Vol. 3, No. 2, July - September, 2015

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messeduesseldorf@md-india.com
www.md-india.com

www.glasstec.de

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T: +91 11 2331 6507 F: +91 11 2335 0357 E: info@aigmf.com

Editor MOHAN LALVANI

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

Vol. 3, No.2 , July - September, 2015

Contents

Empire

Empire Industries Ltd. - VITRUM GLASS
(An ISO 9001-2008 company)

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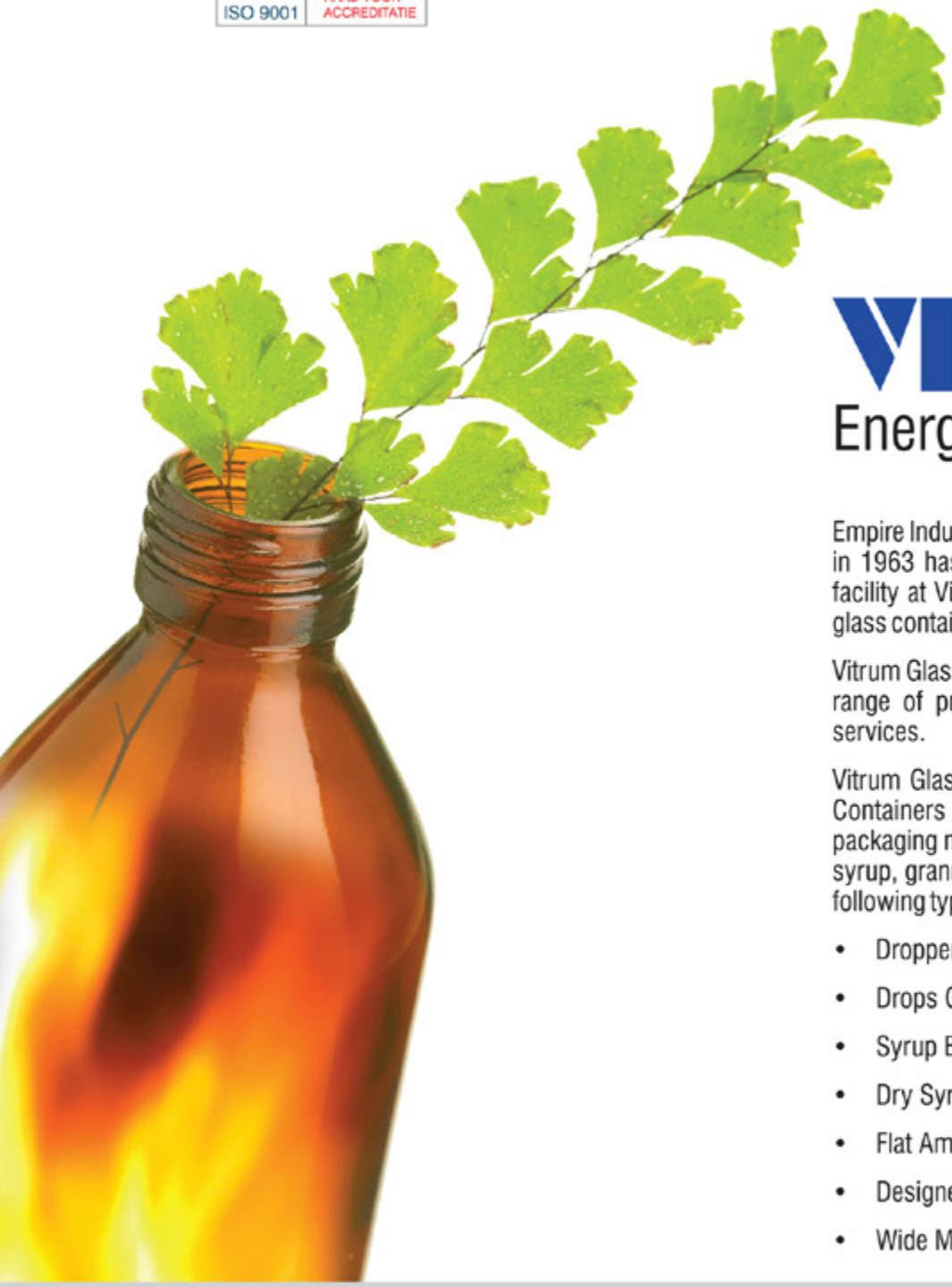

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E-mail: vitmktg@vitrum-glass.com, sgupta@vitrum-glass.com
Website: www.vitrum-glass.com

From President's Desk

The venue for Annual General Meeting of the AIGMF was Paharpur Business Centre, LEED Platinum and BEE 5 star Building with an idea to introduce Green Buildings concept to its members and to also debate on use of glass in buildings as eco-friendly measure.

Mr. Barun Aggarwal, Director, BreatheEasy, a division of Paharpur Business Centre (PBC) gave a presentation on Introduction on Green Buildings. He also spoke on use of glass application in buildings.

The session on green buildings was organised in addition to the presentation on GST- Challenges for the Businesses by Mr. Kabir Bogra, Partner (Indirect Tax) Khaitan & Co., coinciding with AIGMF Executive Committee and Annual General Meeting.

As CSR initiative, AIGMF gifted 100 glass water bottles specially manufactured by Hindustan National Glass and Industries to Paharpur Business Centre to further strengthen green building concept.

Mr. Arun Kumar Dukkipati, Sr. Vice President, AIGMF congratulated PBC for adopting use of glass bottles in its Green Building Business Centre, which is a step forward towards clean environment.

Mr. Dukkipati 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. Dukkipati concluded by saying that use of glass will make smart cities look more elegant, beautiful and eye-catching. Glass application will not only help buildings lit with natural and solar light but will also lead to huge monetary and energy savings for the economy.

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

As an Industry initiative and to link activities of the Federation with Indian Government vision of Smart Cities and Swachh Bharat Mission (Clean India Campaign), AIGMF would be participating in Indian Institute of Packaging's 6th edition of International Packaging Exhibition 'INDIAPACK 2015' at Mumbai from Oct 8-11 and Indian Green Building Congress 2015 from Nov 19-21 at Gandhinagar, Gujarat.

This Special issue carry articles on Smart/Solar Cities and Glass Packaging. Ideas and suggestions are invited at info@aigmf.com ■

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

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Glass Industry bats for Smart Cities and Clean India Campaign

(Delhi, Sept 12, 2015)

The venue for Executive Committee and Annual General Meeting of the AIGMF was Paharpur Business Centre, LEED Platinum and BEE 5 star Building. The venue was purposely chosen to introduce Green Buildings concept to its members and to also debate on use of glass in buildings as eco-friendly measure.

As an Industry initiative, talk on Green Buildings was organised in collaboration with Paharpur Business Centre to brainstorm on Indian Govt., vision of smart/solar cities including Green Building concept that could be adopted for the betterment of society.

Mr. Barun Aggarwal, Director, *BreatheEasy**, a division of *Paharpur Business Centre (PBC)** gave a presentation on Introduction on Green Buildings.

Mr. Aggarwal spoke about BreatheEasyTM that helps individuals breathe pure air and

helps companies implement solutions for improving Indoor Air Quality while reducing energy consumption. His presentation covered following on glass application in buildings:

- Use of flat glass in doors and windows permits use of sun light and saves energy/power bills
- Use of glass in partitions saves wood and checks felling of forests
- Use of glass and glass products in Buildings is quite popular, especially with glass turning from a fragile to a sturdy material i.e. toughened, noise or bullet resistant structure
- Use of Glass is generally maintenance-free for the lifetime of a building

The session on green buildings was organised in addition to the presentation on GST- Challenges for the Businesses by Mr. Kabir Bogra, Partner (Indirect Tax) Khaitan & Co., coinciding with AIGMF meetings.

As CSR initiative, AIGMF gifted 100 glass water bottles specially manufactured by Hindustan National Glass and Industries to Paharpur Business Centre to further strengthen green building concept. The bottles carried a logo on *Act India** which aims at enabling people demand responsible and safe packaging.

Mr. Arun Kumar Dukkipati, Sr. Vice President, AIGMF said that Glass containers made from cullet or weight reduction technology saves energy. Every ton of glass recycled saves 322 KwH of energy, 246 kg of CO_2 and 1.2 tonnes of virgin raw material. He also 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 environment point of view in the present times, when municipalities are finding it difficult to find space to dump urban waste
- Glass 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

Mr. Dukkipati congratulated PBC for adopting use of glass bottles in its Green Building Business Centre, which is a step forward towards clean environment.

Mr. Dukkipati 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. Dukkipati concluded by saying that use of glass will make smart cities look more elegant, beautiful and eye-catching. Glass application will not only help buildings lit with natural and solar light but will also lead to huge monetary and energy savings for the economy.

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

**Paharpur Business Centre (PBC): PBC is a green MSME in the service industry offering 24x7 Luxury Furnished Space for Large and Small Offices, Conferences, Trainings, Interviews, Seminars, Product Launches, etc. Built to DDA standards, it is the first building in India that is USGBC LEED Platinum EB Certified (under O & M category - 2010) and a BEE 5 star rated building with an AAhEPI of 28 Wh/hr/sqm. http://www.pbcnet.com. *BreatheEasy™ is a division of PBC focusing on creating awareness about air pollution and providing innovative solution to combat air pollution indoors and reduce energy for buildings. www.breatheeasy123.com*

ACT India: With an endeavor to provide solutions with ethical standards and scientific acumen, Medwiz Healthcare Communications Pvt. Ltd, the largest healthcare communications agency along with Him Jagriti***, a not-for-profit independent organization has launched a movement called Act India.*

This campaign has been curated keeping in mind the trendsetting decision by Health Ministry's notification. This notification was released on Sept 29, 2014, in lieu of recommendations by Drugs Technical Advisory Board prohibiting use of Polyethylene Terephthalate or Plastic containers for primary packaging of drug formulations used for pediatric, geriatric and in case of pregnant women and women reproductive age group.

***Medwiz Healthcare Communications: Medwiz is one of the leading fast paced Medical Communications agency, which is known for its scientific acumen and integrity. http://www.medwizindia.com*

****Him Jagriti: HimJagriti is a small not-for-profit independent organization with national and international aspirations. It focuses on broader health issues and to provide healthcare to poor individuals in hilly areas of Uttarakhand, India. http://himjagriti.in* ■

THERMAL
INSULATIONS

Saving Energy and Fuel

Lubisol Ltd., is offering significant savings of energy and fuel by efficient thermal insulation of glass furnace crowns.

The Lubisol crown insulation design is based on the principle that the usual light silica bricks insulation is partly replaced by the Lubisol insulation, applied over the light silica bricks. It is followed by a layer of Lubisol Cover Coat on the top. The thickness and the total cost of the insulation remain almost the same, but the heat losses from the crown are reduced by about 800-1000 W/m^2. The amount of the saved fuel is around 1300-1500 m^3/m^2/year natural gas or 1200-1400 kg/m^2/year heavy oil. The cost of the saved fuel is significant.

The insulating material Lubisol 2-SL has a very low specific density of 0.3 kg/dm^3, a high working temperature of 1400 °C and a very low thermal conductivity of 0.11 W/m.K at 500 °C. **The cost for one cubic meter of this insulating material is lower in comparison with the cost of the light silica bricks, and in the same time it is about 3 times more efficient.**

The Lubisol crown insulation package is suitable for application on all types of glass furnaces producing any type of glasses, including float glass, container glass, tableware or technical glass. It is very suitable for insulation of silica crowns as well for AZS and alumina fused cast crowns. It has been applied in the last several years on more than 80 glass furnaces all over the world.

The efficient Lubisol insulation package brings significant energy and fuel savings without any additional material and labor costs. It is a very good technical solution and a better option for the glass industry.

For more information, Contact:

M/s Lubisol Ltd.
Mladost 1, bl. 27, et. 16,
ap. 120, Sofia 1784, Bulgaria
E-mail: office@lubisol.com, lubisoloffice@gmail.com
Website: www.lubisol.com

GLASS –A Fascinated Material & Central Public Works Department (CPWD) Scenario in Mumbai

Dr. K. M. Soni / Ms. Usha Batra
Chief Engineer, Western Zone - I / Chief Architect, Western Region
Central Public Works Department, Mumbai
dr.kmsoni@gmail.com / srarch2@yahoo.co.in

Glass is a fascinating material for many including architects and engineers. It is not only a material of aesthetics but of necessity. One likes to start day with glass and thus cannot think life without glass. Suppose glass would have not been invented then we could not make our hairstyle and ladies could not have dressed so elegantly. Think if glass would not have been there then we could not see outside from our house windows or car windows. Think if glass would not have been invented how leaders could have vision outside from the bullet proof or bullet resistance glass of a car. Therefore glass has become a necessity whether in a house, vehicle, train or household articles. There is a special relationship between glass and buildings. Glass is a magical material which has many different properties and uses, that offers an architect many new possibilities and designs.

Glazing has become a favoured feature in buildings today all over world and has numerous advantages like reduced dead load of the buildings apart from very obvious 'beauty treatment' that it gives to buildings. Use of glass also creates space, and brings the external environment, the sky and outside greenery, into the spaces within the building. Today it is difficult to conceive the contemporary architecture without glass. In combination with modern techniques and materials such as stainless steel, concrete, aluminium and other materials, glass very successfully enhances appearance of buildings. Regardless of its general use in windows, façade or interior partitions, glass also connects the space, improves the quality of space, transmits light, and special glass also contributes to energy saving.

Government of India has already announced development of 100 smart cities and thus use of glass is going to be made on large scale, both for functional as well as aesthetic use.

As per ASSOCHAM report of 2013, glass industry will touch business of 340 billion rupees by this year. Increase in glass is said to be around 15% per annum while in construction it is around 12% per annum. It provides direct employment to about 30 lakh people. So growth of glass is going to increase as increase in income certainly will increase use of glass.

FUNCTIONS OF GLASS

The transparency and translucency of glass has historically given an aesthetic quality to architecture like no other material. It gives a building the ability to change, to move, and to create certain environments. The way in which light transmits through a piece of glass in building can be a powerful design tool for the architects. Glass can reflect, bend, transmit, and

absorb light, all with great accuracy. Most architectural glass is partially transparent with little reflectance and absorbency. There are hundreds of glass compositions as well as different coatings, colours, thicknesses, and laminates, all of which affect the way light passes through it. Thus glass nowadays is an integral part of many facades and roofs. This material can be easily shaped and installed, creating in this way the structures which are gripping and dominating.

Today energy saving is one of the most important challenges. The heat loss through the glass surface on the façade or the roof has been significantly reduced due to modern glass production and processing technologies. Then there is a concern about the safety of the users and the structure itself. Glass must nowadays

conform to the high standards regarding safety of the users and passers-by thus should be resistant to shocks and abrupt temperature changes, and in case they are damaged or shattered, they should not break in. New types of glasses keep the risk of injury to a minimum.

When selecting the type and use of glass in a project, one looks for an optimal balance between aesthetics and function. With wide variety of architectural glass commercially available coupled with the versatility and creativity, one can have the design exciting and challenging.

PROPERTIES OF GLASS

Glass has many properties which other materials do not possess. These include aesthetics, and functional both. Glossy surface of all materials, be tiles, marble, granite or wood is compared with glass. That is why many architects and engineers are fascinated to use it. Glass has such a well smooth surface which one can't get from other materials. Use of glass provides beauty to the buildings.

Glass has the unique property of transparency. Think when glass was not there, one could not use glass in a window so one had to open the window to see through the window. Glass came as a boon to the nature lovers when they found its property of transparency and brought beauty inside the buildings as one could see through it. If you have building right opposite to sea, you can enjoy its beauty without even opening the window.

One always does not need transparency and opaqueness becomes the functional requirement. Glass is the material which can also be manufactured with opaque as well as translucent properties.

Glass is said to be brittle and thus was not considered a strong material. But today strength has become the property of glass. One can have desired strength according to one's requirement and glass can be manufactured in desired thicknesses and even in laminations and also with sandwiching with other materials like plastics and polycarbonate sheets. With even hammering or firing with bullet, special glasses can sustain the damages. Today bullet proof or bullet resistant glass has become a need of bullet proof walls and vehicles.

Another property of glass is reflection and refraction. Reflection property is used in the mirrors so also in reflecting light from its surface. Since light is reflected, heat can also be reflected from its surface. Refraction property is used in utilising solar light. With the properties of refraction, transmittance, and then colour, glass can have many combinations with desired colours.

Glass is also now ready to resist fire. Now even new generation fire resistance glass is available which acts as a barrier to radiant as well as conducted heat transfer.

Thus glass has many useful properties and thus has multi functional properties.

GLASS IN BUILDINGS

Glass has now become an integrated part of the buildings though its journey might not have been very easy. Glass always needed someone to marry with as it was not earlier feasible to fix glass without suitable material. First glass married to wood and was fixed in windows, ventilators and doors. Then came mild steel and steel sections with glass became an ideal couple. This combination is even used today and preferred in many places. Steel was little heavy and having black complexion. Then came a material of light weight having fair complexion and then glass married to this material i.e. aluminium. Beauty is that aluminium is still used for framework with or without ACP (Aluminium Composite Panels). Next glass became independent and thus frameless glass came and is now used in doors and partitions. When multi-storeyed construction started with the necessity in cold regions, glass became a very useful material for structural glazing or glass curtain walls. For aesthetics, point fixed glazing or frameless glazing is now being adopted.

In the regions like Mumbai i.e. in coastal areas, corrosion is a problem. Structural glazed facade protects exposed columns and beams from direct environmental attack and thus has been very useful. In BKC area particularly, it has been used in a large way due to aesthetics.

Thus glass is available for every use in buildings; be aesthetic, functional requirements or fire resistance though special usage glasses are costly at present.

TYPES OF GLASS

Architectural glass comes in four different strength categories as; annealed glass, float glass, heat strengthened glass and fully tempered glass. Then there are specialised glasses with different properties according to the requirements of their functions. Main types of glasses are given in the followings;

Annealed glass

Annealed glass is the basic flat glass of the float process and tends to break into large, jagged shards. It is the basic material used to produce more advanced products through

further processing such as laminating, toughening, coating, etc. It is used in double-glazed windows.

Float glass

It is a sheet of glass made by floating molten glass on a bed of molten metal, typically tin, lead and various low melting alloys to get uniform thickness and very flat surfaces. Float glass is used in windows and as a base material for safety glass, reflective glass and self cleaning glass among others. Float glass can be made in thickness between 1.5 to 20 mm.

Heat strengthened glass

Heat strengthened glass is a semi tempered glass and retains the normal properties of ordinary float glass. It is similar to tempered glass except that the cooling is done at a much slower pace and is about twice as strong as annealed glass of the same physical properties of size and thickness. Heat strengthening adds strength to the glass while limiting the change in its breakage characteristics. This glass is difficult to break compared to ordinary annealed glass but unlike toughened safety glass it breaks typically edge to edge and fragments. Heat-strengthened glass is used in vertical vision spandrel areas and for laminated sloped glazing and in places where high optical quality is required.

Toughened or Tempered glass

Toughened glass is made from annealed glass treated with a thermal tempering process. In the process, a sheet of annealed glass is heated beyond its annealing point and its surfaces are then rapidly cooled while the inner portion of the glass remains hotter. The different cooling rates between the surface and the inside of the glass produces different physical properties, resulting in compressive stresses in the surface balanced by tensile stresses in the body of the glass. Such stresses cause the glass to crumble into small granular chunks during breaking instead of splintering. As a result of its safety and strength, toughened glass is used in a variety of applications, including cars, building facades, glass sliding doors and partitions, shower doors, architectural glass doors and tables, refrigerator trays, mobile screen protectors, as a component of bullet proof glass, diving masks etc.

SPECIALIZED GLASSES TO ENHANCE THEIR PERFORMANCE

Laminated glass

Laminated glass is made of two or more layers of glass with one or more inter layers of polymeric material bonded between the glass layers, produced using either heat and pressure to sandwich a thin layer of Poly Vinyl Butyral (PVB), or Polyurethane (PU) or Ethyl polymer. The glass panes can be basic float glass or tempered or heat strengthened panel. The lamination process comprises glass pre-processing i.e. cutting and grinding, washing and drying, lamination, de-airing/edge sealing and unloading. It provides durability, high-performance and multi-functional benefits and at the same time preserves the aesthetic appearance of glass. Even if the glass breaks, the glass fragments will adhere to the plastic interlayer, minimizing the risk of injury and property damage. It also has security properties as the laminated glass can resist the intrusion because it is virtually impossible to cut through the thick PVB layers even if the glass gets broken. It is also excellent barrier to noise. It also helps in providing protection from injury and property damage during glass breaking due to natural disasters such as hurricanes and earthquakes. It is used in schools, hospitals, hotels and office buildings in glazing, and wherever there are sound control requirements.

Coated glass

Surface coatings are applied to glass to modify its appearance to give advanced characteristics and functions such as low maintenance, scratch resistance, corrosion resistance, special reflection/transmission/absorption properties, etc. Coatings are usually applied by controlled exposure of the glass surface to vapours. The coating process is applied while the glass is still in the float line and still warm, producing what is known as "hard-coated" glass. Alternatively, in the off-line or vacuum coating process, the vapour is applied to the cold glass surface in a vacuum vessel.

Insulated glass

Insulated glass, often called double glazing, is a combination of two or more panes of glass spaced apart with a spacer bar and hermetically sealed with a primary and secondary sealant to form a single unit with one or more air spaces in between. Insulted glass units improve the thermal performance, thus significantly reducing heating and air-conditioning costs. By combining low - e coatings, tinted glasses, reflective coatings, silk screened patterns, laminated glass products and more, a wide variety of insulating glass configurations are available to satisfy a wide range of performance and aesthetic requirements. Insulating glass units are used in a wide range of applications including commercial/residential fixed and operable windows, and curtain walls.

Reflective glass

Reflective glass is an ordinary float glass with a metallic coating that cuts

off solar heat. This special metallic coating also provides a one-way mirror effect, preventing visibility from the outside and thus preserving privacy. Besides the basic functionality of sun control, it also contributes to architectural aesthetics and even energy conservation. It can also be easily cut, heat strengthened or toughened.

Tinted glass

Tinted glass refers to any glass that has been treated with a material such as a film or coating, which reduces its ability to transmit light. Glass can be tinted with various types of coating, which block and/or reflect different amounts and types of light, according to the needs and preferences. Body tinted glass is produced when colourants and iron are introduced during the glass manufacturing process.

Tinted glass is intended for as single or double glazing for a basic level of solar control, and even in furniture, interior design, partitions etc. It is also the base glass for many high performance comfort glasses. Doubly glazed tinted glass reduces solar heat gain, saves energy, and gives a striking visual effect, creates attractive interiors and gives a feeling of spaciousness.

Wired glass

Wired glass is a type of glass into which a wire mesh is embedded during production. Wired glass has an impact resistance similar to that of normal glass, but in case of breakage, the mesh retains the pieces of glass. This product is traditionally accepted as a low-cost fire resistant glass. It is manufactured primarily as a fire retardant, with wire mesh inlaid in the glass to prevent it from shattering and breaking out under stress or when exposed to high temperatures. With the window intact, the glass keeps the fire at bay, protecting those on the other side from the harmful effects of smoke and flame. However, the mesh may prevent the fire from penetrating but by itself it could prove dangerous, being made of fine, sharp wires which can hurt.

Mirrored glass

In mirrored glass, a metal coating is applied to one side of the glass, generally made of silver, aluminium, gold or chrome. For simple mirrored glass, a fully reflective metal coating is applied and then sealed with a protective layer. To produce one-way mirrors, a much thinner metal coating is used, with no additional sealing or otherwise opaque layer. Apart from functional use, it is also used architecturally to make a very small space appear very large and for special effects in interiors.

GLASSES WITH SPECIAL EFFECTS

Patterned glass

Patterned glass (Fig. 1) is a flat glass whose surfaces display a regular pattern. The most common method for producing patterned glass is to pass heated glass, usually just after its exit from the furnace between rollers whose surfaces contain the negative relief of the desired patterns. Patterned glass is mostly used in interior decoration and architecture, typically for functional reasons, where light but not transparency is desired.

Photochromic glass

Photochromic coatings incorporate organic photochromic dyes to produce self shading glass. Originally developed for sunglasses, these coatings are self-adjusting to ambient light and reduce visible light transmission through the glass. They provide a more evenly distributed illumination of interior space in terms of time regardless of exterior variations and they are typically used to provide shading.

Electrochromic glass

Electrochromic glass as shown in Fig. 2 (a) and (b) is produced with the multi-development of electronics and glass techniques. It is an energy-saving component for buildings and can change colour on command. It works by passing low-voltage electrical charges across a microscopically-thin coating on the glass surface, activating an electro-chromic layer which changes colour

Figure 1: Patterned glass

Figure 2 (a) & (b): Electro chromic glass

from clear to dark. The electric current can be activated manually or by sensors which react to light intensity. It changes light transmission properties in response to voltage and thus controls the amount of light and heat passing through. Its applications include in the offices, meeting rooms, hotels, villas, bathroom doors and windows, shower rooms, kitchen cabinets, glass curtain walls, technical resident conservatories and commercial buildings, as well as automobile skylights, exhibition halls, hospitals, etc.

Frosted glass

Frosted glass is produced by sand blasting or acid etching of clear sheet glass to have the effect of translucent to stop clear visibility of other side. Its applications include privacy while admitting light.

Smart glass

Smart glass is the glass whose light transmission properties are altered when voltage, light or heat is applied. Generally, smart glass changes wavelength of light from translucent to transparent or block all. Some smart technologies include electro chromic, photo chromic, thermo chromic, suspended particle, micro blind and polymer dispersed liquid crystal devices also. Critical aspects of smart glass include savings in material costs, installation costs, electricity costs and durability, as well as functional features such as the speed of control, possibilities for dimming, and the degree of transparency.

Self cleaning glass

Self cleaning glass is a specific type of glass with a nano coating of titanium dioxide surface which keeps itself free of dirt and grime through photo catalytic decomposition. Self cleaning glass cleans itself in two stages, the first stage called photo-catalysis is the action of light on the surface of the glass to basically chomp away or eat the dirt on the surface and second known as hydrophilicity. This basically ensures that any water that falls on the surface forms sheets and washes away dirt uniformly.

Photovoltaic glass

Photovoltaic glass is a special glass with integrated solar cells embedded between two glass panes with resin filled between them that convert solar energy into electricity. Though different types of photovoltaic vary in their structure, they generally include a cell or multiple cells as the core of the photovoltaic panel**,** a glass cover placed over the photovoltaic cell to protect it from the elements while allowing sunlight to pass through to the cell, an additional plastic anti-reflective sheet often used to enhance the effect of the glass cover and anti-reflective coating of the cell to block reflection, a panel backing (typically plastic) and frame holding all the pieces together and protecting it from damage during installation.

Ceramic printed glass

In such a glass, ceramic frit is applied to the glass through a fine mesh screen with glass enamel before the glass is tempered or heat strengthened. On tempering or heat strengthening, the glass enamel fuses into the glass surface and becomes a permanent coating which cannot be damaged or removed by cleaning or scrubbing etc. It is used in curtain walls, shower installations, glass doors and partitions.

Etched glass

Etching refers to the technique of creating art on the surface of glass by applying acidic, caustic, or abrasive substances. Etched glass (Fig. 3) can be found in a wide variety of decorative contexts, including glass doors and windows, furniture, and serving dishes etc. There are three ways to create etched glass as; sand blasting, acid-etching or chemical etching.

One way to do imprinting images on glass is by sandblasting (Fig. 4). Sandblasting allows for greater variation through the use of different degrees of coarseness in sand giving the finished product a rich textured appearance. Patterns and designs can be created using a mask. Dividers, doors and shower surrounds are some of the most popular architectural uses of sandblasted glass though can be used in numerous interior design applications.

GLASSES FOR SPECIFIC USE

Bent glass

It is a normal glass curved by a special process and is an alternative to the conservative rectangular design of buildings available in a wide range of sizes, allowing the creation of

Figure 3: Etched glass

Figure 4: Sand blasted glass

unique and unconventional shapes. Bent glass enhances aesthetics of architectural structures. Bent glass offers significant advantages over normal glass as the thickness of the glass can be significantly reduced and reduces the overall weight of the structure.

Typical applications for bent laminated glass include railing systems, elevator and revolving door enclosures, skylights and overhead glazing, and interior partitions. Architectural applications include domes, aquariums, revolving doors etc.

Fire resistance glass

In the event of fire, fire resistant glass stops the inflow of oxygen by de-fuelling the fire and thus stops the spread of flame. It can also stop spreading of smoke and hot toxic gases, can reduce radiant & conducted heat transmission and protect life and guards against property loss. Three major goals of fire resistance glass are life safety, property protection and to continue the required operations. It is used for fire separation in escape ways, corridors, refuge areas, vertical separation areas like lift lobby, stairwells, atriums, curtain walls etc.

Bullet resistant glass

Special types of bullet and blast resistant glass is available that does not shatter, but rather absorbs the projectile energy, thus protecting the inhabitants of the structure. It is basically made by layering a polycarbonate material between pieces of ordinary glass in a process called lamination.

Glass blocks

Glass blocks are extraordinarily versatile and available in many aesthetically pleasing sizes and styles offering virtually limitless design possibilities. Architects use glass block walls, partitions and window combined for the delicate beauty and light transmission of glass taking advantage of the strength of glass blocks.

USE OF GLASS IN CPWD

CPWD undertakes construction works of central government ministries and departments, central public sector undertakings, and central autonomous institutions. CPWD undertakes works from the concept to completion stage and thus use of glass is very important for CPWD. Though normal use of glass in windows has become necessity, glass has been used in many other applications by CPWD. In BKC area, CPWD has constructed many important buildings like SEBI building, IDBI building, PNB building, Canara Bank building, Regional Passport Office building and Regional Training Institute of CAG. Some of the buildings are in progress like offices of Central Bureau of Investigation, and Income tax department.

SELECTION CRITERION OF GLASS

Selection criterion of use of glass in CPWD depends upon;

i. Functional
ii. Aesthetics
iii. Client requirements as per the usage of buildings in the vicinity

Main emphasis of use of glass in CPWD is given on functional requirements though other two factors are also considered on case to case basis. CPWD along with CCPS has also brought out a publication named "Guidelines on Use of Glass in Buildings – Human Safety" which has been mandated in the department vide OM No. 129/SE(TAS) 2007/212 dated 04.08.2009 and 18 State Govt. departments, PSUs, States etc.

CPWD has used glass in windows, doors, partitions, interiors and murals, structural glazing and in special applications like solar panels, bullet resistance structures etc. In Mumbai, the following buildings have been recently completed in which glass has been used based on functional requirements only;

i. Distance education bldg. (DEB), MGAHV, Wardha (Fig. 5)
ii. Computer science centre (CSC), VNIT, Nagpur (Fig. 6)
iii. Residential quarters for Income Tax department (IT) at BKC, Mumbai (Fig. 7)

The buildings which have been completed based on aesthetic and

Figure 5: DEB MGAHV

Figure 6: CSC, VNIT

Figure 7: Resdl. qtrs, IT

clients requirements based on buildings constructed in close vicinity include;

i. SEBI building at BKC, Mumbai (Fig. 8)
ii. IDBI building at BKC, Mumbai (Fig. 9)
iii. Canara Bank building at BKC, Mumbai (Fig. 10)
iv. PNB building at BKC, Mumbai (Fig. 11)
v. Regional Training Institute building for CAG at BKC, Mumbai (Fig. 12)
vi. Regional Passport Building at BKC, Mumbai (Fig. 13)

The buildings which are under construction include;

i. CBI office building at BKC, Mumbai (Fig. 14)
ii. Income Tax department office building at BKC, Mumbai (Fig. 15)

CONCLUDING REMARKS

The contemporary architecture is particularly interested in glass, and it is being more extensively applied in architecture as a result of improvement in its production technology.

Accordingly, there is large number of glasses in use today, depending on their properties, and application potential.

For the effective use of glass, it should be used judiciously as per climatic conditions and orientation of the buildings, considering its functional requirements, comfort conditions, indoor air quality, energy efficiency, fire and human, safety requirements and cost considerations.

Fig. 8: SEBI Building, Mumbai

Fig. 9: IDBI Building, Mumbai

Fig. 10: Canara Bank Building, Mumbai

Fig. 11: PNB Building, Mumbai

Fig. 12: RTI Building, Mumbai

Fig. 13: RPO Building, Mumbai

Fig. 14: Proposed CBI Building

Fig. 15: Proposed IT Office Building

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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 & objects of the Federation are:-

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

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

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

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

AIGMF Secretariat

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S. No.	Company Name and Address	Products
1	Mr. Kunal Mittal **Geeta Glass Works** Near Industrial Estate, Firozabad – 283 203 U.P. Tel : +91 9897599707 Email : geetaglassworks@gmail.com	Emply Glass Bottles and other Glassware
2	Mr. Syad Junaid Mukarram **Crown Glass Industries** Karbala Road, Firozabad – 283 203 (U.P.) Tel : +91 9837380888 Email : crownglass2002@yahoo.co.in	Glass & Glassware, Flasks etc.
3	Mr. Pramod Kumar Garg / Mr. Vivek Garg **Jagdamba Glass Works** Near Industrial Estate, Firozabad – 283 203 (U.P.) Tel : +91 9837050690 Email : jgw_apex@yahoo.com	Glass & Glassware, Flasks, Head Light-Covers etc.

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/-
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- 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

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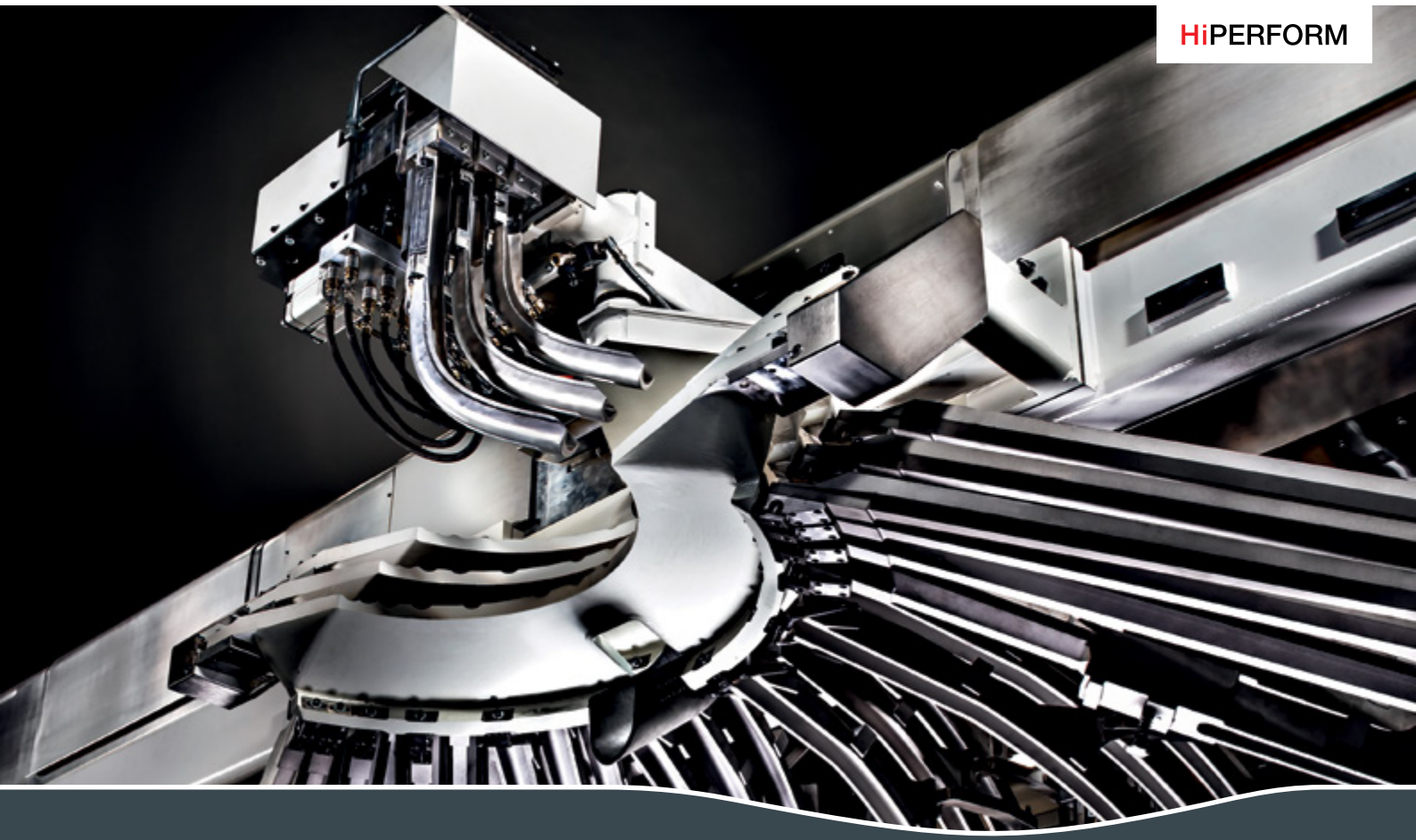

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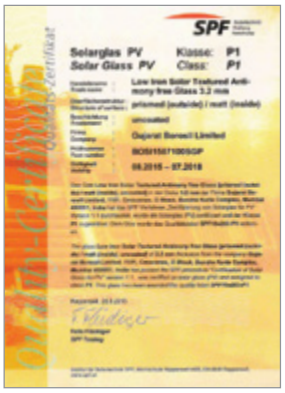

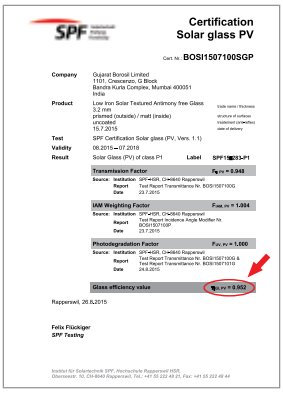

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Solar Energy for the Smart City: A Brief Pathfinder

Prof. (Dr.) A. K. Bandyopadhyay
Technology Consultant & Ex-Principal
Govt. College of Engg. & Ceramic Technology
West Bengal University of Technology, Kolkata
asisbanerjee1000@gmail.com

Abstract:

In the recent past, there has been a surge in the activity of building construction, particularly in the conclave or block mode and some even giving shape to a sort of mini-city with almost all types of amenities and certain facilities that are needed in modern day living. However, with voluminous activities in this field, there is now a 'specific demand' for '**Smart Cities**' with a considerable portion of business activities that further requires more energy than that need for modern housing alone. Ultimately, the core issue is "energy", more particularly "clean" or "renewable" energy. This is the subject matter of this article, where a brief review is given on solar power industry that must be considered for building 'Smart Cities'.

INTRODUCTION

As a primary concern to AIGMF and other relevant organizations or people, glass is a very important material for the 'building construction industry' for many decades in India. Some articles have also been written in **Kanch**, as in Ref. **[1,2]**, during the last few years on this issue. Many years ago, say 25 to 30 years ago, people used to do construction of residential or commercial buildings – mostly in isolation in discrete plots of land in and around large or medium sized cities in India. Although, there were few who constructed a bunch of buildings together (called 'building complex'), depending on the availability of a suitable size of land. However, in those years, mostly this type of activity was badly organized or very much unregulated with scant regard to environmental issues. Also, there was a shortage of suitable type of 'construction materials' or components. This was also compounded by the lack of business interest by the well-known group of industries, who did not even venture into this field. Since that period of time, there has been a sea-change in the mindset of various industrial groups, obviously with a lot of 'investment' into this sphere of activity. Only, in 2013-14, the Govt. of India has been seriously talking about large parcels of land in a new area to be able to construct 'smart cities'.

In the language of the modern day information technology (IT), 'smart cities immediately mean a lot of clean industry providing jobs and residential complexes that conform to the basic norms of IT in terms of automation of various systems or functions of a city. For example: (a) transport system (like in Singapore or similar cities), (b) waste disposal system (like in Taiwan), (c) sewage system (like in S. Korea), (d) safety and security system with smart cameras and sensors, (e) use of normal 'float' glass as doors and windows **[3]** as well as photo-reflective glasses as in E-Glass **[4]** and different types of "facades" consistent with the quality and safety norms for modern buildings **[5]**, (f) distribution system of residential apartments or commercial offices, (g) employment generation and recruitment system, etc.; the last one being very important as the number and quality of employment will primarily drive the "performance" of a 'smart city'. *For example, it is observed in many new office/housing complexes, the employees from IT and related fields openly eating in shanty shops/eateries where no consideration is given to basic hygiene and sanitation*. While these issues are taken into consideration, the "energy" remains the main focus

area, as described recently in several articles in **Kanch** and elsewhere **[6-8]**.

In the present article, mainly solar power will be discussed as a 'pathfinder' for making a significant impression or rather contribution towards creating smaller modern cities with a possibility of enlarging them to a larger dimension – not only with all the modern amenities and special facilities – but also a supply of plenty of energy. If such amount of energy is produced through the solar route, then the impact on the environment will be minimal – as the so-called environmentalists go against the use of glasses in the building construction industry. In this respect, a good 'collaboration' between AIGMF and CCPS would be an essential component in giving a constant guidance as well as new ideas to the government for achieving the success in making 'smart cities'.

SCENARIO IN THE USA

Before embarking on the issue of use of solar power, the relevant details on the scenario in the international arena need to be described here in brief to insist on the point that "solar power is making a splash in very recent periods". This renewable power is growing at such a rate that it had its hottest year for growth in the history of solar power, and the future still looks bright. For example, last year in the context of USA, solar activity is beating the 'tech company average' as an industry – according to a Forbes Magazine study on the top 25 growing business: Google, Amazon, Facebook and Apple grew by 30, 32, 38 and 39% respectively – whereas the growth of solar power was even higher than "Apple" at 40% (only, LinkedIn grew faster than solar power). So, the solar power is the 'state champion'.

It is also useful to compare the strategic position of solar energy within the 'energy producing community' that will gauge the incremental effect and its 'growth impact' further. Already in the lead as the fastest-growing clean and renewable energy source in America, solar power is growing to account for 29% of new American electricity, trailing just behind natural gas at 46%. Surely, this should give enough motivation to our domestic companies to aggressively pursue the route to solar energy. This assumes more importance as the government is seriously trying to make 'smart cities'.

Solar Power is spreading its way across every corner of America, but for now California is still in the lead for new installations. More than half of last year's solar power growth was from California alone, generating 2,621 MW. Not far behind California were Arizona at 421 MW, and North Carolina at 335 MW. Together, these states, with Massachusetts and New Jersey in the north-east made 81% of the 2013 installations (see for example, SEIA and GTM Research studies). Markets for each state still have plenty of room to grow.

It is said that while 2017 will be a critical year, as the "tax credit" in the USA is dropping from 30% to 10% for solar power, unless the Federal Government does something special during the coming years. Moreover, this disincentive even would not put a stop to the growth of solar installations. Now, there are already enough solar panel installations to power more than 20 lakh homes, and solar power is just starting to really ramp up. If things keep going this way, solar power might affect energy companies the way the internet impacted the newspaper industry.

The Cost Factor and Growth

The cost of solar power installation is also important, as there is a massive effort to reduce the overall cost in every country pointing at Sunny days for solar power. For example, the changes in solar panel technology are making solar power installations easier, quicker, and cheaper. That's why we see how solar power has grown and changed in recent years. In 2006, a solar panel installation was occurring every 80 minutes. Now, a solar power system is being set up every 4 minutes. By 2016 it will be every 80 seconds. With the reduction in time of installation, the cost should be reduced correspondingly. With the cost of solar power installations falling, and already down almost 10% from last year, it can be safely said that the industry is growing rapidly. In the last year, solar power observed a massive 41% increase in installations. In the previous 18 months, the growth of solar power outweighed its progress in the last 30 years. That's commendable and definitely worth a mention in this context.

Concurrent activity in the field of reducing cost by developing 'innovative methods and technologies', more and more plants are coming up. As a result, two-thirds of all the solar projects worldwide, i.e. 66%, were built in the past two and a half years — the same proportion holds true in the USA. Surprisingly, in 2011, after 40 years of solar power, the total installations still stood at only 50 GW. By 2012, they had doubled to more than 100 GW. By 2015, the size of global solar power should exceed 200 GW, considering the completion of many on-going projects. The US had 930 MW of solar power installations in the third quarter of 2013 alone. Now, it has more than 12 GW of solar power and is one of top 5 countries in the world to pass that mark; this will be discussed in the next issue of **Kanch**. While much of solar power still relies on the state subsidies, 51% of California's residential PV systems

were installed without assistance from California's Solar Initiative.

For the above speed of activity, in order to top it up, the marketing efforts are also accelerated to a great extent. GTM research forecasts that more than $1 billion will be spent by the solar power industry to acquire customers. This will account for about 10% of the total cost of installations. In order to stay competitive, top solar panel companies are working hard to have the best sales and marketing processes. There are still lots of room for innovation in this space.

INDIAN SCENARIO

There is a market-buzz that India is said to be making a target of 1000 MW solar capacity addition for 2015. Among many regions, Delhi Capital Region (DCR) badly needs solar power and it will be interesting to know the capacity of DCR to be added in the new target. India seems to have just increased the amount of solar power plant licenses it plans to award next year by 30% — a move that adds one additional GW of capacity to the government's 2015 target.

The push is part of India's "J. N. National Solar Mission (JNNSM)". The goal is to install 10 GW of solar by 2017 and 20 GW by 2022. India's current solar capacity now stands at 2.18 GW — part of 27 GW of overall renewable capacity that includes wind and hydropower — after it added one GW of solar installations over the course of 2013. This appears to be rather slower, but efforts are being made to augment it to a greater extent. This would also allow India to gain slightly on the 'carbon credit' front, in terms of international recognition for showing lesser reliance on the fossil fuel (mainly coal) to generate our energy needs.

However, the Indian government also down-scaled its target for 'solar-thermal' plants in the same decision, reducing its 2015 target to 100 MW of capacity from 1,080 MW originally. Rather than producing electricity from solar photovoltaic cells, solar-thermal plants use mirrors to concentrate massive amounts of sunlight on a single point, thus heating water to steam that drives electricity-generating turbines. Only one of the eight solar-thermal projects India had scheduled for completion last year is finished, while the other seven have faced delays and cost overruns.

India's push for solar has not come without a few other bumps. The JNNSM raised the ire of American officials by requiring that half of the solar components purchased to meet the target come from domestic Indian suppliers. More recently, Phase II of the JNNSM expanded that requirement to the purchase of thin film solar panels, which the USA often exports to India. USA representatives say that the requirement violates trade agreements between the two countries under World Trade Organization (WTO) rules. India and the USA have little time left to reach an agreement, before the WTO could move into this matter to resolve the dispute.

With the "**Make in India**" mission in place by the present government, it is clear that India has to create domestic manufacturing capacities. India must create more capacities, by considering our future needs, like China has done so to keep their business mission in tact a long time ago. This is a serious policy matter, where there seems to be not much option left. Otherwise, we will end up importing for the rest of our lives that will have contradiction with the above slogan for the domestic industry.

It is known that 66% of India's electricity comes from burning coal at present, and the country's coal imports actually hit a record high in the last fiscal year. With the introduction of rationalization of auction process for 'coal blocks', the situation might improve a little bit on the 'balance of payments' front. However, as a result, India's smog problem comes closer to that of the rival China's, and the use of combined fossil fuel of the two countries has made Asia the biggest territorial emitter of carbon dioxide in the world. On top of that, acquiring coal supplies is becoming both a more costly endeavour for India and a less reliable one. This caution on the environment has been duly mentioned several times in the articles in **Kanch** during the last few years, while writing about solar energy and energy efficient buildings with E-glass.

Climate change driven by humanity's carbon emissions is also a serious issue for India: the latest Climate Change Vulnerability Index (CCVI) determined the country is facing "extreme risk" from the droughts, floods, sea level rise, and the extreme storms that global warming will bring. As there is a massive effort in terms of international conferences and meetings all over the world, India has to do something tangible to reduce carbon emission with due regards to climate change issues.

The New Concept

The fact that energy systems must go non-conventional is quite apparent. But to do it in a manner that would be cost-effective and actually bear returns on investment would be the challenge. Sometimes, we may not think of a 'return on investment' as we normally do for other businesses. However, the cost-effectiveness is definitely an important issue. A new concept, such as "Pay as you Save" is a concept that has found its place in promoting solar energy in the

city, and is generating quite a bit of enthusiasm. This concept in terms of a simple payment mechanism, as practiced by some investors and entrepreneurs, is becoming quite popular. It is also devised as a clever strategy for future business growth.

The company has to chip in with a portion of capital amount of the total budget after deducting the subsidy quotient. The remaining capital amount would be paid as a fixed monthly amount equivalent to price per kWh for a period of 5 to 10 years. This scheme, called "Pay as you Save", seems to be a very good deal and a company called Aspiration Energy has ventured into this arena, where others are also trying for a meaningful entry. Industries have been keen on taking this up, in order to achieve substantial savings in energy expenditure.

This has worked very well in the 630 KW heating plant installed in Wheels India plant at Padi. Every year, an amount of about Rs. 49 lacs was saved on furnace oil. No wonder the concerned industry is convinced that the system was way ahead of conventional heating technology that uses furnace oil.

The above type of new concept in getting customers interested in such "win-win" ventures becomes effective. This is due to the fact that by harnessing solar energy for industrial purposes is yet to gain currency mainly due to the involvement of huge capital costs and it also suffers from poor efficiency. This is where the 'rooftop solar thermal power system', which has been installed in Padi, can be employed for heating operations, and also this type of system obviously comes in handy. The rooftop solar thermal power system is a technology used for high degree heating in several industries including milk, automobile, electroplating and chemical. *Each of these industries is also a great consumer of container and other glasses, and hence it is of concern to AIGMF*. A picture of "Rooftop Solar Thermal Power System" is shown above, which is not only more efficient but also achieve considerable savings.

By comparing the positive aspects of the 'solar thermal power system' to the PV cells both cost- and efficiency-wise, it can be pointed out that the cost works out to only Rs. 3/kWh and gives 100% heating efficiency, whereas the efficiency level of PV cells is around 15%; although there are all-out efforts in increasing the efficiency of the PV cells by some innovative methods.

CONCLUSIONS

After depicting the importance of solar energy in creating 'smart cities', first the actual scenario is shown in case of the USA in some details that could be considered as benchmark for India, e.g. California Solar Initiative (CSI), and it could also give us a great motivation for our development in this nascent field. By describing briefly the cost aspect and concurrent growth with its vast potential, the solar energy scenario in India is discussed with some newer development for solar heating installations for different industries. It is quite clear that there is a strong need to change our pace of development to augment the capacity of solar power plants further for the betterment of our projects on 'smart cities' in general, glass industry in particular.

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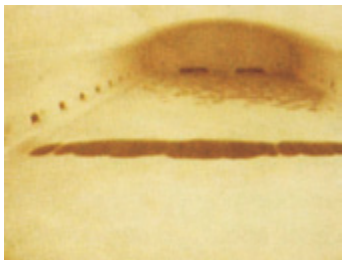
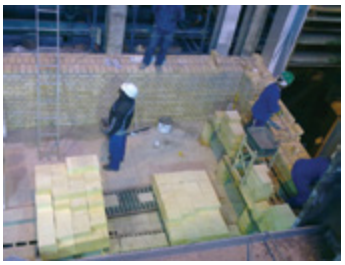






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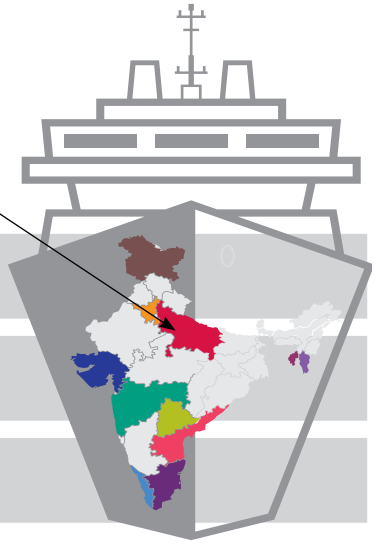

Call it the government's apathy towards it or its resistance to change, Firozabad – India's biggest glass cluster – is slowly losing its sheen. But still, it's not all doom and gloom. The trend can be reversed. All that this city requires is a radically formulated sip of change and, of course, a little push from the government to binge on success!

NEAREST PORT / ICD: ICD TUGHLAKABAD (230 KM) I **NEAREST AIRPORT:** KHERIA AIRPORT, AGRA (51 KM)
NEAREST RAILWAY STATION: FIROZABAD RAILWAY STATION (2 KM)

By Neha Dewan

It's a busy day at work at Jagdamba Glass Works' (JGW) factory unit in Firozabad. As you walk along, awed with the way it all unfolds before the eyes, you can see a bevy of workers lining up the various stages of the glass manufacturing process – cutting, blowing, making, *et al.*

JGW, which has primarily been manufacturing double walled glass liners used in vacuum flasks, is seeing a slow movement this year. "At least 70% of the company's business is from exports. We export glass refills to countries such as Brazil, Europe and China. But the demand is seeing a slow patch at present. Globally, the demand is low and competing with China is increasingly becoming fierce. Their quality is better and costs are lower. More incentives from the government alone can help to change the dismal scenario," says Vivek Garg, Managing Partner, Jagdamba Glass Works.

ROYAL CONNECT

This industrial town of Uttar Pradesh – more popularly christened as the 'Glass City of India' is a renowned name in the business. Located just 40 km from Agra, this mecca of 'all things glass' flaunts its craftsmanship with élan. From fancy bangles and wine glasses to pretty flower vases, all size candle stands, princely chandeliers and cut glass table lamps – you name it and you see it!

Historically, Firozabad was known as Chandwar Nagar. The town derived its name Firozabad after it was given as an estate to Firoz Shah, a general in Akbar's court. During this period, many glass articles were brought to this region. A few when rejected were melted and moulded in local furnaces. And that marked the beginning of glass industry in Firozabad. The industry here received patronage during the Mughal era and the town developed into a glass-making centre, manufacturing lamps, chandeliers, trinkets for the royal courts.

GLEAMING BUSINESS

Today, Firozabad houses more than 400 small-scale units engaged in the production of glass articles that find their way to both domestic and export markets. By rough estimates, Firozabad accounts for almost 70% of the total glass production in the country. Generating employment for lakhs of people, this cluster is the biggest glass industry cluster in India.

Apart from decorative household items of glass, Firozabad is also famous as the 'City of Bangles' with at least 150 bangle-making and decoration units catering to the domestic demand. In fact,

S STRENGTHS	Well established brand in international market	**W** WEAKNESSES	Technology not at par with global standards
	Availability of skilled labour		Low or limited capacity
	Diversified product range		Dominance of unorganised sector
O OPPORTUNITIES	Scope for further diversification	**T** THREATS	Intense competition from China and Vietnam
	MEIS incentives increased for some product categories		Increasing labour and raw material costs
	High global demand		Taj Trapezium Zone (TTZ)

a walk down the 'Bohran Gali' market in the city and shops full of resplendent bangle colours will lure you towards them. Racks with bangles, which are moved frequently through the lane, is a fascinating sight.

ALL IS NOT WELL

Although Firozabad is considered a lucrative glass export hub, the ground reality is that FY2016 is proving to be a challenging year for exporters in the glass trade. Factors such as cut-throat competition from countries such as China and Vietnam, increase in gas and soda ash prices and changes in the duty drawback structure have all played a role in slashing profit margins. "Earlier we were working on a margin of about 14% (7% duty drawback and 7% from Focus Market Scheme; FMS). Now, we are finding it difficult to break-even. FMS is not there anymore for us and drawback has also been revised from 7% to 3%, according to the categories. We are 30% down this time as compared to last year and it is a worrisome situation," laments Anuj Jain, Partner at Amita International, a Firozabad based company which manufactures and exports glass handicrafts. Good news for Jain, the government has recently introduced changes in the MEIS scheme, which can be taken advantage of by export-manufacturers like Amita Intl.

And then there are other factors. Prices of gas and soda ash – the main

This mecca of 'all things glass' flaunts its craftsmanship with élan!

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raw material used in glass manufacturing – have gone up considerably. "We are not able to match the prices offered by other countries, particularly China, Vietnam and Taiwan. Prices are at least 30-40% lesser in these countries. And since gas prices almost doubled last year, the raw material cost has gone up by 30-40%. However, at the same time, we have not been able to increase our prices owing to the slump in the international market," Sanjay Agarwal, Treasurer, All India Glass Manufacturers' Federation (AIGMF) tells *The Dollar Business*.

The city's location is also playing spoilsport. Firozabad falls under the Taj Trapezium Zone (TTZ) which does not allow the use of charcoal in the area, as per the Supreme Court's directives. This has made life more difficult for manufacturers and exporters of glassware.

GREENER PASTURES

In order to counter the challenges, a few are changing track to check what works. Some exporters of handicraft glassware are switching to production of liquor bottles where they see robust demand. While some others are exploring new destinations for their products. For instance, Jagdamba Glass Works is venturing into newer geographies. "We usually receive export orders worth Rs.15-20 crore annually. It is the same this year too. Although the demand is low, we have explored other markets such as Turkey and parts of EU which has helped us retain export revenues," says Garg.

Then there are other exporters such as Gupta Glass House who are relying more on their diversified product portfolio and as such do not find much competition from China. "In our company, we are dealing with over 70% items in mosaic. The handicraft item that we are dealing in is not manufactured in China. And the one manufactured in Turkey is at least 3-4 times more expensive than the one made in India," avers Priyank Gupta of Gupta Glass House.

VOICES OF DISSENT

The industry, however, is unanimous on the front that government incentives and support is surely lacking at present and is an absolute must if growth has to be back on track. "We are bringing in foreign currency for the country, so we should be given some incentives. Small exporters, particularly, are in bad shape at present. They should be offered adequate support from the government that can back up their survival in such a volatile market," Jain of Amita International

"GOVT. DUTIES EXIST AT EVERY STEP AND ADD UP TO THE PRODUCTION COST"

TDB: Glass exports, this year, from Firozabad is witnessing a significant drop. What factors are responsible for the decline in exports?

Sanjay Agarwal (SA): In Firozabad, we manufacture several varieties of glass, but it's the glass handicrafts that are exported the most. This year has been particularly bad as we are not able to match the prices offered by other countries, particularly China, Vietnam and Taiwan. Prices are at least 30-40% lesser in these countries. And since gas prices almost doubled last year, the raw material cost has gone up by 30-40%. Labour prices too have increased. However, at the same time, we have not been able to increase our prices owing to the slump in the international market which dampened consumer spending, resulting in fewer orders for the exporters.

TDB: How have government policies and taxes impacted the industry in Firozabad?

SA: Excise duty on handicrafts is present only in India. Duties exist at each and every step in the process and add up to the costs. We are paying the highest VAT – 14%. The natural gas in some of the states is VATable whereas in UP it isn't VATable. So there is a direct difference of about 10% in cost of other manufacturers and us. We had approached the UP government too but nothing has been done so far. Even the container subsidy has not been revised for the last 15 years. No margins exist at present. Rumour is that the small exporters will not get any drawback or incentive from the government. They want to do away with the small-scale businesses which is very surprising. People in Firozabad are currently exporting only on the drawback. This industry is slowly perishing as we are not able to compete. In fact, the manufacturers in Firozabad are facing severe survival crisis these days. Further, since the area falls in the Taj Trapezium Zone (TTZ) area – there is a restriction on new units. You cannot expand your capacity nor build any new unit. This is hindering the growth of the industry.

TDB: Is the industry getting enough support when it comes to soda ash and gas, which constitute almost 60% of your production cost?

SA: Till 2012, we were allotted 11 lakh cubic meters of subsidised natural gas every day. But since then, under the new uniform price mechanism, gas prices have almost doubled. Soda ash is another major problem area. In India, it is manufactured by only three players – GHCL, Tata Chemicals and NIRMA. These three, time and again, get together and increase the prices. This time they have increased it by at least 30%. Production cost is going up but we can't increase our selling prices.

SANJAY AGARWAL
TREASURER, THE ALL INDIA GLASS MANUFACTURERS' FEDERATION (AIGMF)

tells *The Dollar Business*.

This apart, most industry observers and exporters are of the view that China has scaled up primarily due to favourable government policies that have aided its growth. "There is a place in China called Yiwu, where nearly 200 shops have been set by the government. Such initiatives help greatly in boosting both exports and domestic sales. Similar initiatives can really help in reviving the industry's growth" adds Agarwal of AIGMF.

A SILVER LINING

The bottomline is that a concerted effort – from both the government and the industry – needs to be made to push Firozabad back on the growth trajectory. When it comes to counter competition from China, some of the leading players in the glass industry feel that an anti-dumping duty should be imposed on glass imported from China. It will not only safeguard the interest of domestic players, but will also give exports the needed boost. "Despite sitting in the glass city, we are importing glasswares from China and selling them here. How much sense does this make? If you want to 'Make in India' then provide the basic facilities that encourage manufacturing," asserts Jain. An upgradation in technology to meet qualitative international standards, removal of infrastructural bottlenecks that deter buyers and improving the quality of education collectively can help give Firozabad the much-needed facelift. If all this becomes a reality, India's glass city can certainly relive those "glory days"!

neha@thedollarbusiness.com

"IF EVERYTHING GETS AUTOMATED, THE ART OF FIROZABAD WILL TAKE A HIT"

TDB: How lucrative is Firozabad as a glass export hub?

Priyank Gupta (PG): There is no dearth of opportunities here. Firozabad's glass industry has immense growth potential. Labour is cheap and raw material is easily available. Roughly 50% of the industrial land is owned by Uttar Pradesh State Industrial Development Corporation (UPSIDC). Availability of private land is also not an issue. Naturally, costs and processes would vary largely. Unfinished glass and chemicals are mainly coming from Delhi and Ghaziabad. There is no inconvenience in terms of infrastructure since we have learnt to work around issues including electricity, which is a problem in most parts of the state.

TDB: The technology used here is not at par with international standards. Don't you think this is the major hindrance in the industry's growth?

PG: Yes, this is true. The reason is simple. There is no support from the government. Firozabad doesn't enjoy any facility or financial support from the government when it comes to upgrade technology in glass making as can be seen in China.

TDB: How have the export volumes turned out for you in FY2014-15?

PG: The export demand is down by at least 50% this year. Our business has almost halved. International market volatility, competition from China and currency fluctuation have all contributed to this drop.

TDB: What kind of competition is the industry facing from China?

PG: There is cut-throat competition from China. Firozabad no longer enjoys a monopoly in the international market as cheap Chinese products have made serious inroads into it. A drinking glass that was once a major selling product from Firozabad no longer exists. There is a world of a difference between our glass products and the ones manufactured in China, both in terms of quality and design. Their glass is 10 times stronger than our glass! This apart, mushrooming automated factories will end up spoiling the market. If everything gets automated, the art of Firozabad will take a hit.

TDB: What efforts are being made to ramp up demand?

PG: We are going by 'wait-and-watch' policy. We will go by how things shape up in October. If recovery doesn't happen during October fair, the entire cycle will get disrupted. We will see the response to assess if the sentiments have improved. Only then we can decide if we have to introduce any new category or to bring changes in some items. So far, we have not got any negative feedback from the buyers. But if the situation persists, we will approach them more aggressively.

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OWNER, GUPTA GLASS HOUSE, FIROZABAD

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PKK@ Borosil.com / vr@Borosil.com

Abstract:

Antimony is a highly toxic element, present at remote locations in our planet, and is used in glasses to enhance its optical performances.

Why has United States EPA set a limit of 6 parts per billion in drinking water for Antimony?

Antimony is a –

- geno toxic causing chromosomal damage in human leucocytes
- carcinogenic causing cancer. It also causes pneumoconiosis, a respiratory ailment.
- Gastro Intestinal problems,
- cardiovascular problems,
- Dermal problems,
- Increased incidence of spontaneous abortions and mensuration problems and other reproductive ailments.

Soil containing antimony pollutes ground water, which when ingested causes headaches, abdominal pain, constipation, colic, distaste of food, loss of appetite, small mouth ulcer with salivation, dizziness, loss of weight , albuminuria, and glycosuria.[2]

Experiments conducted which have been published in "Science of the total Environment " also show that Antimony impedes growth of plants significantly and poses danger to the animals and human beings who consume food products made from those plants.[3]

Soluble antimony in the soil is taken by plants through roots. Soil containing antimony affects seed germination process and cause reduction in yield of food grains. Seed germination and pot experiments for rice were conducted to investigate the effects of Sb(III) and Sb(V) on the growth and yield of rice, and the concentration of antimony in rice tissue. Antimony was applied either as antimony potassium tartrate (III) or as potassium antimonate (V) in the experiments. The results show that Sb (III) and Sb (V) can affect the growth of root and rice sprout, and reduce the transformation ratio of dry matter during the germination period of rice seed, also, it can affect the activity of α-amylase and the growth of rice. A reduction in yield and an increase of antimony in rice were significantly related to Sb application rates to soils.

The results also suggest that not only the application rate of Sb, but also the chemical form of Sb form should be considered while assessing the effect of Sb on plant and the danger of Sb contamination of soils as well as of food. A reduction in yield and an increase of antimony in rice were significantly related to Sb application rates to soils. The results also suggest that not only the application rate of Sb, but also the chemical form of Sb form should be considered while assessing the effect of Sb on plant and the danger of Sb contamination of soils as well as of food.

Actions against the danger posed by Antimony to Human race as well as environment are the ones initiated by European Union Parliament committee for RoHS recast.

European Union Parliament has formed a committee for making changes in the directive 2002/95/EC of the European Parliament and of the council of 27th Jan 2003 on the restriction of certain hazardous substances which is also called RoHS recast in which Antimony was also included for the

substances to be restricted/banned.[4]

Solar glass is typically a Soda-Lime glass with very low iron content suitable for high transmission of solar energy. Even though the specifications state that iron content of 200 ppm is acceptable, good quality solar glass has an iron content of around 120 ppm and commonly produced solar glass has an iron content of 140 ppm.

Solar glass provides mechanical strength to the module while allowing maximum transmission to reach the solar cells. Solar glass is also used in Solar thermal collectors and Green houses, though these require different spectra of sun.

E.G. Photovoltaic industry uses 380 to 1100 nm of the spectrum, which is based on the cells currently available.

Glass for green houses must perform well for the spectrum 380 to 780 nm.

Solar thermal industry uses almost the entire spectrum of solar energy from 350 to 2500 nm.

WHAT IS ANTIMONY?

Antimony is a toxic substance occurring in nature; it is positioned next to arsenic on the periodic table

- It causes cancer
- It causes reproductive problems
- It causes skin problems
- It causes respiratory problems
- It causes chromosomal damage in leucocytes

DOES ALL GLASS HAVE ANTIMONY?

None of the undernoted common glasses contain any Antimony.

- Normal window glass
- glass bottles
- drinking glasses
- glass lamps

WHY THEN DOES SOLAR GLASS CONTAIN ANTIMONY?

- The basic function of solar glass is to transmit as much solar energy as possible while protecting the solar cell array and the entire grid contained in the panel which produces and channelizes electricity iron in glass inhibits transmission of solar energy through the glass. Despite best efforts, some residual iron does stay behind in the raw materials
- Addition of Antimony makes an oxidizing batch, in which most of the residual iron is oxidized into Ferric form (Fe_2O_3), which does not inhibit transmission of solar energy.
- Normal glass batch with sodium sulphate and carbon is a reducing batch, which leaves a part of the iron in the glass in the form of Ferrous, or FeO, which absorbs solar energy, and a part in the form of Ferric (Fe_2O_3).

WHAT IS THE PERCEIVED BENEFIT ARISING FROM USING ANTIMONY?

The measurement of Solar transmission records a rise in glass using antimony. This is a very short term perceived benefit which comes at a horrible cost of permanent antimony poisoning of the environment.

ISN'T ANTIMONY TRAPPED IN THE GLASS? HOW CAN IT DAMAGE THE ENVIRONMENT?

- In physics glass is a liquid, subject to dissolution
- A simple test based on USP (United States Pharmacopoeia) was conducted on solar glass containing Antimony to see how much Antimony leached out.
- A sample was crushed to a powder of 300-500 microns and diluted with 50 times its volume in distilled water.
- This was raised to a temperature of 121°C and kept in an autoclave at 1 bar for just 2 hours.
- This water tested for 4.5 PPM of Antimony
- EPA in USA limits Antimony in drinking water to 0.006 PPM
- The leachate tested was 750 times over the prescribed limit!

The clear answer: Antimony is NOT trapped in the glass. It DOES leach out in large quantities!

WHY HAS THE EU REGULATORY BODY NOT BANNED ANTIMONY IN SOLAR GLASS AS YET?

- Antimony in glass was recommended by EU RoHS recast committee to be banned in EU.
- At that time, dispensation was granted to optical glass and solar glass because European industry had then represented that it wasn't possible to make these products without Antimony
- Glass manufacturers, including BOROSIL, have been hard at work since then trying to eliminate Antimony from those glasses where it is considered necessary to use it.

CAN SOLAR GLASS BE MADE SUCCESSFULLY WITHOUT ANTIMONY?

- BOROSIL has successfully eliminated Antimony from solar glass.

- Other companies which have successfully eliminated Antimony from other speciality glasses are:
  - SCHOTT Glass of Germany, which has successfully eliminated Antimony from CERAN cooktop glass .
  - CORNING Glass of USA, which has developed an Antimony free glass for glass seals
  - ASAHI GLASS of Japan, which has successfully eliminated Antimony and Arsenic from touch screen glass used in smart phones

WHAT IS THE SIZE OF THE PROBLEM POSED BY ANTIMONY IN SOLAR GLASS?

- The problem posed by solar glass containing Antimony is of GIGANTIC proportions.
- Germany alone must dispose of 600,000 Tonnes of solar panels till 2034.
- It starts really worsening after 2035, when the figure rises to 400,000 Tonnes per year!
- Both India and China have announced extensive solar energy programs. India has announced installation of 100 GW of solar power by 2022. This will need 6,000,000 tons of panels!
- The usual method of disposal of large volumes of such panels is to crush them and dump in a land fill.
- If such a land fill is inundated by rain, then the concentration of Antimony glass will be much higher than the 1:50 dilution used in our test. It could be 1:3 or 1:5. Who knows?
- This toxic water will find its way into the ground, into farm produce, drinking water. It will affect birds and animals as well.

URGENT REGULATORY ACTION NOW REQUIRED

- With the availability of an Antimony-free solar glass with a matching transmission performance, it is time for the regulatory bodies to ban Antimony from solar glass altogether.
- It is equally important for regulatory bodies to determine the method and cost of disposal of modules containing glass with antimony. Users of solar panels containing glass with Antimony must be informed of the cost of disposal of such panels.

NOT THE FIRST TIME THAT BANNING A POLLUTANT HAS LED TO MARGINALLY LOWER PERFORMANCE!

- In olden days, it was normal to add lead to petrol to enhance performance. When regulators first banned lead in petrol, there was a great outcry against it, but industry very quickly adjusted to the new unleaded petrol. Finally, engine output and performance far exceeds anything using leaded petrol.
- There was a similar outcry from glass, steel and other hot-working industries, when the use of asbestos was banned. Substitutes were soon found.

1. WHY IS ORDINARY FLAT GLASS UNSUITABLE FOR USE IN SOLAR APPLICATION?

Commercially available Soda lime glass transmits about 85% solar energy, whereas a minimum of 91.5% is required. Low iron glasses were developed to allow higher light transmission, by modifying ordinary flat glass composition using very pure high-grade raw materials and adding minor elements.

2. FACTORS AFFECTING SOLAR TRANSMISSION IN GLASS:

- When solar irradiation falls on a sheet of float glass, three phenomena come into play, viz. Reflectance, Absorbance and Transmittance.
- Reflectance: It is universally agreed that each surface of the float glass reflects about 4% of the light. Assuming there is nil absorption in the subject glass, it will transmit a maximum of 92% of the solar irradiation.
- By using textured rolled glass, light reflectance is reduced, and commercially available solar glasses indeed succeed in achieving 92% transmission in the desired spectral range.
- Absorption and transmittance: Residual iron in the raw materials used to make flat glass are responsible for absorbing solar radiation, rendering the glass inefficient for the purpose of being used as the cover for a PV module.
- This leaves only a further reduction of transmission due to absorption which is at the rate of 0.1% per mm thickness of glass, which need not be dealt with here.
- In addition to glass composition, which principally determines the quantum of transmittance, there can be further reduction due to Rayleigh and Mie scattering effects, due to the presence of defects such as bubbles and seeds, variations in glass surface geometry, due to imperfect glass production or glass aging as the photon flux is altered by the above effects.

3. MEASURING SOLAR PANEL POWER OUTPUT

This paper deals essentially with solar glass being used in PV modules. The spectrum relevant for power generation for c-Si solar cells is 380 to 1100 nm.

Measurement of power output of PV Modules –

Once a PV module has been made, and is cooled down to the appropriate temperature, it is placed on a sun simulator. The power output

generated in a module, arising from the momentary flash generated by most sun simulators is recorded as the 'Peak Watt' output of that module. This forms the basis for the same of that module. Most sun simulators use Xenon-arc lamps which produce the light which is meant to simulate sunlight. Whereas the Solar spectrum is defined by ASTM G 173-03, the spectrum produced by the Xenon lamp is different.

The spectra as defined in ASTM G 173 represents terrestrial solar spectral irradiance of sun on a surface of a particular orientation as defined in the standard under specified atmospheric conditions.

The spectra provide distribution of solar irradiance power in watts per m2 per nm of spectral bandwidth and these are used as a common reference for evaluating PV materials with reference to the performance measured under various natural and artificial sources of light. The tilt angle selected is approximately the average latitude for the 48 states of USA over a period of one year.

4. ROLE OF IRON OXIDE IN SOLAR TRANSMISSION

Iron oxide normally contains Ferrous (Fe^{+2}) and Ferric (Fe^{+3}) ions with characteristic absorptions in the near IR range of the spectrum, i.e., about 1100 nm, and in the UV region, i.e., about 380 nm.

When iron is present in glass with a high percentage of Fe^{+3} ions, it gives a yellow to yellow-green hue, causes the absorbtion in the UV region. On the other hand, when Fe^{+2} ions are present in a higher percentage, it gives raise to a blue colour and causes the absorbtion strongly in the infrared region. Typically Soda-Lime Solar glass contains about 140 ppm iron,mentioned as Fe_2O_3. But it is in both Fe_2 and Fe_3 states, with about 30% concentration of the iron being present in the Fe+2 ionic state. [1]

Ferric absorption is in the range of 380 to 410 nm range and ferrous absorbs in the range 500 to 1100 nm. Ferric absorption is almost matching with that of intrinsic silica UV cutoff value and hence does not, in general, affect the PV performance.

Renowned institutions such as Fraunhofer Institute determine the percentage of Ferrous and Ferric components of iron in a solar glass by photometric methods to a certain level of accuracy level.

Other methods to determine the ferrous –ferric content in glass involve use of orthophenanthroline using colorimetric methods. This is important to control the level of absorbance of PV relevant radiation getting absorbed in the solar glass.

Compared to a pure Si glass with UV cut off at 280nm, network modifiers shift the UV absorption to a longer wavelength. UV cut off is optimized to a level of 380 nm so that it protects the EVA from damage and at the same time the solar module efficiency is not reduced. In the range between 380 to 1100 nm, the absorption due to alkaline and alkaline earth network modifiers is negligible. The spectral transmission characteristics of a Soda-Lime glass in the range 380 to 780 nm is transparent for most applications. The Colour of the glass is normally as a result of the presence of tramp iron oxides which are essentially coming from the batch ingredients such as Quartz, Feldspar, Limestone and Dolomite or from handling of the batch and cullet.

5. CONTROL OF FERROUS AND FERRIC OXIDES IN GLASS:

Solar glass manufacturers manipulate the iron content so that most of the iron is converted to Ferric. This is done by minimizing the redox ratio of Ferrous to Ferric by addition of certain minor elements such as Cerium, Antimony and Arsenic.

Cerium has the disadvantage of Solarization. It has been found that certain glass compositions develop a browning effect/discolouration when they get exposed to radiation, which reduces the overall transmission of the glass due to changes occurring between the elements in the glass and the radiation. If the source of radiation is the sun, then the changes that occur due to that are referred to as Solarization.

Solarization reactions within a glass appear to be caused by a transfer of electrons between ions which donate and ions which accept and this can also cause structural changes and subsequent damage to the glass network when glass receives very high energy radiation (which does not in any way happen in the case of Sunlight radiation).

Solar irradiation falling on a PV module in which the glass contains cerium is used, the EVA gets yellowish due to UV degradation, caused by solarisation in the glass. Hence Cerium usage in Solar glass has been stopped in the last decade.

Arsenic usage was stopped long back, due to various bans and restrictions in place, as it is commonly known to be a highly toxic substance. That leaves Antimony, which is not widely understood as being a very toxic substance by the general population and hence is widely used by all solar glass manufacturers in their Solar glass batch.

The most obvious step to improve the solar transmission of an iron containing glass is to reduce the amount of iron present. Efforts to reduce this iron from the glass making batch often come to a halt when a level of 110 ppm has been

achieved. Further efforts to reduce iron make the glass prohibitively expensive due to high cost of pure raw materials. Commercially produced solar glasses thus contain about 140 ppm of iron, while the better quality of solar glasses go even lower in iron content. The quick fix adopted by Solar glass manufacturers around the world is to add highly toxic antimony.

By doing so, they achieve oxidization of the iron in the glass to the extent of nearly 90%, as compared to a typical concentration of 70%. While this marginally reduces the transmission in the 380 to 410 nm range, it boosts transmission in the 500 to 100 nm range, which is desired bandwidth to squeeze better performance from PV cells.

6. GLASS AND SOLAR MODULE PERFORMANCE USING GLASS WITH ANTIMONY AND ANTIMONY-FREE:

Curve showing transmission characteristics of solar glass with antimony, and the antimony free solar glass developed by Gujarat Borosil and the Antimony-free glass normal:

As can be seen from this figure, the curve for the glass with antimony is

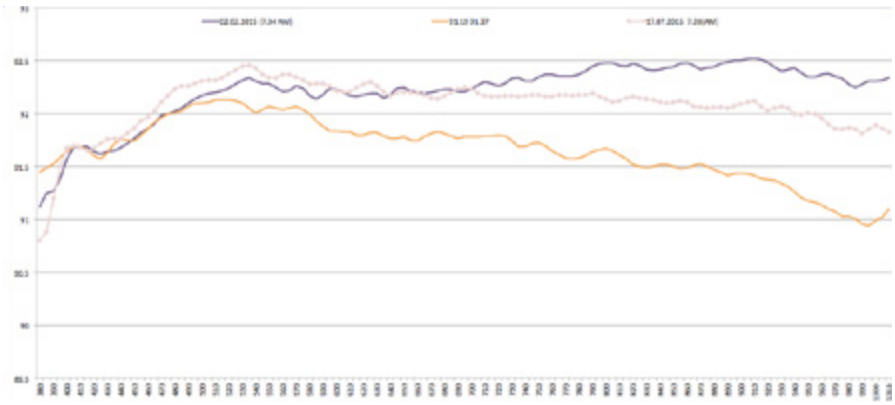


Fig1. Curves: antimony(blue),Antimony-free glass GBL(pink), Antimony-free(orange)

showing a lower transmission in the range from 380 ~ 500 nm, where the solar irradiation is at its peak, but continues to perform with high transmission in the region 500 ~ 1100 nm. In the case of the glass without antimony, the transmission curve is higher in the UV side of the spectrum, but drops after 500 nm as a result of greater absorption by its ferrous content.

However, overall transmission is higher for the glass without Antimony.

This reveals that the flash tester records a very similar output from the panels, regardless of the glass used to make it – with or without antimony.

Fig. 3 given below is showing the Performance comparison of a field installation using modules made using

(a) Saint Gobain Albarino glass containing Antimony and

(b) Gujarat Borosil glass without Antimony

Results over several months from the BOROSIL 302 KW rooftop grid connected R&D installation shows a superior performance from modules made using Gujarat Borosil glass without antimony.

All modules were made by EMVEE Corporation, Bangalore, keeping every other component exactly the same, made at the same time under the same conditions. The power output details from this installation is in the public domain, and daily power output can be accessed at website of the inverter manufacturer.

The results are derived from two sets of installations, each set comprising 96 modules. The modules made using the Saint Gobain Albarino are designated

Glass Type	Serial No	Isc(A)	Voc(V)	Pmax(W)	Vpm (V)	Ipm(A)
P/M design Without Antimony	20152401897	8.59	37.49	245.77	30.35	8.10
	20152401898	8.60	37.42	243.01	30.10	8.07
	20152401899	8.60	37.57	246.54	30.45	8.10
	20152401900	8.63	37.51	245.55	30.23	8.12
	20152401901	8.59	37.54	245.69	30.32	8.10
Average		8.60	37.51	245.31	30.29	8.10
P/M design With Antimony	20152401902	8.58	37.44	244.44	30.29	8.07
	20152401903	8.56	37.40	244.25	30.27	8.07
	20152401904	8.56	37.44	244.17	30.27	8.07
	20152401905	8.57	37.44	245.23	30.35	8.08
	20152401906	8.58	37.45	245.31	30.35	8.08
Average		8.57	37.43	244.68	30.30	8.07
Difference between Non Antimony & Antimony glass		0.03	0.03			

Fig:2 Flash test performance from modules made using glass with Antimony, and glass without Antimony.

Fig.3: Comparison of performance of Antimony(Green) and Antimony-free (Red) glass modules

Fig.4:PV module arrays at Vyline Glass Works, India with Antimony and Antimony-free glass modules

Fig.5: Installation of PV module arrays at Vyline Glass Works, India with Antimony and Antimony-free glass modules

(SG-AP-04) and the modules made using the Antimony-free glass from Gujarat Borosil are designated (B-P-11).

7. WHY MODULE MAKERS SHY AWAY FROM ANTIMONY-FREE GLASS:

Module manufacturers are paid per peak watt power output as depicted in the report of the flash tester. The accuracy and reliability of this power output is another matter entirely.

Until Gujarat Borosil made the breakthrough, the comparison of power output from modules using glass with Antimony and glass without antimony showed a drop of power of about 0.7% between glasses with the same iron content, keeping all other module component Parameters such as efficiency of the cells used, EVA, etc. the same.

After Gujarat Borosil Limited has made the breakthrough on the antimony-free glass (Patent applied) it has achieved results on par with glass containing antimony, as seen in the table depicted in Fig. 2.

The iron content in this Antimony-free glass has been measured by TuV Rheinland to be 83 ppm. Neither they, nor Fraunhofer Institute, Wurzburg, Germany have ever tested any commercially made textured solar glass with such a low concentration of iron.

By suitably modifying its batch constituents and iron content in glass, module trials have proved that the glass produced is not only free from Antimony, but has power output slightly higher than made with glass containing antimony.

8. THE COST OF DISCARDING ANTIMONY IN TERMS OF EFFICIENCY

If a glass maker were to discard Antimony from the glass batch, it would reduce the power output of the Module by just 0.7%, as measured by the flash tester! An infinitesimal gain for a gigantic price!

As we have shown in our chart in Fig. 3, there is no real loss in output. To paraphrase Sir Winston Churchill, late Prime Minister of England, never has so much been sacrificed for so little!

9. WHY THE THREAT TO HUMAN LIFE POSED BY ANTIMONY IN GLASS REQUIRES AN IMMEDIATE BAN

PV modules are laminates, bringing together tempered glass, silicon cells, back sheets, EVA films, tightly binding everything to a composite whole. Assuming an ordinary module to be 250W, there are 148 MILLION modules powering the 37 GW used in Germany ALONE. More modules in France and Italy, the other two European nations with well developed solar PV programs.

No industrial process has yet been developed which can separate the glass from the rest of the module after it has been discarded. The only industrial method of mass disposal currently known, is to first remove aluminium frames, then crush and compact the modules and use it in land fill.

10. LEACHATE TESTS

What, if any, toxic chemicals leach out from these crushed and compacted discarded PV modules?

A simple test based on USP (United States Pharmacopeia) was conducted on solar glass containing Antimony to see how much Antimony leached out. A sample was crushed to a powder of 300-500 microns and diluted with 50 times its volume in distilled water. This was raised to a temperature of 121°C and kept in an autoclave at 1 bar for just 2 hours.

The results are alarming! This test showed that leached antimony in the water measured 4.5 ppm which is 750 TIMES OVER the maximum limit set by the United States EPA.

This test was repeated at the prestigious Indian Institute of Technology, Mumbai, and the results of the first test were confirmed. Their tests revealed Antimony concentrations in the leach liquor to have reached 5.05 ppm and 6.35 ppm respectively!

We decided to conduct an experiment to ascertain the leaching of Antimony from Solar glass in ordinary conditions.

Two plastic containers were each filled with 14 Kg of antimony glass cullet from two different manufacturers and 5 Litres of demineralised water was added to each. Both containers were placed under the open sky to simulate landfill conditions. Water level was maintained and samples were taken after shaking the container well for uniformity of sample. The sampled water from the containers were then analysed for antimony once a week and the results are tabulated below.

These results are startling. They prove that Antimony has begun to leach out in atmospheric conditions, within less than four weeks of inundation!

11. END OF LIFE CONSIDERATIONS FOR PV MODULES:

[5]This shows that antimony glass poses a grave danger to the environment, plants and animals if the panels are crushed and dumped in the landfill which is the normal way of disposal of damaged Solar panel. This is true even in advanced countries such as USA and Germany.

The world at large, including leading research institutions in Solar energy research have so far adopted an Ostrich like attitude, downplaying the catastrophe that is waiting to befall on the world when millions of PV modules with antimony glass are going to be dumped in landfills around the world.

The ground water contamination will be colossal, and may become overwhelming.

Silicon Valley toxics coalition white paper[6] issued on Jan 14, 2009, has mentioned as below:

"Potential End-of-Life Hazards for Solar PV Products

What will happen to today's solar panels at the end of their usefulness which is estimated at 25 years or more?

Not only do solar PV products contain many of the same materials as electronic waste(e-waste), but they also contain a growing number of new and emerging materials that present complex recycling challenges. These challenges include finding ways to recycle the small amounts of valuable materials on which many of the new solar PV technologies are based. Much like e-waste, solar panels will leave a toxic legacy if they end up in landfills) where the materials they contain can leach into ground water) or incinerators(where burning can release toxic materials into the air). To avoid a repeat of the e-waste crisis, we need to ensure that decommissioned solar PV products are recycled responsibly and do not enter the waste stream at all.

Responsible recycling means that waste is not shipped to developing countries for dismantling or recycled using U.S. prison labour."

It is common knowledge that a huge quantity of Solar panels are ending up in landfills at their end of life.

It is estimated that Germany alone will dispose off nearly 200,000 tonnes of solar panels in the year 2038.

Unlike thin film modules, where the module manufacturer takes the responsibility of taking back the module and reprocess it to remove toxic elements, there is no such guideline in crystalline PV modules. Moreover, since the antimony in present in glass and the glass is contaminated with cells and other contaminants, it will be extremely expensive to recycle the cullet. The better and proper solution is to avoid use of Antimony in glass.

The extract from a poster displayed at PVSEC 2014 is given here for the knowledge of the audience.

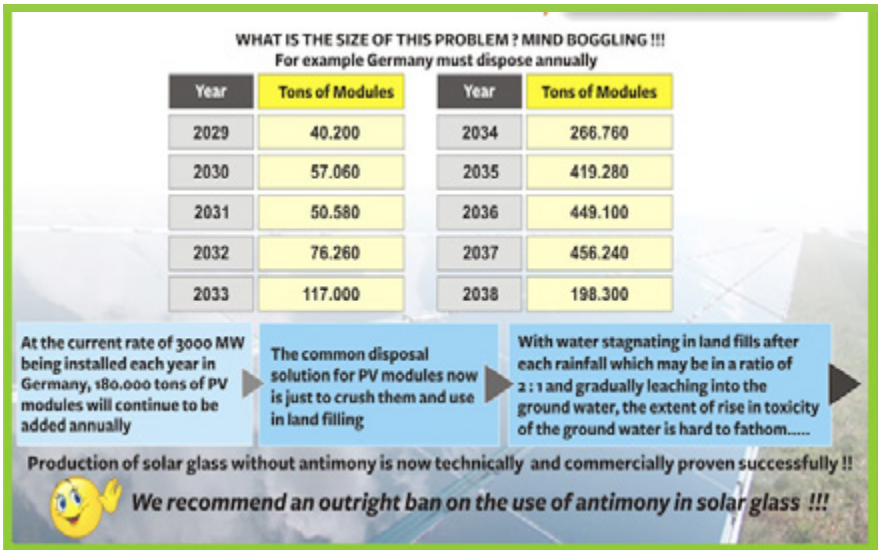
12. MAGNITUDE OF THE PROBLEM POSED BY ANTIMONY IN PV MODULES:

What is the size of the problem posed by Antimony in solar glass?

Date	Concentration of Antimony leachate Container Number	
	1	2
01 May 2015	Experiment started	
07 May 2015	Not found	
14 May 2015	"	
21 May 2015	"	
26 May 2015	0.23 ppm	0.16 ppm
02 June 2015	0.31 ppm	0.23 ppm
10 June 2015	0.40 ppm	0.30 ppm

Fig 6. Leachate test results

Fig:7. Photo showing leachate test set up



- The problem posed by solar glass containing Antimony is of GIGANTIC proportions.
- 600,000 Tonnes of solar panels are expected to be disposed off till 2034 in Germany alone.
- From 2035 onwards, the figure rises to 400,000 Tonnes per year!
- Both India and China have announced extensive solar energy programs. India has announced installation of 100 GW of solar power by 2022. This will need 6,000,000 tons of panels!
- The usual method of disposal of large volumes of such panels is to crush them and dump in a land fill.
- If such a land fill is inundated by rain, then the concentration of Antimony glass will be much higher than the 1:50 dilution used in our test. It could be 1:3 or 1:5. Who knows?

Though the following article from Mail online [7] is not pertaining to PV modules, it is relevant as it talks of antimony Leaching:

"Small doses of antimony can make you feel ill and depressed. Larger quantities can cause violent vomiting and even death. The study stressed that amounts of antimony were well below official recommended levels. But it also discovered that the levels almost doubled when the bottles were stored for three months. "

13. CONCLUSIONS:

It is essential that nations around the world who boast of Green Energy, understand the problems that they will be facing when Antimony containing glass is dumped in large scale in landfills. Rather than looking at ways of extracting antimony from the e-waste or looking at expensive ways of recycling the toxic waste, it will be easier if the world adapts Antimony-free solar glass and eliminate antimony from glass manufacturing similar to the way they have eliminated Lead and Arsenic.

14. URGENT REGULATORY ACTIONS REQUIRED:

- Since an Antimony-free solar glass having a close enough performance is now available, it is time for the regulatory bodies to ban solar glass with antimony altogether.
- It is also extremely important for regulatory bodies to determine the method and cost of disposal of modules containing glass with antimony. Users of solar panels containing glass with Antimony must be informed of the cost of disposal of such panels.
- It may be noted that petrol performance was routinely enhanced with lead in olden days. Once lead in petrol was banned, industry adjusted to the new unleaded petrol. Finally, engine output and performance far exceeds anything using leaded petrol.
- Similarly asbestos was banned from use in hot applications in glass and steel manufacturing. Substitutes were soon found.

16. THE WAY FORWARD:

Regulatory bodies around the world must straightaway ban the use of Antimony in solar glass.

Actions taken against the use of Antimony are far too little and are too late. Unless definitive action such as banning of Antimony from solar glass manufacture is taken, the threat looming ahead is real.

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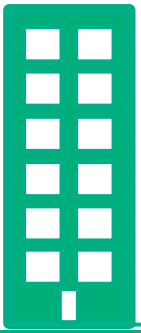

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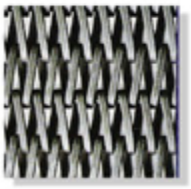

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Photovoltaic Effect and Solar Energy: A Brief Perspective – Part II

Sutapa Adhikari and B. Majhi
Dept. of Electronics & Communication Engg.,
National Institute of Technology, Durgapur-713209

Prof. (Dr.) A. K. Bandyopadhyay
Technology Consultant & Ex-Principal
Govt. College of Engg. & Ceramic Technology
West Bengal University of Technology, Kolkata
asisbanerjee1000@gmail.com

Abstract:

It is known that sunlight transports a lot of energy, which is abundantly and freely available with some variations from one geographical region to the other. Moreover, there is some seasonal variation from summer to winter months within a given geography. Hence, there is a huge surge of activity in the field of solar energy in the entire planet, and this source of energy is renewable. Some perspectives of renewable energy as well as some aspects of solar power plants were discussed in brief in a previous paper in Kanch (Ref. [1]). Then, some details were given in terms of a brief perspective in the Part – I of an article on 'photovoltaic effect and solar energy" in the last issue of Kanch (Ref. [2]). Some more aspects on the science behind the solar energy production would be described in some details in the Part – II in this article.

INTRODUCTION

An understanding of the *photovoltaic effect* in the creation of "voltage" or "electric current" in a material upon exposure to light is essential to get a good grasp on solar energy [1]. In different materials, it is also essential to understand the nature of bandgap, which signifies the difference between the 'valence band' where electrons are arranged and the 'conduction band' where the electrons flow to give rise to the conductivity of a material. If this gap is very large, the material is known as insulator, i.e. glass, ceramic, wood, etc. If the gap is almost zero, then the material is considered as metal, i.e. copper, aluminium, iron, etc. which are known as good conductors of electricity. However, if the bandgap is somewhere intermediate between the above two types, then the material is called semiconductor, i.e. silicon, germanium, gallium arsenide, etc. that helps us to understand the photovoltaic effect and consequently the mechanism of solar energy production [2].

There is a difference in processes between the standard and obvious photovoltaic effect. When the sunlight is incident upon a material surface, the electrons present in the valence band absorb energy and, being excited, jump to the conduction band and become free. These highly excited, non-thermal electrons diffuse, and some reach a junction, e.g. p-n junction in a semiconductor in a solar cell, where they are accelerated into a different material by a built-in potential that is known as Galvanic potential. This generates an 'electromotive force', and thus some of the light or "photons" energy is converted into "electric energy". As the photons in the sun-light provoke this 'electromotive force' or rather 'electric energy', the process is called "photovoltaic effect". The 'photovoltaic effect' (whether created by direct excitation or thermal effects), it will depend on many material parameters.

In most photovoltaic applications, the radiation is sunlight, and the devices are called solar cells. In the case of a p-n junction solar cell, illuminating the material creates an electric current as excited electrons and the remaining holes are swept in different directions by the built-in electric field of the depletion region [3].

In Part-II of this article, some more aspects will be discussed to get a better view of solar cells or rather on their application in the production of solar energy in terms of a characteristic equation.

EQUATION FOR SOLAR CURRENT

Before going into the details, a brief recapitulation is necessary on the theory of solar cells, wherein the physical processes by which 'photons' of sun-light are converted into electrical current need to be explained when striking a suitable semiconductor device. The theoretical studies are of practical use because they predict the fundamental limits of solar cell, and give guidance on the phenomena that contribute to losses and solar cell efficiency. Let us give a simple description as: (a) The 'photons' of sunlight hit the solar panel and they are absorbed by the semiconducting materials, such as silicon wafers, (b) The negatively charged 'electrons' are knocked loose from the silicon atoms, allowing them to flow through the material to produce electricity. It is due to the special composition of 'solar cells', the electrons are only allowed to move in a single direction, (c) An array of solar cells converts solar energy into a usable amount of direct current (DC) electricity, which is then converted to AC electricity, as per the requirement.

It is noted that to understand the electronic behaviour of a solar cell, it is useful to create a model which is electrically equivalent that is based on discrete 'electrical components' that are known as 'circuit elements', whose behaviour is well known. In an ideal solar cell, a "diode" can be put in parallel to the 'current source', and the solar cell may be modelled accordingly. However, in actual practice, no solar cell is ideal, thereby adding a 'shunt resistance' and a 'series resistance' component to the model [4]. The resulting 'equivalent circuit' of a solar cell as well as the 'schematic representation', as shown in Ref. [2], can be used in the circuit diagrams.

The characteristic equation of a solar cell, which relates solar cell parameters to the output current and voltage, is described as follows:

$$I = I_L - I_0\{exp[q(V + IR_S)/nkT] - I\} - (V + IR_S)/R_{SH}$$

Where, I = output current in Ampere, I_L = photo-generated current in Ampere, I_0 = reverse saturation current in Ampere, V = voltage across the output terminals in Volt, R_S = series resistance in Ohms, n = diode ideality factor (1 for an ideal diode), q = elementary charge, k = Boltzmann›s constant, T = absolute temperature, and R_{SH} = shunt resistance in Ohms.

In principle, given a particular operating voltage V the equation may be solved to determine the operating current I at that voltage. However, because the equation involves I on both sides in a transcendental function the equation has no general analytical solution. However, even without a solution, it is physically instructive. Furthermore, it could easily be solved using numerical methods. Since the parameters I_0, n, R_S, and R_{SH} cannot be measured directly, the most common application of the characteristic equation is nonlinear regression to extract the values of these parameters on the basis of their combined effect on solar cell behaviour.

OPEN-CIRCUIT VOLTAGE

When the cell is operated at open circuit, $I = 0$ and the voltage across an output terminals is defined as the *open-circuit voltage*. Assuming that the shunt resistance is high enough to neglect the final term of the characteristic equation, the open-circuit voltage V_{OC} is expressed as:

$$V_{OC} \approx \{(nkT)/q\} ln(I_L/I_0 + 1)$$

Where, the terms have their usual meaning, as explained above.

Similarly, there is another situation in which the cell is operated at short circuit, $V = 0$ and the current I through the terminals is defined as the *short-circuit current*. It can be shown that for a high-quality solar cell (low R_S and I_0, and high R_{SH}), the short circuit current I_{SC} is written as:

$$I_{SC} \approx I_L$$

It is not possible to extract any power from the device when operating at either open circuit or short circuit conditions.

Effect of Physical Size

The values of I_0, R_S, and R_{SH} are dependent upon the physical size of the solar cell. In comparing otherwise identical cells, a cell with twice the surface area of another will, in principle, have double the I_0 because it has twice the junction area across which current can leak. It will also have half the R_S and R_{SH} because it has twice the cross-sectional area through which current can flow. For this reason, the characteristic equation is frequently written in terms of current density (J), or current produced per unit cell area as:

$$J = J_L - J_0\{exp[q(V + JR_S)/nkT] - 1\} - (V + JR_S)/R_{SH}$$

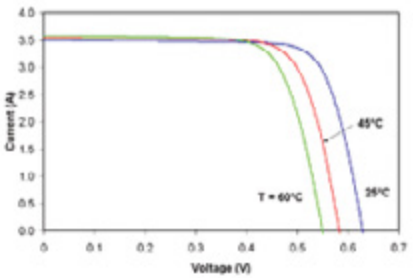
Where, J = current density, J_L = photogenerated current density and J_0 = reverse saturation current density in ampere/sq. cm; R_S = specific series resistance and R_{SH} = specific shunt resistance in Ohms-sq. cm.

This formulation has several advantages. One is that since cell characteristics are referenced to a common cross-sectional area

they may be compared for cells of different physical dimensions. While this is of limited benefit in a manufacturing setting, where all cells tend to be the same size, it is useful in research and in comparing cells between manufacturers. Another advantage is that the above current density equation naturally scales the parameter values to similar orders of magnitude, which can make numerical extraction of them simpler and relatively more accurate even with naive solution methods.

There are practical limitations of this formulation. For instance, certain parasitic effects grow in importance as cell sizes shrink and can affect the extracted parameter values. Recombination and contamination of the junction tend to be greatest at the perimeter of the cell, so very small cells may exhibit higher values of J_0 or lower values of R_{SH} than larger cells that are otherwise identical. In such cases, comparisons between cells must be made cautiously and with these effects in mind.

This approach should only be used for comparing solar cells with comparable layout. For instance, a comparison between primarily quadratical solar cells like typical crystalline silicon solar cells and narrow but long solar cells like typical thin film solar cells can lead to wrong assumptions caused by the different kinds of current paths and therefore the influence of for instance a distributed series resistance R_S. Macro-architecture of the solar cells could result in different surface areas being placed in any fixed volume - particularly for thin film solar cells and flexible solar cells which may allow for highly convoluted folded structures. If volume is the binding constraint, then the 'efficiency density' based on surface area may be of less relevance **[5,6]**.



The Cell temperature

The effect of temperature on the current-voltage characteristics of a solar cell is shown above. The temperature affects the characteristic equation in two ways: (a) directly, via T in the exponential term, and (b) indirectly, via its effect on I_0. Strictly speaking, the temperature affects all of the terms, but these two far more significantly than the others. While increasing T reduces the magnitude of the exponent in the characteristic equation, the value of I_0 increases exponentially with T. The net effect is to reduce the open-circuit voltage (V_{OC}) linearly with increasing temperature. The magnitude of this reduction is inversely proportional to V_{OC}; that is, cells with higher values of V_{OC} suffer smaller reductions in voltage with increasing temperature. For most crystalline silicon solar cells, the change in V_{OC} with temperature is about -0.50% /°C, though the rate for the highest-efficiency crystalline silicon cells is around -0.35% /°C. By way of comparison, the rate for amorphous silicon solar cells is -0.20% /°C to -0.30% /°C, depending on how the cell is made.

It has to be noted that the amount of photo-generated current I_L increases slightly with increasing temperature because of an increase in the number of thermally generated carriers in the cell. However, this effect is modest: about 0.065% /°C for crystalline silicon cells and 0.09% for amorphous silicon cells.

The overall effect of temperature on 'cell efficiency' can be computed using these factors in combination with the characteristic equation. However, since the change in voltage is much stronger than the change in current, the overall effect on efficiency tends to be similar to that on voltage. Most crystalline silicon solar cells decline in efficiency by 0.50% /°C and most amorphous cells decline by 0.15-0.25% /°C. The figure above shows I-V curves that might typically be seen for a crystalline silicon solar cell at various temperatures.

The Series Resistance

As series resistance increases, the voltage drop between the junction voltage and the terminal voltage becomes greater for the same current. The result is that the current-controlled portion of the I-V curve begins to sag toward the origin, producing a significant decrease in the terminal voltage (V) and a slight reduction in I_{SC}, the short-circuit current. Very high values of R_S will also produce a significant reduction in I_{SC}; in these regimes, series resistance dominates and the behavior of the solar cell resembles that of a resistor. Losses caused by series resistance are in a first approximation given by $P_{loss}=V_{Rs}I=I^2R_S$ and increase quadratically with photo-current. The losses arising out of the series resistance are therefore most important at high illumination intensities.

The Shunt Resistance

As shunt resistance decreases, the current diverted through the shunt resistor increases for a given level of junction voltage. The result is that the voltage-controlled portion of the I-V curve begins to sag far from the origin, producing a significant decrease in the terminal current I

and a slight reduction in V_{OC}. Very low values of R_{SH} will produce a significant reduction in V_{OC}. Much as in the case of a high series resistance, a badly shunted solar cell will take on operating characteristics similar to those of a resistor.

The Reverse Saturation Current

If one assumes infinite shunt resistance, the characteristic equation can be solved for V_{OC} as:

$$V_{OC} \approx \{(kT)/q\} ln(I_{SC}/I_0 + 1)$$

Thus, an increase in I_0 produces a reduction in V_{OC} proportional to the inverse of the logarithm of the increase. This explains mathematically the reason for the reduction in V_{OC} that accompanies increases in temperature described above. Physically, the 'reverse saturation current' is a measure of the «leakage» of carriers across the p-n junction in reverse bias. This leakage is a result of carrier recombination in the neutral regions on either side of the junction.

The Ideality Factor

The ideality factor (also called the emissivity factor) is a fitting parameter that describes how closely the diode›s behavior matches that predicted by theory, which assumes the p-n junction of the diode is an infinite plane and no recombination occurs within the space-charge region. A perfect match to theory is indicated when $n = 1$. When recombination in the space-charge region dominate other recombination, however, $n = 2$.

It can be stated that most solar cells, which are quite large compared to conventional diodes, well approximate an infinite plane and will usually exhibit near-ideal behavior under Standard Test Condition ($n \approx 1$). However, under certain operating conditions, the device operation may be dominated by recombination in the space-charge region. This is characterized by a significant increase in I_0 as well as an increase in ideality factor to $n \approx 2$. The latter tends to increase solar cell output voltage while the former acts to erode it. Therefore, the net effect is a combination of the increase in voltage for increasing n. Typically, I_0 is the more significant factor and the result is a reduction in voltage.

CONCLUSIONS

In order to understand photo-generation of electric current, the photo-voltaic effect and its influence on the solar energy production in typical silicon wafers placed on the flat glass surfaces are described in terms of various parameters, such as physical size, cell temperature, series and shunt resistances, reverse saturation current and finally the ideality factor. To get a better output from a given cell configuration, these parameters could be varied in a controlled manner for better efficiency of solar energy production. The use of flat glass will also increase with more and more solar plants.

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European standards for measuring furnace particulate emissions

The emission of particulate matter from glass furnaces is regulated by authorities around the world, although there is no single standard assessment method or one standard emission regulation. The impact of this inconsistency is being addressed by TC13, the environment committee of the International Commission on Glass. Mark Pudner and Simon Slade describe the European standard methods and outline some of the potential consequences of using the differing techniques. A second article will describe the methods used in the USA in the next issue of Glass Worldwide. Understanding and interpreting results of differing methods is especially important when comparing measurements against legally enforceable limits.

The CEN standard reference method (EN13284 -1) for measuring low dust concentrations defines dust as: 'particles, of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions'.

The choice of monitoring methods within the European Union is governed by the hierarchy of standards set out in the Monitoring BREF and DD CEN/TS15675 Annex B. If a CEN standard is available it is mandatory to use it. If there is no CEN standard and an ISO standard exists, this must be used. The Vienna Agreement between CEN and ISO means that if either party is developing a standard rather than duplicating the work, the other party may adopt the standard under a parallel vote. CEN standards have an advantage over ISO standards in that they must be validated; there is no requirement for ISO standards to undergo validation.

According to this hierarchy, the standards given in table 1 would be applied in Europe for the measurement of dust, PM_{10}, $PM_{2.5}$ and condensable particulate.

Determinand	Standard
Dust	EN 13284-1
PM_{10} and $PM_{2.5}$ (<50mg/m3)	EN ISO 23210:2009
PM_{10} and $PM_{2.5}$ (>50mg/m3)	ISO 13271:2012
Condensable particulate*	ISO 25597:2013

Table 1: Standards applied in Europe for the measurement of dust, PM_{10}, $PM_{2.5}$ and condensable particulate.

**This standard also describes a method for in-stack measurement of PM_{10} and $PM_{2.5}$ using cyclones. Under the hierarchy of standards, EN ISO 23210 must be used.*

EN13284-1:2001

EN13284-1 is the CEN standard reference method for the measurement of low dust concentrations (<50mg/m^3) from stationary sources. It was developed for use on incinerators and validated for concentrations of 5mg/m^3 with a 30 minutes sample time. The scope states that it may also be applied to other processes and higher concentrations.

EN13284-1 allows for the measurement of dust using either an in-stack or out-stack filter. There is no minimum flue gas temperature requirement for in-stack. However, the standard recommends that in-stack filtration is not used if water droplets are present, as filter clogging may occur. For out-stack filtration, it recommends that the probe and filter are heated to 160ºC. The in-stack method is the most practical to carry out, as there is no need for a heated probe and filter with the associated controller and power leads. This makes it easier to manoeuvre on the sample platform, where space is often limited. Even if the criteria for in-stack filtration are met, an out-stack filter may be used, eg if a test house wishes to combine the measurement of dust with an impinger method for acid gases or moisture.

The standard recognises that on certain processes, the concentration will depend on the filtration temperature and/or the drying temperature prior to weighing. This applies to processes with semi-volatile compounds in the flue gas, eg boron compounds. To ensure that volatile particulates are reported consistently, prior to weighing samples must be conditioned at 160ºC for one hour. If volatiles are to be measured, a lower temperature is allowed, provided it is indicated. The standard requires the uncertainty of the weighing procedure to be < 5% of the ELV.

Although the standard is validated at 5mg/m^3, it is difficult to measure the lower dust concentrations typical after a bag filter unit. Since publication, work in the UK has found that filter material loss during sampling and handling may be up to 50% of the collected particulate when measuring emissions that are <5mg/m^3. The study highlights issues with laser cut filters, which are susceptible to mechanical damage at the filter edge[1]. It found that preconditioning filters by sampling clean air at 30 litres/min for five minutes may reduce filter losses during testing.

BS EN132984-1 is currently undergoing review and it is expected that the new version will contain >

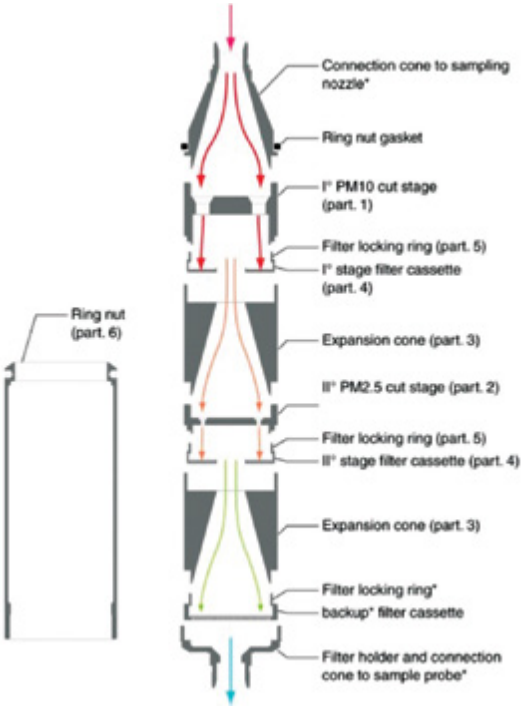

Figure 1: The TCR Tecora, MSSI cascade impactor.

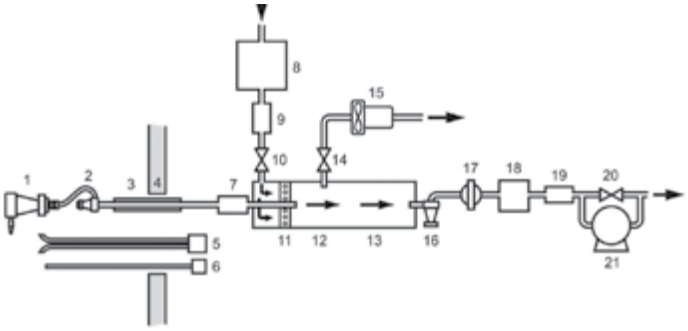

Figure 2: Conceptual schematic diagram of the ISO25597 dilution sampling train.

improvements to the weighing procedure. It may also recommend that a post sampling leak check is not carried out, as this may cause loss of particulate from the filter surface.

The main concern for glassmakers is the potential difference in results when in-stack and out-stack filtration are used. In comparative tests, several TC13 members had recorded higher results when using the out-stack method. It was thought that this may be due to the formation of condensed sulphur compounds in the probe and filter of the out-stack sample train. This is especially important when comparing measurements with legally-enforceable limits and is the basis for this TC13 study.

EN ISO23210:2009

EN ISO 23210 describes a method for the measurement of concentrations of primary PM_{10} and $PM_{2.5}$ using a two-stage cascade impactor that separates particles according to their aerodynamic diameter. Unlike in the USA, there is currently no requirement in Europe to test for PM_{10} and $PM_{2.5}$ or condensable particulates. The flow rate through the impactor is set to give different cut-off diameters at each stage: >10µm; <10 and >2.5µm; <2.5µm.

Impactors used must have been validated to meet the requirements of the standard. The TCR Tecora, MSSI cascade impactor, shown in figure 1 is one example.

The flow rate through the impactor must remain constant during the sampling period, in order to achieve the desired cut points. Instead of multi-point sampling across the chimney diameter, a single representative sampling point is used. A nozzle is selected so the isokinetic rate remains between 90% and 130% of the impactor flow rate.

ISO13271:2012

This standard specifies a method for measurement of the mass concentration of PM_{10} and $PM_{2.5}$ using a two stage virtual impactor, suitable for use at dust concentrations >50mg/m^3. The virtual impactor separates particles in a similar way to the cascade impactor but has a different method of collection. Rather than the particles being collected by impaction onto a collecting plate, the particles pass through a collection nozzle and are collected on a filter. As most glass furnace emissions are now abated, this standard is only likely to be relevant for measurement before an abatement system.

ISO25597:2013

In Europe, ISO25597 has recently replaced US EPA Method 202 as the standard for sampling condensable particulate matter. (The US methods will be described in the second paper of the TC13 series in the next issue of *Glass Worldwide*.) This specifies procedures for the measurement of filterable and condensed particulate matter, with two types of sample train:

- Basic measurement of filterable particulate in-stack using PM_{10} and $PM_{2.5}$ cyclones.
- Use of a dilution chamber to simulate reactions occurring as waste gas exits the stack and mixes with the atmosphere.

Under the hierarchy of standards, it would not be permitted to use the basic sample train alone for measuring PM_{10} and $PM_{2.5}$ in dust concentrations <50mg/m^3. CEN's cascade impactor method must be used.

GTS sampling on a chimney at a glass container factory in the UK.

Figure 2 shows a conceptual schematic diagram of the ISO25597 dilution sampling train. The first stage removes the filterable particulate > $PM_{2.5}$ using in-stack PM_{10} and $PM_{2.5}$ cyclones. The gas then enters the dilution chamber, where it mixes with air. Once fully mixed, it passes into a zone where the aerosols are aged. The aged gas is then sampled through a $PM_{2.5}$ cyclone and filter.

The standard sets out the following criteria for the dilution system:

- A minimum dilution ratio of 20:1.
- Residence time in the ageing zone >10seconds.
- Relative humidity of the diluted gas <70%.
- Temperature of the diluted gas < 42ºC.

The system must be validated to ensure that the gas is sufficiently well mixed as it enters the ageing zone and the residence time meets the minimum requirements.

It is doubtful that this standard could currently be applied in the glass industry due to its availability, cost and complexity. It is more likely that EPA method 202 would still be used as the equipment is readily available and the method is far more practical to carry out on a sample platform. However, this is an academic issue because there are currently no regulatory requirements to measure glass furnaces' emissions of condensable particulate matter in Europe. ■

ABOUT THE AUTHORS:
Mark Pudner is Principal Technologist at GTS and Simon Slade is Secretary of TC13 (the environment committee of the ICG) and Principal Technologist at the NSG Technical Centre

FURTHER INFORMATION:
Glass Technology Services Ltd, Chapeltown, Sheffield, South Yorkshire, UK
tel: +44 114 290 1801
email: m.pudner@glass-ts.com
web: www.glass-ts.com

NSG Technical Centre, Ormskirk, Lancashire, UK
tel: +44 1695 54673
email: Simon.Slade@nsg.com
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[TO BE PUBLISHED IN GAZETTE OF INDIA, EXTRAORDINARY, PART II, SECTION 3, SUB-SECTION (i)]

GOVERNMENT OF INDIA
MINISTRY OF FINANCE
DEPARTMENT OF REVENUE

Notification No. 47/2015-Customs (ADD)

New Delhi, the 8th of September, 2015

G.S.R. (E). – Whereas, the designated authority, vide notification No. 15/24/2013-DGAD, dated the 3rd January, 2014, published in the Gazette of India, Extraordinary, Part I, Section 1 dated the 3rd January, 2014, had initiated a review in the matter of continuation of anti-dumping duty on imports of Float Glass of thickness 2 mm to 12 mm (both inclusive) of clear as well as tinted variety (other than green glass) but not including reflective glass, processed glass meant for decorative, industrial or automotive purposes (hereinafter referred to as the subject goods), falling under heading 7005 of the First Schedule to the Customs Tariff Act, 1975 (51 of 1975), originating in, or exported from, the Peoples' Republic of China (in short 'China PR') and Indonesia (hereinafter referred to as the subject countries), imposed vide notification of the Government of India in the Ministry of Finance (Department of Revenue), No. 04/2009-Customs, dated the 6th January, 2009, published in the Gazette of India, Part II, Section 3, Sub-section (i), vide number G.S.R. 14(E), dated the 6th January, 2009, and had requested for extension of anti-dumping duty for an additional period of one year from the date of its expiry, in terms of sub-section (5) of section 9A of the said Customs Tariff Act, pending the completion of the review;

And whereas the Central Government had extended the anti-dumping duty imposed on the subject goods originating in, or exported from the subject countries vide notification No. 07/2014-Customs (ADD), dated the 23rd January, 2014, published in the Gazette of India, Part II, Section 3, Sub-section (i), vide number G.S.R. 49(E), dated the 23rd January, 2014 up to and inclusive of 5th January, 2015;

And whereas the designated authority vide notification No. 15/24/2013-DGAD, dated the 2nd July, 2015, published in Part I, Section 1 of the Gazette of India, Extraordinary, dated the 2nd July 2015 has concluded that –

a) the subject goods have continued to enter the Indian market from China PR at prices less than their normal values and the dumping margin is substantial and above *de minimis*. However, there has been insignificant imports from Indonesia though the dumping margin is positive and above *de minimis*;

b) the domestic industry has suffered material injury due to the presence of dumped imports from several countries, including the subject countries, during the injury investigation period;

c) the goods are likely to be exported from China PR at dumped prices in the event of cessation of anti-dumping duty and dumping is likely to continue from China PR. However, in view of insignificant imports during the injury investigation period and in the absence of credible evidence supporting likelihood of recurrence of dumping from Indonesia the DA concludes that there is no imminent likelihood of recurrence of dumping from Indonesia; and

d) injury to the domestic industry is likely to continue in the event of cessation of anti-dumping duty on imports of subject goods from China PR because of continuation of dumped imports from that country,

and has recommended continuation of anti-dumping duty on imports of subject goods originating in, or exported from, China PR;

Now, therefore, in exercise of the powers conferred by sub-sections (1) and (5) of section 9A of the Customs Tariff Act, 1975 (51 of 1975) read with rules 18 and 23 of the Customs Tariff (Identification, Assessment and

Collection of Anti-dumping Duty on Dumped Articles and for Determination of Injury) Rules, 1995, the Central Government after considering the aforesaid findings of the designated authority, hereby imposes on the goods the description of which is specified in column (3) of the Table below, falling under heading of the First Schedule to the said Customs Tariff Act as specified in the corresponding entry in column (2), originating in the country specified in the corresponding entry in column (4), exported from the country specified in the corresponding entry in column (5), produced by the producer specified in the corresponding entry in column (6) and exported by the exporter specified in the corresponding entry in column (7), and imported into India, an anti-dumping duty at the rate equal to the amount indicated in the corresponding entry in column (8), in the currency as specified in the corresponding entry in column (10) and as per unit of measurement as specified in the corresponding entry in column (9) of the said Table.

-

Table

S. No.	Heading	Description of Goods	Countries of origin	Count-ries of Export	Pro-duc-er	Expo-rter	Duty amo-unt	Unit of Meas-urem-ent	Curre-ncy
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	7005	Float Glass	China PR	China PR	Any	Any	218	MT	United States Dollar
2	7005	Float Glass	China PR	Any	Any	Any	218	MT	United States Dollar
3	7005	Float Glass	Any, other than countries attracting anti-dumping duty	China PR	Any	Any	218	MT	United States Dollar

Note 1: " Float Glass" means Float Glass of thickness 2 mm to 12 mm (both thickness inclusive) of clear as well as tinted variety (other than green glass) but not including reflective glass, processed glass meant for decorative, industrial or automotive purposes.

Note 2: In case of goods originating from countries against which antidumping duties are in force, antidumping duty applicable under those notifications shall apply.

The anti-dumping duty imposed under this notification shall be effective for a period of five years (unless revoked, amended or superseded earlier) from the date of publication of this notification in the Gazette of India and shall be paid in Indian currency.

Explanation. - For the purposes of this notification, rate of exchange applicable for the purposes of calculation of such anti-dumping duty shall be the rate which is specified in the notification of the Government of India, in the Ministry of Finance (Department of Revenue), issued from time to time, under section 14 of the Customs Act, 1962 (52 of 1962) and the relevant date for determination of the rate of exchange shall be the date of presentation of the bill of entry under section 46 of the said Customs Act.

[F. No. 354/ 211/2002-TRU] (Pt.-II)

(Anurag Sehgal)

Under Secretary to the Government of India ▪

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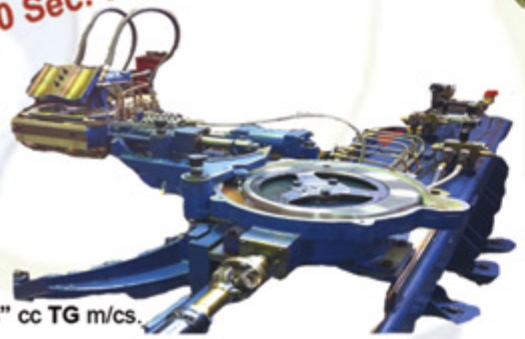
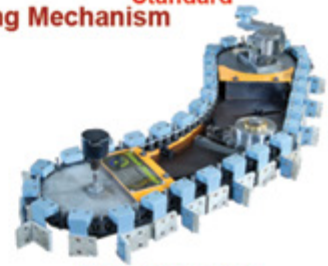


Gob Distributor

€ - Valve Block



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Personality Profile:

Balkrishna Gupta

Born on December 31, 1922 in a small village on the outskirts of Firozabad* (*Uttar Pradesh, INDIA*), Mr. Balkrishna Gupta belongs from a modest family and could only study till middle level school

Mr. Bal Krishna Gupta is the Founder and Chairman of Advance Group of Glass Industries, Firozabad. He has more than 70 years of vast experience of running many glass manufacturing units in Firozabad (*which is also know as Glass city of India*).

Mr. Gupta has served as Former President of The All India Glass Manufacturers' Federation (AIGMF) and was Former President with Uttar Pradesh Glass Manufacturers' Syndicate (UPGMS) for many terms.

Mr. Gupta is a self-made tycoon who started his 1st glass business in partnership with Ganga Glass in 1946 for just 2 Anna's (12.5 paisa or 12/100 of an Indian rupee). He suffered loss in his maiden business but continued as he was self-motivated to excel. To achieve his ambitions, he borrowed Rs. 10,000 from his father in 1950s and since then has never looked back.

Today his group employs more 10,000 people directly or indirectly.

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Located at Advance Puram, Raja-Ka-Taal, Agra Road, Firozabad (Uttar Pradesh) Advance Group is into manufacturing of Handicraft items, Thermos Flasks, Industrial Lamps, Table ware, bulb shells, Glass Bottles, etc.

Its various facilities are spread over 30,000 sq. mtr and is about 250 kms away from New Delhi, India's Capital.

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- Pankaj Glass Works Ltd.
- Advance Glass Works
- Adarsh Kanch Udyog Pvt. Ltd.
- Advance Lamp Component Pvt. Ltd.
- Advance Vacuum Flask Industries Pvt. Ltd.
- Oriental Glass Works
- Modern Glass Industries
- Orchid Greens
- Boss Deco

The group started manufacturing Mouth Blown products in the year 1970. Advance Group was the 1st company in Firozabad to introduce oil furnace technology in its unit 'Unique Glass', which was previously run on coal.

In 1994, 1st automatic bulb shell manufacturing unit was started by the group. In 1996, the Group switched over to natural gas as per the directive of Govt of India to protect Taj Mahal from Industrial pollution in and around Taj Trapezium Zone.

At the age of 93, Mr. Gupta still plays an active role as member of UPGMS (a zonal association of the AIGMF) for the growth and development of Glass Industry.

Mr. Bal Krishna Gupta, Chief Guest at 2nd Glasspex India in 2011 inaugurating the Exhibition at Bombay Exhibition Centre, Mumbai in the august presence- MDI (Messe Düsseldorf GmbH/Messe Düsseldorf India Pvt. Ltd.) and AIGMF Officials

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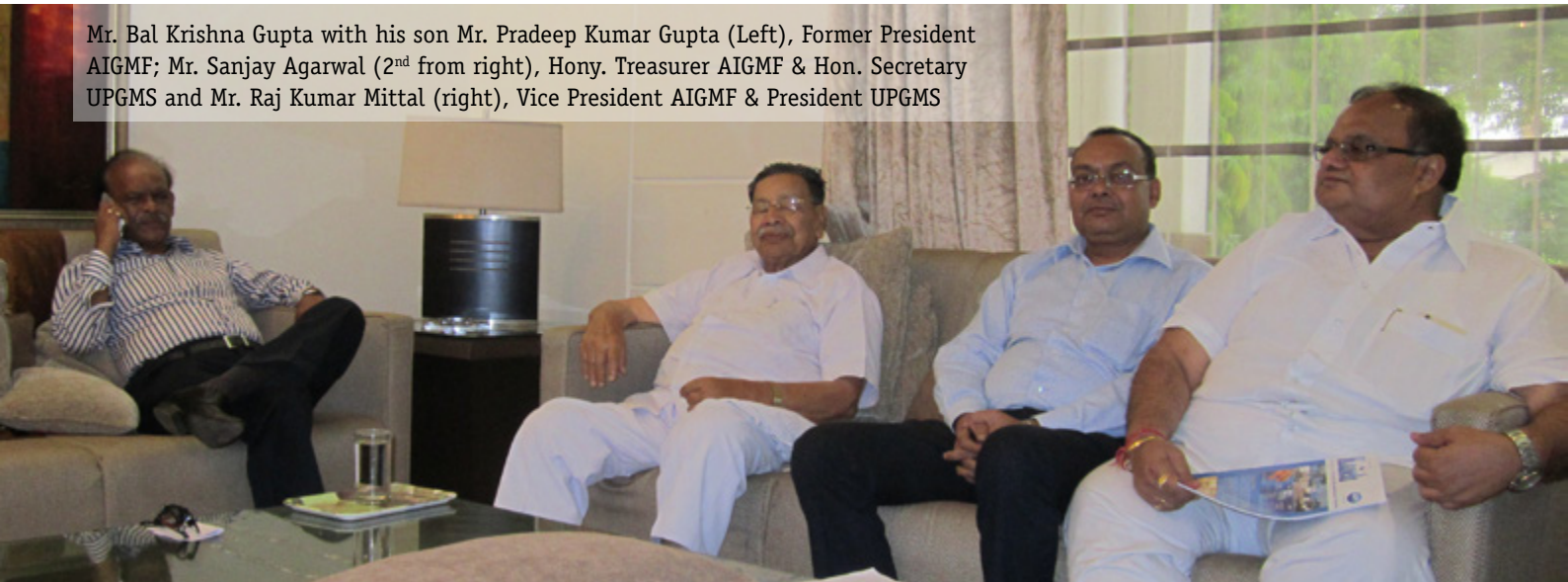
निवास	:	105, हनुमान गंज, फिरोज़ाबाद
शिक्षा	:	हिन्दी का श्रेष्ठ तथा अंग्रेजी का व्यवहारोपयोगी ज्ञान
संस्थापक	:	एडवान्स ग्रुप ऑफ ग्लास इण्डस्ट्रीज, फिरोज़ाबाद
अध्यक्ष	:	अ.भा. ब्रज-साहित्य संगम, मथुरा
(साहित्य एवं शिक्षा जगत)		- ब्रज कला केन्द्र आगरा
		- मानसरोवर साहित्य संगम, फिरोज़ाबाद
		- श्री आर. के. इण्टर कॉलेज, कोटला
		- महात्मा गान्धी शिक्षण संस्थान पी.जी. कॉलेज, फिरोज़ाबाद
उपलब्ध अलंकरण:		- 'उत्तर प्रदेश रत्न' (आ. ई. कॉन्फ्रेंस ऑफ इन्टेलेक्चुअल्स, उ.प्र.)
		- 'आर्य-भूषण' (गुरुकुल महाविद्यालय, ज्वालापुर, हरिद्वार)
		- 'साहित्य-सेवी' (हिन्दी साहित्य सम्मेलन, इलाहाबाद)
		- 'वाणी-भूषण' (अ.भा. ब्रज-साहित्य संगम, मथुरा)
		- 'भाषा भूषण' साहित्य मंडल श्रीनाथ द्वारा, (राज.)
योगदान	:	- श्री आर. के. इण्टर कालेज, कोटला (संस्थापक)
		- श्री आर. के. गर्ल्स हाईस्कूल, कोटला (संस्थापक)
अध्यक्ष	:	- यू.पी. ग्लास सिण्डीकेट, फिरोज़ाबाद
(औद्योगिक जगत)		- ऑल इण्डिया ग्लास मैन्यूफैक्चर्स फैडरेशन, नई दिल्ली
		- साइण्टिफिक ग्लास मैन्युफैक्चर्स एसोसिएशन, फिरोज़ाबाद
		- नेशनल चैम्बर ऑफ इण्डस्ट्रीज एण्ड कॉमर्स, यू.पी., आगरा
		- आगरा प्रोडक्टिविटी काउन्सिल, आगरा


ऑल इण्डिया ग्लास फैडरेशन की मीटिंग के सदस्यों द्वारा आनन्द 'गुजरात' में क्रिकेट खेलते हुए श्री गुप्ता

विशेष:-

- कृषक-परिवार में जन्म लेकर स्व-पराक्रम एवं बुद्धि-बल द्वारा देश के प्रमुख काँच-उद्योगपति के पद पर सुप्रतिष्ठित।
- ग्लास मैन्युफैक्चरिंग के क्षेत्र में विशेषज्ञता प्राप्ति के लिए अमेरिका, जर्मनी, लन्दन, पेरिस, रूस, इटली तथा अन्य देशों की यात्राएँ।
- काँच-उद्योग की स्थापना हेतु परामर्शदाता के रूप में बांग्ला देश की सरकार द्वारा आमन्त्रित एवं वहाँ की यात्रा।
- अनेक सामाजिक, साहित्यिक, सांस्कृतिक एवं शैक्षणिक संस्थाओं से सम्बद्ध, अनेक स्थानों पर अनेकों बार अभिनन्दित।
- हिन्दी के सुधी कवि, निबन्धकार एवं यात्रा-वृतान्त लेखक।
- साहित्य-कला स्नेही, समाज सेवी, गान्धीवादी, खद्दरप्रेमी, हँसमुख, हाजिर जबाब, धीरे-गंभीर तथा आकर्षक व्यक्तित्व के धनी।


Mr. Bal Krishna Gupta with his son Mr. Pradeep Kumar Gupta (Left), Former President AIGMF; Mr. Sanjay Agarwal (2nd from right), Hony. Treasurer AIGMF & Hon. Secretary UPGMS and Mr. Raj Kumar Mittal (right), Vice President AIGMF & President UPGMS

श्री बालकृष्ण गुप्त द्वारा संचालित कारखाने और उनके भागीदार

क्रम सं.	सन्	नाम संस्थान	भागीदारों के नाम
1.	1946	गंगा ग्लास वर्क्स, फीरोज़ाबाद	बा. रामसरन, बा. गंगाराम
2.	1948	ओरियन्टल ग्लास वर्क्स, फीरोज़ाबाद	श्री नाथूराम प्रेमी •
3.	1948	इरफान ग्लास वर्क्स, फीरोज़ाबाद	श्री जय कुमार जैन • बा. हजारीलाल जैन •
4.	1948	आदर्श ग्लास वर्क्स, फीरोज़ाबाद	ला. गिरधारी लाल
5.	1948	बापू ग्लास वर्क्स, फीरोज़ाबाद	हाजी इरफान अलीसाहब •
6.	1948	संत ग्लास वर्क्स, फीरोज़ाबाद	मीर फारुख अली •
7.	1948	महावीर ग्लास वर्क्स, फीरोज़ाबाद	बा. सुनहरी लाल जैन
8.	1948	शिव ग्लास वर्क्स, फीरोज़ाबाद	श्रीकृष्णचन्द्र गुप्ता (भैयाजी)
9.	1948	सावित्री ग्लास वर्क्स, फीरोज़ाबाद	श्री विमल नारायन जैन श्री मानिकचन्द जैन •
10.	1954	एडवांस ग्लास वर्क्स, फीरोज़ाबाद	श्री रतीराम • श्री बालकृष्ण गोयल •
11.	1960	राजस्थान पिग्मेंअ एण्ड कैमीकल्स	बा. हनुमान प्रसाद, आगरा
12.	1970	वैश्य ग्लास वर्क्स, फीरोज़ाबाद	बा. मुंशीलाल, आगरा
13.	1970	दुर्गा ग्लास वर्क्स, फीरोज़ाबाद	श्री त्रिलोकीनाथ अग्रवाल
14.	1970	यूनिक ग्लास वर्क्स, फीरोज़ाबाद	श्री ब्रजभूषण अग्रवाल
15.	1985	ओम् ग्लास वर्क्स, फीरोज़ाबाद	श्री बिहारी लाल शमा
16.	1985	पंकज ग्लास वर्क्स, फीरोज़ाबाद	श्री सुरेश चन्द्र दुबे
17.		श्री नाथ कोरोगेटस	श्री महेशचन्द्र महर्षि
18.		ए.जी. इण्डस्ट्रीज	श्री विशाल महर्षि श्री चकलेश जैन
19.	1985	शंकर साइन्टिफिक ग्लास वर्क्स	श्री धर्मेन्द्र कुमार गुप्ता
20.	1985	आदर्श काँच उद्योग, फीरोज़ाबाद	श्री रामकिशोर गुप्ता
21.	1985	मार्डन ग्लास इण्डस्ट्रीज, फीरोज़ाबाद	श्री सुरेशचन्द्र बंसल
22.	1985	एडवांस कंपोनेन्ट्स प्रा.लि.	श्री प्रवीणचन्द्र जी
23.	1985	एडवांस ग्लास इन्टरनेशनल, दिल्ली	श्री एम.सी. दुबे
24.	1985	डैको पौटरी प्रा.लि., गाजियाबाद	श्री बी.के. शर्मा
25.	1955	डैको ग्लास वर्क्स, गाजियाबाद	
26.	1994	एडवांस लैम्प एण्ड कम्पनी	
27.	1995	एडवांस फ्लाश कं. प्रा.लि., गाजियाबाद	
28.	1996	एडवांस एक्सपोर्ट दिल्ली	

• चिन्हांकित भागीदार दिवंगत हो चुके हैं।

महामहिम राष्ट्रपति श्री फखरुद्दीन अली अहमद के एडवान्स ग्लास वर्क्स पर पधारने पर

श्री गुप्ताजी की कलम से.....

हैसियत! तेरे लिए क्या नहीं किया मैने?
ईमान तक दाव पर लगा दिया मैने।
तूने आने के बाद कैसे गुल खिलाये हैं।
घर में लगता है जैसे अस्पताल आये हैं।

सुख: तुम बहुत मिले, किन्तु दु:ख को हटा न सके,
धन: तुम बहुत मिले, किन्तु हबस को मिटा न सके।

एडवान्स ग्लास उद्योग समूह के चेयरमैन उ० प्र० रत्न श्री बालकृष्ण गुप्त के साथ समूह के सदस्य

FAMILY AND OTHER ACTIVITIES

Mr. Gupta proudly informs that his family members are very supportive. His son Mr. Pradeep Kumar Gupta (Former President AIGMF) and grandsons have taken their businesses to new heights.

Mr. Gupta is a well known poet and has authored many Hindi literature books. He likes reading books on poetry and religion in his free time.

He has served as Former President of Brij- Sahitya Sangam, Mathura; Brij Kala Kendra Agra; Mansarovar Sahitya Sangam, Firozabad.

Mr. Gupta along with local industry leaders have funded a Trauma Centre at Firozabad. He is also an active member with many state run NGOs and social welfare groups. He considers TATA Group as his role model when it comes to serving society.

Mr. Gupta is one of founding members of Shri RK Inter College, Kotla and Shri RK Girls High School, Kotla.

TITLES / ACHIEVEMENTS

President Bangle Association (1939-48)

President AIGMF (1983-84)

President UPGMS (for many terms)

He holds numerous awards i.e. Uttar Pradesh Ratan (A.E. Conference of Intellectual, UP), Arya Bhushan (Gurukul Mahavidhalay, Jwalapur, Haridwar), Sahitya Sevi (Hindi Sahitya Sammelan, Allahabad), Vani Bhushan (A. Bha. Brij- Sahitya Sangam, Mathura) and Bhasha Bhooshan Sahitya Mandal Shri Nathdwara, (Rajasthan), etc.

Apart from Glass Industry, he has also served as President of Industrial Institutions namely; Scientific Glass Manufacturers' Association, Firozabad; National Chamber of Industries and Commerce, Agra and Agra Productivity Council.

Mr. Gupta has widely travelled within India and other parts of the world i.e. Germany, England, France, Russia, and Italy in connection with business.

GLASS INDUSTRY

Mr. Gupta believes that Industry Associations play a very vital role in bringing all members together on a common platform.

As Executive Committee member of the AIGMF, he encourages all segments of glass industry including small, medium and large scale units to work together and speak one language.

According to Mr. Gupta, Glass Industry is not doing well in the present scenario, overcapacity is one of the main reasons, which needs correction. He also feels that there is slump in exports. Dumping of glass and glassware mainly by China and other countries has led to economic slowdown.

Anti-Dumping Duty imposed by Govt. of India on the import of raw materials and CENVAT, etc., are other reasons which are affecting growth of Glass Industry. In his view, Govt has done very little to overcome these issues.

Mr. Gupta says, for convenience sake, people are fast switching to plastic disposable items, which poses a great threat to environment and health of the people. He feels that there is an urgent need to run consumer awareness campaigns on the goodness of glass citing environmental and health reasons.

At the same time, Mr. Gupta is of the view that with change in lifestyle and mind-set, more people are demanding eco-friendly products i.e. glass tumblers / bottles / packaging specifically for drug formulations, etc. According to him, Glass being 100% recyclable and environmental friendly product always score more points when compared with other products.

(R to L) Mr. Bal Krishna Gupta with Mr. C. K. Somany, Former AIGMF President; Mr. Bharat Somany, AIGMF Office Bearer; Mr. S.C. Bansal, Former AIGMF President and Mr. Arun Kumar Dukipatti, AIGMF Office Bearer at Executive Committee meeting of AIGMF in Firozabad

**** Firozabad*** *is a city in India, in the state of Uttar Pradesh also known as City of Bangle. The city is famous for glass and bangle works, and its related small scale industry is famous throughout the world.*

GLASS PLANT'S SCRAP TRADER

WE ARE ONE OF THE LEADING GLASS PLANT'S SCRAP TRADERS OF INDIA.

WE ARE ALWAYS INTERESTED IN BUYING SCRAP MATERIAL FROM GLASS FACTORIES.

WE DEAL IN:-

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*UNUSED REFRACTORY.

*USED GLASS FURNACES.

*GLASS PLANTS MACHINERY.

*SICK OR CLOSED GLASS UNITS.




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GLASS News

ANNUAL GENERAL MEETING OF THE ALL INDIA GLASS MANUFACTURERS' FEDERATION (AIGMF)

Following were elected as Office Bearers of the AIGMF for the year 2015-16 in the Annual General Body Meeting held on September 12, 2015:

President
Mr. Sanjay Ganjoo
Aashi India Glass Ltd., Roorkee

Sr. Vice President
Mr. Arun Kumar Dukkipati
AGI glaspac (An SBU of HSIL Ltd), Hyderabad

Vice President
Mr. Raj Kumar Mittal
Mittal Ceramics, Firozabad

Hony. General Secretary
Mr. Bharat Somany
HNG & Ind. Ltd., Bahadurgarh

Hony. Treasurer
Mr. Sanjay Agarwal
Kwality Glass Works, Firozabad

On the recommendations of Zonal Associations following were nominated as members of the Executive Committee for the year 2015-16:

Northern India Glass Manufacturers' Association (NIGMA)

1. Mr. Ram Bahadur Dadu, Gujarat Guardian Ltd., New Delhi
2. Mr. Shailendra Kumar Misra, HNG & Inds. Ltd., Bahadurgarh

Eastern India Glass Manufacturers' Association (EIGMA)

1. Mr. Vinay Saran – HNG & Inds. Ltd., Kolkata

South India Glass Manufacturers' Association (SIGMA)

1. Mr. Sandip Somany - AGI glaspac, Hyderabad

U.P. Glass Manufacturers' Syndicate (UPGMS)

1. Mr. Deepak Gupta, Hilite Glass (P) Ltd., Firozabad
2. Mr. Sanjay Mittal, Farukhi Glass Industries, Firozabad
3. Mr. Dharmendra Mohan Gupta, Firozabad Glass Shell Industries, Firozabad
4. Mr. Anurag Gupta, Om Glass Works (P) Ltd., Firozabad
5. Mr. Mukesh Kumar Bansal, Sri Sitaram Glass Works, Firozabad
6. Mr. Uma Shankar Agarwal, Pooja Glass Works (P) Ltd., Firozabad

Western India Glass Manufacturers' Association (WIGMA)

1. Mr. H.R. Bhandari, Pragati Glass Ltd.
2. Mr. G.K. Sarda, Empire Industries Ltd., Vitrum Glass
3. Mr. Vijay Shah, Piramal Glass Ltd.
4. Mr. S.U. Mody – Neutral Glass & Allied Industries Ltd.

The following were co-opted as members of the Executive Committee for the year 2015–2016:

1. Mr. C.K. Somany - HNG & Ind. Ltd., Kolkata
2. Mr. Balkrishna Gupta - Advance Glass Works, Firozabad
3. Mr. Sanjay Somany - HNG & Ind. Ltd., Bahadurgarh
4. Mr. Pradeep Kumar Gupta - Om Glass Works Pvt. Ltd.
5. Mr. P.K. Kheruka - Borosil Glass Works Ltd.
6. Mr. Mukul Somany, HNG & Ind. Ltd., Kolkata
7. Mr. KC Jain, HNG Float Glass Ltd., Mumbai

"WHEN GLASS MEETS PHARMA": BROAD KNOWLEDGE BUNDLED IN A LITTLE BOOK

A new book written by SCHOTT scientist Dr. Bettine Boltres provides pharmaceutical companies with basic knowledge of glass and how this material is used best in the pharmaceutical industry. "When Glass meets Pharma" succinctly describes what characteristics the material has, why it possibly interacts with drugs and how it can be processed most effectively in production.

"Glass is the material of choice for the pharmaceutical industry when it comes to packing drugs. Nevertheless, the demands on packaging are rising rapidly, mainly due to more stringent regulations by the health authorities. By sharing our knowledge of glass with companies in the pharmaceutical industry, we help them to use glass more effectively," Boltres describes her motivation for writing the book.

The book has been published in English by Editio Cantor Verlag (ISBN 978-3-87193-432-2). The print edition is now available in bookstores and at www.amazon.com

An eBook edition is also available (ISBN 978-3-87193-433-9).

GLASS RECYCLING HITS 73% IN THE EU

Latest industry data – published by the European Container Glass Federation (FEVE) – show that the EU28 average recycling rate for glass packaging hits the 73% mark for the first time. Over 25 billion glass containers continue to be recycled in a bottle to bottle closed loop making glass a model of the circular economy.

Sweden, Belgium, Luxembourg, Austria and Germany continue to be the best performers and to record striking rates. Italy, the Netherlands and Malta improved on previous years. However, it is Eastern Europe that is catching up as the industry begins to address the glass recycling challenges in these countries. Estonia, Slovenia, Slovak Republic and Croatia – recorded promising growth rates. The increased recycling efforts make Europe the continent with the highest glass recycling rates in the world.

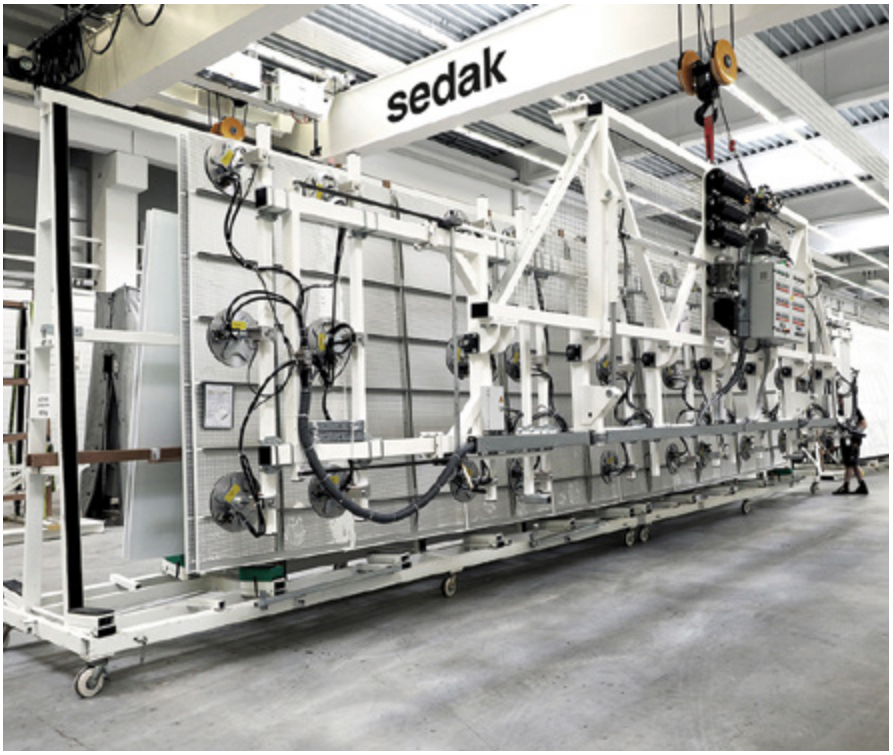
According to FEVE President Vitaliano Torno "The high glass recycling rate of 73% shows that the glass packaging model is the best performing closed loop business model, but more resources need to be invested to improve glass recycling even further and especially in countries lagging behind".

Glass recycling enables the container glass industry to dramatically reduce its environmental footprint by saving energy and raw materials, and it helps maintaining 125,000 stable and local jobs in the EU. Glass plants deliver more than half of their products within 300 km and more than 70% of raw materials travel less than 300 km.

"The same glass can be recycled over and over again – comments Adeline Farrelly, FEVE Secretary General. We call on the European Commission to acknowledge bottle to bottle multiple recycling in the incoming Circular Economy Proposal: this is key to incentivise real and sustainably sound recycling schemes in the EU and attract investments."

SUCTION SOLUTION FROM EUROTECH HANDLES GLASS PANES WITH EXTREME STRUCTURED SURFACES

Sedak designed euroTECH vacuum lifting device is capable of handling three-tonne glass segments of 14 metres in width, three metres in height and 10 millimetres thickness at a time. The weight and size of the segments are remarkable on their own, but the panes being handled



also exhibit extremely structured, rather than smooth, surfaces. The suction cups are each fitted with a sealing ring of special chloroprene, allowing them to form an air-tight connection to the component in spite of the uneven surface. The specially designed handling solution can pivot up to 105 degrees and uses 30 adjustable, flexible and spring-loaded suction cups arranged along the cross beams of a lightweight support frame. The suction cups can be controlled individually by hand or from a central operating console. Each suction cup has a maximum load lifting capacity of 2,300 N at 60% vacuum.

INDIAN GOVT. APPROVAL TO DEVELOP 50 SOLAR CITIES

The Ministry of New and Renewable Energy has approved a proposed master plan to develop 50 solar cities, including three in the national capital region.

Out of the proposed 60 solar cities, sanctions have been issued for 50 cities that include New Delhi, Agra, Chandigarh, Gurgaon, Faridabad, Amritsar, New Town (Kolkata), Howrah, Madhyamgram, Kochi and Bhopal, as per the information available on the ministry's website.

Of these 50 cities, master plans have been prepared for 46 cities, including Agra, Gandhinagar, Rajkot, Surat, Thane, Shirdi, Nagpur, Aurangabad, Imphal, Chandigarh, Gurgaon, Faridabad, Bilaspur, Raipur, Agartala, Guwahati, Jorhat, Mysore, Shimla, Hamirpur, Jodhpur, Vijayawada, Ludhiana, Amritsar, Dehradun, Panaji and New Delhi (NDMC area), it added.

Further, in-principle approvals have been given to five cities namely Thiruvananthapuram, Jaipur, Indore, Leh and Mahbubnagar, it said.

"Master plan of Indore has been prepared and the other corporations/ state nodal agencies are in the process of engaging consultants for preparation of master plans," the ministry said.

The ministry had empanelled 26 consultants in June 2009 to prepare master plan for the development of solar cities.

Eight cities are to be developed as 'Model Solar Cities', the ministry said. Of these 8 cities, Nagpur, Chandigarh, Gandhinagar and Mysore have so far been selected to be developed as 'Model Solar Cities.

Fifteen cities will be developed as 'Pilot Solar Cities.'

Of the 15 cities, the government has so far named 13 that include Agartala, Coimbatore, Rajkot, Shimla, Faridabad, Thane, Raipur, Shirdi, Leh, Aizawl, Puducherry, Vijaywada and Amritsar are being developed as Pilot Solar City, it said.

IMPROVED EFFICIENCY WHEN HANDLING WINDOWS

Assembling and transporting the windows, glass sheets and glass-construction elements by hand is now much easier, and only one person is required to operate the device. The operator can move and position

the components very easily and precisely using the ergonomic handle. Even with large and heavy elements, no further members of staff are required. Simplifying the work processes in this way saves time and leads to a higher output per shift and working day. Since handling with a vacuum is also very gentle, damage during transport is now a thing of the past .

Schmalz VacuMaster Window Handling

VacuMaster Window Comfort vacuum lifting device for handling glass sheets and windows weighing up to 225 kg

Using the ergonomic controller, the windows can be lifted, rotated 90° and set down again, all at the touch of a button

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

Using NNPB forming technology for refillable beer bottles

Dr Wenke Hu, William Slusser, Peter de Haan and Gary Smay consider the internal pressure and vertical load implications of using NNPB forming technology for refillable beer bottles.

Prior to 1970, most glass beverage containers were manufactured by the blow and blow (BB) process. However, it became apparent that to achieve the goal of reduced glass weight, innovations in the forming process were needed for greater control of glass distribution. This led to the innovation of the narrow neck press and blow (NNPB) process[1, 2, 3, 4]. Initially this technology was used to manufacture non-refillable bottles at reduced glass weights, while continuing to meet conventional minimum thickness requirements. This was achieved through the ability of the plunger to actively position glass, creating more uniform thickness distributions for a given glass weight. Today, NNPB technology is widely used in the production of non-refillable beverage bottles throughout the worldwide glass container industry.

In recent years, the industry has begun to consider the potential use of NNPB technology for refillable beverage containers, which had been historically formed using the BB process. The interest in the NNPB process is the same as the established use for non-refillable bottles – to reduce weight by taking advantage of improved glass thickness distributions inherent in the NNPB process. However, refillable bottles present distinct challenges due to reduced glass surface strengths that are associated with repeated use. Therefore, the current study was undertaken to evaluate the viability of using bottles that have been manufactured by the NNPB process in the refillable marketplace.

This study utilised computer stress analyses to evaluate refillable bottles made by the NNPB process compared to the same bottles made using BB technology. In this initial study, internal pressure and vertical load results will be discussed. Impact considerations will be reported in a subsequent presentation.

Four different beer bottle sizes and designs (330ml, 500ml, 650ml and 750ml) were evaluated, as shown in figure 1. The internal pressure and vertical load stress indices of each design were obtained through finite element analysis (FEA), utilising an Autodesk mechanical simulation programme[5, 6]. Two different approaches were evaluated:

- Approach No 1: Minimum glass thicknesses were held 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 BB processes.
- Approach No 2: Average glass thicknesses were held constant while the minimum and maximum thicknesses were allowed to fluctuate based on typical max to min thickness ratios for the NNPB and the BB processes.

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

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 variation would have to be accounted for prior to the commercial release of the package, 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 BB processes are shown in table 1. These values are based on numerous measurements of bottles made by the BB 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.

Finite element analysis: The Solidworks file for each model was imported into Autodesk simulation for the purposes of finite element analyses. For the internal pressure analyses, a unit pressure load was applied to the entire inside surface profile of the bottle. For the vertical load analyses, the load was applied vertically upward along the entire circumference of the bearing surface, with the top of the finish being fixed. This loading configuration was used to simplify the computing process; the results would be the same if the load were applied downward to the top of the finish, with the bearing surface being fixed.

Stress indices were obtained from the finite element analysis for key regions along the entire inside and outside surfaces of the containers. The stress index represents the amount of principal stress generated by a unit load of either internal pressure or a unit load of vertical force. These values represent the tensile stress distributions in each of the four designs and for each of the two manufacturing processes.

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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 analyses of the 330ml capacity bottle will be presented in this section.

Approach No 1: Identical minimum thicknesses - With identical minimum thicknesses, the resulting glass weights were approximately 14% lighter for the bottles made by the NNPB process than for bottles made by the BB 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 BB process.

As shown in table 3, both internal pressure and vertical load stress indices were approximately 1% to 9% higher for bottles made by the NNPB process compared to the BB process, due to the overall higher glass weights that were associated with the BB process. The maximum difference was observed for the bearing surface region (9.2%), while the minimum difference was observed for the heel contact region (1.0%). The stress index differences for vertical load were approximately 4% to 7% higher for the NNPB ware. The largest difference was observed for the maximum stress at the heel region (6.6%), while the smallest difference was observed for the shoulder contact region (3.8%). Thus, bottles that were manufactured by the BB process, using this theoretical approach, would exhibit less stress. However, this improvement would be at the expense of an increase in glass weight.

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 BB process were nearly identical, as shown in table 2. However, as shown in table 4, the internal pressure stress indices for the NNPB bottles were 2% to 21% lower as compared to the bottles made by the BB process. The maximum difference was observed for the heel contact region (21.0%), while the minimum difference was observed for the inside knuckle region (1.8%). The stress index differences for vertical load were approximately 14% to 17% lower for the NNPB ware. The largest difference was observed for the maximum stress throughout the heel region (16.7%), while the smallest difference was observed specifically for the heel contact region (13.5%).

Thus, bottles made by the NNPB process in these considerations of nearly equal bottle weight would exhibit significantly lower stresses compared to bottles made by the BB process. These stress index reductions were due to the higher minimum thickness achieved with the NNPB process, which is the result of less thickness variation and improved glass distribution. It should also be noted that there are certain practical limitations associated with the NNPB process, as discussed in the next section.

MANUFACTURING CONSIDERATIONS

From the time of its inception to the present day, many of the technical barriers associated with NNPB technology have been overcome[7]. This has allowed a substantially wider range of glass containers to be manufactured using this technology. However, one barrier that remains is the inability to manufacture large capacity bottles that require higher glass weights. The most important limiting factor impeding the production of higher weight containers is the inability to adequately control the temperature of the plunger. In the glass industry, it is generally acknowledged that the plunger temperature is critical in the forming

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	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 max to min thickness ratios for the NNPB and the BB 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 (g).

Internal Pressure	Stress Indices (MPa/Bar)	
Key Bottle Regions	NNPB	Blow and Blow
Maximum Shoulder	2.25	2.16
Shoulder Contact	0.95	0.94
Maximum Sidewall	2.62	2.56
Heel Contact	1.06	1.05
Inside Knuckle	4.58	4.32
Bearing Surface	3.21	2.94
Maximum Bottom	3.15	2.98
Vertical Load	**Stress Indices (KPa/Kg_f)**	
Key Bottle Regions	NNPB	Blow and Blow
Maximum Shoulder	65.4	62.3
Shoulder Contact	41.0	39.5
Heel Contact	35.0	33.4
Maximum Heel	48.6	45.6

Table 3: Internal pressure and vertical load stress indices for 330ml bottle with identical minimum thickness.

Internal Pressure	Stress Indices (MPa/Bar)	
Key Bottle Regions	NNPB	Blow and Blow
Maximum Shoulder	1.81	2.16
Shoulder Contact	0.81	0.94
Maximum Sidewall	2.08	2.56
Heel Contact	0.83	1.05
Inside Knuckle	4.24	4.32
Bearing Surface	2.69	2.94
Maximum Bottom	2.69	2.98
Vertical Load	**Stress Indices (KPa/Kg_f)**	
Key Bottle Regions	NNPB	Blow and Blow
Maximum Shoulder	51.7	62.3
Shoulder Contact	33.4	39.5
Heel Contact	28.9	33.4
Maximum Heel	38.0	45.6

Table 4: Internal pressure and vertical load stress indices for 330ml bottle with identical average thickness.

process. Higher temperatures in combination with the mechanical stresses imposed on the plunger during sliding contact with the semi-molten glass causes plunger wear that typically leads to premature plunger failure due to material loss[8].

There is a practical rate at which the plunger can be cooled effectively and there is a corresponding glass weight maximum, beyond which that practical cooling rate is exceeded. The result is the heat transfer rate will be insufficient to properly form the parison at higher glass weights. While it is anticipated that this barrier will either be mitigated to some extent or eliminated altogether through innovation in material composition and forming technology, it should be recognised that the results presented here were based on idealised theoretical calculations and therefore, did not account for the practical limits associated with the NNPB forming process discussed in this section.

CONCLUSION

In this study, both identical minimum thicknesses and identical average thicknesses for NNPB and BB processes were analysed for internal pressure and vertical load stresses through finite element analysis. It was concluded that:

- When minimum thicknesses were maintained at the same value, bottle weight could be reduced approximately 14% through the use of the NNPB process. This weight reduction can be achieved with manageable increases in the stress index.
- When the average thicknesses are held at the same value, both the internal pressure and the vertical load performance can be significantly improved through the use of the NNPB process, while the bottle weight remains unchanged.

Based on these results, NNPB would appear to be a viable candidate for refillable bottle production. However, additional work to include the effects of NNPB production on impact resistance is planned using the same approaches that were utilised in this study. These results will be reported in a future presentation. ■

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ABOUT THE AUTHORS:

Dr Wenke Hu, Senior Scientist, William G Slusser, Research Services Manager, Peter de Haan, Senior Scientist and Gary Smay, Senior Scientist (retired) at American Glass Research

FURTHER INFORMATION:

American Glass Research, Butler, Pennsylvania, USA
tel: +1 724 482 2163
email: tbarr@agrintl.com
web: www.americanglassresearch.com

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