we do see opportunities in Industry 4.0," says Bystronic Product Manager Tobias Neff and adds that today's glass production already embraces some 4.0 elements. He explains that work pieces are triggered by individual data that permit tracking all the way from manufacturing to delivery and even confirm a "successful production complete" to customers. In future, he goes on to explain, Bystronic lines could be equipped with additional software that allows customers to specify the precise sorting order for sheets. "The link between the line and window makers is a key aspect for us," remarks Neff.

ROBOTS DO NOT ALWAYS HELP

Bystronic's cooperation partner Hegla, a solutions provider for flat glass production, has also made automation the highest priority for some time now. The sorting system Sortjet and the dynamic residual plate storage Remaster have already laid the foundation for applying the 4.0 strategy to further developments in flat glass processing, says General Manager Manfred Vollbracht, and adds that customer-oriented networking and communication potential to complete the 4.0 strategy rank high in Hegla's current development projects.

Vollbracht also points out that automation and digitisation in glass finishing are not always the panacea for higher efficiency. Automatic edge deletion and system-controlled PVB trimming tools were pioneering solutions when introduced to the market, he says. Before their introduction the production process had to be interrupted so that operators could perform these jobs manually – while now these process steps are in-line, forming part of glass cutting. "The success of these solutions can also be attributed to the fact that no elaborate, multi-axis robots had to be installed for this but the existing controls, drive technology and sensors of the cutting system could be used," explains Vollbracht. This means integration and the

efficient use of existing equipment deliver more benefits than additional machinery.

And what about innovations for glass handling devices? Is there also still room for improvement when it comes to vacuum lifters, glass tongs and the like? Holger Schadwinkel of Wirth, a company specialising in solutions for industrial construction and material handling, explains that the potential for innovations in lifting devices for internal applications is low. "By using compressed air to generate a vacuum and a faster air supply for suction devices we already achieve very short cycle times today." This is unlike the devices for construction site applications. The demands made in architecture are rising: ever bigger, ever heavier, ever more convex, concave and even 3D curved sheets are in demand, Schadwinkel reports and adds: "This is why we now build devices nobody would have thought of five to six years ago in terms of load-bearing capacity and functions built into the devices."

How handle this? Many glass production and finishing processes still require manuel intervention today. Automation and digitisation can ease and speed up this work.
Photo: Messe Düsseldorf

At glasstec 2016 in Düsseldorf, the world's biggest and most international trade fair in the glass sector, companies can take a closer look at the innovations of all of these machinery producers and equipment providers and find out about the decisive trends from September 20–23, 2016. Smart manufacturing technologies will not only be demonstrated hands-on by the exhibitors but also discussed by experts at the technical symposium of the special show "glass technology live" held on September 21, 2016 under the auspices of VDMA's Forum Glass Technology. The expert audience is sure to see: there is still plenty of room for innovations in the glass sector ■

FEA studies of impact loads on NNPB refillable bottles

Dr Wenke Hu, William G Slusser and Gary Smay discuss impact load considerations when using NNPB forming technology for refillable beer bottles.

In a previous study, the internal pressure and vertical load performance of refillable bottles was evaluated through computer stress analysis. The evaluation compared the same bottle designs made by both the narrow neck press and blow (NNPB) process and the blow and blow process using two different approaches[1]: (a) The minimum thicknesses were maintained constant, while the maximum and average thicknesses were allowed to fluctuate based on typical maximum to minimum (max-to-min) thickness ratios for the NNPB and the B/B processes; and (b) the average thicknesses were maintained constant, while the minimum and maximum thicknesses were allowed to fluctuate, based on typical max-to-min thickness ratios for the NNPB and the B/B processes.

In the present study, the discussion is extended to include impact forces. The same approach from the previous study was used for four different beer bottle sizes and designs (330ml, 500ml, 650ml and 750ml), as shown in figure 1. The impact stress indices of each design were obtained through finite element analysis (FEA), utilising an Autodesk mechanical simulation programme[2, 3].

In these studies, the physical dimensions of the bottles were maintained constant throughout the analyses. This was done to avoid dimensional changes that would add complexity to the stress analysis. It is understood that keeping the dimensions constant will affect the overflow capacities. For the current bottle designs, these were found to vary by about 3%. While this volume variation would have to be taken into account in actual commercial practice, it did not significantly alter the results of the stress analyses.

CONTAINER FINITE ELEMENT ANALYSIS

Thickness distributions and computer modeling: The max-to-min thickness ratios that were used in this study for the NNPB and B/B processes are shown in table 1. These values are based on numerous measurements of bottles made by the B/B and NNPB processes in unrelated studies. The minimum thickness values for refillable beer bottles were chosen based on the body diameter of the container and the carbonation level of typical beers, as established by worldwide specifications.

A 3D symmetrical model was created using Solidworks for each of the four glass container designs. The outer surface profile was created from information that was provided on technical drawings of these four specific bottles. The glass weights shown in table 2 were calculated on a theoretical basis starting from the minimum thicknesses, while simultaneously considering the max-to-min thickness ratios for each of the two forming processes, along with the two approaches being evaluated in this study.

Impact analysis: For any given impact, three stress modes are generated as shown in figure 2: (a) The contact mode on the outside glass surface at the impact site; (b) the flexure mode on the inside surface, directly opposite of the impact site; and (c) the hinge mode that occurs on the outside surface at a distance away from the impact site[4].

The prediction of these stresses in a container subjected to an impact load is difficult due to the dynamic nature of impact. Fully dynamic analysis requires substantial computational modeling and time. Alternatively, for a low speed impact of just metres per second (velocities typically encountered by glass containers), a quasi-static approach can be accurately used to evaluate the impact stresses, since the duration of an impact is long in comparison to the time period of the fundamental frequencies[2].

A methodology has been developed that permits the prediction of impact stresses by combining finite element analysis with an impact index concept[2]. The impact index can be written as

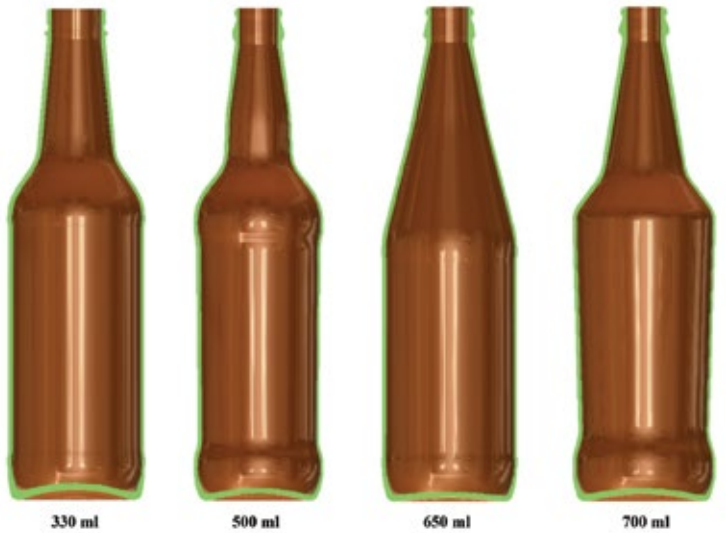

Figure 1: 3D Solidworks model for four different bottle sizes. The green coloured region represents the thickness distribution.

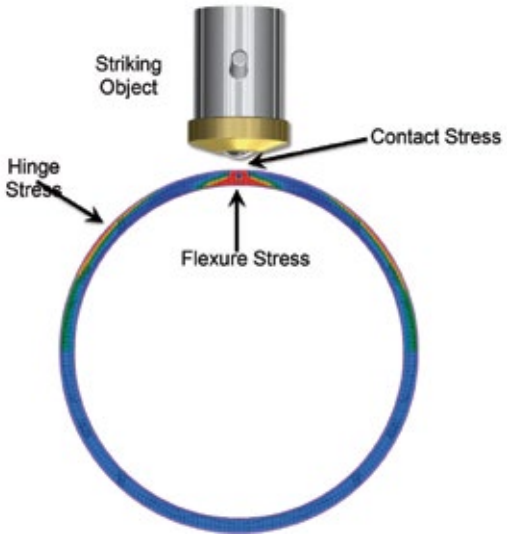

Figure 2: Tensile stresses developed during impact.

$$\frac{\sigma}{V} = \frac{\sigma}{F} \times \frac{F}{V} \qquad (1)$$

where σ is the stress, V is the impact velocity and F is the peak force generated during the impact. While σ/F can be obtained directly from finite element analysis, the force index F/V can be written as follows[2,5]:

$$\frac{F}{V} = \sqrt{km} \qquad (2)$$

where m is the effective mass and k is the contact stiffness. These values are dependent on the centre of gravity, radius of gyration, bottle dimensions and bottle weight and must be determined for each unique bottle design being considered[5].
Combining equations (1) and (2) results in:

$$\frac{\sigma}{V} = \frac{\sigma}{F} \times \sqrt{km} \qquad (3)$$

The use of equation (3) results in an impact stress per unit velocity index that can be used to evaluate container impact performance in a manner similar to the way in which an internal pressure stress index is currently used[2].

In this study, the unit impulse force in the FEA analyses was applied directly to the minimum thickness location at the shoulder and heel contact of the subject bottles. The stresses generated in the model for key regions (such as the contact point, flexure region, in-plane hinge region and shoulder and heel hinge regions) were calculated. The flexure stress occurred on the inside surface, directly opposite of the impact point and the in-plane hinge stress occurred on the outside surface at the same height as the impact point. The maximum hinge stress usually occurred in the upper shoulder region for the shoulder impact, while the maximum hinge stress usually occurred in the lower most heel region, below the contact point for the heel impact. Moreover, bearing surface hinge stresses occurred in the bearing surface region. The stresses in each of these key regions were obtained for each of the four designs and for both manufacturing processes.

	Sidewall region	Bottom region
NNPB	1.50-to-1	1.25-to-1
Blow and Blow	2.00-to-1	1.50-to-1

Table 1: Typical maximum to minimum thickness ratios for the NNPB and the B/B processes.

Bottle Size	Identical Minimum Thickness		Identical Average Thickness	
	NNPB	Blow and Blow	NNPB	Blow and Blow
330 ml	153	177	177	177
500 ml	231	266	266	266
650 ml	261	302	302	302
750 ml	315	366	366	366

Table 2: Calculated glass weights.

RESULTS AND DISCUSSION

The results from the evaluations of the four different bottles produced the same general trends. Consequently, for simplicity of the discussion, only the results from the >

Shoulder Impact	Stress Indices (MPa/cps)	
Key Bottle Regions	NNPB	Blow and Blow
Flexure	3.80	3.76
In-Plane Hinge	0.46	0.44
Maximum Hinge	0.66	0.64
Stiffness x 10^3	6.2 kg/cm	6.2 kg/cm

Heel Impact	Stress Indices (MPa/cps)	
Key Bottle Regions	NNPB	Blow and Blow
Flexure	4.55	4.50
In-Plane Hinge	0.52	0.49
Maximum Hinge	1.02	1.00
Bearing Surface Hinge	0.50	0.49
Stiffness x 103	6.6 kg/cm	6.6 kg/cm

Table 3: Impact load stress indices for 330ml bottle with identical minimum thickness.

analyses of the 330ml capacity bottle will be presented here.

Approach No 1 - Identical minimum thicknesses: With identical minimum thicknesses, the resulting glass weights were approximately 14% lighter for bottles made by the NNPB process than for bottles made by the B/B process, as shown in table 2. This weight reduction was expected, since the typical max-to-min thickness ratios were less for the NNPB process compared to the B/B process. Consequently, bottles made by the NNPB process have greater glass thickness uniformity and therefore, less overall weight when the minimum thickness is fixed.

As shown in table 3, the flexure and various hinge impact stress indices, for both shoulder contact and heel contact impact sites, were consistently 1% to 6% higher for bottles made by the NNPB process compared to the B/B process. This increase for the hinge stress is due to the slightly lower glass thicknesses and consequently, more glass compliance in the hinge regions of the bottles. Lack of structural reinforcement also allows for more flexibility at the point of impact and consequently, slightly increased flexure stress. The contact stiffness was similar for bottles from the two processes, since the impacts were directed at the same minimum thicknesses and contact stress is very localised.

Approach No 2 - Identical average thickness: When the average glass thickness was maintained constant, the calculated bottle weight resulting from the use of the NNPB process and the B/B process were identical, as shown in table 2. This was due to the higher minimum glass thicknesses from the NNPB process being essentially offset by the lower maximum glass thickness for the same process. As shown in table 4, the impact stress indices for the NNPB bottles were consistently 4% to 14% lower, compared to the bottles made by the B/B process.

These stress index reductions were due to the higher minimum thicknesses achieved with the NNPB process, which is the result of less thickness variation and improved glass distribution. It should be noted that the contact stiffness increases with the NNPB process due to less bending deformation during the impact associated with the higher minimum thickness. Thus, bottles made by the NNPB process in these considerations of nearly equal bottle weight, would exhibit significantly lower flexure and hinge stresses compared to bottles made by the B/B process. The exception would be the contact stresses, which are associated with the stiffness of the impact site.

Shoulder Impact	Stress Indices (MPa/cps)	
Key Bottle Regions	NNPB	Blow and Blow
Flexure	3.55	3.76
In-Plane Hinge	0.38	0.44
Maximum Hinge	0.59	0.64
Stiffness x 10^3	8.0 kg/cm	6.2 kg/cm

Heel Impact	Stress Indices (MPa/cps)	
Key Bottle Regions	NNPB	Blow and Blow
Flexure	4.30	4.50
In-Plane Hinge	0.45	0.49
Maximum Hinge	0.93	1.00
Bearing Surface Hinge	0.46	0.49
Stiffness x 103	8.9 kg/cm	6.6 kg/cm

Table 4: Impact load stress indices for 330ml bottle with identical average thickness.

CONCLUSION

In this study, both identical minimum thicknesses and identical average thicknesses for NNPB and B/B processes were analysed for shoulder and heel impacts through finite element analysis. It was concluded that:

- When minimum thicknesses were maintained at the same value, bottle weight can be reduced approximately 14% through the use of the NNPB process. This weight reduction can be achieved with only small increases in the impact stress indices.
- When the average thicknesses are held at the same value, impact flexure and hinge stress indices can be significantly decreased through the use of the NNPB process while the bottle weight remains unchanged. Glass stiffness and the resulting contact stresses will be somewhat greater for bottles made by the NNPB process and these values would have to be carefully considered in making any decisions relative to the use of the NNPB process.

Further discussions are planned to include the strength of glass and failure criteria considerations, in order to determine ultimately the effects of the NNPB process on refillable bottle performance. These discussions will be reported in the third and final paper in this series. ■

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Energy efficient renovation boost for added-value glazing

The European Union is committed to reducing emissions from houses and office buildings by 90% by 2050. This ambitious goal can be achieved only through passive housing technologies in new buildings and refurbishing old buildings to improve energy efficiency. This means huge opportunities for glass!

Supporting building renovation is key to boost the market for energy efficiency glass technologies. Yet, current political tools have demonstrated to be toothless at the point that the renovation rate stalls at around 1% per year; a missed opportunity to improve the energy performance of EU buildings and push the market uptake of added-value glazing solutions. Yes, the picture is not gloomy but all hope is not lost.

The review of two pieces of EU legislation foreseen by the end of the year could provide a chance to improve the current situation and ensure a profitable future for the European glass and glazing industries. These are the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD). The EED, for example, requires Member States to set up strategies to foster investments in the renovation of residential and commercial buildings, while the EPBD obliges Member States to define energy performance requirements for buildings and building elements (ie windows) when buildings undergo renovation or components are replaced. Both directives could have a major impact on the glazing market and so now is the time to set right condition for advanced glazing. Glass for Europe is already at work advocating for more renovation and stricter energy efficient requirements for buildings.

SUPPORTING RENOVATION PROJECTS

The EPBD can influence the rate of building renovation in several ways, for example, by providing a stable framework for financing instruments and making renovation simpler for final consumers.

Long-term stability and predictability are crucial for investors. In order to support renovation, financial mechanism needs to be easy and should orient the consumer toward the highest energy efficiency standards. Unfortunately, this is not always the case.

Cost-optimal renovations correspond too often to the minimum performance standards, or better to say, to the cheapest solution, which is rarely the most energy-efficient one. Building owners willing to renovate their property should be guided and accompanied in their choices; technically grounded recommendations for gradual energy efficiency improvements like window upgrades should be made available for example in the Energy Performance Certificates.

REDUCE FINAL ENERGY DEMAND FIRST

Heating and cooling account for 80% of energy consumption in Europe. This is due mainly to the fact that European buildings are poorly insulated. Although improving the insulation of the building shell is the most logical way to increase the energy performance of a building, some argue that it may be enough to improve the efficiency of the heating and cooling system, coupled with more renewables. To Glass for Europe, this would be a mistake: Only once a building is energy-efficient is it appropriate to consider the incremental benefits of renewable energy technologies. This a simple and logical principle, also known as the 'Trias Energetica' model. It is not only a matter of energy performance and improved comfort, applying this model will make EU buildings resilient to a more dynamic and inter-connected energy market.

MAXIMISE ENERGY SAVINGS

Two facts: First, about 85% of glazed areas in Europe's buildings are equipped with inefficient glazing; second, windows and glass facades are too often ill-treated in national building codes. As a result, windows keep on being considered as the weakest part of the building envelope, while they could be net contributors of energy.

The revision of the EPBD must be used to reverse pitfalls identified in building codes and incorporate a major plan for the upgrade of Europe's windows. Member States should be encouraged to put in place effective measures for the phasing out of single glazed and early uncoated double-glazed windows. For example, when a residential dwelling that is equipped with inefficient glazing changes ownership, the new owner could be obliged to retrofit windows within a period of two years. Although such a measure could be viewed as overly prescriptive, similar measures already exist in several Member States for other building components (eg boilers) and there is no reason why this could not be extended to windows.

Glass for Europe has drafted a position paper and an infographic to illustrate how a revised EPBD could put Europe back on the energy efficiency track: www.glassforeurope.com. Spreading this message in the right political forum is going to be a priority of Glass for Europe in the coming months. It is hoped to do this in concert with national partners of the building glass and glazing industry. Together, it is hoped to make a stronger difference for the business and the building glass sector as a whole. ■

GLASS FOR EUROPE
Building, Automotive, Solar-Energy Glass

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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 co-operation 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 ■

Welcomes New Members

S. No.	Company Name and Address	Products/Services
1	Mr. Prashant G Wadnerkar Business Director – Mirror **Valspar (India) Coatings Corporation Private Limited** 66 B & 67, Bommasandra Industrial Area, Hosur Road, Anekal Taluk, Bangalore – 560 099 Tel: +91 80 3911 2803, Fax: +91 80 2783 2814, M: +91 95913 23999 E-mail: prashant.wadnerkar@valspareurope.com Website. www.valsparglobal.com	Paints & Solutions for Mirror, Lacquered Glass
2	Mr. Aman Gupta Operations Head **North East Sillimanite** 1-C, Vinayak Apartment Farm Gate, Khanapara, Guwahati (Assam) – 781 022 Tel: +91 361-2209964/65, M: +91 9864072914 E-mail: nesillimanite@gmail.com	Manufacturers of Refractory Materials for Glass Industry

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 http://www.aigmf.com/membership.php

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

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

ADMISSION FEE / ANNUAL SUBSCRIPTION

Ordinary Members:

- Admission fee ₹ 5000/-
- Annual subscription: Single Unit: ₹ 25,000 + Service Tax as applicable
- More than one Unit: ₹ 1,00,000 + Service Tax as applicable

Affiliate Members:

- Admission fee ₹ 5000/-
- Annual subscription: ₹ 10,000 + Service Tax as applicable
- Applicants for enrollment for a period of five years may pay a consolidated amount of ₹ 45,000 (including admission fee) + Service Tax as applicable

Affiliate Members from countries other than India:

- Admission fee US $ 200
- Annual subscription: US $ 400 + Service Tax as applicable
- Applicants for enrollment for a period of five years may pay a consolidated amount of US $ 1500 (including admission fee) + Service Tax as applicable ■

सौर शक्ति

सौर ऊर्जा सूर्य से प्राप्त शक्ति को कहते हैं। इस ऊर्जा को ऊष्मा या विद्युत में बदलकर अन्य प्रयोगों में लाया जाता है। उस रूप को ही सौर ऊर्जा कहते हैं। घरों, कारों और वायुयानों में सौर ऊर्जा का प्रयोग होता है। ऊर्जा का यह रूप स्वच्छ और प्रदूषण रहित होता है। सूर्य से ऊर्जा प्राप्त कर उसे प्रयोग करने के लिए सोलर पैनलों की आवश्यकता होती है। सोलर पैनलों में सोलर सेल होते हैं जो सूर्य को ऊर्जा को प्रयोग करने लायक बनाते हैं। यह कई तरह के होते हैं। जैसे पानी गर्म करने वाले सोलर पैनल, बिजली पहुंचाने वाले सोलर पैनलों से भिन्न होते हैं।

विधियाँ

सौर ऊर्जा को दो तरीकों से प्रयोग हेतु बदला जाता है।

सौर तापीय विधि (सोलर थर्मल) : इससे सूर्य की ऊर्जा से हवा या तरल को गर्म किया जाता है। इस विधि का प्रयोग घरेलू कार्यों में किया जाता है।

प्रकाशविद्युत विधि (फोटोइलेक्ट्रिक): इस विधि में सौर ऊर्जा को बिजली में बदलने के लिए फोटोवोल्टेक सेलों का प्रयोग होता है। फोटोवोल्टेक सेल का रखरखाव अपेक्षाकृत होता है। इस विधि के लिये ही सौर सेल बनाये जाते हैं।

कुछ वर्ष पूर्व तक सौर ऊर्जा का प्रयोग पुराने ढंग से बनी इमारतों में किया जाता रहा है। कुछ विकसित देशों में जीवाश्म ईंधन की कमी के कारण सौर ऊर्जा की तरफ विशेषज्ञों ने अनुसंधान किये हैं। अनेक उद्योगों में सौर ऊर्जा को अपनाने के प्रयास किए जा रहे हैं। कई विषम क्षेत्रों में सौर ऊर्जा का प्रयोग जारी है जहां अन्य ऊर्जा स्रोतों की पहुंच कम है।

सौर सेल

सौर बैटरी या सौर सेल फोटोवोल्टाइक प्रभाव के द्वारा सूर्य या प्रकाश के किसी अन्य स्रोत से ऊर्जा प्राप्त करता है। अधिकांश उपकरणों के साथ सौर बैटरी इस तरह से जोड़ी जाती है कि वह उस उपकरण का हिस्सा ही बन जाती है और उससे अलग नहीं की जा सकती। सूर्य की रोशनी से एक या दो घंटे में यह पूरी तरह चार्ज हो जाती है। सौर बैटरी में लगे सेल प्रकाश को समाहित कर अर्धचालकों के इलेक्ट्रॉन को धातु के साथ क्रिया करने को प्रेरित करता है। एक बार यह क्रिया होने के बाद इलेक्ट्रॉन में उपस्थित ऊर्जा या तो बैटरी में भंडार हो जाती है या फिर सीधे प्रयोग में आती है। ऊर्जा के भंडारण होने के बाद सौर बैटरी अपने निश्चित समय पर डिस्चार्ज होती है। ये उपकरण में लगे हुए स्वचालित तरीके से पुनः चालू होती है, या उसे कोई व्यक्ति ऑन करता है। सौर सेल को आप घर में भी बना सकते हैं हम आपको एक साधारण सा सोलर सेल बनाने के बारे में बताऐगें यह मात्र एक मोडल है जिससे आप सौर ऊर्जा के बारे में कुछ बेहतर जान सकेंगे। आप इस मोडल से LED बल्ब बगैरह चला सकते हैं। चीजें जो आपको चाहिए:. आपको तांबे के तार, ताम्बे की शीट, एक प्लास्टिक की बोतल, नमक, गर्म पानी की जरूरत है।

विधि

1. एक ताम्र पत्र लें और बराबर भागों में काटें। काटने के बाद आपके पास एक ही आकार के 2 टुकड़े बनेंगे।
2. ताम्बे की एक शीट को लगभग आधे घण्टे तक गर्म करें और फिर उसे ठण्डा होने दें।
3. इसके साथ ताम्बे की एक तार जोड़ दें। उस जगह को साफ कर लें जहां तार जोड़ना है।
4. दूसरी शीट लें और उसे भी तार से जोड़ दें।
5. एक प्लास्टिक बोतल लें और उसे बीच से काट दें अब इसकी तली में नमक और पानी का घोल बना लें।
6. अब गर्म की हुए ताम्बे की शीट को इस घोल में डालें मगर ध्यान रहे कि सिर्फ शीट ही पानी को छुए न की तार।
7. उल्टी दिशा में दूसरी शीट भी डाल दें। आपका सोलर सेल तैयार हो गया।

TIPS:

1. घोल बनाने के लिए नमक का उपयोग करें।
2. सेल को अच्छी धूप में रखें जैसे पानी गर्म होने लगेगा आपका सेल काम करने लगेगा।
3. पानी को 2-3 दिन बाद बदल दें।

कमियाँ

सौर ऊर्जा की कई परेशानियां भी होती हैं। व्यापक पैमाने पर बिजली निर्माण के लिए पैनलों पर भारी निवेश करना पड़ता है। दूसरा, दुनिया में अनेक स्थानों पर सूर्य की रोशनी कम आती है, इसलिए वहां सोलर पैनल कारगर नहीं होते। तीसरा, सोलर पैनल बरसात के मौसम में ज्यादा बिजली नहीं बना पाते। फिर भी विशेषज्ञों का मत है कि भविष्य में सौर ऊर्जा का अधिकाधिक प्रयोग होगा। भारत के प्रधानमंत्री ने हाल में सिलिकॉन वैली की तरह भारत में सोलर वैली बनाने की इच्छा जताई है।

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

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